HANDBOOK OF Sport Psychology

Third Edition

Edited by

Gershon Tenenbaum • Robert C. Eklund

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SPORT PSYCHOLOGY

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GERSHON TENENBAUM AND ROBERT C. EKLUND

John Wiley & Sons, Inc.

This book is printed on acid-free paper. ♾

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data:

Handbook of sport psychology.—3rd ed. / Gershon Tenenbaum and Robert C. Eklund, eds.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-471-73811-4 (cloth)
ISBN-10: 0-471-73811-5 (cloth)
1. Sports—Psychological aspects. 2. Sports—Research. I. Tenenbaum, Gershon. II. Eklund, Robert C. (Robert Charles), 1958–
GV706.4.H37 2007
796.01—dc22

2006008113

Printed in the United States of America.

10 9 8 7 6 5 4 3 2 1

To Hony, my wife, the best partner
I could have wished to share my life with, and to
Ravid, Noam, and Sharon, my children, who bring me pride and joy.

—Gershon Tenenbaum

To my sons, Garth (5 years) and Kieran (3 years), who generously volunteered to
write chapters so that we'd be able to go play sooner, and
my wife, Colleen, who nurtures and supports "play" for the whole Eklund family.

—Robert C. Eklund

In memory of
Hony M. Tenenbaum
September 26, 1954 – July 25, 2006

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PART VIII SPECIAL TOPICS

Foreword

ROBERT SINGER

It certainly is gratifying and exciting for me, as coeditor of the two previous editions of this *Handbook* (i.e., Singer, Murphy, & Tennant, 1993; Singer, Hausenblas, & Janelle, 2001), to realize the impact this type of resource book has had on the field of sport psychology in general, and on so many individuals around the world. These include students, educators, and psychologists, oriented primarily as scholars or as practitioners. Because of this enormous success, the *Handbook* is now being updated and published in the third edition. The two previous editions were successful, and no doubt the present edition will be of even greater significance.

Such expectations can be attributed to a variety of factors. Editors Gershon Tenenbaum and Bob Eklund are very experienced and well-known internationally among sport psychologists for their scientific and professional contributions, and both are highly motivated and organized in their work. They possess a comprehensive understanding of the vast subject matter and recognize the variety of topics and themes associated with the area. The magnitude of the coverage of issues of topical interest in sport psychology, as well as the reputations of the authors contributing to this compendium, reflect the effort made by these editors to produce an outstanding volume. A tremendous increase in research and scholarly activities has been seen in recent decades. Likewise, more students are studying sport psychology to become counselors, clinicians, or sport scientists who work directly with athletes to aid them in the learning mastery of skills and performance enhancement. Then there are also those who will become educators and teach the subject matter of sport psychology. All of these observations generate a need to update the *Handbook* more frequently. The *Handbook* serves not only as a timely overview of recent developments, but also as a stimulus for further scholarly productivity and improved teaching and clinical applications. Better coaching and athletic performance should also occur.

Previous editions of the *Handbook* have tended to continue certain topics, omit others, and include new ones. Editors have a difficult role to play in the decision process on this account. In my opinion, Tenenbaum and Eklund have made wise decisions in their choices for inclusion in this edition—and ones that, I believe, reflect their understanding of and sensitivity to trends in scholarly interests in and impact on sport psychology. A very broad interpretation of the dimensions of sport psychology could lead to a gigantic book. Fortunately, the present editors have shown restraint and good judgment while providing a great variety of diversified contemporary topics. The authors have done an outstanding job in their coverage of assigned topics as well as presentation style. Much research is synthesized, organized, and presented in an excellent manner to challenge and inform and yet hold the reader's interest.

This book cannot be digested by merely scanning the pages. It is meant for the person who is serious about becoming more informed on many selected topics related to sport psychology and who wants to be challenged and stimulated by the scholarly and scientific nature of the field. Every theme may not interest the reader, at least in a first glance at the table of contents. Sometimes, however, following up on themes of less initial interest can be transformative in terms of expanded knowledge and appreciation of contributions in the area. In fact, further research may, serendipitously, be the result of these forays. With all my travels to other countries, I have been continually amazed to see copies of the previous *Handbooks* in the offices of dedicated sport psychologists. No doubt, the same will be true about this edition.

Finally, I appreciate the opportunity to write the Foreword for a book that means so much to me. The *Handbook of Sport Psychology* has been, and will continue to be, a gold standard resource book due to its intellectual content, breadth of topics, excellence of contributors, timeliness of topic coverage, and contributions to sport psychology and sport psychologists. I felt very challenged in attempting to design the framework of the first two *Handbooks.* I am very grateful to my coeditors and the many authors (good friends of mine) who made those volumes a success. No doubt, current editors Tenenbaum and Eklund feel equally proud, and rightfully so, of being able to put everything together in expert fashion to realize the production of a very significant publication that will touch the professional lives of many individuals in the future.

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PART I

Motivation, Emotion, and Psychophysiology

CHAPTER 1

Understanding the Dynamics of Motivation in Sport and Physical Activity

An Achievement Goal Interpretation

GLYN C. ROBERTS, DARREN C. TREASURE, and DAVID E. CONROY

Understanding and enhancing motivation is one of the most popular areas of research in psychology, as well as sport and exercise psychology. In psychology and sport psychology, this research has primarily addressed the role of motivation in individual lives, especially when addressing motivation in achievement contexts. Motivation has usually taken the form of managing the motivation of others, which is often the concern of the parent, the teacher, or the coach, or of managing one's own motivation.

It has been argued (e.g., Roberts, 2001) that the term *motivation* is overused and vague. There are at least 32 theories of motivation that have their own definition of the construct (Ford, 1992), and there are almost as many definitions as there are theorists (Pinder, 1984). It is defined so broadly by some as to incorporate the whole field of psychology, and so narrowly by others as to be almost useless as an organizing construct. The solution for most has been to abandon the term and use descriptions of cognitive processes, such as self-regulation and self-systems, processes such as personal goals and goal setting, or emotional processes. However, most contemporary theorists agree on the important assumption that motivation is not an entity, but a process (e.g., Maehr & Braskamp, 1986). To understand motivation, we must make an attempt to understand the process of motivation and the constructs that drive the process.

UNDERSTANDING MOTIVATION AND ACHIEVEMENT BEHAVIOR

Motivational processes can be defined by the psychological constructs that *energize, direct, and regulate* achievement behavior. Motivation theories may be viewed as being on a continuum ranging from deterministic to mechanistic to organismic to cognitive (for a more extensive treatment of motivation theories, see Ford, 1992; Weiner, 1972). Deterministic and mechanistic theories view humans as passive and driven by psychological needs or drives. Organismic theories acknowledge innate needs but also recognize that a dialectic occurs between the organism and the social context. Cognitive theories view humans as active and initiating action through subjective interpretation of the achievement context. Contemporary theories tend to be organismic or social-cognitive and are based on more dynamic and sophisticated conceptions that assume the human is an active participant in decision making and in planning achievement behavior (e.g., Bandura, 1986; Deci & Ryan, 1985; Dweck & Leggett, 1988; Kuhl, 1986; Maehr & Nicholls, 1980; Nicholls, 1989). Although organismic approaches are experiencing a resurgence in the literature (Hagger & Chatzisarantis, in press), the majority of motivation research in physical activity contexts over the past 30 years has adopted a social-cognitive approach (e.g., Duda, 1992, 2001; Duda & Hall, 2001; Duda & Whitehead, 1998; Roberts, 1984, 1992, 2001; Roberts, Treasure, & Kavussanu, 1997). Specifically, the motivation theory that has emerged as the most popular in sport and physical activity contexts is achievement goal theory. In 1998, Duda and Whitehead identified 135 research studies reported in the 1990s, yet just 2 years later Brunel (2000) identified 160 studies. As we go to press, the number stands at over 200!

Accordingly, in this chapter we take a generally social-cognitive perspective, where achievement may be defined as *the attainment of a personally or socially valued achievement goal that has meaning for the person in a physical* *activity context* (e.g., losing weight, improving a skill, defeating an opponent). Achievement is subjectively defined, and success or failure in obtaining the goal is a subjective state based on the participant's assessment of the outcome of the achievement behavior (e.g., Maehr & Nicholls, 1980; Spink & Roberts, 1981).

ACHIEVEMENT GOAL THEORY IN SPORT AND PHYSICAL ACTIVITY

The history of achievement goal theory (in general and in sport) has been reviewed in several other publications (e.g., Duda, 2005; Duda & Hall, 2001; Roberts, 2001; Roberts et al., 1997), so the present chapter focuses on identifying key constructs, tenets, and limitations of the theory, reviewing empirical support, and presenting recent proposals for expanding or restructuring the approach.

Achievement goal theory assumes that the individual is an intentional, goal-directed organism who operates in a rational manner, and that achievement goals govern achievement beliefs and guide subsequent decision making and behavior in achievement contexts. It is argued that to understand the motivation of individuals, the function and meaning of the achievement behavior to the individual must be taken into account and the goal of action understood. Individuals give meaning to their achievement behavior through the goals they adopt. It is these goals that reflect the purposes of achievement striving. Once adopted, the achievement goal determines the integrated pattern of beliefs that undergird approach and avoidance strategies, the differing engagement levels, and the differing responses to achievement outcomes. By so recognizing the importance of the meaning of behavior, it becomes clear that there may be multiple goals of action, not one (Maehr & Braskamp, 1986). Thus, variation of achievement behavior may not be the manifestation of high or low motivation per se, or the satisfaction of needs, but the expression of different perceptions of appropriate goals with their attendant constellation of cognitions. An individual's investment of personal resources, such as effort, talent, and time, in an activity is dependent on the achievement goal of the individual.

The overall goal of action in achievement goal theory, thereby becoming the conceptual energizing force, is assumed to be the desire to develop and demonstrate competence and to avoid demonstrating incompetence. The demonstration and development of competence is the energizing construct of the motivational processes of achievement goal theory. But competence has more than one meaning. One of Nicholls's (1984) conceptual contributions was to argue that more than one conception of ability exists, and that achievement goals and behavior may differ depending on the conception of ability held by the person. Nicholls argued that two conceptions of ability (at least) are manifest in achievement contexts, namely, an *undifferentiated concept of ability,* where ability and effort are not differentiated by the individual, either because he or she is not capable of differentiating, as is the case with young children, or because the individual chooses not to differentiate; and a *differentiated concept of ability,* where ability and effort are differentiated (Nicholls, 1984, 1989).

Nicholls (1976, 1978, 1980) argued that children originally possess an undifferentiated conception of ability in which they are not able to differentiate the concepts of luck, task difficulty, and effort from ability. From this undifferentiated perspective, children associate ability with learning through effort, so that the more effort one puts forth, the more learning (and ability) one achieves. Following a series of experiments, Nicholls (1978; Nicholls & Miller, 1983, 1984a, 1984b) determined that by the age of 12 children are able to differentiate luck, task difficulty, and effort from ability, enabling a differentiated perspective. When utilizing this differentiated perspective, children begin to see ability as capacity and that the demonstration of competence involves outperforming others. In terms of effort, high ability is inferred when outperforming others while expending equal or less effort or performing equal to others while expending less effort.

Individuals will approach a task or activity with certain goals of action reflecting their personal perceptions and beliefs about the particular achievement activity in which they are engaged and the form of ability they wish to demonstrate (Dennett, 1978; Nicholls, 1984, 1989). The conception of ability they employ and the ways they interpret their performance can be understood in terms of these perceptions and beliefs. These perceptions and beliefs form a *personal theory of achievement* at the activity (Nicholls, 1989; Roberts, 2001; Roberts et al., 1997), which reflects the individual's perception of how things work in achievement situations. The adopted personal theory of achievement affects one's beliefs about how to achieve success and avoid failure at the activity. Therefore, people will differ in which of the conceptions of ability and criteria of success and failure they use, and in how they use them, based on their personal theory of achievement.

The two conceptions of ability thereby become the source of the criteria by which individuals assess success and failure. The goals of action are to meet the criteria by which success and failure are assessed. Nicholls (1989) identifies achievement behavior utilizing the undifferentiated conception of ability as *task involvement* and achievement behavior utilizing the differentiated conception of ability as *ego involvement.* When the individual is task-involved, the goal of action is to develop mastery, improvement, or learning, and the demonstration of ability is self-referenced. Success is realized when mastery or improvement has been attained. The goal of action for an ego-involved individual, on the other hand, is to demonstrate ability relative to others or to outperform others, making ability other-referenced. Success is realized when the performance of others is exceeded, especially when expending less effort than others (Nicholls, 1984, 1989).

In this chapter, when we refer to the motivated state of involvement of the individual, we use the terms ego involvement and task involvement to be consistent with Nicholls's use of the terms. In addition, when we refer to individual differences (e.g., self-schemas, personal theories of achievement, dispositions), we use the terms *task orientation* and *ego orientation.* Other motivation theorists (e.g., Dweck, 1986; Dweck & Legget, 1988; Elliot, 1997; Maehr & Braskamp, 1986) have used different terms to describe the same phenomena. When we refer to the situational determinants of motivation, the achievement cues inherent in the context, and the schemas emerging from achievement situations, we are consistent with Ames (1984a, 1992a, 1992b, 1992c) and refer to the task-involving aspect of the context as *mastery* criteria and the ego-involving aspect of the context as *performance* criteria. Finally, when we refer to the competence goals defined by Elliot (e.g., 1997) and colleagues, we use the terms *mastery* and *performance* goals.

Whether one is engaged in a state of ego or task involvement is dependent on one's dispositional orientation, as well as the perception of achievement cues in the context (Nicholls, 1989). Let us consider first two levels of individual differences: the state of goal involvement and the goal orientation.

States of Goal Involvement

Each of the theories of achievement goal motivation proffered by the major theorists (e.g., Ames, 1984a, 1984b, 1992a, 1992b, 1992c; Dweck, 1986; Dweck & Leggett, 1988; Elliot, 1997; Maehr & Braskamp, 1986; Maehr & Nicholls, 1980; Nicholls, 1984, 1989) hold that important relationships exist between the states of goal involvement and achievement striving. According to Nicholls, if the person is *task-involved,* the conception of ability is undifferentiated and perceived ability becomes less relevant, as the individual is trying to demonstrate or develop mastery at the task rather than demonstrate normative ability. As the individual is trying to demonstrate mastery or improvement, the achievement behaviors will be adaptive in that the individual is more likely to persist in the face of failure, to exert effort, to select challenging tasks, and to be interested in the task (Dweck, 1986; Nicholls, 1984, 1989; Roberts, 1984, 1992; Roberts et al., 1997). On the other hand, if the individual is *ego-involved,* the conception of ability is differentiated and perceived ability is relevant, as the individual is trying to demonstrate normative ability, or avoid demonstrating inability, and how his or her ability fares with comparative others becomes important.

If the individual is ego-involved and perceives himself or herself as high in ability, that person is likely to approach the task and engage in adaptive achievement behaviors. These are the people who seek competitive contests and want to demonstrate superiority. When perceived ability is high, demonstrating high normative ability is likely; therefore the individual is motivated to persist and demonstrate that competence to pertinent others. If one can demonstrate ability with little effort, however, this is evidence of even higher ability. Thus, the ego-involved person is inclined to use the least amount of effort to realize the goal of action (Nicholls, 1984, 1992; Roberts, 1984; Roberts et al., 1997).

On the other hand, if the perception of ability is low, the individual will realize that ability is not likely to be demonstrated, and he or she is likely to manifest maladaptive achievement behaviors (Nicholls, 1989). Maladaptive behaviors are avoiding the task, avoiding challenge, reducing persistence in the face of difficulty, exerting little effort, and, in sport, dropping out if achievement of desired goals appears difficult. These are the people who avoid competitive contests, as their lack of high normative ability is likely to be exposed. Although the participant may view these avoidance behaviors as adaptive because they disguise a lack of ability, they are considered maladaptive in terms of achievement behavior.

It has been argued (e.g., Duda & Hall, 2001; Roberts, 2001; Treasure et al., 2001) that the states of involvement are mutually exclusive (i.e., one is either ego- or task-involved), even though this notion has been questioned in light of parallel processing models of information processing (Harwood & Hardy, 2001). Goal states are very dynamic and can change from moment to moment as information is processed (Gernigon, d'Arripe-Longueville, Delignières, & Ninot, 2004). An athlete may begin a task with strong task-involved motivation, but contextual events may make the athlete wish to demonstrate superiority to others, and so the athlete becomes ego-involved in the task. Thus, goal states are dynamic and ebb and flow depending on the perception of the athlete.

The measurement of goal states is a particularly challenging task. It has been done in three ways. One has been to take an existing goal orientation measure and reword the stem to obtain a state measure (e.g., Hall & Kerr, 1997; Williams, 1998). A second has been to use single-item measures asking participants to indicate whether they focus on achieving a personal standard of performance (self-referenced) or beating others in an upcoming contest (other-referenced; e.g., Harwood & Swain, 1998). The third way is to ask participants to view video replays of the event and retrospectively reflect on their goal involvement at any one point in the contest (e.g., J. Smith & Harwood, 2001). Although the first two procedures may be more predictive of the initial state of involvement than the orientation measures per se (Duda, 2001), Duda has argued that these procedures may not capture the essence of task and ego involvement. In addition, it may be argued that because the states are so dynamic, even if you are able to reflect the state of involvement at the outset of the competition, as the state of involvement ebbs and flows as task and competitive information is processed, we have no indication of the changes that may occur (Roberts, 2001). It is naive and conceptually inconsistent to assume that the state of involvement will remain stable throughout the contest.

The best way of estimating the state of involvement currently available is the procedure used by J. Smith and Harwood (2001). At least we obtain participants' observations of their goal involvement at different times of the contest. This is a superior procedure to determine goal involvement that takes into consideration its dynamic nature. However, this procedure is very labor-intensive; it has to be done with each participant over the course of the contest.

Clearly, the development of an assessment procedure for the state of goal involvement is a major task, especially when one recognizes that achievement goal theory is predicated on one's task or ego involvement in the achievement task. As has been the case with measuring state anxiety, obtaining repeated measures while an athlete is engaged in competition is a practical nightmare. And we have to recognize that repetitive assessments of goal involvement during a competitive encounter may have the effect of changing an athlete's goal involvement state (Duda, 2001)! Certainly, forcing task-involved athletes to consider why they are doing what they are doing may make them more self-aware and ego-involved in the task. To reduce the likelihood of this happening, the retrospective recall strategy of J. Smith and Harwood (2001) is clearly the better procedure, despite its disadvantages.

GOAL ORIENTATIONS

It is assumed that individuals are predisposed (e.g., by their personal theory of achievement) to act in an ego- or task-involved manner; these predispositions are called *achievement goal orientations.* Individual differences in the disposition to be ego- or task-involved may be the result of socialization through task- or ego-involving contexts in the home or experiences in significant achievement contexts (e.g., classrooms, physical activities; Nicholls, 1989; Roberts et al., 1997).

Goal orientations are not to be viewed as traits or based on needs. Rather, they are cognitive schemas that are dynamic and subject to change as information pertaining to one's performance on the task is processed. But the orientations do have some stability over time (Duda & Whitehead, 1998; Roberts, Treasure, & Balague, 1998). These self-cognitions are assumed to be relatively enduring. As examples, Dweck (1986) considers that one's theory of intelligence is relatively stable, and Nicholls (1984) considers one's conceptualization of ability to be stable as well. Thus, being task- or ego-oriented refers to the inclination of the individual to be task- or ego-involved.

To measure goal orientations, researchers have typically created questionnaires that are assumed to assess ego and task goal orientations (e.g., Nicholls, Patashnik, & Nolen, 1985). Although Dweck and her colleagues (e.g., Dweck & Leggett, 1988) conceptualize and measure achievement goals as dichotomous, it has been more usual for researchers to assume that the two goals are conceptually orthogonal and to measure them accordingly (Duda & Whitehead, 1998; Nicholls et al., 1985; Roberts et al., 1998).

Nicholls (1989) has argued that to assess personal achievement goals, individuals should be asked about the criteria that make them feel successful in a given situation, rather than noting their definition of competence. In line with this suggestion, Roberts and colleagues (Roberts & Balague, 1989; Roberts et al., 1998; Treasure & Roberts, 1994b) have developed the Perception of Success Questionnaire (POSQ), and Duda and colleagues (Duda & Nicholls, 1992; Duda & Whitehead, 1998) have developed the Task and Ego Orientation in Sport Questionnaire (TEOSQ). Both have demonstrated acceptable reliability and construct validity (Duda & Whitehead, 1998; Marsh, 1994; Roberts et al., 1998). Although other scales exist, the

POSQ and the TEOSQ best meet the conceptual criteria of measuring orthogonal achievement goals in sport (Duda & Whitehead, 1998). When developing scales in the future, the constructs identified must be conceptually coherent with achievement goal theory. This has not always been the case in the past (e.g., Gill & Deeter, 1988; Vealey & Campbell, 1988), and this has created some conceptual confusion (Marsh, 1994).

Motivational Implications of Goal Orientations

The majority of research in goal orientations has focused on the antecedents and consequences of goal orientations. In this section, we briefly review the research on the association between achievement goals and both cognitive and affective variables, and important outcome variables.

Perceptions of Competence

One of the fundamental differences between task- and ego-oriented athletes is the way they define and assess competence. Task-oriented individuals tend to construe competence based on self-referenced criteria and are primarily concerned with mastery of the task, so they are more likely than ego-oriented individuals to develop perceived competence over time (Elliott & Dweck, 1988). In contrast, ego-oriented individuals feel competent when they compare favorably in relation to others, so high perceived relative ability or competence is less likely to be maintained in ego orientation, especially for those participants who already question their ability (see Dweck, 1986). This prediction of achievement goal theory has been supported in numerous studies with a variety of conceptualizations of competence perceptions (Chi, 1994; Cury, Biddle, Sarrazin, & Famose, 1997; Kavussanu & Roberts, 1996; Nicholls & Miller, 1983, 1984a; Vlachopoulos & Biddle, 1996, 1997).

Thus, several lines of research suggest that using the task-involving conception of achievement to judge demonstrated competence enhances resiliency of perceived competence. The implications of these findings are particularly important in learning contexts. For example, for individuals who are beginning to learn a new physical skill, holding a task orientation may be instrumental in facilitating perceptions of competence, effort, and persistence, and consequently success in the activity. It is not surprising that Van Yperen and Duda (1999), in their study with Dutch male soccer players, found that athletes high in task orientation were judged by their coaches to possess greater soccer skills from pre- to postseason. A task orientation fosters perceptions of competence and success for individuals who are either high or low in perceived competence and encourages the exertion of effort. An ego orientation, on the other hand, may lower perceptions of success, perceived competence, and thus effort, especially for those individuals who already are unsure of their ability.

Beliefs about the Causes of Success

Nicholls (1989, 1992) suggests that one's goal in conjunction with one's beliefs about the causes of success in a situation constitute one's personal theory of how things work in achievement situations. For individuals with low perceived ability, a belief that ability causes success will most likely result in frustration, a lack of confidence and may even lead to dropping out, as these individuals feel they do not possess the ability required to be successful. In the physical activity domain, where practice and hard work are so essential for improvement, especially at the early stages of learning, the belief that effort leads to success is the most adaptive belief for sustaining persistence.

Research on young athletes (e.g., Hom, Duda, & Miller, 1993; Newton & Duda, 1993), high school students (Duda & Nicholls, 1992; Lochbaum & Roberts, 1993), British youth (Duda, Fox, Biddle, & Armstrong, 1992; Treasure & Roberts, 1994a), young disabled athletes participating in wheelchair basketball (White & Duda, 1993), and elite adult athletes (Duda & White, 1992; Guivernau & Duda, 1995; Roberts & Ommundsen, 1996) has consistently demonstrated that a task goal orientation is associated with the belief that hard work and cooperation lead to success in sport. In general, ego orientation has been associated with the view that success is achieved through having high ability and using deception strategies such as cheating and trying to impress the coach. A similar pattern of results has emerged in the physical education context (Walling & Duda, 1995), as well as in research with college students participating in a variety of physical activity classes (e.g., Kavussanu & Roberts, 1996; Roberts, Treasure, & Kavussanu, 1996).

Purposes of Sport

In classroom-based research, ego orientation has been associated with the belief that the purpose of education is to provide one with wealth and social status, which is evidence of superior ability. Task orientation, on the other hand, has been linked to the view that an important purpose of school education is to enhance learning and understanding of the world and to foster commitment to society (Nicholls et al., 1985; Thorkildsen, 1988). Similar findings have been reported in the athletic arena (e.g., Duda, 1989; Duda &

Nicholls, 1992; Roberts, Hall, Jackson, Kimiecik, & Tonymon, 1995; Roberts & Ommundsen, 1996; Roberts et al., 1996, 1997; Treasure & Roberts, 1994a; White, Duda, & Keller, 1998), indicating that worldviews cut across educational and sport contexts.

Task orientation has been associated with the belief that the purpose of sport is to enhance self-esteem, advance good citizenship, foster mastery and cooperation (Duda, 1989), encourage a physically active lifestyle (White et al., 1998), and foster lifetime skills and pro-social values such as social responsibility, cooperation, and willingness to follow rules (Roberts & Ommundsen, 1996; Roberts et al., 1996). Likewise, task orientation is associated with the view that the purpose of physical education is to provide students with opportunities for improvement, hard work, and collaboration with peers (Papaioannou & McDonald, 1993; Walling & Duda, 1995). In contrast, ego orientation has been linked to the view that sport should provide one with social status (Roberts & Ommundsen, 1996; Roberts et al., 1996), enhance one's popularity (Duda, 1989; Roberts & Ommundsen, 1996) and career mobility, build a competitive spirit (Duda, 1989), and teach superiority and deceptive tactics (Duda, 1989; Duda & White, 1992). Ego orientation is also associated with the view that the purpose of physical education is to provide students with an easy class and teach them to be more competitive (Papaioannou & McDonald, 1993; Walling & Duda, 1995).

Affect and Intrinsic Interest

One of the most consistent findings in achievement goal research has been the link between task orientation and experienced enjoyment, satisfaction, and interest during participation in physical activity for high school students (Duda, Chi, Newton, Walling, & Catley, 1995; Duda & Nicholls, 1992), athletes competing in international competition (Walling, Duda, & Chi, 1993), and college students enrolled in a variety of physical activity classes (e.g., Duda et al., 1995; Kavussanu & Roberts, 1996). A positive relationship has also been reported between task orientation and flow, an intrinsically enjoyable experience in college athletes (Jackson & Roberts, 1992). In the studies just cited, ego orientation was either inversely related or unrelated to intrinsic interest, satisfaction, or enjoyment.

Participants with a high task orientation, in combination with either a high or low ego orientation, experience greater enjoyment than those participants who are high in ego orientation and low in task orientation (Biddle, Akande, Vlachopoulos, & Fox, 1996; Cury et al., 1996; Goudas, Biddle, & Fox, 1994; Vlachopoulos & Biddle, 1996, 1997). A task orientation seems to be especially important for continued participation in physical activity as it is associated with enjoyment, and this occurs regardless of one's perceived success (Goudas et al., 1994) or perceived ability (Vlachopoulos & Biddle, 1997) and intrinsic interest (Goudas, Biddle, Fox, & Underwood, 1995).

Another interesting finding of previous research is the different sources of satisfaction associated with goals. Ego-oriented athletes glean satisfaction when they demonstrate success in the normative sense and please their coach and friends, whereas task-oriented individuals feel satisfied when they have mastery experiences and perceive a sense of accomplishment during their sport participation (Roberts & Ommundsen, 1996; Treasure & Roberts, 1994a).

Probably the most significant study to illustrate the association of goals with affect was conducted by Ntoumanis and Biddle (1999). They conducted a meta-analysis with 41 independent samples and found that task orientation and positive affect were positively and moderately to highly correlated. The relationship between ego orientation and both positive and negative affect was small. In essence, being task-involved fosters positive affect in physical activities.

Anxiety

Roberts (1986) was the first to suggest that athletes adopting an ego orientation may experience anxiety as a function of whether or not they believe they can demonstrate sufficient competence in an achievement context. Anxiety should be less likely with a task orientation, because an individual's self-worth is not threatened. Research has generally supported the tenets of goal theory (Roberts, 2001). Task orientation has been negatively associated with precompetitive anxiety (Vealey & Campbell, 1988), cognitive anxiety with young athletes (Ommundsen & Pedersen, 1999), somatic and cognitive anxiety (Hall & Kerr, 1997), task-irrelevant worries and the tendency to think about withdrawing from an activity (Newton & Duda, 1992), and concerns about mistakes and parental criticisms (Hall & Kerr, 1997; Hall, Kerr, & Matthews, 1998). Further, a task orientation has been associated with keeping one's concentration and feeling good about the game (Newton & Duda, 1992) and with effective use of coping strategies in elite competition (Pensgaard & Roberts, 2003). An ego orientation, on the other hand, has been positively related to state and trait anxiety (Boyd, 1990; Newton & Duda, 1992; Vealey & Campbell, 1988; White & Zellner, 1996), cognitive anxiety in the form of worry (White & Zellner, 1996), getting upset in competition, and concentration disruption during competition (Newton & Duda, 1992; White & Zellner, 1996).

Most studies have been conducted with very young athletes (Hall & Kerr, 1997) or with recreational or physical education students (Hall et al., 1998; Ommundsen & Pedersen, 1999; Papaioannou & Kouli, 1999). Ommundsen and Pedersen remind us, however, that it is not sufficient simply to state that being task-involved is beneficial in terms of anxiety. They found that being task-involved did decrease cognitive trait anxiety, but low perceived competence increased both somatic and cognitive anxiety. This suggests that being task-involved is beneficial, but that perceived competence is an important predictor of anxiety, too. Being task-oriented and perceiving one's competence to be high are both important antecedents to reduce anxiety in sport.

The most interesting aspect of the recent work with achievement goal theory has been the attention paid to achievement strategies and outcome variables, especially performance, exerted effort, overtraining and dropping out, and cheating in sport. Achievement goal theory and research in educational and sport settings suggest that personal theories of achievement comprise different beliefs about what leads to success (Nicholls, 1989).

Achievement Strategies

Lochbaum and Roberts (1993) were the first to report that emphasis on problem-solving and adaptive learning strategies was tied to a task orientation in a sport setting. Research (Lochbaum & Roberts, 1993; Ommundsen & Roberts, 1999; Roberts et al., 1995; Roberts & Ommundsen, 1996) has demonstrated that task orientation is associated with adaptive achievement strategies, such as being committed to practice, being less likely to avoid practice, learning, and effort. Typically, in these investigations, ego orientation corresponds to a tendency to avoid practice and to a focus on winning during competition. Goals also differentiate athletes in terms of the perceived benefits of practice. Thus, ego-oriented athletes consider practice as a means to demonstrate competence relative to other athletes, whereas their task-oriented counterparts view practice as a means to foster team cohesion and skill development (Lochbaum & Roberts, 1993; Roberts & Ommundsen, 1996).

When choosing post-climbing task feedback strategies, high ego-oriented climbers who were low in perceived ability were more likely to reject task-related and objective performance feedback than were task-oriented climbers (Cury, Sarrazin, & Famose, 1997). In addition, Cury and Sarrazin (1998) found that high-ego and high-ability athletes selected normative feedback and rejected task-relevant information. High-ego-oriented athletes with low ability requested no feedback and discarded objective information. Research has also given evidence that an ego orientation is related to other unacceptable achievement strategies, such as the use of aggression (Rascle, Coulomb, & Pfister, 1998).

These studies demonstrate that the achievement strategies endorsed by physical activity participants are meaningfully related to their goal perspective. Across studies, task orientation was coupled with adaptive learning strategies, the value of practice to learn new skills and improve, and seeking task-relevant information. In contrast, ego-oriented athletes endorsed avoiding practice as an achievement strategy and avoided task-relevant information, preferring normative feedback (but only when high in perceived ability).

Exerted Effort and Performance

There is little research to date investigating exerted effort and performance. One of the first studies to provide evidence of a performance boost from being task-involved was Vealey and Campbell's (1989). Van Yperen and Duda (1999) found that when football players were task-oriented, an increase in skilled performance (as perceived by the coach) resulted. In addition, the task-oriented players believed that soccer success depended on hard work. Similarly, Theeboom, De Knop, and Weiss (1995) investigated the effect of a mastery program on the development of motor skills of children and found that the task-involved group reported higher levels of enjoyment and reliably exhibited better motor skills than those who were ego-involved.

However, the best evidence thus far that task-oriented athletes perform better than ego-oriented athletes has been presented by Sarrazin, Roberts, Cury, Biddle, and Famose (2002), who investigated exerted effort and performance of adolescents involved in a climbing task. The results demonstrated that task-involved boys exerted more effort than ego-involved boys and performed better (a success rate of 60% versus 42%), and the degree of exerted effort was determined by an interaction of achievement goal, perceived ability, and task difficulty. Ego-involved boys with high perceived ability and task-involved boys with low perceived ability exerted the most effort on the moderate and difficult courses; ego-involved boys with low perceived ability exerted the least effort on the moderate and very difficult courses. Finally, task-involved boys with high perceived ability exerted more effort when the task was perceived as more difficult.

In general, the research has shown that (a) task-involved people exhibit (or report) greater effort than others (Cury et al., 1996; Duda, 1988; Duda & Nicholls, 1992; Durand, Cury, Sarrazin, & Famose, 1996; Goudas et al., 1994; Sarrazin et al., 2002; Solmon, 1996; Tammen, Treasure, & Power, 1992), and (b) ego-involved people with low perceived ability exhibit reduced exerted effort as opposed to people with high perceived ability (Cury, Biddle, et al., 1997). And there is developing evidence that being task-involved leads to better performance. To enhance effort, one should focus on being as task-involved as possible: Task-involved people try harder! And task-involved people perform better!

Moral Functioning and Cheating

Achievement goals have also been linked to moral cognitions and moral behavior in sport. A number of recent studies have identified fairly consistent relationships between task and ego orientations and sportspersonship, moral functioning, moral atmosphere, and endorsement of aggressive tactics among both youth and adult competitive athletes. In general, studies have shown that being high in ego orientation leads to lower sportspersonship, more self-reported cheating, lower moral functioning (i.e., moral judgment, intention, and self-reported cheating behavior), and endorsement of aggression when compared to high task-oriented athletes (Kavussanu & Ntoumanis, 2003; Kavussanu & Roberts, 2001; Lemyre, Roberts, & Ommundsen, 2002; Lemyre, Roberts, Ommundsen, & Miller, 2001; Ryska, 2003).

In recent research, Lemyre and colleagues (2001, 2002) and Ryska (2003) have found that low ego/high task-oriented young male soccer players consistently endorsed values of respect and concern for social conventions, rules and officials, and opponents. Similar to sportspersonship, moral functioning and aggression, as well as gender differences among these variables, have been highlighted in recent sport psychology research. Kavussanu (Kavussanu & Roberts, 2001; Kavussanu, Roberts, & Ntoumanis, 2002) has consistently found ego orientation to positively predict lower moral functioning and males to be generally higher in ego orientation, lower in task orientation, and significantly lower in moral functioning as well as endorsing more aggression than female players.

Recent research has indicated that the coach-created motivational climate may also serve as a precursor to cheating among competitive youth sport participants. Findings by Miller and colleagues (Miller & Roberts, 2003; Miller, Roberts, & Ommundsen, 2004, 2005) show that a high ego-involving motivational climate was associated with low sportspersonship, low moral functioning and reasoning, low moral atmosphere, and endorsement of aggression. Boys cheated more than girls, but within gender, ego-involved boys and girls cheated more than task-involved boys and girls. For boys in particular, being ego-involved meant that they were more likely to engage in cheating behavior, to engage in injurious acts, to be low in moral reasoning, and to perceive the moral atmosphere in the team to be supportive of cheating.

Competitive sport often places individuals in conflicting situations that emphasize winning over sportspersonship and fair play. It would be wrong, however, to attribute this to the competitive nature of sport. The results just cited suggest that it is *not* the competitive context in itself that is the issue. Rather, it may be the salience of ego involvement in the athletic environment that induces differential concern for moral behavior and cheating, rules, respect for officials, and fair play conventions among young players. If athletes are to develop good sportspersonship behaviors and sound moral reasoning, coaches should reinforce the importance of task-involving achievement criteria in the competitive environment.

Burnout

Another outcome variable that is becoming popular in sport research is burnout (see Eklund & Cresswell, Chapter 28). Why is it that some athletes burn out, and what are the precursors of burning out? Some recent research from a motivational perspective has given us some interesting findings. Freudenberger (1980) has explained burnout as a syndrome that includes both physical and emotional exhaustion. These symptoms occur concurrently with patterns of behavior that are strongly achievement oriented (Hall & Kerr, 1997). Individuals experiencing burnout tend to show a strong commitment to the pursuit of goals and set high standards for themselves. Despite personal investment and great persistence, they often experience depression, depersonalization, disillusionment, and dissatisfaction as their goals are continually unmet. Hall et al. (1998) reported a strong relationship among elite athletes' perfectionism, achievement goals, and aptitudes to perform. It is when athletes continually perceived their ability and their effort levels to be inadequate to meet their achievement goals that the maladaptive nature of their motivational orientation became apparent. The athlete may drop out to maintain any real sense of self-worth.

Cohn (1990) has found that athletes at risk of burning out were likely to either participate in too much training and competition, lacked enjoyment while practicing their sport, or experienced too much self- or other-induced pressure. Investigating young elite tennis players, Gould and colleagues (Gould, 1996; Gould, Tuffey, Udry, & Loehr, 1996; Gould, Udry, Tuffey, & Loehr, 1996) found that burned-out athletes believed they had less input into their own training, were higher in amotivation, and were more withdrawn. The burned-out players did not differ from their non-burned-out counterparts in terms of the number of hours they trained; consequently Gould and colleagues posited that the crucial factors leading to burnout were psychological (motivational) rather than physical in nature. This was confirmed by Lemyre, Treasure, and Roberts (2006), who found that variation in motivation contributed to the onset of burnout.

In a series of studies investigating the psychological determinants of burnout, Lemyre and colleagues examined the relationship between motivational disposition variables at the start of the season and signs of burnout at season's end. Lemyre (2005) found that elite winter sport athletes who were ego-involved, focused on normative comparisons, and preoccupied with achieving unrealistic goals, who doubted their own ability, and who had a coach and parents who emphasized performance outcomes were more at risk of developing symptoms of burnout than the more task-involved athletes. Lemyre, Roberts, Treasure, Stray-Gundersen, and Matt (2004) investigated the relationship between psychological variables and hormonal variation to burnout in elite athletes. Results indicated that variation in basal cortisol accounted for 15% of the variance in athlete burnout, and the psychological variables of perfectionism (20%), perceived task involvement (12%), and subjective performance satisfaction (18%) explained 50% of the total variance (67%) in athlete burnout at the end of the season. These findings are meaningful as they underline the importance of personal dispositions (perfectionism and achievement goals) on burnout vulnerability in elite athletes.

The literature just reviewed addressed achievement goals from an individual difference perspective in the traditional achievement goal framework. It supports meaningful relationships between personal goals of achievement and cognitive and affective beliefs about involvement in physical activity. In addition, we have shown that outcomes such as exerted effort, performance, moral behavior and cheating, and burnout are affected by whether one is task- or ego-involved. But whether one is in a state of task or ego involvement is not only dependent on one's personal goal of achievement. The context also has an important influence on one's state of involvement. We address that literature next.

THE MOTIVATIONAL CLIMATE

A fundamental tenet of achievement goal theory is the central role the situation plays in the motivation process (Nicholls, 1984, 1989). Consistent with other motivation research that has emphasized the situational determinants of behavior (e.g., deCharms, 1976, 1984; Deci & Ryan, 1985, 2002), research from an achievement goal perspective has examined how the structure of the environment can make it more or less likely that achievement behaviors, thoughts, and feelings associated with a particular achievement goal are adopted. The premise of this line of research is that the nature of an individual's experience influences the degree to which task and ego criteria are perceived as salient in the context. This is then assumed to affect the achievement behaviors, cognition, and affective responses through individuals' perception of the behaviors necessary to achieve success (Roberts et al., 1997).

Adopting the term *motivational climate* (Ames, 1992b) to describe the goal structure emphasized in the achievement context, researchers have examined two dimensions of the motivational climate, mastery and performance, in sport and physical activity. Mastery (or task-involving) climates refer to structures that support effort, cooperation, and an emphasis on learning and task mastery. Conversely, performance (or ego-involving) climates refer to situations that foster normative comparisons, intrateam competition, and a punitive approach by teachers and coaches to mistakes committed by participants.

A study conducted by Parish and Treasure (2003) is representative of much of the extant literature in the area. In this case, the influence of perceptions of the motivational climate and perceived ability on situational motivation and the physical activity behavior of a large sample of adolescent male and female physical education students was examined. Consistent with achievement goal theory, the results showed that perceptions of a mastery climate were strongly related to more self-determined forms of situational motivation (intrinsic and identified motivation) and, along with gender and perceived ability, most significantly predictive of the actual physical activity behavior of the participants. In contrast, perceptions of a performance climate were found to be strongly related to less self-determined forms of situational motivation (extrinsic and amotivational) and unrelated to physical activity.

Consistent with the findings reported by Parish and Treasure (2003), the extant literature in physical education and sport suggests that the creation of a mastery motivational climate is likely to be important in optimizing positive (i.e., well-being, sportspersonship, persistence, task perseverance, adaptive achievement strategies) and attenuating negative (i.e., overtraining, self-handicapping) responses (e.g., Kuczka & Treasure, 2005; Miller et al., 2004; Ommundsen & Roberts, 1999; Sarrazin et al., 2002; Standage, Duda, & Ntoumanis, 2003; Standage, Treasure, Hooper, & Kuczka, in press; Treasure & Roberts, 2001). This pattern of findings has been confirmed in a meta-analysis consisting of statistically estimated effect sizes from 14 studies ($N = 4{,}484$) that examined the impact of different motivation climates in sport and physical education on cognitive and affective responses (Ntoumanis & Biddle, 1999). The evidence, therefore, supports the position that perceptions of a mastery motivational climate are associated with more adaptive motivational and affective response patterns than perceptions of a performance climate in the context of sport and physical education.

AN INTERACTIONIST APPROACH

Achievement goal research has shown that individual variables and situational variables separately influence achievement behavior, cognition, and affect. Although these two lines of research have been conducted in relative isolation, an interactionist approach that looks to combine both types of variable is expected to provide a far more complete understanding of the motivation process. To this end, Dweck and Leggett (1988) suggested that dispositional goal orientations should be seen as an individual variable that will determine the probability of adopting a certain goal or action, that is, task or ego state of goal involvement, and a particular behavior pattern in achievement contexts. Situational variables, such as perceptions of the motivational climate, were proposed as potential moderators of the influence of the individual variables. As Roberts and colleagues (1997) argue, when the situational criteria are vague or weak, an individual dispositional goal orientation should hold sway. In contexts where the situational criteria are particularly salient, it is possible that perceptions of the climate may override an individual's dispositional goal orientation and be a stronger predictor of behavioral, cognitive, and affective outcomes. It is also proposed that children and young adolescents, who have yet to firm up their personal theories of achievement, may be more susceptible to the influence of situational variables than older adolescents and adults (Roberts & Treasure, 1992).

The result of the limited research that has examined both individual and situational variables has shown that taking into account both of these variables enhances our understanding of the sport context (e.g., Kavussanu & Roberts, 1996; Seifriz, Duda, & Chi, 1992). The limited evidence to date also provides support for Dweck and Leggett's (1988) contention that situational variables may moderate the influence of goal orientations (e.g., Swain & Harwood, 1996; Treasure & Roberts, 1998). When significant interaction effects emerged, they did so in a manner consistent with a moderation model. Although it is often difficult to statistically find significant interaction effects (Aguinis & Stone-Romero, 1997), the findings of the limited studies that have been conducted are consistent with the fundamental tenets of achievement goal theory and speak to the veracity of investigating the interaction in addition to the main effect of individual and situational variables.

ENHANCING MOTIVATION

Research from an achievement goal perspective in sport and physical education has demonstrated that goal orientations and perceptions of the motivational climate are relevant to the ongoing stream of achievement behavior, cognition, and affect. Given the body of empirical work that has documented the adaptive motivation and well-being responses of students who perceive mastery or task-involving climates, physical education teacher and sport coach education programs would benefit from integrating educational information pertaining to the creation of mastery climates into their curricula. Specifically, researchers interested in the sport and physical education experience need to develop strategies and guidelines and explore ways in which coaches, parents, and other significant social agents can engage in the creation of a mastery or task-involving motivational climate.

A paucity of intervention research has been conducted to assess the viability of the teacher and coach education programs designed to enhance motivation from an achievement goal perspective (i.e., Lloyd & Fox, 1992; Solmon, 1996; Treasure & Roberts, 2001). Comparing two different approaches to teaching an aerobics/fitness class to adolescent females, Lloyd and Fox found that participants in the mastery condition reported higher motivation to continue participating in aerobics and more enjoyment than those who participated in the performance condition. Consistent with the findings of Lloyd and Fox, Solmon found that seventh- and eighth-grade students who participated in the mastery condition demonstrated more willingness to persist in a difficult juggling task than those in the performance condition. In addition, students in the performance condition were more likely to attribute success during the intervention to normative ability than those in the mastery condition. This finding is consistent with Nicholls's (1989) contention that achievement goals and beliefs about success are conceptually linked.

Similar to the intervention designed by Solmon (1996), Treasure and Roberts (2001) drew on strategies suggested by Ames (1992a, 1992b, 1992c) to promote either a mastery or a performance climate. The strategies were then organized into the interdependent structures that Epstein (1988, 1989) has argued define the achievement context: task, authority, recognition, grouping, evaluation, and time structures, better known by the acronym TARGET. Responses of female and male young adolescent physical education students suggest that a teacher can influence the salience of a mastery or performance climate and, in so doing, affect a child's motivation in physical education. Although the results of the studies conducted by Solmon and Treasure and Roberts indicate that adopting and adapting classroom-based intervention programs in the context of physical education may be effective, it is important to recognize that there may be significant differences between achievement contexts. This point is even more important when one considers the achievement context of youth sport. In assessing and implementing interventions to enhance the quality of motivation in youth sport, therefore, researchers need to be sensitive to differences between the achievement contexts (Nicholls, 1992).

The few intervention studies that have been conducted clearly show that a mastery climate has positive behavioral, cognitive, and affective outcomes. All of the studies conducted to date, however, have been short term and limited in what they assess. Randomized, controlled studies over time are needed to truly assess the causal role of motivational climates on motivational outcomes.

THE HIERARCHICAL APPROACH TO ACHIEVEMENT GOALS

One of the most provocative attempts at revising and extending achievement goal theory in the past decade has emerged from work on the hierarchical model of achievement motivation (Elliot, 1999). This model is based on the premise that approach and avoidance motivation represent fundamentally different strivings. The approach-avoidance distinction has a long intellectual history (Elliot & Covington, 2001) and was considered in early writing on achievement goals (e.g., Nicholls, 1984, p. 328) but, until recently, was largely neglected in subsequent empirical work.

Briefly, the hierarchical model of achievement motivation asserts that dynamic states of achievement goal involvement are influenced by (a) stable individual differences (e.g., motives, self-perceptions, relationally based variables, neurophysiologic predispositions; Elliot, 1999) and (b) situational variables (e.g., motivational climate; Ames, 1992c; Ames & Archer, 1988). In turn, these dynamic states of goal involvement are posited as direct predictors of achievement processes and outcomes. A complete presentation of the hierarchical model of achievement motivation is beyond the scope of this chapter (see Elliot, 1999). Instead, we focus on a major implication of the premise that approach and avoidance motivation are fundamentally different—specifically, the implication that approach-valenced achievement goals may be distinguished (both conceptually and empirically) from avoidance-valenced achievement goals.

An Expanded Model of Achievement Goals

As described earlier in this chapter, the prevailing models of achievement goals in the educational, industrial-organizational, social, and sport literatures have been dichotomous in nature. Goals are distinguished largely (but not always exclusively) on how competence is defined. From this perspective, competence could be defined in task-referential terms (e.g., How well did I perform this task in relation to how well it could possibly be performed?), in self-referential terms (e.g., How well did I perform this task in relation to my previous performances?), or in normative terms (e.g., How well did I perform this task in relation to others?). Due to their conceptual and empirical similarities, the vast majority of research combined task- and self-referential definitions of competence into a single task, or *mastery,* goal. Normative definitions of competence have typically been designated as ego, or *performance,* goals. We use the terms mastery and performance to refer to the goals in the hierarchical model.

In the mid-1990s, several scholars working in parallel (e.g., Elliot, 1997; Elliot & Harackiewicz, 1996; Middleton & Midgley, 1997; Skaalvik, 1997; Skaalvik & Valas, 1994) returned to the possibility that individuals may sometimes focus on striving not to be incompetent as much as or more than they are striving to be competent. In achievement situations, competence and incompetence are outcomes that individuals typically find appetitive and aversive, respectively. Thus, it is possible to differentiate goals based on their *valence,* or the degree to which the focal outcome is pleasant or unpleasant.

In reviewing the achievement goal literature, Elliot (1994) observed that performance goals that focused on the pleasant possibility of competence (approach goals) led to different outcomes from performance goals focused on the unpleasant possibility of incompetence (avoidance goals). A meta-analysis of the motivation literature revealed that goal valence moderated the effects of performance goals on participants' intrinsic motivation (Rawsthorne & Elliot, 1999). Performance-avoidance goals reduced both free-choice behavior and self-reported interest in a task, whereas performance-approach goals did not have any consistent effect on either intrinsic motivation index. This finding led to the introduction of a tripartite model of achievement goals comprising mastery, performance-approach goals, and performance-avoidance goals (Elliot & Harackiewicz, 1996). In the first empirical test of this tripartite model, the valence of performance goals moderated relations between the goals and relevant antecedents (e.g., achievement motives, competence expectations, sex) and consequences (e.g., intrinsic motivation). A subsequent series of studies extended understanding of how the valence of performance goals can moderate relations between goals and achievement processes and outcomes (e.g., Cury, Da Fonséca, Rufo, Peres, & Sarrazin, 2003; Cury, Da Fonséca, Rufo, & Sarrazin, 2002; Cury, Elliot, Sarrazin, Da Fonséca, & Rufo, 2002; Elliot & Church, 1997; Elliot & McGregor, 1999).

Thus, the argument was proffered that achievement goals should consider both the *definition of competence* and the *valence of the striving,* and the model was expanded to include a fourth possible achievement goal: mastery- avoidance goals (Elliot, 1999; Elliot & Conroy, 2005). As seen in Figure 1.1, the two definitions of competence (i.e., mastery/task versus

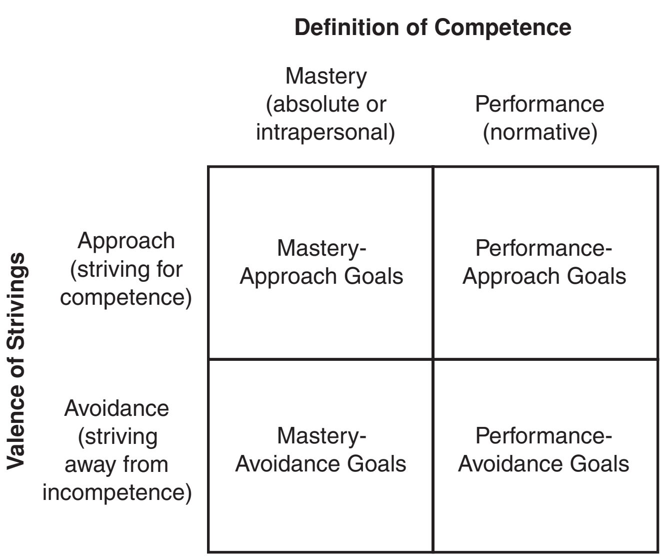

Figure 1.1 The 2 × 2 achievement goal framework. Adapted from "A 2 × 2 Achievement Goal Framework," by A. J. Elliot and H. A. McGregor, 2001, *Journal of Personality and Social Psychology, 80,* p. 502. Copyright 2001 by the American Psychological Association. Adapted with permission.

performance/ego) and two valences of strivings (i.e., approaching competence versus avoiding incompetence) yield a 2 × 2 model of achievement goals comprising mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance goals. These goals can be assessed with the 2 × 2 Achievement Goal Questionnaire for Sport (Conroy, Elliot, & Hofer, 2003).

Mastery-approach (MAp) goals focus on performing a task as well as possible or surpassing a previous performance on a task (i.e., learning, improving). They are equivalent to existing conceptions of mastery or task goals in the dichotomous model of achievement goals. They are expected to be the optimal achievement goal because they combine the more desirable definition of competence with the more desirable valence. In sport settings, these goals are extremely common because they are directly implicated in individuals' striving for personal records and peak performances as well as skill acquisition processes.

Performance-approach (PAp) goals focus on outperforming others. They are equivalent to existing conceptions of performance or ego goals in the dichotomous model of achievement goals. These goals may be adaptive when, as noted earlier, they are accompanied by a high perception of competence. However, in the 2 × 2 model, PAp goals are expected to be suboptimal because of their performance definition of competence, but not entirely dysfunctional because they are valenced toward competence. PAp goals are probably especially salient because of the social comparison processes inherent in sport and other competitive activities.

Performance-avoidance (PAv) goals focus on not being outperformed by others. As described previously, PAv goals provided the impetus to consider how the valence of goals might enhance the predictive power of the goal construct. They are expected to be the most dysfunctional of all achievement goals because they combine the less desirable definition of competence with the less desirable valence. These goals may be expressed when individuals are concerned about losing a contest or appearing incompetent in comparison with others.

Mastery-avoidance (MAv) goals focus on not making mistakes or not doing worse than a previous performance. As the latest addition to the achievement goal family, relatively little is known about these goals. They combine a desirable definition of competence with an undesirable focus on avoiding incompetence, so they are expected to exhibit a mixed set of consequences. Elliot (1999; Elliot & Conroy, 2005; Elliot & McGregor, 2001) has theorized that these goals may be particularly relevant for perfectionists striving for flawlessness, for athletes focused on maintaining their skill level as they near the end of their careers, and for older adults fighting off the natural functional declines associated with aging.

Antecedents and Consequences of 2 × 2 Goal Adoption

Considering that the vast majority of the recent achievement motivation literature in sport has implicitly focused on approach goals (i.e., MAp, PAp), relatively little is known about the correlates and consequences of avoidance-valenced achievement goals in sport. This section reviews documented links between the four goals in the 2 × 2 framework and theoretically relevant antecedents and consequences (e.g., achievement processes and outcomes). The vast majority of the research on goals in the 2 × 2 framework resides outside of the sport and exercise psychology literature. Rather than relying exclusively on the nascent sport psychology literature on 2 × 2 goals, we include selected findings from broader social and educational psychology literatures in this review. There is also some conceptual confusion about whether some variables (e.g., competence valuation) belong as antecedents or consequences of different states of goal involvement; they are listed according to how they were conceptualized in their respective studies.

Antecedents of 2 × 2 Achievement Goals

Empirically-tested antecedents of the four achievement goals are summarized in Table 1.1 based on whether the antecedents have demonstrated positive, negative, or null relations with each goal. These links are based on bivariate relations between each antecedent and the goal; relatively few relations change when third variables (e.g., ability) have been controlled.

Common antecedents of MAp goal involvement appear to include appetitive motivational dispositions (e.g., motives, temperament), positive self-perceptions (e.g., competence- and attachment-related perceptions), and perceived situational importance (e.g., competence valuation, class engagement). On the other hand, aversive motivational dispositions and negative cognitive representations of self and others do not appear to be associated with MAp goal involvement.

Mastery-avoidance goal involvement appears to be linked to antecedents such as negative perceptions of self and others (e.g., anxious attachment, fear of failure), entity rather than incremental theories of intelligence, reduced self-determination, and perceived situational importance. Appetitive motive dispositions do not appear to be MAv goal antecedents.

Common antecedents of PAp goal involvement include both appetitive and aversive motivational dispositions, competence perceptions, and entity rather than incremental theories of ability. Attachment security and self-determination do not appear to be PAp goal antecedents.

Finally, PAv goal involvement appears to be linked to antecedents such as avoidance motivational dispositions, reduced competence expectations, more entity and fewer incremental beliefs about ability, and less self-determination. Appetitive motivational dispositions and attachment security do not appear to be PAv goal antecedents.

Overall, socialization processes (e.g., perceived parenting practices) were not consistently associated with the achievement goals adopted by participants. This finding should be expected because socialization processes are more likely to have direct effects on more stable individual differences (e.g., motives) than on dynamic constructs such as goals.

Consequences of 2 × 2 Achievement Goals

Table 1.2 summarizes consequences of 2 × 2 achievement goals from previous research. Given that empirical tests of the 2 × 2 model are in their early stages, conclusions drawn here should be interpreted with appropriate caution. Special attention should be given to the studies that experimentally manipulated participants' goals (e.g., Cury, Da Fonséca, et al., 2002; Cury, Elliot, et al., 2002; Elliot & Harackiewicz, 1996) because such manipulations provide a much stronger demonstration of the causal role theorized for these goals than do passive observation designs (particularly when data are collected at a single occasion from a single source).

Mastery-approach goals appear to be associated with the optimal set of consequences (e.g., enhanced intrinsic motivation and information processing, reduced anxiety, fewer health center visits). Strikingly, MAp goals have not been linked to superior performance on cognitive tasks. Mastery-avoidance goals were linked with a generally undesirable set of achievement processes (e.g., anxiety, disorganization, surface processing) but did not seem to be associated with undesirable outcomes (e.g., performance, health center visits). Performance-approach goals were the only goals to be positively associated with superior performance. These goals also were linked with a partial set of desirable (e.g., more absorption, competence valuation, and intrinsic motivation; less anxiety) achievement

Table 1.1 Summary of Empirically Tested Antecedents of 2 × 2 Achievement Goals

Goal	Positive Relations	Negative Relations	Null Relations
MAp	Approach temperament (Elliot & Thrash, 2002) Behavioral activation system (Elliot & Thrash, 2002) Competence expectancy (Elliot & Church, 1997) Competence valuation (Elliot & McGregor, 2001) Extraversion (Elliot & Thrash, 2002) *Incremental beliefs about ability* (Cury, Da Fonséca, et al., 2002*) Need for achievement (Elliot & McGregor, 2001; Elliot & Church, 1997; Thrash & Elliot, 2002) Perceived class engagement (Elliot & McGregor, 2001) *Perceived competence* (Cury, Da Fonséca, et al., 2002*; Ommundsen, 2004*) Positive emotionality (Elliot & Thrash, 2002) Secure attachment (Elliot & Reis, 2003) Secure versus avoidant attachment (Elliot & Reis, 2003) Self-determination (Elliot & McGregor, 2001) Work mastery (Elliot & McGregor, 2001)	Avoidance attachment dimension (link mediated by challenge construals; Elliot & Reis, 2003) *Self-handicapping* (Elliot & Church, 2003; Ommundsen, 2004*)	Anxious/ambivalent attachment (Elliot & Reis, 2003) Anxious attachment dimension (Elliot & Reis, 2003) Avoidant attachment (Elliot & Reis, 2003) Avoidance temperament (Elliot & Thrash, 2002) Behavioral inhibition system (Elliot & Thrash, 2002) Competitiveness (Elliot & McGregor, 2001) Defensive pessimism (Elliot & Church, 2003) Entity theory of intelligence (Elliot & McGregor, 2001) *Fear of failure* (Conroy, 2004*; Conroy & Elliot, 2004*; Conroy, Elliot, & Hofer, 2003*; Elliot & Church, 1997; Elliot & McGregor, 2001; Thrash & Elliot, 2002) Incremental theory of intelligence (Elliot & McGregor, 2001) Negative emotionality (Elliot & Thrash, 2002) Neuroticism (Elliot & Thrash, 2002) Parental behavior-focused positive or negative feedback (Elliot & McGregor, 2001) Parental conditional approval (Elliot & McGregor, 2001) Parental identification (Elliot & McGregor, 2001) Parental person-focused positive or negative feedback (Elliot & McGregor, 2001) Parental worry (Elliot & McGregor, 2001) Secure versus anxious/ambivalent attachment (Elliot & Reis, 2003)
MAv	Anxious attachment dimension (link mediated by threat construals and competence valuation; Elliot & Reis, 2003) Competence valuation (Elliot & McGregor, 2001) Entity theory of intelligence (Elliot & McGregor, 2001) *Fear of failure* (Conroy, 2004*; Conroy & Elliot, 2004*; Conroy et al., 2003*; Elliot & McGregor, 2001) Parental person-focused negative feedback (Elliot & McGregor, 2001) Parental worry (Elliot & McGregor, 2001) Perceived class engagement (Elliot & McGregor, 2001)	Incremental theory of intelligence (Elliot & McGregor, 2001) Self-determination (Elliot & McGregor, 2001)	Avoidance attachment dimension (Elliot & Reis, 2003) Competitiveness (Elliot & McGregor, 2001) Conditional parental approval (Elliot & McGregor, 2001) Maternal person-focused positive feedback (Elliot & McGregor, 2001) Need for achievement (Elliot & McGregor, 2001) Parental behavior-focused positive or negative feedback (Elliot & McGregor, 2001) Parental identification (Elliot & McGregor, 2001) Work mastery (Elliot & McGregor, 2001)

Table 1.1 (Continued)

Goal	Positive Relations	Negative Relations	Null Relations
PAp	Approach temperament (Elliot & Thrash, 2002) Avoidance temperament (Elliot & Thrash, 2002) Behavioral activation system (Elliot & Thrash, 2002) Behavioral inhibition system (Elliot & Thrash, 2002) Competence expectancies (Elliot & Church, 1997) Competence valuation (Elliot & McGregor, 2001) Competitiveness (Elliot & McGregor, 2001) Defensive pessimism (Elliot & Church, 2003) *Entity beliefs about ability* (Cury, Da Fonséca, et al., 2002*) Extraversion (Elliot & Thrash, 2002) *Fear of failure* (Conroy, 2004*; Conroy & Elliot, 2004*; Conroy et al., 2003*; Elliot & Church, 1997; Elliot & McGregor, 1999, 2001; Thrash & Elliot, 2002) Maternal worry (Elliot & McGregor, 2001) Need for achievement (Elliot & McGregor, 2001; Elliot & Church, 1997; Thrash & Elliot, 2002) Negative emotionality (Elliot & Thrash, 2002) Neuroticism (Elliot & Thrash, 2002) Parental behavior-focused negative feedback (when identification is high; Elliot & McGregor, 2001) Parental conditional approval (Elliot & McGregor, 2001) Paternal person-focused positive feedback (Elliot & McGregor, 2001) *Perceived competence* (Cury, Da Fonséca, et al., 2002*; Ommundsen, 2004*) Positive emotionality (Elliot & Thrash, 2002) Self-handicapping (Elliot & Church, 2003)	*Incremental beliefs about ability* (Cury, Da Fonséca, et al., 2002*) Parental behavior-focused negative feedback (when identification is low; Elliot & McGregor, 2001) *Self-handicapping* (Ommundsen, 2004*)	Anxious/ambivalent attachment (Elliot & Reis, 2003) Avoidant attachment (Elliot & Reis, 2003) Avoidance attachment dimension (Elliot & Reis, 2003) Anxious attachment dimension (Elliot & Reis, 2003) Entity theory of intelligence (Elliot & McGregor, 2001) Incremental theory of intelligence (Elliot & McGregor, 2001) Maternal person-focused positive feedback (Elliot & McGregor, 2001) Parental behavior-focused positive feedback (Elliot & McGregor, 2001) Paternal worry (Elliot & McGregor, 2001) Perceived class engagement (Elliot & McGregor, 2001) Secure attachment (Elliot & Reis, 2003) Secure versus anxious/ambivalent attachment (Elliot & Reis, 2003) Secure versus avoidant attachment (Elliot & Reis, 2003) Self-determination (Elliot & McGregor, 2001) Work mastery (Elliot & McGregor, 2001)
PAv	Anxious/ambivalent attachment (link mediated by threat construal and competence valuation; Elliot & Reis, 2003) Anxious attachment dimension (Elliot & Reis, 2003) Avoidance temperament (Elliot & Thrash, 2002) Behavioral inhibition system (Elliot & Thrash, 2002) Competence valuation (Elliot & McGregor, 2001) Defensive pessimism (Elliot & Church, 2003) *Entity beliefs about ability* (Cury, Da Fonséca, et al., 2002*; Ommundsen, 2004*)	Competence expectancies (Elliot & Church, 1997) *Incremental beliefs about ability* (Cury, Da Fonséca, et al., 2002*) *Perceived competence* (Cury, Da Fonséca, et al., 2002*; Ommundsen, 2004*) Self-determination (Elliot & McGregor, 2001) Secure versus anxious/ambivalent attachment (Elliot & Reis, 2003)	Approach temperament (Elliot & Thrash, 2002) Avoidant attachment (Elliot & Reis, 2003) Avoidance attachment dimension (Elliot & Reis, 2003) Behavioral activation system (Elliot & Thrash, 2002) Competitiveness (Elliot & McGregor, 2001) Extraversion (Elliot & Thrash, 2002) Incremental theory of intelligence (Elliot & McGregor, 2001) Maternal conditional approval (Elliot & McGregor, 2001)

(continued)

Table 1.1 (Continued)

Goal	Positive Relations	Negative Relations	Null Relations
PAv	Entity theory of intelligence (Elliot & McGregor, 2001) *Fear of failure* (Conroy, 2004*; Conroy & Elliot, 2004*; Conroy et al., 2003*; Elliot & Church, 1997; Elliot & McGregor, 1999, 2001; Thrash & Elliot, 2002) Parental person-focused negative feedback (Elliot & McGregor, 2001) Maternal worry (Elliot & McGregor, 2001) Negative emotionality (Elliot & Thrash, 2002) Neuroticism (Elliot & Thrash, 2002) *Self-handicapping* (Elliot & Church, 2003; Ommundsen, 2004*)		Need for achievement (Elliot & McGregor, 2001; Elliot & Church, 1997; Thrash & Elliot, 2002) Parental behavior-focused positive or negative feedback (Elliot & McGregor, 2001) Paternal conditional approval (Elliot & McGregor, 2001) Parental identification (Elliot & McGregor, 2001) Parental person-focused positive feedback (Elliot & McGregor, 2001) Paternal worry (Elliot & McGregor, 2001) Perceived class engagement (Elliot & McGregor, 2001) Positive emotionality (Elliot & Thrash, 2002) Secure attachment (Elliot & Reis, 2003) Secure versus avoidant attachment (Elliot & Reis, 2003) Work mastery (Elliot & McGregor, 2001)

Note: Antecedent variables are listed in alphabetical order. *Italicized* variables have been documented in sport contexts by the studies marked with an asterisk.

processes and were not associated with any undesirable achievement processes. Finally, PAv goals were consistently linked with the most undesirable achievement processes and outcomes of all four goals. Based on these results, MAp goals appear to be optimal, PAv goals appear to be dysfunctional, and both PAp and MAv goals are neither entirely optimal nor entirely dysfunctional (with the former appearing to be more optimal than the latter).

Critical Issues Regarding 2 × 2 Achievement Goals

Elliot and colleagues (e.g., Elliot, 1997, 1999; Elliot & Conroy, 2005; Elliot & Thrash, 2001, 2002) argue that on both theoretical and empirical grounds, the 2 × 2 model of achievement goals has demonstrated promise for enhancing understanding of achievement motivation. Nevertheless, research on this model in sport contexts has been limited, and further research is required to demonstrate its veracity and potential. Research linking goals, particularly avoidance goals, to hypothesized patterns of antecedents and consequences in sport would be a useful first step in this process. Following are some other issues that will need to be addressed in future research.

Controversy still exists over whether the approach-avoidance distinction merely represents differences in perceptions of competence, especially for the performance dimension. That is, do perceptions of competence moderate relations between goals and various consequences, and if so, would it not be simpler to omit the valence dimension from the goals model? From a conceptual standpoint, the hierarchical model of achievement motivation frames perceptions of competence as antecedents of achievement goals because high perceptions of competence orient individuals toward the possibility of success and low perceptions of competence orient individuals toward the possibility of failure (Elliot, 2005). From an empirical perspective, Elliot and Harackiewicz (1996) have found that perceived competence failed to moderate the effects of any of their tripartite goal manipulation contrasts (i.e., mastery, PAp, PAv) on intrinsic motivation, and all of their main effects for the goal manipulations remained significant with the moderator terms in the model. Based on such evidence, it is argued by Elliot and colleagues that the valence dimension of achievement goals does not appear to be a proxy for perceived competence on either conceptual or empirical grounds.

This approach does not rule out the possibility that individual differences in goal antecedents (e.g., achievement motives) may moderate the effects of the goals on various consequences. For example, PAp goal involvement has been linked to both appetitive and aversive achievement motives (need for achievement and fear of failure, respectively). It

Table 1.2 Summary of Empirically Tested Consequences of 2 × 2 Achievement Goals

Goal	Positive Relations	Negative Relations	Null Relations
MAp	*Competence valuation* (compared to PAv goal condition: Cury, Elliot, et al., 2002*; compared to PAp & PAv goal condition: Cury et al., 2003*) Deep processing (Elliot & McGregor, 2001) Intrinsic motivation (especially in combination with low PAp goals; Elliot & Harackiewicz, 1996) Long-term retention (Elliot & McGregor, 1999) *Posttask free-choice behavior* (Cury, Elliot, et al., 2002*, 2003*) *Task absorption* (compared to PAv goal condition; Cury, Elliot, et al., 2002*)	Health center visits (Elliot & McGregor, 2001) *State anxiety* (compared to PAv goal condition: Cury, Elliot, et al., 2002*; compared to PAp & PAv goal condition: Cury et al., 2003*)	Disorganization (Elliot & McGregor, 2001) Emotionality (Elliot & McGregor, 2001) Graded performance (Elliot & Church, 1997; Elliot & McGregor, 1999, 2001) State test anxiety (Elliot & McGregor, 1999, 2001) Surface processing (Elliot & McGregor, 2001) Worry (Elliot & McGregor, 2001)
MAv	Disorganization (Elliot & McGregor, 2001) Emotionality (Elliot & McGregor, 2001) State test anxiety (Elliot & McGregor, 2001) Surface processing (Elliot & McGregor, 2001) Worry (Elliot & McGregor, 2001)	None reported to date	Deep processing (Elliot & McGregor, 2001) Exam performance (Elliot & McGregor, 2001) Health center visits (Elliot & McGregor, 2001)
PAp	*Competence valuation* (compared to PAv goal condition; Cury, Elliot, et al., 2002*, 2003*) Graded performance, especially in combination with low MAp goals (Elliot & McGregor, 1999, 2001) Intrinsic motivation (compared to PAv; Elliot & Harackiewicz, 1996) *Posttask free-choice behavior* (compared to PAv goal condition; Cury, Elliot, et al., 2002*, 2003*) *Task absorption* (compared to PAv goal condition; Cury, Elliot, et al., 2002*) Surface processing (Elliot & McGregor, 2001)	*State anxiety* (compared to PAv goal condition; Cury, Elliot, et al., 2002*, 2003*)	Deep processing (Elliot & McGregor, 2001) Disorganization (Elliot & McGregor, 2001) Emotionality (Elliot & McGregor, 1999, 2001) Exam performance (Elliot & McGregor, 2001) Health center visits (Elliot & McGregor, 2001) Intrinsic motivation (compared to MAp; Elliot & Harackiewicz, 1996) Long-term retention (Elliot & McGregor, 1999) State test anxiety (Elliot & McGregor, 1999, 2001) *State anxiety* (compared to MAp goal condition; Cury, Elliot, et al., 2002*, 2003*) Surface processing (Elliot & McGregor, 2001) Worry (Elliot & McGregor, 1999, 2001)
PAv	Disorganization (Elliot & McGregor, 2001) Emotionality (Elliot & McGregor, 1999, 2001) Health center visits, especially in combination with low MAp goals (Elliot & McGregor, 2001) *State anxiety* (compared to MAp and PAp goal conditions; Cury et al., 2002*, 2003*) State test anxiety (Elliot & McGregor, 1999, 2001) Surface processing (Elliot & McGregor, 2001) Worry (Elliot & McGregor, 1999, 2001)	Change in GPA (Elliot & Church, 2003) *Competence valuation* (compared to MAp and PAp goal conditions; Cury, Elliot, et al., 2002*, 2003*) Deep processing (Elliot & McGregor, 2001) Graded performance (Elliot & McGregor, 1999, 2001, Elliot & Church, 2003) Intrinsic motivation (Elliot & Harackiewicz, 1996) Long-term retention (Elliot & McGregor, 1999) *Posttask free-choice behavior* (compared to MAp and PAp goal conditions; Cury, Elliot, et al., 2002b, 2003) *Task absorption* (compared to MAp and PAp goal conditions; Cury, Elliot, et al., 2002*)	None reported to date

Note: Antecedent variables are listed in alphabetical order. *Italicized* variables have been documented in sport contexts by the studies marked with an asterisk.

is possible that PAp goals energized by the appetitive motive may yield different consequences than would PAp goals that are energized by the aversive motive. A three-way Goal × Motive × Feedback interaction also is conceivable, as PAp goals may change differentially for individuals with different motive dispositions following failure/success feedback. These cross-level interaction hypotheses are open empirical questions.

Next, it will be important to capture the dynamic features of the goals construct to strengthen claims about the causal effects of goals on achievement processes and outcomes. Some argue that relying on dispositional conceptualizations of goals is inappropriate in the hierarchical model of achievement motivation, but researchers can vary the temporal resolution of their goal assessments. Some studies may assess goals for an event and track processes and outcomes over the course of the event to use in prospective prediction models (e.g., using preseason goals to predict changes in relevant outcomes over the course of the season). Other studies may assess goals, processes, and outcomes on more of a moment-to-moment basis (even though this is difficult to do, as we noted earlier) to capture dynamic links between goals and their consequences (e.g., using daily goals to predict daily fluctuations in relevant outcomes over the course of the season). Both approaches will be valuable provided that the temporal resolution of the goal assessment is clear when interpreting the results.

Finally, whereas a great deal of data has accumulated about individual difference antecedents of different achievement goals, relatively little is known about the situational factors that antecede 2 × 2 goals. Church, Elliot, and Gable (2001) reported differences in classroom environments that predicted students' tripartite goals. There are few published studies regarding links between situational characteristics and 2 × 2 goal involvement in sport, except research based on achievement goal theory investigating motivational climate that indirectly informs performance and mastery achievement striving (for an exception see Conroy, Kaye, & Coatsworth, 2006).

REFLECTIONS ON THE HIERARCHICAL MODEL AND ACHIEVEMENT GOAL THEORY

The introduction of the hierarchical model has challenged many of the tenets and underlying assumptions of what may be referred to as traditional achievement goal theory. One of the most important challenges and differences between the perspectives pertains to the energization of the motivational process. As we have seen, the hierarchical model differentiates goals based on both the definition of competence (a similarity with the dichotomous model) and their valence or the degree to which the focal outcome is pleasant or unpleasant (a difference between the models). The argument is that achievement goals should consider both the definition of competence and the valence of the striving. However, it may be argued that in the hierarchical model we seem to be defining achievement goals as discrete goals based on a definition of competence and achievement strategies aimed at fulfilling some particular objective. In the hierarchical model, goals are midlevel constructs that mediate the effects of a host of individual differences (e.g., achievement motives, self-perceptions, relational variables, demographic characteristics, neurophysiologic predispositions) and situational factors (e.g., norm-based evaluation) on specific motivated behaviors and serve as proximal predictors of achievement-related processes and outcomes (Elliot, 1999). But it is the appetitive (approach) and aversive (avoidance) valence of competence striving that energizes the motivational process. It is assumed that the goals are the manifestation of needs, or at least the "motivational surrogates," as Elliot and Church (1997) state of the needs of achievement motivation (approach) and the fear of failure (avoidance; Kaplan & Maehr, 2002). This suggests that achievement goals represent approaches to self-regulation based on satisfying approach and avoidance needs that are evoked by situational cues. Achievement goals arise from affect-based objectives, at least in part, in the hierarchical model.

In traditional achievement goal theory, it is the goals themselves that are the critical determinants of achievement cognition, affect, and behavior. It is the goals that give meaning to the investment of personal resources because they reflect the purposes underlying achievement actions in achievement contexts. Once endorsed, the goal defines an integrated pattern of beliefs, attributions, and affect that underlie approach and avoidance strategies, different levels of engagement, and the different responses to achievement outcomes (Duda & Hall, 2001; Kaplan & Maehr, 2002). The way an individual interprets his or her performance can be understood in terms of what an individual considers to be important in a particular context and his or her beliefs about what it takes to be successful in that situation. Achievement goals refer to achievement-oriented or achievement-directed behavior where success is the goal. Nicholls (1989) argued that these beliefs and perceptions form a personal theory of achievement in the activity that drives the motivation process, and that a conceptually coherent pattern of relationships should therefore exist between an individual's achievement goals (the subjective meaning of success) and his or her achievement striving. In the achievement goal approach, it is not how one defines competence with its attendant valence; it is how one defines success and the meaning of developing or demonstrating competence. Thus, the hierarchical approach presents energizing constructs that are different. The conceptual argument is whether we need "needs" to explain the energization of the motivational equation, or whether we can accept a cognitive theory of motivation that focuses on thoughts and perceptions as energizing motivated behavior (Maehr, 1987). We need more empirical investigation of the conceptual energizing constructs, and their roles, underlying achievement striving in achievement contexts to better understand the motivational equation.

One other conceptual difference has emerged from the development of measures for the hierarchical model of goals, especially of the 2 × 2 model in sport. Duda (2005) has argued that because the interrelationships between the performance-approach, mastery-avoidance, and performance-avoidance goals is low to moderate (e.g., Conroy et al., 2003), and only the mastery-approach and performance-avoidance goals have demonstrated independence, this creates conceptual problems for the hierarchical approach. How does this relate to the evidence that task and ego goals have been demonstrated to be orthogonal in the dichotomous achievement goal approach, at least from the Maehr and Nicholls approaches (e.g., Maehr & Braskamp, 1986; Maehr & Nicholls, 1980; Nicholls, 1989)? More research is clearly needed to explore this issue as proponents of the 2 × 2 model argue that limited positive correlations should be expected between goals that share either a definition of competence or a valence. However, this raises interesting questions: What are the expected relationships between the goals? Should they demonstrate greater independence to be recognized as extending the range of goals?

In addition, there is evidence that the hierarchical model may have different assumptions underlying performance-approach and avoidance goals. Performance-approach tendencies may be based on demonstrating normative ability and defining competence in normative terms, but recent research has suggested that performance-avoidance may be based on one of three facets: impression management, or "saving face" (Skaalvik, 1997; Skaalvik & Valas, 1994); a fear of failure (Elliot & Church, 1997); or a focus on avoiding demonstrating low ability (Middleton & Midgley, 1997). In an interesting study investigating the measurement technology underlying the hierarchical model, Smith, Duda, Allen, and Hall (2002) wished to determine whether the different measures used were measuring the same constructs. They found that impression management (Skaalvik, 1997) explained the most variance (40%), with fear of failure (Elliot & Church, 1997) and avoiding demonstrating low ability (Middleton & Midgley, 1997) explaining only 9.4% and 8% of the variance, respectively. It would seem important for future research to clarify the conceptual underpinnings of performance-avoidance: What parts are played by fearing failure, avoiding demonstrating low ability, and protecting self-worth? Given the findings of Smith and colleagues, perhaps it is more important to performance-avoiding people to protect self-esteem rather than be motivated to avoid failing. What is the role the protection of self-worth plays? When individuals begin to question their ability to present a positive sense of self, are they more likely to favor avoidance strategies?

Similar arguments may be made for mastery-avoidance goals. These goals involve focusing on not making mistakes or not doing worse than a previous performance. They combine a desirable definition of competence with an undesirable focus on avoiding incompetence. It must be confessed that little is known of these goals as yet. With the traditional achievement goal approach, it is conceptually inconsistent to have a mastery- or task-involved goal with a focus on avoiding appearing incompetent. Traditional achievement goal theory argues that because dispositional orientations are assumed to be orthogonal, the individual may also have an ego-involving orientation, and it is this that may affect whether the individual is also concerned with the demonstration of incompetence. It may be that mastery-avoidance individuals have both ego and task goals; when the context is perceived to evoke ego-involving criteria, they may wish to avoid demonstrating incompetence. However, this needs to be investigated empirically; only when we have data informing theory will we be able to determine the energizing mechanisms behind achievement striving.

This brings us to a further point of conceptual departure between the two approaches: In achievement goal theory, the orientations are considered orthogonal; that is, one can have both orientations to one degree or another. For example, Duda (1988) examined the relationship between achievement goals and specific motivated behaviors such as persistence and behavioral intensity. Participants were classified into four groups, and the findings showed that being high in task orientation (regardless of ego orientation) meant the participants persisted longer and devoted more time to practice. Similar findings were found by Walling and Duda (1995). High-task-oriented students were significantly more likely to believe that success is achieved through intrinsic interest in the activity, cooperation, and high effort, and the high-task/low-ego students were the least likely to believe that success stems from learning to skillfully deceive the teacher. Roberts et al. (1996) found that the high-task groups attributed success to effort more than did low-task groups. In contrast, high-ego groups attributed success to ability more than did low-ego groups. Even elite Olympic athletes, those we would expect to exhibit high ego involvement and to succeed with such a profile (Hardy, 1997), seem to function better when high ego involvement is tempered with high task involvement (e.g., Pensgaard & Roberts, 2002, 2003). This was also true of young elite soccer players (Lemyre et al., 2002).

Being both task- and ego-oriented is conceptually coherent with achievement goal theory. It may well be that being high in both task and ego involvement is valuable in the learning process because it provides multiple sources of competence information to the athlete. Swain and Hardwood (1996) have suggested that an individual with both goal orientations cannot fail to be satisfied. They argue that when one goal is not attained, the second goal can be achieved. Duda (1988) asserted a similar notion and states that persistence may be increased with both orientations because a person has two sources of determining success. For an athlete, being both task- and ego-involved in an activity is both intuitively plausible and conceptually consistent with achievement goal theory. Thus, an athlete may be very ego-involved in a sport when competing, but become very task-involved when training in the same sport. Further, an athlete may be ego-involved in competition, but then when the outcome is certain, or for some other reason, become task-involved before the game or event is completed. We must not forget that task and ego involvement are dynamic constructs and subject to ebb and flow as the athlete plays the game or continues with the activity (Roberts, 1992, 2001). It is not whether an individual should be either task- or ego-involved, but rather when being task-involved or ego-involved is appropriate. This shift of involvement is an important issue to investigate, as it may reflect on intervention strategies for enhancing motivation.

THE FUTURE OF ACHIEVEMENT GOALS

We have discussed the nature of achievement goals as being situated within situation and self-cognitive schemas, the traditional achievement goal approach, or being situated within affect-based incentives (at least partially) in the hierarchical model. However, achievement goals have been based in other constructs, too.

One approach has been to use the concept of value, where goal orientations emerge from the value-laden attractiveness of an achievement context. Values are directed at desirable end states of behavior, and goals are seen as objectives (Bandura, 1986; Eccles & Harold, 1991; Ford, 1992; Kaplan & Maehr, 2002). As an example, Eccles and her colleagues (Eccles & Harold, 1991; Wigfield & Eccles, 1992) suggest that achievement goals emerge from values and expectancies. Thus, mastery goals emerge from intrinsic task values and a belief in one's competence to do the task, whereas performance goals emerge from the utility value of the task for success in an important domain and the expectancy of outperforming others. The research into task value and achievement goals is promising and increasing in sport (Wiess & Ferrer-Caja, 2002), but more research is needed to develop the conceptual base of the approach in physical activity.

Goals have also been seen as "self-primes," a form of heightened self-awareness (Kaplan & Maehr, 2002). Nicholls (1984) has suggested that heightened self-awareness could make thoughts of competence salient. What is an ego goal (or performance-approach and performance-avoidance goals) may well represent a heightened awareness of the self as the person may focus on what he or she can do. However, heightened self-awareness may also affect other thoughts about oneself. Self-awareness certainly may affect ego or performance goals, especially in terms of approach and avoidance goals. It is interesting that the research into self-awareness is meaningful to achievement goal theory and may propose a fruitful line of inquiry. However, more conceptual clarification and research is needed, especially in the mastery/task achievement goal.

There are other metaphors that may guide the development of achievement goals. It will be the business of future research to attempt to combine the various perspectives into a parsimonious explanation of how contexts and individual differences forge achievement goals.

The foregoing reflects one major trend in achievement goal research: the attempt to converge achievement goals into a larger, more parsimonious framework. As discussed earlier, Elliot and colleagues (e.g., 2005) have integrated achievement goal theory with more traditional concepts of achievement needs. Kaplan and Maehr (2002) have argued for more general processes of meaning construction that involve the self and the context in a broader framework. This trend is welcome, as the development of specific achievement goals should be based on a sound conceptual framework.

Still other achievement goals have been identified. Initially pursued (e.g., Maehr & Braskamp, 1986), they fell into disuse as the parsimony of the dichotomous interpretation was demonstrated over time. One early goal was termed a social goal, referring to social approval and/or interpersonal reasons for engaging in achievement tasks (e.g., Ewing, 1981; Maehr & Nicholls, 1980). But little attention has been given to social goals in physical activity in recent times. Another early goal involved extrinsic orientation, where the individual strove to achieve an external criterion of success (e.g., Maehr & Braskamp, 1986). But little attention has been paid to extrinsic goals, except within the framework of other motivational conceptualizations (e.g., Deci & Ryan, 1985, 2002). And qualitative research has identified other goals in addition to ego and task goals (e.g., Dowson & McInerney, 2001). It may well be that future research, particularly qualitative research, may identify and demonstrate how these goals may further our understanding of the origin and development of achievement goals and their behavioral implications.

This reflects a second trend in achievement goal research, that of developing other achievement goals. In particular, there have been arguments in favor of recognizing different criteria of engagement in achievement striving, and that these have their own patterns of consequences. We have discussed the approach and avoidance arguments of Elliot and colleagues that began this trend, but it has also been suggested that we may be able to bifurcate the current mastery (task) definitions of competence into separate categories for absolute (e.g., Did I perform this task as well as this task can be performed?) and intrapersonal (e.g., Did I perform this task better than I did previously?) definitions of competence (Elliot, 1999; Elliot & Conroy, 2005; Harwood, Hardy, & Swain, 2000). The same may be argued for other goals, such as social goals and extrinsic goals, which may also be partitioned into approach and avoidance categories (Dowson & McInerney, 2001). Thus, for example, social goals can be categorized as either approach, in that one can demonstrate competence to gain friends ("If I play well, my friends will like me"), or avoidance, in that competence, or the expectation of failing to demonstrate competence, will lead to social castigation ("If I don't play well, my father shouts at me"). Thus, the trend begun by Elliot continues. However, Elliot and Conroy (2005) argue that any expansions of the achievement goal construct need to relate to existing dimensions of achievement goals (i.e., definitions of competence, valence of strivings) or provide a rationale for incorporating new dimensions of competence. But researchers need to be careful not to add unnecessary complexity to the parsimonious interpretation of achievement goals without a concomitant increase in conceptual integration.

CONCLUSION

There are two important conclusions we may draw. First, performance goals (however they have been defined and conceptualized) are more likely to lead to maladaptive achievement behavior, especially when participants perceive competence to be low, are concerned with failure, or are invested in protecting self-worth. In such circumstances, the evidence is quite clear: Motivation ebbs, task investment is low, persistence is low, performance suffers, satisfaction and enjoyment are lower, and participants feel more negatively about themselves and the achievement context. But this does not mean that ego-oriented goals are always negative; in some situations for some people they are positive. A performance-approach goal (e.g., Elliot, 1997) or an ego (or performance) goal with high perception of competence (e.g., Pensgaard & Roberts, 2002) is facilitative of achievement and functions as a motivating construct. But even then, performance (ego) goals are more fragile and can lead to maladaptive achievement striving as context information is processed (Dweck & Leggett, 1988; Midgley, Kaplan, & Middleton, 2001).

Second, the research is unequivocal that task (mastery) goals are adaptive. When task-involved participants perceive mastery criteria in the context, motivation is optimized, participants are invested in the task, they persist longer, performance is higher, satisfaction and enjoyment are higher, and participants feel more positively about themselves and the task. Being task-involved has been consistently associated with desirable cognitive and affective responses. The research is now clear that if we wish to optimize motivation in physical activity we ought to promote task involvement. It does not matter whether we do it through enhancing socialization experiences so that the individual has a task goal orientation and is naturally task-involved (Nicholls, 1989), or we structure the physical activity context to be more task-involving (e.g., Treasure & Roberts, 1995, 2001). The evidence has led many sport psychologists to conclude that task involvement better enables learners to manage motivation in the sport experience. Consequently, they have urged those involved in pedagogy to promote task involvement as well as develop mastery-oriented environments to facilitate effective motivational patterns for all participants, even if the individuals are high in ego orientation (e.g., Brunel, 2000; Duda, 1992; Hall & Kerr, 1997; Pensgaard & Roberts, 2002; Roberts, 2001; Roberts et al., 1997; Theeboom et al., 1995; Treasure & Roberts, 1995).

However, an important assumption of achievement goal theory from the Nicholls perspective is that the goals are orthogonal; that is, being task- or ego-involved is independent, which means that one can be high or low in each or in both orientations at the same time. The findings of the research discussed here suggest that rather than depressing a high-ego state of involvement and replacing it with a high-task state of involvement, as has been advocated by many researchers, we should concentrate on enhancing the task-involved state. This finding suggests that we do not have to explicitly depress ego involvement to maintain motivation; rather, we should enhance task involvement to moderate the potentially debilitating effects of a high-ego state of involvement.

It may well be that always fostering task-involving criteria may not satisfy all individuals in the sport experience, especially elite athletes (Hardy, 1997). It may well be that athletes at all levels of competition would benefit from being *both* task- and ego-involved. Being both task- and ego-involved is conceptually coherent with achievement goal theory and may be valuable in the learning process because it provides multiple sources of competence information to the athlete. Encouraging individuals to be task-involved in achievement tasks has been demonstrated to optimize motivation, even with elite athletes, but we need not be blind to the fact that some athletes do favor and are motivated by ego-involving criteria. The task for the investigator and the practitioner is to determine when task- or ego-involving criteria of success and failure are motivational. Only further research will verify this hypothesis.

As is clear from the foregoing, it may be concluded that where achievement goals come from, how they are operationalized, and how they are measured are areas with rich research traditions. We may ask: What are the key constructs underlying the motivational equation? Of all the motivational paradigms that are extant, which of the constructs is central to understanding motivation? As Duda and Hall (2001) have suggested, perhaps it is time to begin to seriously attempt to integrate some key constructs and untangle the motivation puzzle, as we and some others have attempted (e.g., Kaplan & Maehr, 2002). Are achievement goals the manifestation of needs, values, the valence of outcomes, or cognitive schemas driving how one sees one's world and responds to the environmental cues with achievement striving? What gives meaning to achievement striving? In sport and physical activity, we need to address these questions and expand our conceptual understanding of motivational processes and achievement behaviors so that we can intervene effectively to enhance motivation and make the sport and physical activity context enjoyable and satisfying for all.

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CHAPTER 2

Emotions in Sport

Current Issues and Perspectives

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Selected issues and perspectives on pleasant and unpleasant emotions experienced by athletes and how and why these emotions affect athletic performance are reviewed in this chapter. A balanced view of emotion-performance relationships requires an overview of a sequence involving three groups of individual difference variables: defining characteristics of emotional experiences, antecedents of emotional experiences, and consequences of emotions for athletic performance. Kuhl (1994) used such a sequential framework for description of a theory of action and state orientations, whereas Vallerand and Blanchard (2000) proposed an "antecedents-consequences" sequence for an integrative analysis and review of emotion theory and research in sport and exercise.

The chapter is based on an individual-oriented and sport-specific framework grounded in extensive research, the individual zones of optimal functioning (IZOF) model (Hanin, 1995, 1997, 2000). A detailed description of the IZOF model is beyond the scope of this chapter; readers are referred to reviews updating the recent developments of the model (Cerin, Szabo, Hunt, & Williams, 2000; Crocker, Kowalski, Graham, & Kowalski, 2002; Hanin, 2000, 2003, 2004; Raglin & Hanin, 2000; Robazza, 2006; Ruiz, 2004: Woodman & Hardy, 2001). The main emphasis here is on defining characteristics of emotional experiences, their antecedents (determinants), and consequences (outcomes, impact). Finally, directions for future research as well as practical implications are suggested.

I would like to express my sincere thanks and deep appreciation for the thoughtful comments and suggestions from Bob Vallerand, Knut A. Hagtvet, and Claudio Robazza, who read an earlier draft of this chapter.

TERMINOLOGY

Terminology issues in emotion research involve attempts to find a more precise definition of emotion (and related affective phenomena) and to provide a detailed description of defining characteristics of emotional experiences. Both aspects are briefly reviewed in the sections that follow.

Defining Emotion

The definition of *emotion* remains ambiguous (Vallerand & Blanchard, 2000). It has even become a common practice to state that it is intuitively clear what emotion is, but difficult or even impossible to define. According to Parkinson (1994), there are several ways of approaching the definition of emotion: (a) by giving examples of items belonging to the category of emotion; (b) by looking at the different aspects and components of emotional experience (Crocker et al., 2002; Vallerand & Blanchard, 2000); and (c) by considering how various aspects combine with one another and how they interact to make an emotion episode what it is, and (d) by relating and contrasting it with other psychological functions. It is also possible to examine the dozens of already suggested definitions of emotion and select the one that best encompasses all or most of the research. However, the problem with such an ideal definition of emotion is that it requires a statement of the necessary and sufficient conditions for application of the term, and that is usually not an easy task (Plutchik, 1980). Therefore,

> an attempt to define emotion is obviously misplaced and doomed to failure. . . . To ask today what is emotion is old-fashioned and likely to lead to semantic hairsplitting; to construct systems that unequivocally explain, predict, and make understandable parts of the range of human experience and

> behavior may, in the long run, be the best or only reply. (Mandler, 1975, pp. 10–11)

Interestingly, in current practice, researchers recognize the fact that there is no perfect term and simply sidestep the search for *the* definition, instead discussing dimensions, categories, and components of emotion (Vallerand & Blanchard, 2000). Additionally, terms describing different affective phenomena (emotion, mood, affect, temperament) are often contrasted (Crocker et al., 2002), although this does not seem to be an effective strategy. Whatever the general definition of emotion proposed, it is important to distinguish among its *defining characteristics, antecedents,* and *consequences* (outcomes). Also important is that "we might start not with the aim of *explaining* emotions but rather with describing a system that has as its product some of the observations that have been called 'emotion' in common language" (Mandler, 1975, p. 4).

This is especially true in sport, as is evident in Martens's (1987, p. 51) comment:

> Sport psychology is theory poor. . . . We have been so eager to test theories of the larger field of psychology in order to confirm our scientific respectability that we have not adequately observed, described, and theorized about our own thing—SPORT. We clearly need to spend more time observing behavior in sport and building our own theories unique to sport.

Unfortunately, this concern remains current in sport psychology research, and a need for an accurate and detailed description of emotional experiences is often underestimated or simply ignored. This results in a premature theoretical speculation in the absence of an adequate database (Hanin, 1997; Raglin & Hanin, 2000). To summarize, one option is to continue a search for a more precise definition of emotion; the other option is to focus on an accurate and detailed description of defining characteristics of emotion and relating it to some specific category.

Emotion as a Category of Experience

Traditionally, emotion as a category is defined as an organized psychophysiological *reaction* to ongoing person-environment (P-E) relationships. For instance, Deci's (1980, p. 85) working definition conveys at least the meaning of emotion:

> An emotion is a reaction to a stimulus event (either actual or imagined). It involves change in the viscera and musculature of the person, is experienced subjectively in characteristic ways, is expressed through such means as facial changes and action tendencies, and may mediate and energize subsequent behaviors.

Another working characterization views emotions as valenced reactions to events, agents, or objects, with their particular nature being determined by the way the eliciting situation is construed (Ortony, Clore, & Collins, 1988). In this approach, there are three broad classes of emotions that result from focusing on one of three salient aspects of the world: events and their consequences, agents and their actions, or objects, pure and simple (p. 13). Finally, a widely accepted proposal of an emotion as a set of stages or a process (Izard, 1977, 1993) was made by Frijda (1986). It includes the following sequence: Appraisal → Context evaluation → Action readiness → Physiological change, expression, action (see Oatley & Jenkins, 1992, for review).

In most cases, the definition of emotion as a reaction captures only one aspect of the P-E interaction. The person's response is related to, but still separate from, the environment. Moreover, a descriptive definition of emotion is somewhat limited because it does not include the causal cognitive, motivational, and rational variables and processes involved in arousing and sustaining an emotion (Lazarus, 2000, p. 230). The cognitive-relational motivational theory of emotion elaborates the notion of P-E interaction as applied to stress-related emotions and later to pleasant and unpleasant emotions.

To study something as an *indivisible unity,* according to Vygotsky (1926/1984), it is necessary to find a construct that appropriately captures the characteristics of both interacting elements. In psychology, *experience* is a relevant construct to study P-E interactions because it reflects a person's attitude toward different aspects of the environment and the meaning of the environment for the person. Experience has a biosocial orientation as every experience is always someone's experience of something and, as such, is best represented as a unit of consciousness. Thus, the analysis of any difficult situation should focus not so much on the situation or on the person per se but on *how this situation is experienced by this person.*

Emotional experience as an indivisible component of total human functioning reflects the nature of past, ongoing, or anticipated P-E interactions. Vygotsky (1926/1984) identified at least three types of P-E interactions: the predominance of an organism over the environment, the P-E balance, and the predominance of the environment over an organism. These notions were applied to performance emotions in sport (Hanin, 1989, 1997), and it was proposed that P-E interactions are best represented by the relationships between task demands and a person's resources (Hanin, 2003, 2004). From this perspective, emotion research in sport should describe, predict, and explain an athlete's optimal and dysfunctional *experiences* accompanying individually successful and poor performances. A working definition of experience includes the totality of past and present characteristics that determines the particular quality of a person's performance (Hanin, 2003).

In the sport context, there are three interrelated types of performance-related experiences: *state-like experiences,* or emotional states, as a component of situational, multimodal, and dynamic manifestations of total human functioning; *traitlike experiences,* or relatively stable emotion patterns (emotionality, dispositions, qualities) reflecting a repeated nature of athletic activity; and *meta-experiences* (awareness, attitudes, preferences/rejections of one's experiences; Mayer & Stevens, 1994), which are lessons learned or reflected experiences in successful and less than successful performances (Hanin, 2004).

In contrast to situational states and repeated patterns of experience, meta-experiences reflect how an athlete feels about his or her past, present, or anticipated emotional experiences and the perceived effects of these emotional experiences on performance or general well-being. For instance, an athlete may feel nervous and uncertain prior to a competition. That characterizes his or her situational emotional state as triggered by a specific meaning of the particular situation for this athlete. On the other hand, feeling nervous can be a typical (repeated) pattern of this athlete's emotional response in similar situations. Therefore, in this particular case, trait competitive anxiety would indicate how often the athlete experiences elevated anxiety and feels nervous, tense, or apprehensive prior to or during competition. However, an athlete's meta-experience (attitude to experiencing a high level of competition anxiety and awareness of its helpful or harmful effects on performance) is even more important to estimate. Meta-experiences are formed when athletes (and coaches) spontaneously and deliberately reflect on the conditions leading to their successful, and less than successful, performances. Meta-experiences determine an athlete's perception and a choice of coping and self-regulation strategies, and therefore should be a major target of interventions.

Interestingly, most research in sport psychology during the past 2 decades has focused mainly on situational emotional states (such as competition anxiety) and relatively stable emotion patterns (e.g., trait anxiety). Meta-experiences in sport, although undefined as a separate parameter (Hanin, 2003), were actually implied in the assessment of optimal and dysfunctional zones of emotion intensity (Hanin, 1978, 1986; Hanin & Syrjä, 1995) and in the ratings of "directional" anxiety (or perceived impact) on performance (Jones, 1995). On the other hand, in practice, emotion regulation is often based on reframing an athlete's attitude toward specific emotional experiences. For instance, it is difficult to imagine how an athlete can constructively use high anxiety without a positive attitude and expectation of its helpful effects. In other words, meta-experience adds a special meaning and a new quality to perceived situational state, which is interpreted (or reinterpreted) as facilitating or debilitating. Therefore, the role of meta-experiences as determinants of appraisal and coping processes should be reemphasized, especially in intervention studies. Based on Vygotsky's suggestion, emotion is construed not as a reaction, but as experience (situational and repeated) and meta-experience reflecting the dynamics of P-E interactions.

DEFINING CHARACTERISTICS OF EMOTION EXPERIENCE

A comprehensive analysis and understanding of emotion experiences in sport requires an accurate description of their basic dimensions or defining characteristics. What are these basic (i.e., sufficient and necessary) dimensions? Apparently, emotion experiences are complex phenomena requiring multidimensional characterization.

For decades in emotion research, typical dimensions were *valence* (i.e., hedonic tone) and *intensity.* Both were used in conceptualizing global emotion content (pleasure/displeasure and high and low activation). On the other hand, historically, emotion *components* have been characterized by three parameters derived from measurement methods rather than from the conceptualization of emotion dimensions. These include physiological concomitants, introspective (verbal) self-reports, and behavioral observation (Eysenck, 1975). From this perspective, typical dimensions are emotion intensity, emotion valence, and emotion manifestation as assessed by cognitive labels, bodily response, and behavioral displays (expression or suppression). A need to go beyond these widely accepted dimensions to capture a more complete picture of emotional experiences is clearly indicated (Hanin, 1995, 1997, 2000, 2003). In the sections that follow, a brief description of the five basic dimensions characterizing emotion experiences is provided.

Multidimensionality of Emotion Experiences

An alternative multidimensional approach was proposed in the IZOF model (see Hanin, 1997, 2000, for a review). It was derived from the *method of bases* developed for the systems description of complex phenomena (Ganzen, 1984). In the systems description, a multitude of elements of the object under investigation is contrasted with the elements of the basis (the logical foundation). Ganzen, having analyzed the descriptions of different objects and phenomena, proposed that "spatiality, time, information and energy were the basic characteristics of any object that typically functions as their integrator" (p. 44). These separate concepts (space, time, energy, information, and a substrate) were suggested as a conceptual basis (pentabasis, or a five-element foundation) to integrate existing concepts and empirical research findings. This descriptive framework makes it possible to (a) examine the completeness of description of the phenomenon, (b) better organize the components, (c) compare different descriptions, and (d) discover the similarity in the objects or phenomena of different natures (pp. 41–42).

This approach has been theoretically substantiated and empirically validated in the systems descriptions of psychological subdisciplines, general characteristics of the nervous system, and the description of human personality and individuality (Ganzen, 1984). In the sports setting, the pentabasis and the idea of systems description were used in the longitudinal study of communication patterns in top sport teams (Hanin, 1980, 1992), in sports career and athlete crisis research (Stambulova, 2000), and in investigations of performance-related emotions (Hanin, 1993, 1995, 1997, 2000).

In its current form, the IZOF model posits five basic dimensions that capture defining characteristics of emotion experience as a component of different psychobiosocial states related to performance (Hanin, 2000, 2003). I argue that emotional experience is always manifested in some *form* (subjectively perceived or observable); it has specific *content* (or quality); it is characterized quantitatively by its *intensity* and as a process that unfolds over *time* (Folkman & Lazarus, 1985) in a particular *context.* Thus, the multilevel and system description of emotion as a component of performance-related states should include at least five interrelated dimensions: form, content, intensity, time, and context. Three of these dimensions (form, content, and intensity) describe the structure and function of the subjective emotional experiences and meta-experiences; time and context characterize dynamics of performers' subjective experiences in a specific social setting. Actually, these five basic dimensions include traditional emotion components (implied form, valence, and intensity) and provide a tool for a systems description of emotional experiences (for more detail, see Hanin, 1997, 2000, 2003, 2004; Robazza, 2006). The following sections focus mainly on emotion form, content, and intensity.

Situational Emotion and Nonemotion Experiences

An athlete's performance state manifests itself in the form dimension, which consists of seven basic components or modalities: cognitive, emotional (affective), motivational, bodily, behavioral, operational (action tendencies), and communicative (see Hanin, 1997, 2000, for a review). From this perspective, situational emotional experience (e.g., anxiety or anger) is a component of the *psychobiosocial state* related to nonemotion components.

Current individual-oriented research focuses on emotional, motivational, and bodily components of performance state and their interactive effects. Recent empirical evidence indicates that to describe performance-related experiences, athletes use their own vocabulary of idiosyncratic labels. However, an athlete's vocabulary describing performance-related states usually includes not only self-generated emotion words but also labels describing nonemotion experiences: cognitive, motivational, bodily, motor-behavioral, operational, and communicative (Hanin, 1997; Hanin & Stambulova, 2002; Ruiz & Hanin, 2004a, 2004b). For instance, Hanin and Stambulova examined emotional experiences prior to, during, and after personally best and worst competitions in 85 skilled Russian athletes using a metaphor-generation method. Each athlete had to complete a sentence, "Prior to my best competition I felt like . . . ," that generated a metaphor (e.g., "I felt like a *tiger*") as a symbolic representation of a feeling state. Completing a paraphrased sentence, "In other words, I felt myself . . . ," elicited an interpretation (e.g., "I felt strong and focused") of an athlete's state as symbolized in the metaphor. Then athletes generated metaphors and interpretative descriptors for competition situations during and after performance. The same procedure was repeated to describe how they felt prior to, during, and after worst-ever competitions. These six situations elicited 510 idiosyncratic and functionally meaningful metaphors and 922 interpretative descriptors. As predicted, metaphors and descriptors reflected high action readiness in best-ever competition and low action readiness in worst-ever competition. Athletes also used different metaphors to describe, symbolically, their experiences prior to, during, and after performance as the meaning of these situations changed. Interestingly, the accompanying idiosyncratic labels described not only emotional experiences but also the multiple connotations of nonemotion components of the psychobiosocial states. Similar findings based on self-generated metaphors and accompanying interpretative descriptors were obtained in studying a sample of top Spanish karate athletes (Ruiz & Hanin, 2004b).

Because emotion, as a concept, remains largely undefined, it is not surprising that distinctions between emotions and nonemotions are sometimes not quite clear, especially in assessments. For instance, an inspection of the 10 global affect scales described by Watson and Tellegen (1985) shows that some of the items are "conceptually faulty and would not be considered emotions by appraisal-centered theorists" (Lazarus, 2000, p. 239). In other words, emotion descriptors in existing emotion scales often represent not only "pure" emotions, but also nonemotion components of a state (cognitive, motivational, bodily, and behavioral). Apparently, research-wise, it is important to clearly distinguish among emotion, nonemotion, and borderline modalities of a state (Lazarus, 2000). From the applied perspective, however, a more holistic description of the performance-related state, including emotions and nonemotion experiences, could be equally important and sometimes perhaps even more appropriate.

Recently, Robazza, Bortoli, and Hanin (2004) showed that athletes are well aware of several nonemotion modalities of their performance state (motivational, bodily, sensory-motor, and behavioral). In another study (Hanin, 1999), seven positively toned items (*motivated, willing, desirous, hopeful, keen, daring,* and *interested*) and seven negatively toned descriptors (*unmotivated, unwilling, reluctant, hopeless, bored, compelled,* and *uninterested*) discriminated quite well the motivational states of 29 highly skilled ice hockey players before their successful and less than successful games (see Figure 2.1).

In contrast, motivational domains in this sample had multiple and diverse connotations. Table 2.1 provides a summary of responses of these players to a question about what motivates (and what does not motivate) them before the game.

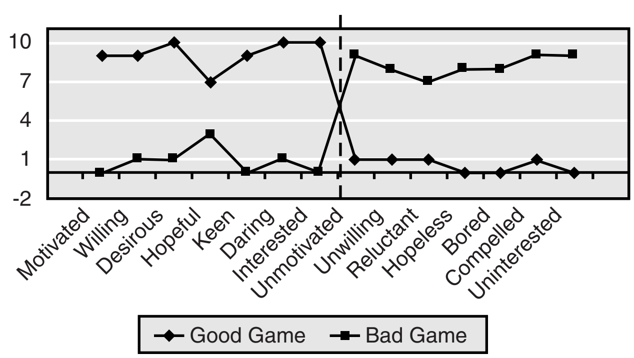


Figure 2.1 Individualized motivational profile of ice hockey players ($N = 29$). Adapted from "Sports-Specific Emotion-Motivational Profiling: An Individualized Assessment Program" (pp. 238–240), by Y. Hanin, in *Psychology of Sport: Enhancing the Quality of Life,* V. Hosek, P. Tilinger, and L. Bilek (Eds.), 1999, proceedings of the 10th European Congress of Sport Psychology: Part 1, Prague, Czech Republic: Charles University Press. Adapted with permission.

Table 2.1 Enhancing and Detrimental Motivational Domains for Ice Hockey Players

Enhancing Motivational Domains		
"I'm motivated if . . . "		
Focus on:	*Feeling state:*	*Our game:*
• Winning	• Self-confident	• Important
• Fighting	• Trust myself	• Challenging
• Doing my best	• Enjoying the game	• Tough
• Learning	• Psyched up	• Well started
Ice hockey:	*Opponent:*	*Own team:*
• My serious hobby	• Tough	• I play for my team
• My future profession	• Good	• I work for team's success
• My life	• Strong	• Good climate in the team
Detrimental Motivational Domains		
"I'm not motivated if . . . "		
Preparation:	*Feeling state:*	*Our game:*
• Insufficient recovery	• Too tired	• Too easy
• Poor shape	• Health problems	• "Meaningless"
• Poor planning	• Dissatisfied	• Nothing works
	• Too satisfied	• Clearly lost
		• Bad start
Outside sport:	*Opponent:*	*Own team:*
• Family	• Too easy	• Repeated losses
• School	• Clearly weaker	• Poor team climate
• Other concerns		

Note: $N = 29$ Finnish ice hockey players.

Adapted from *Emotions in Hockey,* by Y. L. Hanin, May 2000, paper presented at the IIHF International Coaching Symposium: Building a Hockey Base for the 21st Century, St. Petersburg, Russia. Adapted with permission.

Numerous athlete-generated bodily descriptors are examples of another component in the form dimension. These idiosyncratic bodily labels included different experiences located in face, legs/feet, arms/hands, neck/shoulders, and stomach (see Table 2.2). Also mentioned were characteristics of movements, heart rate, and feeling thirsty, hungry, cold, and pain (Robazza, Bortoli, et al., 2004). Interestingly, these symptoms are more diverse compared to researcher-generated items, for instance, in the Competitive State Anxiety Inventory (CSAI-2). Future research might identify idiosyncratic bodily descriptors of different emotional experiences related to successful and poor performances across different sports and groups of athletes.

Although "reading the players" is an important social psychological skill for a coach, especially in team sports, behavioral indicators of specific emotional experiences have not yet become a focus of systematic studies in sport psychology. Several attempts to examine this modality suggest that coaches and athletes are well aware of the behavioral symptoms of certain emotions. For instance, in an unpublished

Table 2.2 Idiosyncratic Bodily Experiences

Face	*Legs/feet*	*Arms/hands*	*Neck/shoulders*	*Stomach*
• Tense/relaxed • Nervous tics • Yawns • Dry mouth	• Tense • Loose • Cold	• Tense/relaxed • Sweaty/cold	• Tense	• Tense
Movements	*Heart rate*	*Feeling*	*Pain*	
• Energetic • Vigorous • Sharp • Smooth • Slow • Stiff	• Perceived • Irregular • Accelerated	• Fresh • Thirsty • Hungry/no appetite • Exhausted/tired • Cold/warm • Sweating • Urinary pressure • Lightness	• Physical pain • Headache • Back pain • Stomachache • Lack of pain	

Adapted from *Emotions in Hockey* by Y. L. Hanin, May 2000, paper presented at the IIHF International Coaching Symposium: Building a Hockey Base for the 21st Century, St. Petersburg, Russia; and "Pre-Competition Emotions, Bodily Symptoms, and Task-Specific Qualities as Predictors of Performance in High-Level Karate Athletes," by L. C. Robazza, Y. Bortoli, and Hanin, 2004, *Journal of Applied Sport Psychology, 16*(2), pp. 151–165. Adapted with permission.

exploratory study, Hanin (2005) asked 16 ice hockey coaches to describe behavioral markers of a player who feels self-confident. According to these coaches, such a player

> *looks purposeful, relaxed, calm, certain, focused, determined, happy and willing to go on ice. His body language is active. He stands up tall; his nose is not facing the ground; his voice is very sure; he radiates energy; he smiles and talks but stays focused; he looks forward to the situation; he enjoys playing (expressive movements); he makes eye contact with the coach and does not rush.* In contrast, a player with low self-confidence prior to the game, is *silent; thinks a lot; wants to be alone; sometimes talks too much to forget the game; tries to relax by laughing; worries a lot; asks when to go on the ice.* [italics added for emphasis]

These coaches were also able to describe, in much detail, observable behaviors of the players who feel high or low anxiety, complacency (satisfaction), and anger. There is clearly a need for development of behaviorally anchored scales enabling controlled observation of athletes' displays (expression or suppression) of emotional experiences prior to, during, and after successful and poor performances. In team sports, the major focus and concern of the coach are the emotional states of the goal keeper and the key players (leaders and subleaders), who affect the emotional dynamics of the entire team.

Emotion Content

Emotion content as a qualitative characteristic includes such general categories of emotional experiences as positive-negative (Russell, Weiss, & Mendelsohn, 1989; Watson & Tellegen, 1985), functionally optimal-dysfunctional (Hanin, 1978, 1993), and facilitating-debilitating (Alpert & Haber, 1960; Jones, 1991, 1995). Therefore, content is one of the basic dimensions in the systematic study of emotional experiences. It is difficult to imagine an emotion without a distinctive content and intensity (Lazarus, 2000). Both quality and intensity determine the functional impact of emotions on performance and well-being.

Two traditional approaches to categorizing emotion content are the *dimensional* (global affect) approach and the *discrete* (basic) emotion approach. The global approach emphasizes pleasantness-unpleasantness (valence or hedonic tone), tension-relaxation, and quiescence-activation (Russell, 1980; Watson & Tellegen, 1985). The discrete emotion approach centers on discrete categories of emotion based on their qualitative content (anxiety, anger, joy, etc.) and claims that there are clusters of "universal" and discrete emotion syndromes (Lazarus, 2000).

Although several emotion researchers embrace the notion of emotion types, they are still inclined to reject the idea that there is a set of "basic" emotions such that they, together with their combinations, account for all emotions (see, e.g., Ortony, Clore, & Collins, 1988, p. 25). Another objection is that any list of basic (discrete) emotions, ranging from 3 (Spinoza) to 6 (Ekman), 10 (Izard), and 15 (Lazarus), remains arguable. Hanin (1999) compared basic emotion labels proposed by 23 investigators representing eight different approaches to emotion research. It was found that, all in all, there were 47 labels of basic emotions (with 32 negatively toned and 15 positively toned emotion descriptors). The most selected emotion labels were *fear* (19 researchers), *anger* (18), *sadness* (9), *and disgust* (7); 23 labels were proposed only once, and 10 labels were selected twice (see Table 2.3).

Although any list of discrete emotions is arguable, at least two important aspects were clearly identified by Lazarus (2000). First, the list should include both negatively toned emotions (e.g., anger, anxiety, fright, sadness, guilt, shame, envy, jealousy, disgust) and positively toned emotions (relief, hope, happiness/joy, pride, love, gratitude, compassion). Second, regardless of the exact list, "a primary empirical and theoretical concern is to identify the *most important emotions,* their distinctive characteristics, antecedent causal variables and consequences, and *how they might influence competitive performance* in sports" (Lazarus, 2000, p. 232, italics added).

In competitive and high-achievement sports, the most important emotions are usually personally relevant, task-specific, and functionally helpful or harmful emotions really experienced by athletes. This assumption has received strong empirical support (Hanin, 1997, 2000, 2004; Robazza, 2006) and is based on the notion that "under similar environmental conditions, people perceive themselves differently, think differently, cope differently, and experience and display emotions differently" (Lazarus, 1998, p. 213). Thus, the functional importance of emotional experiences is associated with their goal relevance and with the extent that each athlete is able to perform up to his or her potential using effectively available resources.

In contrast, the usual laboratory study of emotion assumes that if the stimulus conditions are equal for all subjects, then the average of all subjects' responses best represents the group for the variable measured. Implicit in this assumption is the idea of equivalent life and performance histories, which obviously cannot be met in studies with humans. Lacey (1967) has demonstrated that different subjects tend to respond by activating different major physiological response systems, and that within any large group of subjects, several types of responders always exist. Obviously, this is true not only for bodily responses, but also for emotional experiences described by athletes' self-generated idiosyncratic labels (see Hanin, 2000, for a review).

Table 2.3 Basic Emotions: Frequencies of Label Selection

Fear (19)	Anxiety (2)	Pain (1)
Anger (18)	Curiosity (2)	Panic (1)
Sadness (9)	*Elation* (2)	Pity (1)
Disgust (7)	*Enjoyment* (2)	*Pride* (1)
Joy (6)	*Expectancy* (2)	Resignation (1)
Happiness (5)	Loneliness (2)	Sleepiness (1)
Interest (5)	Rage (2)	Sensuous comfort (1)
Surprise (5)	Contempt (2)	Sex-lust (1)
Love (4)	Appetite (1)	Shock (1)
Pleasure (3)	Grief (1)	Subjection (1)
Satisfaction (3)	*Acceptance* (1)	Succor (1)
Shyness (3)	*Amazement* (1)	Tenderness (1)
Distress (3)	Anticipation (1)	Tension (1)
Shame (3)	Boredom (1)	Want (1)
Guilt (2)	Despair (1)	Wonder (1)
Sorrow (2)	*Quiet* (1)	

Note: $N = 23$ researchers. Positively toned emotions are in italics.

Adapted from *Emotions in Hockey* by Y. L. Hanin, May 2000, paper presented at the IIHF International Coaching Symposium: Building a Hockey Base for the 21st Century, St. Petersburg, Russia. Adapted with permission.

Idiosyncratic Emotion Content

To identify person-relevant and functionally important emotional experiences, the IZOF model proposes that athletes use their own vocabulary of self-generated idiosyncratic labels. These self-generated emotion labels describe athletes' subjective pleasant and unpleasant experiences prior to (or during) their successful and poor performances. The implication is that success-related experiences are helpful for (or at least do not disturb) an athlete's performance, whereas failure-related experiences are detrimental (harmful) for individual performance. Although the main emphasis of the IZOF model is on emotion effects on athletic performance, the functionality-dysfunctionality of emotions is not limited to perceived (anticipated) helpful/harmful effects on performance. For instance, the functionality of emotions can be based on anticipated emotion effects on postperformance recovery (Hanin, 2002), performance-induced injuries (Devonport, Lane, & Hanin, 2005; Würth & Hanin, 2005), or an athlete's general well-being (Diener, 2000). Moreover, empirical findings suggest that the functionality of emotions relevant with respect to one criterion, for instance, performance, is not necessarily relevant for other outcomes, such as leisure quality, postinjury recovery, or general well-being in healing or educational settings. In other words, in each particular setting, functionality-dysfunctionality should be clearly specified as a set of intrapersonal, interpersonal, health, or well-being consequences (see Oatley & Jenkins, 1992, for a general discussion of emotion function and dysfunction).

In the IZOF approach developed for the high-achievement setting, emotion content is conceptualized within the framework of two interrelated factors: *hedonic tone,* or valence (pleasure-displeasure), and *performance functionality* (optimal-dysfunctional effects on performance processes and outcomes). Both factors reflect qualitatively different aspects of emotional experiences related to individually successful and poor performances (Hanin, 1997). Selected idiosyncratic emotion labels are classified into one of the four global emotion categories derived from hedonic tone and performance functionality: pleasant and functionally optimal emotions (P+), unpleasant and functionally optimal emotions (N+), pleasant and dysfunctional emotions (P–), and unpleasant and dysfunctional (N–) emotions. Optimal (P+ and N+) emotional experiences accompany successful performances, whereas dysfunctional (N– and P–) emotional experiences are usually related to poor performance.

These four emotion categories provide an initial structure that is sufficiently broad and robust to generate a pool of idiosyncratic, individually relevant, and task-specific emotions experienced by athletes prior to, during, and after their successful and less than successful performances. It is important that athlete-generated labels describe idiosyncratic and experientially grounded emotions. Moreover, the individualized framework provides an opportunity for athletes to reflect on and report their most significant pleasant and unpleasant emotional experiences related to their individually successful and poor performances. Self-generation of idiosyncratic personally relevant labels, assisted by an emotion stimulus list (Hanin, 1997, 2000, 2003; Robazza & Bortoli, 2003), is a feature that makes the IZOF approach different from both global affect and discrete emotion approaches.

In the individualized approach, the pleasure-displeasure distinction is similar to a global dimensional approach, which, however, does not have the functionality-dysfunctionality distinction. Additionally, the four-category global framework does not limit, in any way, selection of the most appropriate idiosyncratic emotion descriptors. Therefore, athletes reconstruct their performance-related experiences by generating their own idiosyncratic labels. They are not forced to squeeze their unique subjective experiences into researcher-generated descriptors of preselected discrete emotions (anxiety, anger, joy, etc.). Moreover, self-generated labels reflecting an athlete's perspective, when aggregated across athletes and sport events, identify prototype (most often selected) emotional experiences that can be recategorized using a selected discrete emotion framework (Hanin, 2000, 2004; Hanin & Syrjä, 1995; Robazza, 2006; Ruiz & Hanin, 2004a).

It is reasonable to ask about the extent to which the content of athlete-generated emotion labels are similar to (or different from) researcher-generated emotion labels used in existing standardized scales. Conversely, how are self-generated idiosyncratic emotion labels related to the existing lists of discrete emotions? To answer these questions, emotion experiences of individual athletes should be contrasted with standardized group-oriented emotion scales that are currently used to describe how athletes feel before, during, or after performance. The most popular scales developed in nonsport settings are Spielberger, Gorsuch, and Lushene's (1970) State-Trait Anxiety Inventory (STAI), McNair, Lorr, and Droppleman's (1971) Profile of Mood State (POMS), and Watson and Tellegen's (1985) Positive and Negative Affect Schedule (PANAS). Sport-specific scales include Martens, Vealey, and Burton's (1990) CSAI-2 and Smith, Smoll, and Schutz's (1990) Sport Anxiety Scale (SAS).

One problem with most group-oriented scales is that they use a pool of researcher-generated items with "fixed" emotion content (global or discrete). These similar emotion items usually imply the same psychological meaning of emotion descriptors for all athletes. However, in most cases, it is not known to what extent emotion content assessed with the group-oriented scales reflects emotion content really experienced by individual players in their successful and poor performances. Two studies involving 50 skilled soccer players and 46 ice hockey players compared the content of emotion items in STAI, POMS, PANAS, and CSAI-2 scales and individual emotional experiences assessed by athlete-generated labels (Syrjä & Hanin, 1997, 1998). The findings revealed that 80% to 85% of self-generated emotion labels were not included in the selected standardized scales. In other words, the scales with researcher-generated items did not assess 80% to 85% of the emotional content of athletes' performance-related subjective experiences. These findings received additional empirical support in another study involving Spanish elite karate athletes who expressed individual preferences in the selection of idiosyncratic labels describing their anger states of varying intensity (Ruiz & Hanin, 2004a).

In another study (Ruiz & Hanin, 2004b), idiosyncratic emotion labels generated by 16 high-level Spanish karate athletes were compared with the list of 15 discrete emotions proposed by Lazarus (2000). In individualized emotion profiling, these athletes generated 98 idiosyncratic, symbolic, and functionally meaningful metaphors and 167 interpretative labels describing how they felt prior to, during, and after their best and worst performances. As expected, self-generated interpretative emotion descriptors were highly idiosyncratic and context-specific. These self-generated idiosyncratic labels were related to three pleasant discrete emotions (happiness, pride, and relief) and three stress-related unpleasant emotions (anger, anxiety, and sadness). Additionally, athletes' experiences in worst performance were related to fright and shame. Interestingly, the athletes' self-generated labels had no content overlap with seven other discrete emotions (love, hope, compassion, gratitude, envy, jealousy, and guilt) proposed by Lazarus (1991, 2000). These findings suggest a specificity of emotion content in high-achievement settings, especially if the emphasis is on such extreme and qualitatively different situations as success and failure.

Pure or Mixed Emotions

Systematic assessment of the idiosyncratic emotion content of athletes' experiences provides an answer to the question about pure and mixed emotions. Most of the research in sport psychology during the past decades has focused on selected stress-related emotions, such as anxiety. As a result, the complex picture of actual emotional experience was oversimplified and incomplete at best. Research into pleasant and unpleasant idiosyncratic emotions has made it increasingly clear that in real-life situations, athletes' experiences are better described by mixed rather than pure selected emotions (Diener & Emmons, 1985; Gould & Tuffey, 1996; Hanin, 1997, 2000, 2003; Hanin & Syrjä, 1995; Jones & Hanton, 2001; Morgan, 1984; Plutchik, 1980; Schimmack, 2001).

To illustrate this notion, idiosyncratic emotion labels generated by a junior international-level tennis player describing his emotional experiences prior to, during, and after his best and worst games are presented in Figure 2.2a and 2.2b. Prior to his best-ever game (Figure 2.2a), the player felt high intensity of pleasant optimal emotions (P+): He felt highly *determined, confident, excited, dynamic,* and *comfortable.* He also felt moderately *aggressive, alarmed,* and somewhat *uncertain* (N+) at the same time. Moreover, his unpleasant dysfunctional emotions (N–; *nervous, afraid, worried, and intense*) were of low intensity. This pattern was similar during that game, except that he felt *alert* and *quick* but not too *excited* and had no premature *satisfaction.* In contrast, prior to his worst-ever game (Figure 2.2b), this player felt highly *nervous* and *worried* (N–), and these experiences were even more intense during the game. Interestingly, at the same time, his optimal pleasant emotions prior to and during the game were of moderate and low intensity, respectively. If only the anxiety level in this player in his best and worst games were measured, the entire profile of his emotional experiences and their impact on his performance would be missed.

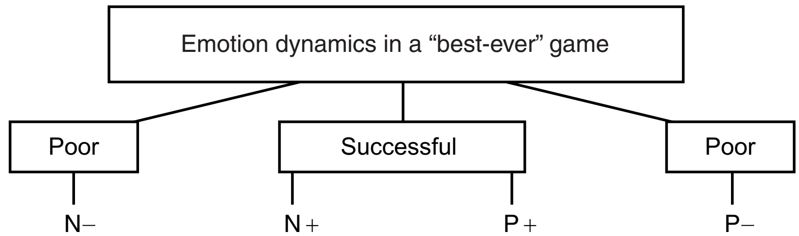
Clusters of emotion content and intensity change from pregame to midgame and postgame situations for this player. Because his emotional experiences are related to different aspects of the environment, they are, again, better described by a cluster of mixed emotions rather than by a few pure or discrete emotions. Mixed emotions reflect a set of different domains that are perceived by an athlete in a particular performance situation or significant events outside sport. Interestingly, a similar mixture of motivational domains was established in ice hockey players describing what can motivate or de-motivate them before the game (see Table 2.1).

Future research in sport psychology should focus on mixed pleasant and unpleasant emotions representing actually experienced states rather than pure emotions. Also, the effect of discrete emotions, such as anxiety or anger, should be analyzed in the context of other, potentially related emotions. Finally, although mixed emotions certainly represent one important aspect of performance-related experiences, another aspect emerged in the analysis of labels generated by athletes. It was revealed that there are emotion mixtures and mixtures of nonemotion components (alert, energized, motivated, determined) of the psychobiosocial state (Hanin, 1993, 1997). Similar supporting data were obtained when standardized normative scales were contrasted with idiosyncratic emotion descriptors generated by athletes (Hanin, 2000; Syrjä & Hanin, 1997, 1998). Developing an empirical typology of "emotion mixture" seems like a promising future direction in emotion content research in sport (Diener & Emmons, 1985; Hanin, 1993, 1997; Schimmack, 2001).

Emotion Intensity

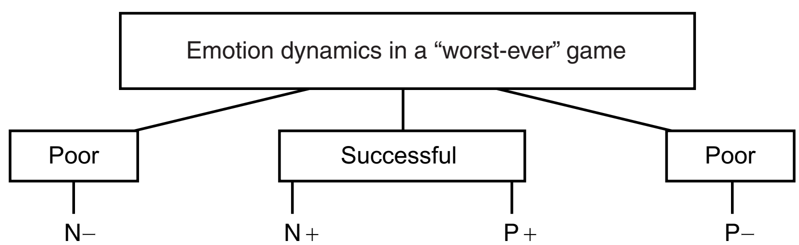
Emotion intensity is one of the most important dimensions; together with emotion content, it determines the effect of emotion on athletic performance. Numerous studies focused on the link between intensity of anxiety and performance outcomes in different athletes. However, assumptions that the optimal level of anxiety intensity in all athletes should be either moderate (U-inverted hypothesis), high (drive theory), or low (quiescence model) did not receive much empirical support. In most cases, the curves describing, for instance, the shape of anxiety-performance relationships in the zero-maximum range of intensity (from sleep to extreme excitement) were tentative at best. Most of these curves were based on two or three cross-sectional comparisons of anxiety levels in groups of athletes (Landers, 1994). These data usually did not include the entire working range of intensity because under laboratory conditions it is quite a challenge to manipulate the intensity level along the entire

(a)



	N−	N+	P+	P−
Before the game	• Nervous 2 • Afraid 2 • Worried 1 • Intense 1	• Alarmed 3 • Aggressive 5	• Determined 9 • Confident 8 • Excited 8 • Comfortable 9 • Dynamic 7	• Satisfied 2 • Sure 3 • Easy 3
During the game	• Tense 2 • Nervous 2 • Intense 1 • Anxious 2	• Aggressive 4 • Unsafe 4 • Uncertain 2 • Alarmed 4	• Confident 9 • Determined 10 • Alert, quick 9 • Comfortable 7	• ------ • ------ • ------
After the game	• Exhausted 1 • Restless 1	• Concerned 1	• Comfortable 8 • Inspired 7 • Determined 8 • Focused 1	• Happy 8 • Satisfied 9 • Easy 4 • Pleased 2

(b)



	N−	N+	P+	P−
Before the game	• Nervous 9 • Afraid 7 • Worried 7 • Intense 6	• Alarmed 4 • Aggressive 6	• Determined 5 • Confident 4 • Excited 3 • Comfortable 3 • Dynamic 2	• Satisfied 2 • Sure 1 • Easy 2
During the game	• Tense 8 • Nervous 9 • Insecure 9 • Anxious 9 • Angry 9	• Aggressive 3 • Unsafe 6 • Uncertain 5 • Alarmed 5	• Confident 2 • Determined 1 • Alert, quick 3 • Comfortable 1	• Relaxed 3 • Easy 2
After the game	• Exhausted 8 • Unhappy 8 • Irritated 7 • Dissatisfied 7 • Restless 6	• Angry 6 • Annoyed 4 • Concerned 3	• Comfortable 1 • Inspired 1 • Determined 4	• Satisfied 1 • Easy 2 • Pleased 3

Figure 2.2 Emotional dynamics in an international-level tennis player in best (a) and worst (b) games. Adapted from "Performance Related Emotional States in Sport: A Qualitative Analysis" [48 paragraphs, Online journal], by Y. L. Hanin, February 2003, *Forum Qualitative Sozialforschung, 4*(1), available from http://www.qualitative-research.net/fqs-texte/1-03/1-03hanin-e.htm. Adapted with permission.

range of intensity. Interestingly, Yerkes and Dodson (1908) were not sure if the levels of intensity of the stimulus used in their experiments with mice were "most favorable."

The problem becomes even more complicated when separate and interactive effects of different components of anxiety, or multiple pleasant and unpleasant emotions, are examined. Applied research and practice in high-achievement sport, however, require a more individualized approach that can predict an individual performance. One strategy to solve the problem was proposed by Hanin (1978, 1995, 1997, 2000), who argued that it is unproductive to focus only on actual anxiety and corresponding levels of performance, matters that are difficult to compare across athletes. For instance, what one athlete would consider a good or even excellent performance could be perceived by another athlete as poor. Therefore, the emphasis should be on analysis of past performance history and estimation of intensity of emotions accompanying individually successful and unsuccessful performances.

Because the "moderate anxiety for all" assumption did not work in practice, a more intraindividual focus and individualized criteria in the evaluation of current anxiety intensity were needed (Hanin, 1978, 1995; Raglin & Hanin, 2000). Several studies have reported the percentage of athletes performing their best when experiencing high, moderate, or low anxiety (see Jokela & Hanin, 1999). The distribution of athletes in these categories was surprisingly well balanced across different studies: high ($M = 34.2$; 26% to 50%), moderate ($M = 34.6$; 22% to 44%), and or low ($M = 35$; 25% to 48%). Moreover, Jokela and Hanin (1999) were unable to identify a single study in their meta-analysis that demonstrated that different athletes had the same (or similar) optimal levels of anxiety.

The individual-oriented strategy proposed by Hanin (1978, 1986, 1989) to predict the effects of anxiety on athletic performance emphasized a need to analyze an athlete's past performance history to identify emotions accompanying individually best performances. The main emphasis in this approach is on predicting individual performance by contrasting, for instance, current anxiety level with the previously established success-related anxiety level (high, moderate, or low). The concept of zones of optimal functioning (ZOF) initially proposed in precompetition anxiety research was a tentative optimal range of intensity scores predicting individually successful performance. Later, the ZOF concept, extended to pleasant and unpleasant emotions, was later termed IZOF (individual zones of optimal functioning) to emphasize the within-individual focus of the model (Hanin, 1995, 1997, 2000).

Probability of successful performance was high when current precompetition anxiety was near or within the previously established individually optimal intensity zones. When precompetition anxiety fell outside the zones (i.e., higher or lower), individual performance usually deteriorated. The interest in individually oriented optimal zones of anxiety intensity reflected the fundamental fact that each athlete has a unique set of resources that are situationally available (or unavailable) for coping with the demands of an environment. Recently, similar results were obtained in studies of optimal and dysfunctional effects of situational anger on athletic performance (Ruiz & Hanin, 2004a, 2004b).

There were several advantages of the individualized approach to precompetition anxiety based on the realities of high-achievement sport and an accurate description. First, the step-by-step methodology for establishing the IZOFs was proposed. Second, an athlete's past performance history was considered, and individually optimal anxiety level and zones were established. Third, testable predictions of individual (and group) performance based on current anxiety and IZOFs were available. Fourth, the approach was empirically tested using different anxiety measures (STAI, CSAI-2, POMS, and the Body Awareness Scale; Koltyn & Morgan, 1997; Wang & Morgan, 1987) across different samples, different sports, and different countries.

Numerous studies provided strong empirical support for the approach and the recall methodology of assessing optimal levels and zones of individually optimal anxiety (Hanin, 1995; Jokela & Hanin, 1999, meta-analysis). However, initially, the IZOF anxiety model focused on precompetition anxiety as a discrete stress-related emotion syndrome with "fixed" emotion content, and the main emphasis in the IZOF anxiety research was on identifying the individually salient intensity of state anxiety (Raglin & Hanin, 2000).

The IZOF notion was proposed as an experience-based, individualized criterion to predict individual performance. The concept was derived from observations of real emotional experiences of athletes that were optimal in individually successful performances. When an athlete's anxiety was out of the optimal zone, his or her performance clearly deteriorated. Empirical findings consistently demonstrated high interindividual variability of optimal precompetition anxiety across different samples of elite and competitive athletes (Hanin, 1978, 1995; Raglin, 1992; Raglin & Hanin, 2000; Raglin & Turner, 1993). Therefore, the IZOF concept became a guiding principle in the assessment, prediction, and optimization of an individual's performance.

Despite encouraging empirical support for the validity of individual-oriented performance predictions based on the IZOF anxiety hypothesis, many questions arise: Do optimal and dysfunctional intensity levels and zones change during a season? And if they do, how are these changes related to an athlete's available resources and readiness for a competition? Does the accuracy of recall change with an athlete's increased self-awareness? What is the validity and reliability of the empirical method of intensity zone estimation (direct observations)? Can it be used without a recall method? How are the intensity levels and zones related to the optimal and dysfunctional impact of emotion on performance? How and why, for instance, is high anxiety helpful or harmful to individual performance? Finally, how can we enhance the accuracy of intensity zone estimation based either on categorical (either in or out of the optimal zone) or continuous measures along the entire working range of intensity? These and other questions provide directions for future work.

For instance, the empirical (direct) method of estimation of intensity zones consists of repeating actual assessments in several successful and unsuccessful competitions, plotting emotion intensity levels, and evaluating the distribution of optimal intensity scores (Hanin, 2000, p. 164). Traditionally, optimal intensity levels and zones are based on either the mean ±0.5 standard deviation range or on the interquartile range (IQR), which includes the range of scores from the 25th percentile to the 75th percentile. The IQR is one of several interpercentile measures of variability that tell how the middle 50% of the distribution is scattered. The clear disadvantages of the direct assessment method are that it requires many data points, it ignores an athlete's past performance history, and it is usually limited to pre- and postperformance assessments and is cost- and time-ineffective (Hanin, 2000; Raglin & Hanin, 2000). Finally, the direct method, if used without recall of individually best and worst performances, has a very limited and sometimes dubious value in prediction. On the other hand, it is important to explore the accuracy of zone estimation in direct assessments using different methods.

Kamata, Tenenbaum, and Hanin (2002) proposed a probabilistic approach to zone estimation based on frequencies of different performance levels related to corresponding perceived or objective measures of emotion intensity. This exploratory study aimed to improve the categorical approach to zone estimation using two hypothetical cases with 50 and 33 data points, respectively, and laboratory data (105 trial observations) from a single individual (Freeman, 1940). The relationships between reaction time (performance) and palmar skin resistance (anxiety) were examined. To determine the IZOFs and their associated probabilistic curve thresholds, observable performance outcomes were categorized into four levels (poor, moderate, good, and excellent), and then intensity scores were regressed onto the corresponding performance categories using logistic ordinal regression. The regression coefficients were used to establish emotion-related probability curves associated with each performance category. Thus, for each performance category, a range of arousal/affect level was determined so that within this range the probability of performing at this level was higher than in the other performance categories. It was also revealed that the probabilistic method of zone estimation had wider zones than in the traditional method of estimation. Additionally, more correct classifications within the zones and fewer incorrect classifications outside the zones were obtained.

These findings and the subsequent replication studies (Cohen, Tenenbaum, & English, in press; Golden, Tenenbaum, & Kamata, 2004) provide preliminary evidence of how to improve the accuracy of categorical assessments of performance-related emotion zones. These results should be accepted with caution, however, because the Kamata et al. (2002) study used only hypothetical and laboratory data. Again, many questions arise: What is the minimum number of observations in each performance category required to estimate the probability-based zones? This method of estimation of intensity zones requires a large number of direct observations, which is often impractical and ineffective in terms of cost or time. On the other hand, too few observations in a particular performance category (optimal or poor) preclude the possibility of establishing the optimal or dysfunctional zones. Can the probability curves be used to predict future performance? At this point, there is no empirical evidence to suggest that the probability curves for different performance levels based on observations of only actual (but not the best ever) performance can predict future performance. Classification of observations using frequencies of observed performance categories seems circular. Considering a high variability of athletic performance in each season, how often (during the season and across several seasons) should the probability-based zones of intensity (and performance ranges) be estimated? How are the probability zones related to direct emotion effects on performance? What are the practical implications of these probability-based zones? This method in its present form has a strong categorical focus and what is beyond the zones of intensity is still not assessed. These and other questions provide directions for future work. A more radical approach involving the estimation of emotion impact on performance along the entire range of working intensity ("intensity-impact" contingencies; Hanin, 1997, 2000; Robazza, Bortoli, & Hanin, in press) is briefly described later in the chapter.

From Anxiety to Multiple Emotions

There is a growing consensus in applied sport psychology that prediction of athletic performance should be based on multiple pleasant (positively toned) and unpleasant (negatively toned) emotions rather than only on precompetition anxiety (Cerin et al., 2000; Crocker et al., 2002; Gould & Tuffey, 1996; Hanin, 1993, 1997, 2004; Jones & Hanton, 2001; Kerr, 1997; Lane, Terry, & Karageorghis, 1995; Lazarus, 1993; Raglin & Hanin, 2000; Robazza, 2006). Substantial empirical evidence indicates that unpleasant emotions do not always harm athletic performance. For instance, such emotions as anger, anxiety, and tension can sometimes be beneficial in competition (for reviews, see Hanin, 1978, 1995; Jones, 1995; Raglin, 1992; Raglin & Hanin, 2000). These findings are in accord with the earlier observations and anecdotal evidence indicating that highly skilled and experienced athletes can deliberately use relatively high anxiety to their advantage (Hanin, 1978; Mahoney & Avener, 1977). As a result, these expert performers often perceive anxiety as facilitating their performance (Jones, 1995).

On the other hand, the findings indicate that pleasant emotions are not always beneficial for successful performance (Hanin, 1997, 2000). Too much of some pleasant emotions can sometimes lead to a poor performance due to complacency and underestimation of task demands and insufficient focus and dysfunctional energy levels (too high or too low). Therefore, although some athletes perform up to their potential when they are stress-free, others deliberately generate and use competitive stress to their advantage as an additional resource and a tool for mobilization in emergency situations.

Much of the earlier research proceeded from a nomothetic perspective with the aim of making predictions regarding athletes and exercise participants in general (Smith, 1996; Vallerand, 1997). Recent numerous studies, however, have begun to reflect an idiographic perspective with the aim of making predictions about individuals or subsets of athletes (Hanin, 1995, 1997, 2000, 2004; Robazza, 2006; Vallerand & Blanchard, 2000).

Although precompetition anxiety is an important stress-related emotion, it is still only part of the emotional mix that influences athletic performance. Determining the interactive effects of emotions enhancing and impairing sporting activity is crucial for an accurate prediction of emotion-performance relationships. In this case, a high probability of individually successful performance is expected when combined maximum enhancing and minimum impairing effects are observed. On the other hand, a high probability of individually average and poor performance is expected when a combination of high enhancing and high impairing effects or low enhancing and low inhibitory effects are observed. Finally, a high probability of poor performance is expected when low enhancing and high inhibitory effects are observed.

In the case of pleasant-unpleasant and optimal-dysfunctional emotion intensities, it is important to assess interactive effects of four different categories of emotions: P+ (pleasant optimal), N+ (unpleasant optimal), P− (pleasant dysfunctional), and N− (unpleasant dysfunctional). Therefore, the IZOF principle was further developed to account for these interactive effects. With the development of individualized emotion profiling (Hanin, 1997, 2000; Hanin & Syrjä, 1995, 1996), the extended IZOF concept is used to describe separate and interactive effects of both pleasant and unpleasant emotions using athlete-generated items. Specifically, the individual zone of optimal intensity is identified for each functionally optimal emotion, and the individual zone of dysfunctional intensity is identified for each dysfunctional emotion. In both cases, recall is used to examine past performance history rather than wait and see when successful and extremely poor performances occur. Past experiences were used to predict present and future performances.

It is assumed that there are IZOFs in some emotions (P+, N+) within which the probability of successful performance is the highest. There are also dysfunctional zones in other emotions (P−, N−) within which the probability of poor performance is the highest. Optimal and dysfunctional intensity levels can be low, moderate, or high and vary for the same and different emotions in different athletes (Hanin & Syrjä, 1995). Moreover, it is possible to estimate functionally optimal and dysfunctional effects, separately and jointly, only when these emotions are near or within these previously established individual zones. In other words, the total effect of pleasant and unpleasant emotions on performance appears to be determined by the interaction of optimal and dysfunctional effects. Although functionally optimal emotions are important predictors of

Emotion effects		Harmful effects (N–P–)	
		High	Low
Helpful effects (P+N+)	High	Average performance	Successful performance
	Low	Poor performance	Average performance

Figure 2.3 Interactive effects of enhancing and harmful emotions.

successful performance, they alone may not be sufficient due to the fact that emotional experiences involve mixed feelings. Therefore, potential detrimental effects of dysfunctional emotions should be considered as these emotions are sometimes experienced at the same time as optimal emotions. Four quadrants in Figure 2.3 illustrate this principle in a matrix form, and the IZOF iceberg, or bell-shaped emotion profile, visually represents interactive effects (Hanin, 1997, 2000, 2003). Therefore, the notion of a zone, as applied to a wide range of pleasant and unpleasant emotions, seems appropriate in providing individualized criteria to evaluate both optimal and dysfunctional effects separately and jointly.

Empirical research revealed a high degree of *interindividual variability* in the intensity and content of idiosyncratic optimal and dysfunctional emotions related to individually successful and poor performances. It was also shown that different athletes perform up to their potential experiencing emotions of different content and intensity, and there is no universal intensity level and zone that are similar and optimal or dysfunctional for all athletes.

Beyond Optimal Intensity Zones

Prediction of individual performance based on contrasts of precompetition emotional states with previously established IZOFs in multiple emotions received fairly good empirical support (Annesi, 1998; Hanin, 2000, 2004; Robazza, Pellizzari, & Hanin, 2004). In most cases, the optimal and dysfunctional zones were established using the focused recall procedures described earlier (Hanin, 2000, 2003; Hanin & Syrjä, 1995, 1996). This proved to be effective with highly skilled and experienced athletes, who are usually well aware of their personally significant experiences, and meta-experiences, related to successful and poor performances. Therefore, previously established zones were useful as individualized criteria to predict individual performance.

In earlier research on optimal anxiety, the main emphasis was on personally best and worst performance and emotions accompanying these two personally significant situations. However, it was not known if experienced emotions represented also an optimal or dysfunctional (repeated) pattern. All other performance levels were assumed to be between these two extremities. When the focus of research shifted from anxiety to pleasant and unpleasant emotions, a new construct was proposed: a notion of *individual performance range* with distinctions between personal best and personal worst categories, including personally standard and substandard performances. Although the initial approach was based on categorical assessments (in or out of the zone), a more comprehensive approach (Hanin, 1997, 2000) required continuous (along the entire working range of intensity) estimation of what was beyond the zones of intensity and performance ranges. Such an assessment strategy is important when multiple items of emotion and nonemotion experiences are used to estimate the partial and total impact of emotional experiences on performance.

The IZOF-based research in performance anxiety has also indicated that if intensity was closely out of the zones, performance deteriorated, but in some cases, performance did not deteriorate when intensities were further from the zones (Turner & Raglin, 1996). Finally, several IZOF emotion studies revealed that different emotions can be optimal or dysfunctional or both. These findings suggest that each emotion (in each of the four emotion categories) may have a different effect (optimal or dysfunctional) depending on its intensity level. In other words, a categorical approach, as a practical tool for a rough estimate of optimal and dysfunctional intensity, is practically acceptable when we have a total intensity score. But what is the impact of emotion on performance when the intensity is well beyond the zones or even along the entire range of working intensity? To answer this question, a continuous approach in establishing intensity-impact contingencies for each emotion (partial effect) and for all emotions (total effect) was needed. The multiple emotion assessment requires the assessment of partial effects continuously rather than categorically and the use of the principle of being in or out of the zone for total scores.

In an exploratory study, 12 top Finnish cross-country skiers estimated perceived effects of each self-generated emotion on their performance along the entire range of intensity (Hanin, 1997, 2000). As a result, the intensity-impact contingency for each idiosyncratic emotion generated by the athletes was created. This study provided initial empirical support for a more detailed estimation of the interactive effects of different emotions on athletic performance. Specifically, it was shown that being outside the optimal zones may indeed produce a less enhancing effect, or even have a detrimental effect (e.g., an absence of motivation or energy), on individual performance.

Similarly, being out of the dysfunctional zones in performance-inhibiting emotions can be not only less detrimental but sometimes can even enhance individual performance effects (e.g., an absence of fatigue or depression). Therefore, a more accurate estimation of total emotion impact on performance was possible, providing it was based on individualized intensity-impact contingencies developed by athletes for each emotion. The development of intensity-impact contingencies is based on an athlete's awareness and ability to report his or her own experiences. Additional research is needed to estimate how accurately athletes of varying skill and experience are able to do such estimations and how accurate are the predictions that are based on these contingencies.

A recent study by Robazza et al. (in press) examined the perceived effect of idiosyncratic emotions and bodily symptoms on athletic performance along the entire emotion-intensity range. The participants were 35 elite Italian athletes (16 females and 19 males) competing in either figure skating or gymnastics. Idiosyncratic emotional descriptors were rated on Borg's Category Ratio (CR-10) scale to estimate the perceived impact on performance and hedonic tone for each level of emotion intensity range. The findings revealed large interindividual variability in the content of emotions as well as in the shape of the curves representing the intensity-impact contingencies. At the group level, the emotion-performance link was positively linear for optimal-pleasant emotions, bell-shaped for optimal-unpleasant emotions, and negatively linear for both dysfunctional-unpleasant and dysfunctional-pleasant emotions. Future research should focus on how intensity-impact contingencies can be used in the estimation of total impact to predict individual performance.

By definition, emotion is an unfolding process (Folkman & Lazarus, 1985). Its dynamics involve two basic dimensions: *context* and *time* (Hanin, 1997). The context dimension is an environmental characteristic reflecting the impact of situational, interpersonal, intragroup, and organizational factors on emotion intensity and content in sport settings. Emotional experiences of varying form, content, and intensity are usually observed in different settings (context). Situational impact is manifested in emotions experienced in practices and competitions during athletes' anticipated or real contacts and interactions with significant others (a partner, a coach, and teammates). Context dimension also includes culturally coded and culturally determined beliefs of participants about the expected impact of specific emotions on their performance and about the rules of emotion display (expression or suppression) in a particular subculture.

Current emotion research in sport psychology focuses on several contexts, such as successful and unsuccessful competitions of varying significance (local, national, international), and different practices. Additionally, there are a number of individually difficult situations, or specific performance episodes, that have a special meaning for athletes and teams (weather conditions, competition sites, good and bad memories of past performances). These situations may also include qualifications, performance in the finals, play-offs, meeting a weaker opponent, and performing after repeated success or a series of slumps.

As for the *time* dimension, traditionally it is associated with a short-term situational emotion dynamics across three interrelated situations: prior to an action, during task execution, and after performance in a single competition (or practice; Cerin et al., 2000; Hanin, 1993, 1997, 2000; Jones, 1991; Syrjä, Hanin, & Pesonen, 1995). The time dimension, however, is not limited to what is going on cross-sectionally in a single competition. Moreover, cross-sectional assessments do not usually reflect the specifics of transitions of emotional experience from pre-event to midevent to postevent situations (Hanin & Stambulova, 2002; Ruiz & Hanin, 2004a). Thus, to reflect a real dynamics of emotional experience as a process, cross-sectional measures should be supplemented by qualitative methods, such as narratives or video-assisted self-confrontation interviews (Hanin, 2003; Sève, Ria, Poizat, Saury, & Durand, in press).

Long-term temporal dynamics are related to emotion-performance relationships during a competitive season (seasons), the 4-year Olympic cycle, or an athlete's sports career. The best indicators of long-term development of emotional experiences are relatively stable emotion patterns and especially meta-experiences. In the assessment of temporal patterns of emotional experiences, future researchers should include both *topological* (phases, cycles, sequencing, periodicity, timing) and *metric* (duration, frequency) characteristics. Research on topological characteristics of temporal patterns in the dynamics of emotions in sport remains nonexistent.

Finally, emotion-performance relationships are dynamic and bidirectional: pre-event emotions produce beneficial or detrimental effects on performance and ongoing performance process (successful or unsuccessful) affects an athlete's emotional state. Thus, to describe emotion-performance relationships, it is important to establish the patterns of emotion impact on performance and performance impact on emotions. This latter aspect of performance-emotion relationships is especially important in research into temporal patterns of emotions across several game episodes, especially in ball games and combat sports (Sève et al., in press).

Most sport events are continuous, and in long duration sports, much happens between the start and the finish. Therefore, temporal patterns are important to consider in explaining how emotion affects performance and performance-induced emotions. For instance, preperformance situations can be explained by the "anticipated gain-loss" appraisals involving challenge and threat and related emotions (Lazarus, 2000). However, what happens when "occurred gain-loss" appraisals involving benefit and harm are triggered? And how do intermediate occurrences during performance affect appraisals and emotional experiences? All these are promising directions for future researchers.

EMOTION-PERFORMANCE RELATIONSHIPS

A detailed description of defining characteristics of emotional experiences based on systematic observations of athletic performance is an important starting point. However, to explain emotion-performance relationships in sport, it is also necessary to look at the antecedents and consequences (effects) of emotions relating to athletic performance. After that, a tentative explanation of individual differences in emotion response is possible. In this section a brief overview of antecedents and consequences of emotional experiences and two interconnected explanations of their effects on performance are suggested.

Antecedents of Emotions in Sport

According to Vallerand and Blanchard (2000), theory and research on antecedents of emotions deal with psychological processes eliciting emotions with the aim to understand and predict how an individual will feel in a given sport situation. Several existing cognitive theories and research on antecedents of emotion in sport illustrate well past research and recent trends potentially important in sport settings. Vallerand and Blanchard provide a detailed review of the early contributions to theory on emotion, selected appraisal theories, goal and motivational theory, and research. Readers are also referred to another excellent review of selected cognitive theories and sports-specific models by Crocker et al. (2002) that deals with emotion antecedents.

Most of these approaches emphasize the role of a variety of *intrapersonal* determinants of self-directed emotions, including individual differences in traitlike characteristics. These are achievement needs, anxiety, mastery orientation, cognitions (expectancy of success), efficacy beliefs, causal ascriptions, and incentives related to goal orientations and their sources or locus (Hareli & Weiner, 2002). Weiner's extension of his previous attribution-emotion model suggests that *interpersonal* context gives rise to a variety of socially related emotions and personality inferences that have far-reaching consequences. Specifically, a good deal of individuals' self-definition and emotional experiences are derived from how they are perceived and the feelings they elicit from others in achievement settings (p. 183). For instance, just as the player is experiencing different emotions based on the task outcome and the perceived cause of the outcome, involved observers (teammates, coach, fans) also are experiencing different emotions. *Self-directed* emotions include pride, gratitude, shame and guilt, and hopelessness; *other-directed* emotions are pride, envy, admiration, schadenfreude (joy at the shame of another), sympathy and contempt, anger, arrogance, modesty, and deceit.

Potentially interesting as a future research direction in sport is an emphasis on self- and other-directed social emotions. This is a neglected area of research both in general and sport psychology. This direction focuses on *interpersonal* and *intragroup* determinants of emotional experiences. For instance, several earlier studies of interpersonal and intragroup anxiety in sports setting are examples of how emotions can reflect an athlete's interactions and communication with partners or coach or how an athlete feels in different groups, including the team, study group, family, and friends (Cratty & Hanin, 1980; Hanin, 1980, 1989, 1992; Hanin & Bulanova, 1981).

It is important to distinguish intrapersonal, interpersonal, and intragroup antecedents of emotional experiences. Intrapersonal factors include those that affect a person's perception of person-environment interaction. Person-environment interactions are important, and a psychosocial perspective is central in the functional interpretation of the dynamics of emotion-performance relationships. As discussed earlier, emotion is conceptualized as an unfolding process reflecting person-environment interactions. Ongoing appraisals of these interactions result in a change in the personal meaning of a situation, which exerts influence on emotional experiences related to performance. Changes in personal meaning as well as in a situational mind-set reflecting the dynamics of the performance process can trigger considerable functional shifts in emotion content and intensity.

In Lazarus's (1991, 2000) emotion theory explaining the dynamic, unfolding nature of emotion, the notion of personal relational meaning is especially useful. Lazarus conceptualized this in terms of two basic performance outcomes: gain and loss. These outcomes are either anticipated (challenge and threat) or occurred (benefit and harm). As a two-factor categorization of relational meaning and time, these four basic appraisal patterns can partly explain the dynamics of emotion-performance relationships. Specifically, functionally optimal pleasant and unpleasant emotions (P+, N+) prior to and during activity are usually anticipatory and are triggered by the appraisals of challenge and/or threat. These appraisals activate strong action tendencies prior to and during performance and help to recruit available resources and to use them effectively. In other words, these emotions, if interpreted from the goal reprioritization approach (Carver, 2003; Simon, 1967), seem to signal a call for even greater investment of resources and effort. In contrast, situationally dysfunctional pleasant and unpleasant emotions (P–, N–), prior to and during performance, are usually triggered by premature perception of already achieved or occurred outcomes (appraisals of benefits and harm) before the task is completed. These appraisals activate weak or distracting emotions, sending a signal that the main goals have already been achieved (P–) or could not be achieved (N–), and there is no need for (or no sense in) further exertion. These dysfunctional emotions signal either a call for less investment (P–) or a failure to maintain efforts due to a lack of resources.

Finally, most of these approaches emphasize *distal,* or traitlike and relatively stable, antecedents that function across repeated typical situations. In a single situation, more attention is required for *proximal* antecedents that act as *situational* determinants of concrete emotional experiences (Kuhl, 1994). Table 2.1 illustrates this distinction by listing different situational motivational domains generated by the players. Thus, proximal antecedents of a highly motivated state include a special focus (winning and fighting), trying to do one's best, a specific feeling state, and perception of the game (as important, challenging, tough, and well started) and perception of the opponent (as tough, good, strong). Important but more distal antecedents include perception of ice hockey (as a serious hobby, future profession, life) and one's own team (playing for the team and team climate). In contrast, Figure 2.2b lists antecedents of negative motivation (or a lack of motivation) along the same domains; most of these have proximal and direct de-motivational effects.

Consequences of Emotions

In discussing the consequences (functional impact, effects) of emotional experiences, several aspects should be considered. First, emotion functional effects observed in sport settings could be either *facilitating* (helpful, beneficial, optimal, useful, positive) or *debilitating* (harmful, detrimental, dysfunctional, negative) or *neutral* (nondisturbing, having no impact). Second, a target (or direction) of emotion impact could be the situational *performance* (process or outcomes) or a psychobiosocial *state* (and its cognitive, motivational, bodily, behavioral, or communicative components) or *relationships* (interpersonal or intragroup) or general *well-being* and *health,* or *multitarget* combined effects. Third, due to the social nature of emotional experiences reflecting person-environment interactions, emotion consequences are usually both self-directed and other-directed (see Hareli & Weiner, 2002, for a more detailed discussion). Emotion functional effects therefore include not only intrapersonal but also interpersonal and intragroup consequences. Fourth, as in the case with antecedents, emotion consequences can also be distal (long term or accumulated) or proximal (more immediate, situational, and short term; Kuhl, 1994). Here I limit discussion to functional effects of emotion on athletic performance. These effects are apparently different from the functional (or dysfunctional) effects of emotions, for instance, in educational or clinical settings as compared to high-achievement sport.

The basic question in performance-related emotion research is how to define and describe emotion functionality or the effect of emotion on performance (or well-being, health, leisure). The notion of functional effect is not new. It has been around in psychology for some time under different labels: most favorable stimulus (Yerkes & Dodson, 1908), optimal arousal (Berlyne, 1960; Schlosberg, 1954), and facilitating-debilitating anxiety (Alpert & Haber, 1960; Jones, 1991; Liebert & Morris, 1967). Initially, optimal (or dysfunctional) effects were simply assumed. The main focus, for instance, in test anxiety research and in clinical psychology was on contrasting anxiety intensity and performance and on alleviating debilitative consequences of high anxiety. In elite sports, however, it was clear that state anxiety does not necessarily impair athletic performance and, in some circumstances for some athletes, can enhance it. Moreover, experienced and elite athletes were usually well aware of the impact of various emotional states on their performance (Hackfort & Schwenkmezger, 1993; Hanin, 1978, 1986, 1995; Jones, 1995; Mahoney & Avener, 1977).

As was shown earlier, the interaction of specific emotion content (anxiety, anger, etc.) with emotion intensity (high, moderate, or low) produces specific optimal or dysfunctional effects on athletic performance (Emotion content X* Intensity = Emotion impact). Several strategies exist in the practice of sport psychology to assess emotion effects on performance. First, the *emotion-based* strategy involves the collection of multiple measures of emotion intensity in a sample of athletes and contrasting them with the corresponding performance outcomes. Current models of competitive anxiety are examples of such an approach. Second, the *performance-based* approach identifies personally best and worst performances and focuses on accompanying success-related and failure-related emotion content and intensity of individual athletes (Hanin, 1986, 1997, 2000; Raglin, 1992; Raglin & Hanin, 2000; Robazza 2006). Here, functional effects of emotions are established by identifying individually successful performance (personal best) and accompanying emotions that were helpful or at least not detrimental to an individual athlete's performance. In other words, in both strategies, functionality of emotions is implied but not assessed directly as a special construct. Third, the *perception-based* strategy focuses directly on assessment of the functional and dysfunctional effects of emotions using athletes' subjective experiences (or rather, meta-experiences) and self-ratings of anticipated or already experienced impact on performance. One option here is that athletes simply rate the magnitude of facilitating or debilitating effects (called the "directional" approach; see Jones, 1995), or they can report qualitative characteristics of specific emotion effects on their performance (Hanin, 1993, 1997, 2000, 2003; Hanin & Syrjä, 1995; Sève et al., in press; Syrjä, 2000). In the perception-based approach to emotion impact estimation, athletes' experiences and especially meta-experiences (self-awareness) are important. Finally, direct emotion effects on performance process can be estimated in controlled observations of changes in movement patterns, muscular tension, or frequency of preliminary or performance movements under different emotion intensity levels (e.g., Pijpers, Oudejans, Holsheimer, & Bakker, 2003; Weinberg, 1978; Weinberg & Hunt, 1976).

Direct Rating of Emotion Effects

In early test anxiety literature, Alpert and Haber (1960) were among the first to assess whether test anxiety was facilitative, debilitative, or had no effect on subsequent performance. They proposed the "direction of effect" dimension, operationalized in two independent constructs of facilitating and debilitating anxiety as *response tendencies* in test situations. The Achievement Anxiety Test (AAT), with two separate subscales as trait-specific measures of facilitating and debilitating anxiety, was constructed. The facilitating scale of nine items was based on a prototype of the item "Anxiety helps me to do better during examinations and tests." The debilitating scale of 10 items was based on a prototype of the item "Anxiety interferes with my performance during examinations and tests." Although the AAT did not assess the specific effects of test anxiety (in what way it was helpful or harmful) on the individual performance process, relatively stable "facilitating anxiety added significantly to the prediction of grade-point average (performance outcomes) when it was combined with a measure of debilitating anxiety" (p. 215).

In sports, the concept of facilitating-debilitating effects of anxiety on performance with some modification was introduced by Jones (see Jones, 1995, for review), who proposed using a single-item bipolar direction scale to rate the degree to which the situationally experienced intensity of each symptom on the Martens et al. (1990) CSAI-2 was either facilitative or debilitative to subsequent performance. The response scale ranged from −3 ("very debilitative") to +3 ("very facilitative"), so that possible direction scores on the CSAI-2 subscales ranged from −27 to + 27. The major emphasis in the "directional perception" approach is on rating perceived effects of situational anxiety symptoms on performance within the sequence of *anxiety intensity → perceived effects → performance outcomes.* In contrast, earlier approaches focused on the *anxiety intensity ≥ performance outcomes* relationships did not assess anxiety effects directly.

Research provides reasonable empirical support for the validity and potential utility of the direction construct in the assessment of situational states and relatively stable patterns of anxiety. However, it should be recognized that optimal and dysfunctional effects of high and low anxiety on athletic performance are well-known in competitive and especially in elite sports (Hanin, 1978, 1986, 1995; Mahoney & Avenir, 1977; Raglin, 1992). Moreover, it is not surprising that elite athletes sometimes experience lower anxiety intensity and rate its effects as more facilitating than do nonelite and less experienced athletes.

Although directional research seems intuitively appealing, in its present form it has several limitations. First, the construct of emotion effect (direction) has been neither defined nor adequately described. Second, similar to test anxiety studies, current research is limited to rating only the extent to which anxiety is either helpful (facilitating) or harmful (debilitative) to an athlete's performance. These ratings fail to indicate the way a specific anxiety intensity affects (or does not affect) an athlete's performance process positively or negatively. Third, in most cases, researchers failed to collect performance data directly to examine anticipated and actual impact of anxiety intensity on performance (see, e.g., Jones & Hanton, 2001). Therefore, it is still not clear if athletes who rated anxiety as facilitating really succeeded and those who rated anxiety as debilitating really failed to perform up to their potential. Fourth, it is also not known if the direction ratings of similar anxiety intensity are stable over time or if they change from competition to competition. Fifth, it is not clear how direction scores, in their present form, can be used for prediction of individual performance. Finally, although the directional approach begins to consider different feeling states (pleasant and unpleasant), the anxiety-oriented framework does not estimate the functional impact on performance of a wide range of pleasant and unpleasant emotions.

Two questions are relevant to the discussion of emotion functionality: Are negatively toned emotions invariably detrimental to sporting performance? Are positively toned emotions always beneficial for performance? Numerous IZOF-based studies (Hanin, 1978, 1986, 1995, 1997, 2000; Hanin & Syrjä, 1995, 1996; Jokela & Hanin, 1999; Raglin & Hanin, 2000; Robazza, 2006; Ruiz, 2004; Ruiz & Hanin, 2004a, 2004b; Syrjä, 2000) provide strong empirical evidence suggesting a clearly negative response to both questions. In other words, unpleasant emotions can sometimes be helpful for performance (see Hanin, 1978, 1986; Hardy, 1990; Jones, 1995; Jones & Hanton, 2001; Ruiz, 2004), and pleasant emotions are sometimes harmful for performance (see Carver, 2003; Fredrickson, 2001; Fredrickson & Losada, 2005; Hanin, 1993, 1997, 2000). Thus, the view that emotion valence is the only or a major predictor of the effect of emotion or its regulation is oversimplistic at best (Cole, Martin, & Dennis, 2004).

Therefore, attempts to propose the notion of positive and negative anxiety based on its perceived effects seem questionable at best. Much confusion in this positive-negative anxiety debate (Burton & Naylor, 1997; Hardy, 1997; Jones & Hanton, 2001) comes from a failure to distinguish between emotion content, emotion intensity, and emotion functionality (helpful or harmful effects). For instance, Jones and Hanton argue that anxiety by definition is a negative (unpleasant) feeling state but claim that the CSAI-2 does not measure competitive anxiety directly, but only the symptoms associated with the response. They believe that "if a negative score on the direction scale is revealed then this signifies a state of anxiety. If a positive direction score is found, this points to another state previously mislabeled as anxiety" (p. 393). This assumption is actually true if it suggests that there are mixed emotions, besides pure anxiety, that add to positive impact on performance. However, this assumption is not true, and is even contradictory, if labeling of anxiety state depends entirely on a negative direction score. Qualitatively, anxiety is a negatively toned unpleasant state reflected in several specific symptoms (feelings of tension, apprehension, nervousness, etc.). Actually, anxiety and nonanxiety labels describe fixed or conventionally defined emotion content, whereas functional effects represent a different characteristic. Thus, using an athlete's own vocabulary of emotion labels along with researcher-generated items could be instrumental in the partial solution of this problem.

The main issue in emotion research now is not only to rate the perceived impact of emotions, but to identify, for instance, in what way high, moderate, or low anxiety (or any other emotion) is helpful or harmful to athletic performance. Hanin and coworkers (Hanin & Syrjä, 1995; Syrjä, 2000) collected qualitative data describing how highly skilled ice hockey and soccer players perceive the functional effects of facilitating and debilitating emotions for their performance. Two major functions emerged in the content analysis of players' interpretations of perceived emotion effects: enhancing or detrimental to effort and skill. For instance, a player who experiences dissatisfaction perceives it as a helpful emotion because this emotion helps him or her to try harder, to maintain a fighting spirit, to be better than his or her opponent, to put more effort into the game, and to be more alert. Harmful effects of too much satisfaction (complacency) are reflected in being too concerned with success, not trying to play better, being too arrogant, not careful, and too risky; as result, skating becomes difficult (Hanin & Syrjä, 1995, pp. 180–181). A more detailed description of perceived functional effects of selected emotions across four global categories (P+, N+, P–, and N–) is found elsewhere (Ruiz, 2004; Syrjä, 2000).

Explaining Individual Differences

Numerous empirical studies revealed large interindividual variability of emotion intensity and emotion content in athletes performing similar and different sporting tasks. How can these findings be explained? Why do some athletes perform well while experiencing high anxiety, whereas others fail to cope with competitive stress? Why is emotion content different in different athletes performing the same task? I propose two possible explanations to account for these differences: a *resource-matching hypothesis,* based on the construct of internal and external resources, and two constructs, *energy mobilization* and *energy utilization* (Hanin, 1997, 2000, 2004).

The construct of internal and external resources proposed here is not new. For example, it is used in the conservation of resources (COR) model proposed by Hobfoll (1989) to define and explain psychological stress. Examples of broadly defined resources include not only personal characteristics (self-esteem, mastery, and well-being) but also interpersonal, material, and work-related resources. The basic tenet of the COR model is that people strive to retain, protect, and build resources because the potential or actual loss of these resources is a threat and a source of psychological stress. From this perspective, psychological stress is defined as a reaction to the environment in which there is (a) the threat of a net loss of resources, (b) the net loss of resources, or (c) a lack of resource gain following the investment of resources. There is a clear overlap of these ideas with the relational themes and appraisal patterns (anticipated and occurred) proposed by Lazarus (2000). Hobfoll also proposed an instrument to measure a gain and a loss of resources that was used in empirical studies with different populations outside the sport setting.

The life span model of developmental challenge proposed by Hendry and Kloep (2002) employs the constructs of resources and challenges to explain the processes of human growth. Examples of potential resources include *biological dispositions* (health, personality, "talents," intelligence, body shape, attractiveness); *social resources* (trust, attachment, size and quality of network); *skills* (basic, learning, social, psychomotor); *self-efficiency* (self-efficacy appraisals, experience with success, assurance from others, locus of control); and *structural resources* (country, race, class, family, income, gender).

To explain intraindividual and interindividual variability of emotion content and intensity in similar and different performance situations, a *resource-matching hypothesis* was proposed (Hanin, 2000, 2004; Hanin & Stambulova, 2002, 2004). Based on the idea that emotional experiences reflect person-environment interaction, it was suggested that it is not so much the task requirements per se that determine optimal and dysfunctional content and intensity of situational emotional experiences but an interaction (match or mismatch) between task demands and an athlete's resources (available, recruited, and utilized).

In competitive sport, resources are defined as psychobiosocial assets that determine athletes' ability to perform consistently up to their potential. Here the emphasis is on how available resources are identified and then systematically and effectively recruited, used, recuperated, and further developed. Thus, for instance, a complex task can be very easy for an athlete with sufficient resources that can be recruited when needed and utilized effectively. In contrast, a task generally considered relatively easy can be very demanding and difficult if an athlete is unable to recruit available resources or not ready to use them efficiently (Hanin, 2003, 2004; Hanin & Stambulova, 2002, 2004; Ruiz & Hanin, 2004a, 2004b).

The resource-matching hypothesis proposes three potential causes of intraindividual and interindividual variability in optimal emotion content and intensity. These include interindividual differences in (a) *available* resources, (b) the ability to *recruit* them at the right time and place, and (c) the skill to *use* them *efficiently.* Finally, there are clear intraindividual and interindividual differences in situational *readiness* to recruit, utilize, and recuperate these resources.

The four categories of emotion content proposed in the IZOF model and derived from the interaction of two factors (hedonic tone and performance functionality) also reflect a resources-based interpretation of emotion function and provide important signals. Specifically, pregame or midgame optimal pleasant emotions (P+) reflect a state of being in the *challenge zone,* when an athlete is well prepared (ready for the game) and his or her available resources are sufficient, can be recruited when needed, and can be used effectively, matching well the task demands. It is also suggested that these emotions are essential elements of optimal functioning as vehicles for individual growth and social connection, building people's personal and social resources. These emotions can broaden thought-action repertoires, undo lingering negative emotions, fuel and build psychological resilience, and enhance emotional well-being (Fredrickson, 2001). Pregame or midgame optimal unpleasant emotions (N+) reflect a state of being in the *emergency zone,* when an athlete's normal resources are not sufficient for the task at hand or task demands exceed available resources, producing a threat to goal achievement. Additionally, there can be situational problems with the recruitment or utilization of available resources. Thus, an athlete is not completely ready for the task and there is a need to compensate for the lack of resources or their insufficient use.

Pregame or midgame dysfunctional pleasant emotions (P−) reflect a state of being in the *comfort zone,* or excessive complacency, when an athlete tends to underestimate task demands and overestimate his or her own resources, usually after successful performance or playing with a weaker opponent. Situational complacency and too much confidence result in failure to recruit and use needed resources (insufficient mobilization), and an athlete is actually not ready for the game. Pregame or midgame dysfunctional unpleasant emotions (N−) reflect a state of being in the *dejection zone,* when an athlete, for some reason, overestimates task demands and underestimates his or her resources, especially after a series of unsuccessful performances, a performance slump, or overtraining. In this situation, there is a clear lack of resources, serious problems with their recruitment and utilization, and therefore inability to compensate situationally.

The resource-matching hypothesis suggests that emotional experiences related to athletic performance serve a very important regulatory function. Emotions are elicited by appraisals and produce a strong regulatory effect on performance. On the other hand, any unexpected change in performance process affects situational appraisals of ongoing person-environment interactions, which often result in emotion shifts or reversals (Kerr, 1997). Therefore, emotional experiences in athletic performance have not only a *regulatory* function, but also a *signal* function reflecting an athlete's perception of situational match or mismatch between task demands and available resources. From this perspective, in midevent situations emotions are indicators of effectiveness of ongoing action that correspond either to "rate of progress" or "error signal" (Carver, 2003, p. 243). Moreover, pleasant optimal emotions "represent a sign that things are going better than necessary and are presumed to induce coasting that facilitates the shift of attention and effort to other behavioral domains" (p. 241).

Two constructs and their opposites related to energizing and organizing effects of emotion account for the possible impact of emotions on the athletic performance process (Hanin, 1997, 2000, 2004): energy mobilization (and energy de-mobilization) and energy utilization (and misuse of energy). Optimal and dysfunctional emotion function can be conceptualized within the framework of two closely related but independent factors: energy mobilization (optimal effort, intensity) and energy utilization (efficiency, optimal information processing). The former is related to the situational resources available to an individual performer, whereas the latter characterizes the efficiency of using these resources. Based on these two factors, four relatively independent global effects of emotions are derived: (1) energizing or energy-mobilizing effects, (2) energy de-mobilizing effects, (3) energy utilization or regulation effects, and (4) energy misuse or deregulation effects. These four types of effects provide a framework for interpretation of separate and interactive impacts of pleasant and unpleasant emotions on individual performance. Based on the nature of these interactions, the total impact of emotions on athletic performance can be optimal (regarding effort and skill), para-optimal (with only effort or skill being optimal), or dysfunctional (both in effort and skill).

From the functional effect perspective, the constructs of energy mobilization-utilization (and their opposites) seem useful in explaining why, for some athletes, optimal emotions are predominantly pleasant, whereas, for other athletes, they are unpleasant. For instance, low-anxious athletes are typically smart users of available energy and are less distracted by task-irrelevant and energy-wasting concerns. In contrast, high-anxious athletes typically generate more energy, especially in stressful or emergency situations, because they are often less efficient in its use due to a narrow attention focus and an overload in information-processing function. Thus, unpleasant emotions, such as anxiety, are functionally useful for these athletes in that they help to generate additional energy to compensate for the apparent limitation in information processing or the use of energy.

Effectiveness of athletic performance is usually related to the amount of available energy and its efficient use. Different athletes can be successful by using different resources. In other words, the same level of performance may be achieved either through the increase of total effort or via skillful (smart) utilization of available resources (efficiency). However, usually optimal emotion regulatory function is manifested in an athlete's efficient recruitment (effort) and utilization (skill) of available resources, resulting in energizing and organizing effects on performance. In contrast, emotion dysfunction in self-regulation usually reflects a failure to recruit resources and their inefficient utilization, resulting in de-energizing and disorganizing effects of emotion on athletic performance.

Optimality of emotions, then, is related to their mobilizing function and getting ready for a task at hand by using either normal resources, as in the case of pleasant optimal (P+) emotions, or emergency resources, as in the case of unpleasant optimal (N+) strong emotions. In contrast, dysfunctional emotions (both unpleasant, N–, and pleasant, P–) are signals of inability to effectively use available resources or to compensate for their situational depletion. Too much satisfaction or celebration of intermediate success can be really distracting and demobilizational. Therefore, both positive and negative emotions can produce adaptive and maladaptive outcomes. Apparently, total effects depend on the interaction of mixed (pleasant and unpleasant) emotions and their ratio (of positive and negative).

There is evidence suggesting that high ratios of positive to negative affect would distinguish individuals who flourish (live within an optimal range of human functioning) from those who do not (Fredrickson & Losada, 2005). These investigators, applying the reformulated balanced-states-of-mind model (Schwartz, 1997), showed that positivity ratios at or above 2.9 are associated with human flourishing (Fredrickson & Losada, 2005, p. 685). Problems occur with too much positivity, and appropriate negativity may play an important role in the complex dynamics of human flourishing. Moreover, certain forms of negativity promote flourishing better than others (pp. 684–685). Although the positivity ratio was found to be one of the correlates of successful athletic performance (Hanin, Jokela, & Syrjä, 1998), both positivity and negativity of emotions should be appropriate or optimal for the task at hand, especially in high-achievement sports. Future research could also examine the role of the functionality-to-dysfunctionality ratio reflecting interactive effects of different emotion effects.

CONCLUSION

The main purpose of this chapter was to review selected issues and perspectives with a focus on defining characteristics, antecedents, and consequences of emotional experiences related to athletic performance. The emphasis on basic emotion dimensions (form, content, intensity, and partially time and context) seems especially appropriate. It provides conceptual and methodological tools to describe, predict, and partly explain situational emotional experiences and meta-experiences related to athletic performance. From the applied perspective, the major advantage of the individualized approach to studying emotion-performance relationships is in its ability to describe and explain findings that are often missed or ignored in group-oriented models. The resource-matching hypothesis was proposed to explain intra- and interindividual variability of optimal and dysfunctional emotion experiences. Future research may focus on relatively stable emotion patterns and meta-experiences that explain idiosyncratic preference in appraisals and coping processes.

There is ample empirical evidence that unpleasant emotions such as anxiety, anger, and tension are often situationally helpful for athletic performance. Such strong unpleasant emotions can help generate more energy and sustain effort; they often can compensate for a situational lack or depletion of needed resources, for instance, in the case of extreme fatigue. These emotions, if well channeled in the task process, can substantially postpone fatigue, sustain alertness, and maintain the right focus. In other words, coping with competitive stress involves not only alleviating it, but also using it to enhance performance.

There is also evidence that pleasant emotions are not always beneficial for performance, especially in sports requiring sustained focus, effort, and persistency for a relatively long time. Excessive complacency and satisfaction following unexpected or repeated successes can present a special problem in high-achievement settings because of the de-motivational impact. Moreover, high self-confidence can sometimes lead to excessive complacency and underestimation of an opponent, resulting in insufficient alertness, lack of focus, or carelessness and too much risk taking. These, in turn, can have harmful effects on performance, often leading to unexpected and season-ending injuries (Devonport, Lane, & Hanin, 2005; Würth &

Hanin, 2005). In such cases, self-generated labels of idiosyncratic emotional experiences are the best indicators of how an athlete can perform up to his or her potential (either stress-free or using competitive stress to advantage). These findings suggest that another promising area in emotion research in high-achievement sport is to establish the role of emotion in optimal recovery. Similar to identification of emotions that have optimal and dysfunctional effects on individual performance, it is possible to estimate which emotions are optimal for effective recovery after considerable training loads or important competitions (Hanin, 2002).

Research on emotional experiences related to athletic performance has direct practical implications. For instance, competitive athletes usually face three issues: how to identify emotional states related to individually successful and poor performances, how to predict emotion-performance relationships, and how to select person- and task-relevant techniques of self-regulation. Compelling empirical evidence described in this chapter provides several tentative guidelines on how to deal with these three issues.

First, to identify individually optimal and dysfunctional emotional experiences, establish the individually relevant cluster (constellation) of emotions and their intensities prior to, during, and after successful and less than successful (poor, average, or customary) performances. These qualitatively and quantitatively extreme situational experiences serve as individualized criteria in the evaluation of currently anticipated and experienced emotional states. Additionally, it is important to identify athletes' specific beliefs and attitudes about their emotion impact on performance (their meta-experiences). Are they aware of such effects? How do they usually cope with stress- and complacency-producing situations? Are these situational emotional experiences random or relatively stable patterns, which athletes can or cannot reproduce in important competitions? The main purpose of such individualized assessments is to enhance an athlete's awareness and acceptance of these experiences.

Second, prediction of emotion-performance relationships is based on the notion of being in or out of the zone, using categorical or continuous (intensity-impact contingencies) approaches. A categorical approach predicts performance based on the comparison between previously established individual zones and actual scores of intensity. A continuous approach is based on perceived intensity-impact contingencies along the entire working intensity range of each emotion. Here the emphasis is on an estimation of partial and total effects rather than only a selected optimal range of each emotion. In both cases, a decision about emotion regulation is based on the magnitude of deviations either from optimal and dysfunctional zones or from a total effect in the selected emotion modality. Furthermore, intervention should aim not only at helping athletes to enter or reenter their optimal zones, but also to stay away from the dysfunctional zones. Finally, predictions should also consider the total anticipated functional effects of emotion on performance that are usually manifested in an increase (or a decrease) of effort (energy) and efficiency (or inefficiency) in the utilization of available resources.

Third, emotion regulation refers to changes associated with activated emotions. These include changes in the emotion itself (e.g., changes in intensity, duration; Thompson, 1994) or in other psychological processes (e.g., memory, social interaction). However, emotion regulation is not defined by which emotions are activated but by systematic changes associated with activated emotions. Thus, evidence that one person is angrier than another does not by itself show that the first person is regulating anger differently from the second (Cole et al., 2004).

Although there are numerous techniques of emotion regulation in the practice of sport psychology, effective emotion regulation should be based on individualized assessments and predictions of emotion performance relationships. Moreover, a selected method or intervention strategy (technique) should match an athlete's resources and individual style, as well as the demands of the situation. In other words, the method should match previously established individual patterns of coping with emotion-inducing situations. Additionally, the effective intervention program usually includes not one but several appropriate methods of self-regulation. Finally, a focus on different modalities of psychobiosocial state with multimodal and intermodal orientation is another new research direction worth exploring in the future.

Cole et al. (2004) provide a detailed discussion of an emotion regulation construct that could be relevant in sport. For instance, it is suggested that the term *emotion regulation* can denote two types of regulatory phenomena: emotion as *regulating* and emotion as *regulated.* Emotion as regulating refers to changes that appear to result from the activated emotion. Emotion as regulated refers to changes in the activated emotion (in emotion valence, intensity, or time course). These changes may occur within the individual (e.g., reducing stress through self-soothing) or between individuals (e.g., a player provides support for a teammate).

Finally, there are several directions for effective emotion regulation. Most focus directly on emotional response by using different mental skills. However, there are other options, such as a change in the current situation or its perception (personal meaning) by an athlete, or a special organization of athletic activity for an athlete or a team (role expectations and game tactics).

The performance focus in emotion research is central in high-achievement sport. However, it does not preclude seeing these results in a wider context. Specifically, emotion impact (outcomes) can have optimal and dysfunctional outcomes not only for performance but also for general well-being (Diener, 2000) of athletes and their health status, quality of leisure time, and other domains of their life. The emphasis on performance, however, is understandable, as sport and athletic achievement is one of the most important domains in the life of athletes.

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CHAPTER 3

Intrinsic and Extrinsic Motivation in Sport and Physical Activity

A Review and a Look at the Future

ROBERT J. VALLERAND

Motivation has been repeatedly reported as a key element of athletes' success in sports (Gould, Dieffenbach, & Moffett, 2002) and exercisers' persistence with an exercise regimen (Wilson & Rodgers, in press). Thus, it is not surprising that much research has been conducted on motivation in sport and physical activity. Intrinsic motivation (doing something for its own sake) and extrinsic motivation (doing something as a means to an end and not for its own sake), in particular, have been very popular topics and have allowed researchers to make sense of several phenomena of importance in sport and physical activity (see Vallerand, Deci, & Ryan, 1987; Vallerand & Rousseau, 2001). The purpose of this chapter is to present a review of research on intrinsic and extrinsic motivation with a keen eye on the most recent research and trends. I start by defining motivation in general and intrinsic and extrinsic motivation in particular. I then present a brief overview of the organismic approach, specifically self-determination theory (SDT; Deci & Ryan, 2000). I present the hierarchical model of intrinsic and extrinsic motivation (HMIEM; Vallerand, 1997, 2001, in press; Vallerand & Ratelle, 2002), which serves as the organizing framework for the review. I then focus on recent research that has appeared since our initial review (Vallerand & Rousseau, 2001). Finally, I conclude by highlighting recent research trends considered to be important and provide suggestions for future research directions that appear promising.

MOTIVATION AND SELF-DETERMINATION THEORY

The concept of motivation can be defined as "the hypothetical construct used to describe the internal and/or external forces that produce the initiation, direction, intensity, and persistence of behavior" (Vallerand & Thill, 1993, p. 18; translated from French). The emphasis on internal and external forces fits in very well with the presence of two major types of motivation that have been heavily researched, namely, intrinsic and extrinsic motivation. Whereas initially research and models focused on the reactive or passive role of humans in their action with the environment, later research showed that people don't merely react to rewards (Weiner, 1972). In fact, a movement gathered momentum in the late 1950s and early 1960s positing that the innate needs of competence (White, 1959), autonomy (Angyal, 1941; deCharms, 1968), and relatedness (Harlow, 1958) were important in leading the person to be proactive in exploring the environment. This led to the development of a second position, termed the organismic approach, where it is proposed that individuals are actively engaged and proactive in their interaction with the environment because "people are inherently motivated to feel connected to others within a social milieu [*relatedness*], to function effectively in that milieu [*competence*], and to feel a sense of personal initiative while doing so [*autonomy*]" (Deci & Ryan, 1994, p. 7).

Self-determination theory (Deci & Ryan, 1985, 2000) has pursued the work of early need theorists. It posits that competence, autonomy, and relatedness are universally essential for optimal human development, motivation, and integrity. That is, a need serves the function of promoting psychological health; conversely, when needs are not met, psychological health is undermined. Research supports this crucial hypothesis with students (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000) and athletes (Gagné, Ryan, &

Bargman, 2003) in different cultures (Sheldon, Elliot, Kim, & Kasser, 2001). Thus, clearly needs do matter with respect to people's well-being and motivation. However, needs matter for at least two other reasons. First, from a motivational perspective, needs represent the energy underlying people's behavior. That is, people engage in certain activities in order to satisfy their needs. To the extent that their needs are satisfied, people will be motivated to engage in such activities out of their own choosing without any prodding (self-determined motivation). A second reason needs are important is because they represent the process through which changes in motivation take place. The fulfillment of our psychological needs is important because it orients us toward certain types of behaviors and activities in the hope that they will fulfill our needs. In such a quest, the social environment is as much an opponent as an ally, at times leading us to activities that satisfy our needs and at other times steering us in directions that go counter to the adaptive development of the self and the experience of positive outcomes.

A HIERARCHICAL MODEL OF INTRINSIC AND EXTRINSIC MOTIVATION

Over the years, research conducted on intrinsic and extrinsic motivation has shown that personality, situational-level-based motivation, and intermediate contextual level (or life domain) motivations are influenced by a host of factors and lead to various outcomes. Various conceptual frameworks in addition to SDT have been advanced to explain the major findings (see Vallerand, 1997). Building on such research and theory and especially SDT, a model has been proposed relative to the integration of the different levels at which motivation research has been conducted. The HMIEM (Vallerand, 1997, 2001, in press; Vallerand & Perreault, 1999; Vallerand & Ratelle, 2002) comprises five postulates and five corollaries. Taken together, these postulates and corollaries explain (a) the motivational determinants and consequences at three levels of generality as well as (b) the interactions among motivation at the three levels of generality, while taking into account the complexity of human motivation (see Figure 3.1). The model is briefly described next.

A Multidimensional Perspective of Motivation

A first postulate of the HMIEM is that the concepts of intrinsic motivation, extrinsic motivation, and amotivation are needed to make sense of a full range of motivational processes. Intrinsic motivation refers to performing an activity for itself and the pleasure and satisfaction derived from participation (Deci, 1971). Vallerand and his colleagues (Vallerand, Blais, Brière, & Pelletier, 1989; Vallerand et al., 1992, 1993) posited the existence of three types of intrinsic motivation: intrinsic motivation to know, intrinsic motivation to accomplish things, and intrinsic motivation to experience stimulation. Intrinsic motivation to know refers to engaging in an activity for the pleasure and satisfaction that one experiences while learning, exploring, or trying to understand something new. Basketball players who practice because they enjoy learning new offensive moves display intrinsic motivation to know. Intrinsic motivation to accomplish things pertains to engaging in a given activity for the pleasure and satisfaction experienced while one is *attempting* to accomplish or create something or to surpass oneself. Finally, intrinsic motivation to experience stimulation is at work when one engages in an activity to experience pleasant sensations associated mainly with one's senses (e.g., sensory and aesthetic pleasure). Swimmers who swim because they enjoy the pleasant sensations they experience while their bodies glide through water display this type of intrinsic motivation. This tripartite distinction highlights the different fashions in which intrinsic motivation may be experienced in sport and exercise. Much research (Fairchild, Horst, Finney, & Barron, 2005; Hein, Müür, & Koka, 2004) supports this taxonomy.

Extrinsic motivation refers to engaging in an activity as a means to an end and not for its own sake. There are different types of extrinsic motivation, some of which are more self-determined in nature (Deci & Ryan, 1985, 2000). In other words, individuals may *choose* to perform an activity, even though they do *not* do it for pleasure. Deci and Ryan (1985) have proposed four types of extrinsic motivation. External regulation refers to behavior that is regulated through external means, such as rewards and constraints. For instance, an athlete might say, "I'm going to today's practice because I want the coach to let me play tomorrow." With introjected regulation, individuals begin to internalize the reasons for their actions. However, this type of extrinsic motivation is not self-determined because individuals still experience pressure, although this time the pressure is self-imposed (e.g., through guilt and anxiety). An example of introjected regulation is the athlete who goes to a practice because he would feel guilty if he missed it. It is only with identified regulation that behavior is done out of choice. When they display

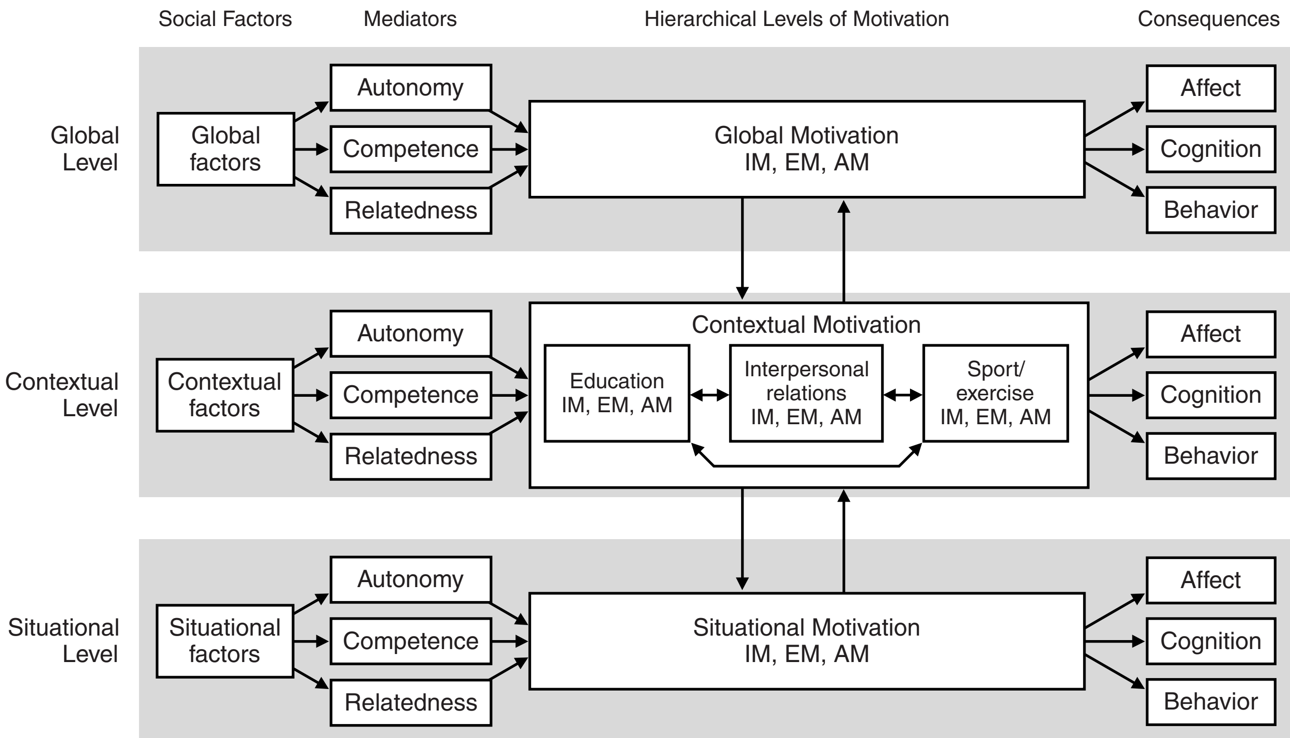

Figure 3.1 The hierarchical model of intrinsic and extrinsic motivation. *Note:* IM = Intrinsic Motivation; EM = Extrinsic Motivation; AM = Amotivation. *Source:* "Intrinsic and Extrinsic Motivation in Sport and Exercise: A Review Using the Hierarchical Model of Intrinsic and Extrinsic Motivation" (p. 391), by R. J. Vallerand and F. L. Rousseau, in *Handbook of Sport Psychology,* second edition, R. N. Singer, H. A. Hausenblas, and C. M. Janelle (Eds.), 2001, New York: Wiley. Reprinted with permission.

identified regulation, athletes freely perform the activity even if it is not pleasant in itself. An example of identified regulation is the soccer player who does not like weight lifting but who nevertheless chooses to do it because she knows that building her strength will allow her to become a better player. Integrated regulation also involves doing an activity out of choice; however, in this case, the choice represents a harmonious part of the individual's self. In other words, one's choices are made as a function of their coherence with other aspects of the self. An example of integrated regulation is the ice hockey player who chooses to postpone a night out with his friends on Friday to be in top shape for the big game on Saturday afternoon.

Finally, amotivation refers to the lack of intentionality and thus the relative absence of motivation. When amotivated, athletes experience feelings of incompetence and expectancies of uncontrollability. They are relatively without purpose with respect to the activity and therefore have little motivation (intrinsic or extrinsic) to perform it.

Motivation at Different Levels of Generality

A second issue underscored by Postulate 2 of the HMIEM is that intrinsic and extrinsic motivation and amotivation exist at three levels of generality: global, contextual, and situational. Motivation at the global level refers to a general motivational orientation to interact with the environment in an intrinsic, extrinsic, or amotivated way. It is similar to a personality trait where one is predominantly intrinsically or extrinsically motivated, or even amotivated. Motivation at the contextual level is an individual's usual motivational orientation toward a specific context or a set of specific and related activities. Research on intrinsic and extrinsic contextual motivation has typically focused on three contexts: education (or work), interpersonal relationships, and leisure (of which sport is an important part; see

Vallerand, 1997). Finally, motivation at the situational level refers to the motivation individuals experience when engaging in a specific activity at a given moment in time. Situational motivation refers to a motivational state. It is important to distinguish among these three levels as such a conceptualization provides a more refined understanding of motivational processes involved in human behavior.

Assessing Motivation

It is important to have a brief look at methodological advances that have taken place to assess the different types of motivation across the three levels of generality. This will facilitate the understanding of the review presented in the later sections.

At the situational level, researchers have developed the Situational Motivation Scale (SIMS; Guay, Vallerand, & Blanchard, 2000), which measures intrinsic motivation (without distinguishing the three types), identified and external types of extrinsic motivation, and amotivation. The choice to measure only four motivational types was dictated by the need to keep the scale as brief as possible (16 items, although an introjected regulation scale is also available) to capture situational motivation in many lab and field situations without overloading participants with a long questionnaire. The results of several studies (Edwards, Portman, & Bethea, 2002; Guay et al., 2000; Lévesque & Pelletier, 2003; Standage & Treasure, 2002; Standage, Treasure, Duda, & Prusak, 2003) have shown that the scale displays adequate factorial structure and internal consistency and leads to theory-informed predictions. Although several studies typically yielded support for the factorial structure of the scale (see Guay et al., 2000), some authors (Standage, Treasure, et al., 2003) suggested that the factorial structure of a 14-item version of the scale might be more appropriate than the 16-item original version. Close inspection of the Standage, Treasure, et al. (2003) data supports this. However, the data also reveal that overall the factorial structure of the 16-item scale is still appropriate. Because the use of the scale in sport has just begun and support for the full-scale version has been obtained in several studies, it is recommended that researchers use the full-scale and not the 14-item version at this point.

Scales assessing motivation at the contextual level have also been developed. Because we were mainly interested in college students and because research revealed that college students rated education, leisure, and interpersonal relationships as their three main life contexts (Blais, Vallerand, Gagnon, Brière, & Pelletier, 1990), scales were developed to measure motivation in these contexts. The Academic Motivation Scale (AMS; Vallerand et al., 1989, 1992, 1993) assesses contextual motivation toward education; the Interpersonal Motivation Inventory (Blais, Vallerand, Pelletier, & Brière, 1994) assesses contextual motivation in interpersonal relationships; and the Leisure Motivation Scale (Pelletier, Vallerand, Green-Demers, Blais, & Brière, 1996) measures contextual motivation toward leisure activities. Because sport represents an important type of leisure activity for most people and a full-fledged life context for athletes, we have also developed a scale to assess sport motivation, both in French (the Echelle de Motivation dans les Sports; Brière, Vallerand, Blais, & Pelletier, 1995) and in English (Sport Motivation Scale; SMS; Pelletier et al., 1995). The SMS assesses the seven types of motivational constructs described earlier, although recently Pelletier and Kabush (2005, cited in Pelletier & Sarrazin, in press) added an integrated regulation subscale to the SMS. The SMS has been translated into several languages and fully validated in French, English, Greek, and Finnish and used in a variety of sports too numerous to mention. Overall, the validity and reliability of the SMS has been repeatedly supported (see Pelletier & Sarrazin, in press, for a review). This also applies to measures of the other life contexts.

Scales assessing some of the constructs proposed by SDT and the HMIEM have been developed to measure motivation toward exercise, such as the Behavioral Regulation in Exercise Questionnaire (BREQ; Markland & Tobin, 2004; Mullan, Markland, & Ingledew, 1997), the Exercise Motivation Scale (Li, 1999), and the Perceived Locus of Causality Scale (Goudas, Biddle, & Fox, 1994). These scales have shown adequate levels of validity and reliability.

Finally, the Global Motivation Scale (GMS; Guay, Vallerand, Pelletier, & Blais, 1999) has been developed to assess the three different types of intrinsic motivation, and the identified, introjected, and external types of extrinsic motivation, as well as amotivation toward life in general. More recently, Pelletier and his colleagues (Pelletier, Dion, & Lévesque, 2004) have added an integration subscale. Results with the GMS indicate that the scale is both reliable and valid and relatively free from social desirability (Guay, Mageau, & Vallerand, 2003; Guay et al., 1999).

Motivation as a Social Phenomenon

A third issue of interest is that motivation is a social phenomenon. Corollary 3.1 of the hierarchical model states that motivation can result from social factors that can be global, contextual, or situational, depending on the level of generality. Global social factors are so pervasive that they are present in most aspects of a person's life. An example of a global factor is the role of parents, as their presence is felt across children's life and as such should affect their global motivation. On the other hand, contextual social factors are present on a general or recurrent basis in one specific life context but not necessarily in another. For example, a controlling coach may influence an adolescent's motivation toward sport but not toward education. Finally, situational social factors are present at a given point in time (e.g., receiving positive feedback from the coach after completing a great catch in baseball).

Corollary 3.2 is closely related to Corollary 3.1. In line with the work of several theorists (deCharms, 1968; Deci & Ryan, 2000; White, 1959), it states that the impact of social factors on motivation is mediated by perceptions of competence, autonomy, and relatedness. This means that motivation is not influenced by social factors per se, but by the way individuals *interpret* those factors in terms of facilitating their needs for competence, autonomy, and relatedness.

Motivation as an Intrapersonal Phenomenon

Motivation is also an intrapersonal phenomenon. According to Corollary 3.3, motivation at one level of the hierarchy also results from top-down effects of motivation at the proximal level higher up in the hierarchy. For example, if one's predominant contextual motivation toward a given sport is intrinsic motivation, then, all other factors being equal, one should have a tendency to display intrinsic motivation toward an activity related to one's sport at a specific point in time (at the situational level). Moreover, the dynamic nature of the relationship among motivations at different levels can result not only in top-down effects, but also in bottom-up effects. Thus, Postulate 4 states that over time, there is a recursive bottom-up relationship between motivation at a given level and motivation at the next higher level in the hierarchy. For example, an athlete repeatedly experiencing situational intrinsic motivation in a particular sport should eventually develop an increase in contextual intrinsic motivation toward this sport. In addition, contextual motivations can have facilitative or debilitative effects toward one another, depending on their level of self-determined motivation. The more self-determined one's motivation toward a given life context, the more it will facilitate one's motivation toward another life context because it is more fully integrated in the self. Finally, global motivation can also serve an integrative function regarding the interplay between two or more life contextual motivations and the experiences related to them (see Koestner, Bernieri, & Zuckerman, 1992).

Motivational Consequences

Motivation can also lead to important consequences of at least three types: affective, cognitive, and behavioral (Postulate 5; Vallerand, 1997). Furthermore, according to Corollary 5.1, consequences are hypothesized to be decreasingly positive from intrinsic motivation to amotivation. Finally, consequences can occur at all three levels of generality depending on the level of motivation that has produced them (Corollary 5.2).

In summary, the HMIEM deals with at least two important elements. First, it identifies the psychological mechanisms underlying the determinants and outcomes of motivation. In doing so, the model provides a rich framework to integrate existing knowledge on intrinsic and extrinsic motivation. Second, the hierarchical model proposes new directions for future research. Table 3.1 summarizes the

Table 3.1 Postulates and Corollaries of the Hierarchical Model

Postulate 1	A complete analysis of motivation must include intrinsic and extrinsic motivation and amotivation.
Postulate 2	Intrinsic and extrinsic motivation exist at three levels of generality: the global, contextual, and situational levels.
Postulate 3	Motivation is determined by social factors and top-down effects from motivation at the proximal level higher up in the hierarchy.
Corollary 3.1	Motivation can result from social factors that are either global, contextual, or situational depending on the level of generality.
Corollary 3.2	The impact of social factors on motivation is mediated by perceptions of competence, autonomy, and relatedness.
Corollary 3.3	Motivation results from top-down effects from motivation at the proximal level higher up in the hierarchy.
Postulate 4	There is a recursive bottom-up relationship between motivation at a given level and motivation at the next higher level in the hierarchy.
Postulate 5	Motivation leads to important consequences.
Corollary 5.1	Consequences are decreasingly positive from intrinsic motivation to amotivation.
Corollary 5.2	Motivational consequences exist at the three levels of the hierarchy, and the degree of generality of the consequences depends on the level of the motivation that has produced them.

Adapted from "Toward a Hierarchical Model of Intrinsic and Extrinsic Motivation" (Vol. 29, pp. 271–360), by R. J. Vallerand, in *Advances in Experimental Social Psychology,* M. P. Zanna (Ed.), 1997, New York: Academic Press.

postulates and corollaries of the model. This framework is used in this chapter to review the literature on intrinsic and extrinsic motivation in sport and physical activity.

RESEARCH ON MOTIVATION AT THE SITUATIONAL LEVEL

As discussed previously, situational motivation refers to the motivation individuals experience while engaging in a given activity at a specific point in time. An example would be the basketball player who is practicing her jump shot at 3:00 P.M. on a Saturday for the sheer pleasure of executing the movement and feeling the flow of the movement. In this section, the studies dealing with the determinants and consequences of situational motivation in sport and physical activity are reviewed.

Determinants

Several motivational determinants have been studied. Below, we focus on rewards and awards, competition, positive and negative feedback, and choice.

Rewards and Awards

The use of rewards, in particular, has attracted a lot of attention at the situational level over the past 10 years. Deci, Koestner, and Ryan (1999, 2001) conducted a meta-analysis of 128 laboratory experiments that revealed that rewards that are provided contingent on engaging in the activity, completing the activity, or reaching a certain level of performance all decrease intrinsic motivation. However, rewards that are not expected and that are task-noncontingent (not related to the task) do not decrease intrinsic motivation. Finally, although all participants (no gender effects) experience negative effects, children are more affected than college-age students. Laboratory research involving tasks associated with sport or exercise has yielded findings similar to that of the Deci et al. (1999) meta-analysis. Thus, athletes and participants who engage in a sport-related activity to receive a trophy or a reward display a decrease in situational intrinsic motivation as assessed by self-report scales (e.g., Thomas & Tennant, 1978) and the free-choice measure (Orlick & Mosher, 1978). Additional research is needed to determine if the negative effects of rewards and awards findings replicate in actual sport settings and to identify the boundaries of such effects.

Competition

In the context of competitive sport, the focus is often on beating the opponent. Initial research using a cognitive task has shown that such a competitive focus undermines the intrinsic motivation of young adults (Deci, Betley, Kahle, Abrams, & Porac, 1981). Results from the Vallerand, Gauvin, and Halliwell (1986b) study showed that this conclusion also applies to 10- to 12-year-old children who engaged in a balancing task (i.e., the stabilometer). Winning or losing a competition represents another potent social determinant of motivation. Research in sport reveals that winners (e.g., Vallerand, Gauvin, & Halliwell, 1986a; Weinberg & Ragan, 1979) and those who subjectively feel that they have done well in competition (McAuley & Tammen, 1989) display higher levels of intrinsic motivation than losers and those who feel that they have not done well. A recent series of four studies on basketball by Tauer and Harackiewicz (2004) assessed the effects of competition, cooperation, and intergroup competition on children's enjoyment on a basketball free-throw task. Three findings of interest were found. First, they replicated the findings on success and failure of competition mentioned earlier. Second, cooperation and competition did not differ across studies. And third, intergroup competition consistently led to the highest levels of enjoyment. The authors posit that engaging in intergroup competition leads individuals to derive the best of both worlds: They experience the excitement of competition as well as the interpersonal enthusiasm derived from having a teammate.

The fact that the competition and intergroup competition conditions did not lead to lower levels of enjoyment than the cooperation condition is surprising. These findings could be due to measurement and methodological issues (a no-feedback, no-competition control group was not included, and, though related, enjoyment and intrinsic motivation are nevertheless different constructs). In addition, because the focus in the Tauer and Harackiewicz (2004) studies was on trying to do well and not necessarily on beating others at all cost (as in past competition research), the controlling dimension of competition may have been downplayed in favor of the informational dimension of competition (see Deci, Betley, et al., 1981), thereby eliminating the negative effects of competition typically found in most studies. Clearly, future research on the effects of competition on intrinsic motivation is needed.

Positive and Negative Feedback

By providing athletes with feedback about their strengths and weaknesses, coaches, fitness instructors, and physical education teachers may influence athletes' situational intrinsic motivation. Past research has indeed shown that positive feedback enhances and negative feedback decreases situational intrinsic motivation (Vallerand & Reid, 1984, 1988). For example, Thill and Mouanda (1990) showed that team handball players receiving bogus negative verbal feedback (indicating failure) after shooting at targets report lower levels of situational intrinsic motivation than players receiving bogus positive verbal feedback (indicating success).

However, other dimensions of the feedback in addition to its valence (positive or negative) are important to consider. For instance, a review of the literature by Henderlong and Lepper (2002) underscored that praise must be used with caution as it can increase, decrease, or have no effects on children's intrinsic motivation. To the extent that the message is believed, an increase in intrinsic motivation will follow. However, if the feedback is not perceived as sincere, negative effects can occur. In addition, much research also reveals that the style of feedback delivery is important. Specifically, when the message is presented in an autonomy-supportive fashion (e.g., "It is important for your own good to do this"), athletes feel as if they are in control and can make choices within reasonable limits (Deci, Schwartz, Sheinman, & Ryan, 1981). On the other hand, messages are controlling when they force or coerce athletes to behave in a certain way (e.g., "You must do this. You have no choice"). Controlling statements typically undermine intrinsic motivation, whereas autonomy-supportive statements preserve it or even enhance it (see Mageau & Vallerand, 2003, for a review of such research).

Choice

Research in sport and exercise reveals that choice facilitates intrinsic motivation with respect to physical activity. For example, Dwyer (1995) showed that having the opportunity to choose the songs they wanted to hear while exercising increases feelings of choice and intrinsic motivation relative to participants in a control condition, even though both groups heard the same songs. Similar findings have also been reported with respect to physical education classes (e.g., Goudas, Biddle, Fox, & Underwood, 1995). Thus, it appears that choice represents an important factor to consider with respect to situational motivation.

Mediational Evidence

Because individuals need to feel competent, autonomous, and connected to significant others in their interaction with their environment, activities that allow them to satisfy these needs will be engaged in by choice out of intrinsic motivation or identified regulation when they have the opportunity to do so. Thus, need satisfaction is hypothesized to mediate the impact of social factors on motivation. Research has found support for this hypothesis. For instance, in a study with master swimmers, Kowal and Fortier (2000) showed that perceptions of competence, autonomy, and relatedness mediate the relationship between social factors (perceived success and motivational climate) and situational motivation following a meet. In another study, Guay et al. (2000, Study 4) looked at the role of the three psychological mediators in the *changes* in situational motivation over two subsequent collegiate basketball games. Results revealed a differentiated picture for each type of situational motivation. Athletes who experienced perceptions of relatedness, autonomy, and collective competence displayed an increase in intrinsic motivation from game 1 to game 2. Increases in identified regulation were predicted by perceptions of autonomy and relatedness, whereas increases in amotivation were negatively predicted only by perceptions of relatedness. Finally, changes in external regulation were not significantly predicted by any of the predictors. These findings are interesting in that they reveal that with respect to team sports, collective competence represents an important mediator that needs to be looked at more closely in future research. More generally, these findings underscore the fact that the hypothesized psychological mediators need to be taken into account to better understand changes that occur at the situational level over time.

Corollary 3.3 posits that there is a top-down effect from motivation at the contextual level on motivation at the situational level. For instance, an athlete who usually plays her favorite sport, tennis, because of high contextual intrinsic motivation should be predisposed to display high levels of intrinsic motivation at a given moment (high level of situational intrinsic motivation) while playing tennis. Research supports the top-down effect. For instance, Gagné et al. (2003) measured gymnasts' contextual motivation toward gymnastics at Time 1 and their situational motivation at the beginning of practice each day for 15 days. In line with the top-down effect posited by the HMIEM, correlations between contextual motivation and situational motivation were always positive and varied from .22 to .50. These findings also suggest that although the top-down effect was present each day for 15 consecutive days, its impact varied daily, presumably due to the presence of situational factors that differed in importance on a given day.

Other studies have tested the validity of the top-down effect in physical education settings. For instance, Ntoumanis and Blaymires (2003) had participants complete the contextual measures of motivation toward physical activity (the Perceived Locus of Causality [PLOC] Scale of Goudas et al., 1994) and toward education (the AMS; Vallerand et al., 1992, 1993). One month later, students engaged in a typical science class in the classroom and a typical physical education class in the gymnasium, and situational motivation toward each was assessed with the SIMS. Ntoumanis and Blaymires found that students' situational motivation during the science class was positively predicted by their contextual motivation toward education, and their situational motivation toward physical activity in the gymnasium was predicted by their contextual motivation toward physical activity. These findings provide support for the HMIEM's position that it is not simply any motivation at the contextual level that will influence situational motivation, but rather the contextual motivation that is pertinent to the activity being performed.

The HMIEM posits that life contexts can be seen as schemas that serve to store contextual cues in addition to the relevant contextual motivation. If this is so, then presenting relevant contextual cues should be sufficient to trigger the appropriate contextual motivation stored with the cues, thereby setting in motion the top-down effect on situational motivation. Furthermore, such a triggering can take place outside of awareness (see Bargh, 2005). Recent research by Ratelle, Baldwin, and Vallerand (2005) has supported this hypothesis. In two studies, Ratelle et al. showed that simply hearing a sound (in the background and out of awareness) initially paired with a controlling message on a first task was sufficient to produce a decrease in situational motivation on a second task. Why? Because according to the HMIEM, working on a new type of task (the first one) creates a new context in which cues inherent to that new context such as the sound paired with the task were stored with the contextual motivation related to such types of task. So, when a task relevant to that context is later available (the second task), the mere sound triggers the relevant contextual motivation stored in the schema along with the cue, and the top-down effect takes place. These findings provide support for the top-down effect and show that such an effect can be triggered nonconsciously.

A final note on the top-down effect is in order. In a study on leisure, Iwasaki and Mannell (1999) obtained an interaction between the relevant contextual motivation and the actual situational factor that was manipulated (choice versus being controlled). More specifically, it was found that the top-down effect took place only in the choice condition where participants experienced some autonomy. It is thus possible that some situational conditions are more conducive to the top-down effect than others. Research on this issue in sport would appear to be in order.

Summary

In summary, the studies reviewed show that social factors such as rewards, competition, verbal feedback, and choice can influence individuals' situational motivation. Moreover, perceived competence, autonomy, and relatedness have been shown to mediate the impact of social factors on situational motivation. Finally, support for Corollary 3.3 on the top-down effect has been found to support the impact of contextual motivation on situational motivation.

Consequences

According to the hierarchical model, situational motivation leads to situational consequences (outcomes that are experienced at one specific point in time and with respect to a specific activity) that can be affective, cognitive, and behavioral in nature (Vallerand, 1997). In addition, the most positive consequences should be produced by the most self-determined forms of motivation (i.e., intrinsic motivation and identified regulation), and the least self-determined forms of motivation (i.e., external regulation and especially amotivation) should lead to the most negative consequences (Corollary 5.1). Introjection should lead to intermediate effects.

Affective Outcomes

In line with the hierarchical model and SDT, several studies in sport and exercise have shown that intrinsic motivation predicts the occurrence of positive affect in sports (e.g., McAuley & Tammen, 1989; Scanlan & Lewthwaite, 1986). Other research by Kowal and Fortier (1999) showed that swimming for intrinsic reasons was associated with the highest levels of flow during practice, followed decreasingly by identified regulation, external regulation, and amotivation (the last two scales yielded mostly negative correlations). Similar findings were obtained with gymnasts (Gagné et al., 2003), with a number of affective variables (positive and negative affect, vitality, and self-esteem) experienced before practice over a period of 15 consecutive days.

Experimental conditions known to induce intrinsic motivation and identified regulation have also been found to lead to positive affective outcomes. For instance, in an exercise setting, Parfitt and Gledhill (2004) showed that low-active individuals who engaged in a 20-minute exercise bout under a choice condition (deciding which types of exercise to do) reported less fatigue, psychological distress, and perceived exertion than those in a no-choice condition even though the total output as measured by heart rate was similar. Furthermore, these benefits seemed to increase over time. In another study, it was found that college students who engaged in a basketball dribbling task as part of a physical education course under conditions of personal relevance and instrumentality (the task is personally beneficial and will be directly useful in the course) experienced higher levels of intrinsic motivation and enjoyment than students who saw no relevance or instrumentality in that particular task (Simons, Dewitte, & Lens, 2003). In line with Deci, Eghrari, Patrick, and Leone (1994), it appears that choice and personal relevance may represent important motivational catalysts for tasks that may not be initially interesting.

Cognitive Outcomes

In the Kowal and Fortier (1999) study with master swimmers described earlier, higher levels of self-determined motivation predicted better concentration on the task at hand. These results may be explained by the fact that when intrinsically motivated, individuals focus more on the task and may become more impervious to external distractions (e.g., behaviors from the coach, teammates, or the crowd), and thus can devote all their attention and concentration to the task. These hypothesized mediating processes nevertheless remain to be empirically tested in future research.

Behavioral Outcomes

Finally, the HMIEM also posits that higher levels of self-determined situational motivation should result in positive behavioral consequences at a specific moment in time. Research is supportive of the hypothesis. For instance, in their study with gymnasts, Gagné et al. (2003) found that intrinsic motivation predicted attendance at practice each day over a 15-day period. In addition, the results from the Simons et al. (2003) study revealed that physical education students who saw a basketball dribbling task as personally relevant and instrumental were more intrinsically motivated, expended more effort and time on the task, and also displayed higher levels of objective performance than those in less self-determined conditions.

Summary

Research shows that situational motivation leads to several affective, cognitive, and behavioral outcomes. Furthermore, higher levels of self-determined motivation result in more positive situational outcomes, whereas lower levels of self-determined motivation result in less positive situational outcomes (Corollary 5.1). Although additional research is needed, especially with respect to cognitive outcomes, extant findings on consequences at the situational level provide support for the HMIEM as well as SDT.

RESEARCH ON MOTIVATION AT THE CONTEXTUAL LEVEL

Contextual motivation refers to one's generalized motivation toward a specific life context. In the present section, studies on the determinants and consequences of contextual intrinsic and extrinsic motivation in sport and physical activity are reviewed.

Determinants

Several contextual factors have been found to influence athletes' contextual motivation toward sport, including the coach, the motivational climate, scholarships, and the sport structures. This research is reviewed next.

The Coach

The coach represents one of the most important sources of influence on athletes' motivation and quality of involvement in sport (Pensgaard & Roberts, 2002). Mageau and Vallerand (2003) have proposed a model that posits that coaches' influence on their athletes' motivation takes place mainly through the coaches' interactional behavior with them. Such behavior can convey varying degrees of autonomy-support, structure, and involvement and caring toward the athletes, which are hypothesized to influence athletes' perceptions of autonomy, competence, and relatedness. In turn, these perceptions facilitate athletes' self-determined motivation. Of particular interest is the fact that Mageau and Vallerand have identified some of the determinants of coaches' behavior toward athletes. These include their personal orientations toward coaching (i.e., a natural tendency to be controlling or autonomy-supportive), the context within which coaches work (e.g., a pressure cooker), and the perception coaches may have of their athletes' behavior and motivation. This model is presented in Figure 3.2.

With respect to the effects of autonomy-supportive behavior on motivation, much research has shown that athletes who feel that their coaches are controlling tend to report lower levels of contextual intrinsic motivation and identified regulation and higher levels of amotivation and external regulation than those who feel that their coaches and instructors are autonomy-supportive (e.g., Amorose &

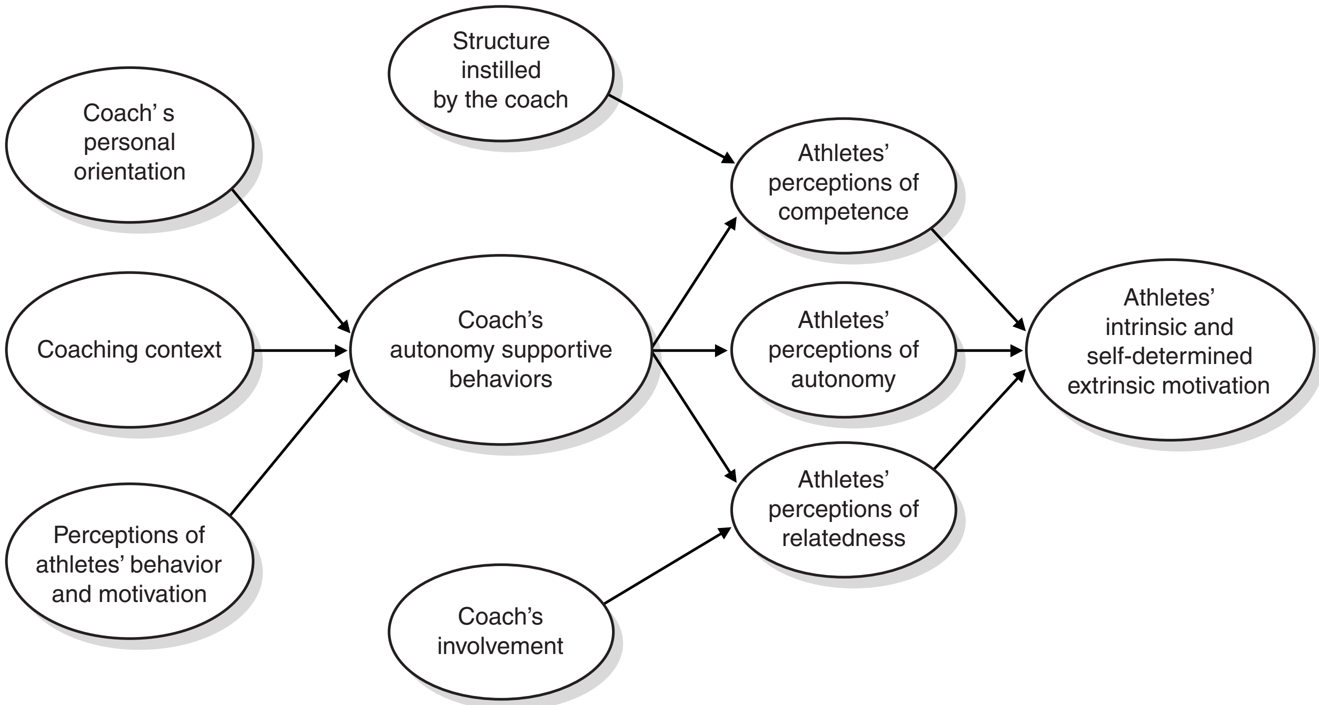

Figure 3.2 The coach-athlete model of motivation. *Source:* "The Coach-Athlete Relationship: A Motivational Model," by G. A. Mageau and R. J. Vallerand, 2003, *Journal of Sports Sciences, 21,* pp. 883–904. Reprinted with permission.

Horn, 2000, 2001; Hollembeak & Amorose, 2005; Pelletier, Fortier, Vallerand, & Brière, 2001; Pelletier et al., 1995; Reinboth, Duda, & Ntoumanis, 2004). Similar findings have been obtained in physical activity settings where a controlling teacher contributes to amotivation toward physical activity (Ntoumanis, Pensgaard, Martin, & Pipe, 2004), whereas autonomy support from important people in one's life facilitates self-determined motivation toward exercise (Wilson & Rodgers, 2004).

To the best of my knowledge, only one study has looked at the role of the coach in athletes' *changes* in motivation at the contextual level (Amorose & Horn, 2001). In this study, it was found that increases in Division 1 athletes' intrinsic motivation over the season was predicted by their perceptions that their coaches provided high-level training and instruction behavior and low frequencies of autocratic (or controlling) behavior. These findings thus underscore the fact that controlling behavior from the coach will undermine athletes' intrinsic motivation, whereas providing time and instruction is likely to facilitate its development.

Very little research has looked at the *determinants* of the coach's autonomy-supportive versus controlling behavior in sport and physical activity. However, some research has started to assess some of these relationships in the field of education (see Mageau & Vallerand, 2003, for a more complete review). For instance, research by Pelletier, Séguin-Lévesque, and Legault (2002) has shown that teachers who experience a lot of pressure from the administration to teach in a specific way or to have their students perform at a high level (pressure from above) and who have unruly and/or amotivated students (pressure from below) end up using controlling behavior toward their students (see also Pelletier & Vallerand, 1996, on this issue). Furthermore, research reveals that teachers who have a personal disposition to be controlling rather than autonomy-supportive as assessed by the Problem in School Questionnaire display more controlling behavior toward their students, who in turn display lower levels of intrinsic motivation (see Deci, Schwartz, et al., 1981). In light of the importance of coaches' behavior for their athletes' motivation, it is important to conduct future research on the determinants and consequences of such behavior. The Mageau and Vallerand model represents an appropriate point of departure for such research.

Motivational Climate

Coaches may also influence their athletes indirectly through the type of motivational climate they help to create. The motivational climate refers to the general ambience that exists in a team or club and the message it conveys to athletes. There are two main types of motivational climate: task-involved (or mastery) and ego-involved (or performance; see Duda & Hall, 2001). A task-oriented climate encourages participants to perform an activity in order to improve their skills; an ego-involved climate leads athletes to believe that they must outperform other athletes, including their teammates. Research reveals that a task climate is more conducive to the growth of self-determined forms of motivation (intrinsic motivation and identified regulation), whereas the opposite takes place with an ego-involved climate with respect to a variety of sports (Kavussanu & Roberts, 1996; Sarrazin, Vallerand, Guillet, Pelletier, & Curry, 2002) and physical activity (Brunel, 1999; Ferrer-Caja & Weiss, 2000; Kowal & Fortier, 2000; Ntoumanis, 2001a; Standage, Duda, & Ntoumanis, 2003).

Scholarships and Sport Structures

Scholarships qualify as a contextual factor because they represent a type of reward that will remain present for the duration of the athlete's collegiate career. The purpose of scholarships is typically to provide athletes with more time for training and studying. Unfortunately, scholarship recipients may come to feel that they play more to justify the scholarship they have received than for the pleasure of the game. As a result, they may feel controlled (feel that they must perform) and become less intrinsically motivated. Early research provided support for this hypothesis (E. D. Ryan, 1977; Wagner, Lounsbury, & Fitzgerald, 1989), although E. D. Ryan (1980) subsequently found that the negative effects were only true for football players and not for male wrestlers and female athletes from a variety of sports. More recently, using the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989), Amorose and Horn (2000) found that scholarship athletes felt more competent and less pressured than nonscholarship athletes (which is not surprising, as they're supposed to be better!), although in a subsequent study (Amorose & Horn, 2001), they didn't find any differences. Because the IMI displays some conceptual problems (see Vallerand & Fortier, 1998), future research using other scales such as the SMS is needed to more clearly determine the motivational effect of scholarships.

Another contextual factor of interest pertains to the sport structures. These refer to the organizational pattern that is inherent in athletic leagues. For instance, certain leagues may foster competitive structures, whereas others may instill a more relaxed climate where self-improvement is the goal. Sport structures are important because they convey an implicit message that may affect athletes' motivational processes. If the message conveyed to athletes is that winning is the only thing, then athletes will probably experience lower levels of intrinsic motivation and have less fun. However, if structures lead athletes to predominantly focus on self-improvement, they are likely to experience higher levels of intrinsic and identified regulation, and consequently more enjoyment. Research supports this hypothesis (Fortier, Vallerand, Brière, & Provencher, 1995; Frederick, Morrison, & Manning, 1996).

Mediational Evidence

Several studies have now provided support for mediational effects at the contextual level (Hollembeak & Amorose, 2005; Ntoumanis, 2001a, in press; Reinboth et al., 2004; Sarrazin et al., 2002), both in sports and in physical activity settings. Perhaps one of the most impressive studies is that of Ntoumanis (2001b), who attempted to link specific social factors (cooperative learning, emphasis on improvement, and perceived choice) prevalent in British physical education classes to physical education students' perceptions of autonomy, competence, and relatedness, and in turn to their contextual motivation toward exercise. Results from a path analysis revealed that a classroom in which emphasis was on improvement led to perceptions of competence, whereas cooperative learning and perceived choice led, respectively, to perceptions of relatedness and autonomy. In addition, although all three mediators were related as hypothesized to the different types of motivation, the most important predictor was perceived competence. This is in line with past research in sports (see Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Vallerand & Reid, 1984) but not in education, where perceived autonomy has been found to have the most important mediating effects (e.g., Vallerand, Fortier, et al., 1997). Future research is needed on the relative mediating impact of the three needs as a function of life contexts.

A final type of motivational determinant comes from the top-down effect (Corollary 3.3), where an individual who has a predisposition to do things out of intrinsic motivation (e.g., a high level of global intrinsic motivation) should display high levels of intrinsic motivation toward, for instance, basketball in general (e.g., a high level of contextual intrinsic motivation). Research using longitudinal and prospective designs has found support for the top-down effect with respect to the contexts of education (Guay et al., 2003) and physical activity (Vallerand, Guay, Mageau, Blanchard, &

Cadorette, 2005, Study 3) over extended periods of time up to 5 years, and with a variety of participants, including some from the general population.

Noteworthy is that researchers have started to look at the role of personality variables, other than global motivation, and how these predict contextual motivation. For instance, Ingledew, Markland, and Sheppard (2003) related the personality dimensions of the Big 5 (Costa & McRae, 1992) to contextual motivation toward exercise using the BREQ. It was found that contextual intrinsic motivation was predicted by extraversion and conscientiousness; identified regulation by extraversion; introjected regulation by neuroticism; and external regulation by less conscientiousness and less openness to experience (amotivation was not assessed). Other researchers (Miquelon, Vallerand, Grouzet, & Cardinal, 2005) have shown that adaptive forms of perfectionism (Hewitt & Flett, 2002) are conducive to self-determined forms of motivation toward education, whereas maladaptive perfectionism leads to non-self-determined motivation. Overall, these two sets of findings are important because they suggest that motivation at the contextual level may be influenced to some extent by personality variables other than global motivation. Future research is needed to pursue these initial efforts.

Summary

Studies reviewed in this section indicate that contextual self-determined motivation toward sport is influenced by several social factors: such as coaches' behavior, sport structures, scholarships, and the team's climate (or fitness center ambience). Furthermore, the relationships between those social factors and contextual self-determined motivation toward sport or exercise are mediated by individuals' general sense of competence, autonomy, and relatedness toward sport or exercise. Finally, global motivation and other personality variables have been found to predict contextual motivation.

Consequences

Several types of motivational outcomes have been studied at the contextual level. Next, we review empirical research on the affective, cognitive, and behavioral outcomes.

Affective Outcomes

Much research in sport has been designed to examine the positive relationship between contextual intrinsic motivation and affective consequences such as satisfaction, interest, and enjoyment (e.g., Brière et al., 1995; Pelletier et al., 1995) and the negative relationship with burnout (Raedeke, 1997). More recent research (Cresswell & Eklund, 2005) has extended such work by showing, in line with Corollary 5.1, the presence of the hypothesized continuum where intrinsic motivation (especially intrinsic motivation toward stimulation and intrinsic motivation toward accomplishment) was negatively associated with burnout and amotivation was strongly and positively associated with it. Along the same lines, Lemyre, Treasure, and Roberts (in press), showed that decreases in the self-determined motivation of top Division 1 swimmers over the course of the season predicted increases in burnout at season's end.

Similar findings have been obtained in physical activity settings with other types of affective outcomes. For instance, a study by Ntoumanis (2001a) has shown that boredom in physical education classes was negatively predicted by intrinsic motivation but positively by amotivation and external regulation. Using the BREQ, Karageorghis and Vlachopoulos (2002) have also shown that contextual introjected regulation toward exercise predicted exercise dependence. Finally, Wilson and Rodgers (2002) found that identified regulation and intrinsic motivation contributed to physical self-esteem but that external and introjected regulation did not.

Cognitive Outcomes

Optimal concentration may represent one of the most important predictors of performance. In line with Corollary 5.1 of the hierarchical model, research with athletes from a variety of sports (Brière et al., 1995; Pelletier et al., 1995) as well as with physical education students (Ntoumanis, 2001a) and adult exercisers (Vallerand et al., 2005, Study 3) has shown that the highest levels of concentration result from the self-determined forms of motivation. Wilson, Rodgers, Hall, and Gammage (2003) have also shown that not only the level of concentration but also its quality is affected by motivation. Specifically, adults who mainly exercise out of non-self-determined motivation display an imagery style much more oriented toward the image they project to others than those who engage in exercise out of self-determined motivation. Such an imagery style is far from ideal when performing a demanding task.

In sum, the proposed link between the various forms of motivation and cognitive outcomes has been obtained with various populations in both sport and physical activity settings. However, there is a need to look at other types of cognitive outcomes (learning, memory, recall of broken plays, etc.) to more fully probe the relationship between motivation and cognitive outcomes. For instance, higher levels of contextual self-determined motivation should lead top-level athletes to be more proactive and secure (Hodgins & Knee, 2002), thereby leading them to recall more errors they may have committed in game situations, and eventually to work on these mistakes and thus improve.

Behavioral Outcomes

Increased attention has been given to the role of contextual motivation in behavioral types of outcomes such as intentions to pursue engagement in sport or physical activity. Such research provides support for the adaptive role of self-determined motivation in both sports (Chatzisarantis et al., 2003; Sarrazin et al., 2002), and exercise (Ingledew, Markland, & Medley, 1998; Ntoumanis, 2001a; Thøgersen-Ntoumani & Ntoumanis, in press; Wilson & Rodgers, 2004; Wilson, Rodgers, Fraser, & Murray, 2004). Of particular interest is the research of Ferrer-Caja and Weiss (2000) showing that intrinsic motivation positively predicts effort and persistence as assessed by the physical education teacher. It thus appears that more objective forms of outcomes assessment (such as teacher reports) yield findings similar to those obtained with participants' own reports (Fortier & Grenier, 1999; Li, 1999), thereby providing further validity to research in this area.

Results from this research reveal that, typically, the more self-determined the motivation, the more one intends to continue engagement in the activity. However, a major difference seems to emerge between the exercise and the sport studies. Specifically, although all studies reveal the presence of the hypothesized continuum, there is a difference with the main positive predictor of intentions. The results of a meta-analysis conducted mainly with sport studies (Chatzisarantis et al., 2003) reveal that intrinsic motivation is the main predictor. On the other hand, in exercise studies, identified regulation appears to be the main predictor (see Wilson & Rodgers, in press). One possible explanation for this discrepancy proposed by Vallerand (1997) deals with the nature of the activity. When the task is perceived as interesting, as in most sports, intrinsic motivation should lead to the most positive outcomes, as intrinsic motivation is then the optimal type of motivation. However, when the task is uninteresting, as is often the case with exercise, at least in the initial stages, then identified regulation may become a more important determinant of positive consequences than intrinsic motivation. Indeed, if a task is relatively dull and unappealing, intrinsic motivation may be insufficient to engage in it. Rather, what is needed is a motivational force leading the person to choose to engage in the activity despite the fact that it is not interesting. Identified regulation can provide such a force. This hypothesis makes sense and is in line with data from various studies, but additional research is needed to empirically test this hypothesis using a controlled design within the confines of the same study.

Research has also looked at the role of contextual motivation in persisting in sport. In a longitudinal study of over 22 months with Canadian teen swimmers, Pelletier et al. (2001) found support for the presence of a continuum, with the most important positive predictor of persistence being intrinsic motivation and the most important negative predictor being amotivation. Similar findings have been obtained in a study with French handball players over 21 months (Sarrazin et al., 2002) and with adult exercisers (Fortier & Grenier, 1999; Ryan, Frederick, Lepes, Rubio, & Sheldon, 1997). Of additional interest is the fact that Pelletier et al. found that the relationships between motivation at Time 1 and persistence changed over time. Specifically, although the link to external regulation was not significant at 10 months, it became significant and negative at 22 months. Conversely, the link between introjection and behavior, which was slightly positive initially, became null at 22 months. These findings suggest that the negative effects of external and introjected regulation may take place further down the road, perhaps when it is clear that the extrinsic payoffs (e.g., awards, fame) are no longer forthcoming. Future research on this issue appears important.

More recently, researchers have started to focus on specific types of motivations to better understand the intricacies of continued behavioral engagement in exercise. For instance, Hein et al. (2004) looked at the predictive role of the three types of intrinsic motivation with respect to British teenagers' intentions to engage in sport and exercise after high school. The results revealed that intrinsic motivation to experience stimulation was the best predictor, followed by intrinsic motivation to accomplish things. The contribution of intrinsic motivation to know was not significant. The two predictors accounted for a total of 65% of the variance in intentions to exercise. These findings are in line with those of Jackson, Kimiecik, Ford, and Marsh (1998), who found that the best predictor of flow was intrinsic motivation to experience stimulation. It is thus possible that the pleasant experience of stimulation is what people seek from their exercise participation, and not necessarily the pleasure to learn or accomplish something. These results would seem to have some applied importance.

Other research (Vallerand & Losier, 1994) has shown that, over the course of a hockey season, a self-determined motivational profile led to an increase in the tendency to show respect and concern for others (a positive sportspersonship orientation; see Vallerand, Brière, et al., 1997; Vallerand, Deshaies, Cuerrier, Brière, & Pelletier, 1996). Athletes who are self-determined toward their sport focus on the activity itself and not the end result. Winning is not a matter of life or death for them. Rather, respect and concern for the rules and participants is more important because it ensures the creation of a pleasant environment for all participants. The Vallerand and Losier findings have been replicated with physical education students over a 1-year period (Chantal & Bernache-Assollant, 2003). Subsequent research by Chantal, Robin, Vernat, and Bernache-Assollant (2005) extended these findings by distinguishing between reactive (wanting to hurt someone) and instrumental (displaying energy toward the game and not the opponent) aggression and showing that self-determined motivation toward sport facilitates sportspersonship orientations, which in turn leads to instrumental but not reactive aggression.

A final motivational outcome of interest is performance. Because self-determined forms of contextual motivation have been found to facilitate persistence at a specific activity, given equal ability and coaching, additional practice should lead to increased performance. There is a lot of evidence to support the role of self-determined motivation in performance on nonsport tasks (see Vallerand, 1997, for a review). Limited evidence exists for this hypothesis in sport and physical activity, where it has been found that inducing intrinsic motivation was conducive to better performance in putting (Beauchamp, Halliwell, Fournier, & Koestner, 1996) as well as swimming (Pelletier, Vallerand, Brière, & Blais, 2006). However, because neither study contained a true experimental design, alternative hypotheses exist.

Summary

The studies reviewed in this section provide strong support for the hierarchical model, with respect to the determinants and outcomes associated with contextual self-determined forms of motivation. However, future research using prospective, longitudinal, and experimental designs is necessary to more fully document the role of motivation in long-term outcomes, especially performance.

RESEARCH ON MOTIVATION AT THE GLOBAL LEVEL

Very little research has focused on motivation and determinants and consequences at the global level. However, as we see below, the available research underscores the importance of such research.

Determinants

No research appears to have examined how global social factors may affect global motivation. However, research by Vallerand and O'Connor (1991) with elderly individuals has revealed that the type of residence they live in seems to impact their global motivation. Elderly people living in residences that provided autonomy support (as assessed by observers) reported higher levels of contextual self-determined motivation toward most aspects of their lives (across six life contexts) compared to those living in controlling residences. Thus, although Vallerand and O'Connor did not measure global motivation per se, it does appear that spending most of one's life in a controlling or autonomy-supportive residence may represent a global social factor likely to influence global motivation. Similar research could be conducted on the impact on global motivation of living in sports boarding schools (see Riordan, 1977).

Another global factor that would appear relevant for children is parents. Indeed, parents are a constant presence in all aspects of their children's life. They are thus in a prime position to influence the development of their personality (Eccles & Wigfield, 2002), including global motivation. Assor, Roth, and Deci (2004) have conducted very informative research that partly addresses this issue. In two studies, these authors found that children who perceived their parents to be providing conditional regard (a form of control where love is provided conditionally to children upon certain behaviors on their part) display high levels of introjection uniformly across four life contexts (e.g., prosocial behavior, sports). The picture was partly supportive with identified regulation, where parental conditional regard was negatively correlated with identified regulation in some contexts (i.e., emotional control and academic domains) but not in the other two. It is hypothesized that if parental behavior can affect individual functioning and motivation in four life contexts largely in the same direction, global motivation is likely to be affected as well. Future research is needed to test this hypothesis.

Consequences

There are at least three ways through which global motivation can affect outcomes. A first influence comes from the influence of global motivation on global psychological adjustment. Because global self-determined motivation reflects a proactive way of interacting with one's environment, it would be predicted that having such a motivation should lead to better adaptive functioning and psychological adjustment. Empirical support exists for this hypothesis. For instance, Ratelle, Vallerand, Chantal, and Provencher (2004) showed that global self-determined motivation positively predicted increases in psychological adjustment that took place over a 1-year period with adults from the general population. Because experiencing positive psychological adjustment at the global level may provide additional strength to face demanding situations and failure experiences in sport, this first function of global motivation deserves attention in sport and physical activity.

A second way through which global motivation has been found to affect functioning is the protective function it may serve. A recent study by Pelletier et al. (2004) has shown that global motivation plays a protective function, leading women to perceive less pressure from society to have a thin body and to internalize to a lesser degree society's stereotypes regarding thinness. Global self-determined motivation also had a direct negative effect on bulimic symptomatology. Because bulimic symptomatology does take place in sports, research on the protective function of global motivation with athletes is important.

Finally, global motivation can also serve an integrative function among life contexts. For instance, Koestner et al. (1992) have shown that adults with a predominant autonomy-causality orientation (the equivalent of a self-determined global motivation) display behavior that is more in line with their attitudes and inner values than individuals with a control (or non-self-determined) orientation. Similar findings have been obtained with children (Joussemet, Koestner, Lekes, & Houlfort, 2004). Thus, athletes with global self-determined motivation would be expected to have a sport-contextual motivation better integrated with other contextual motivations in their life. They would therefore be expected to experience fewer conflicts among life contexts and in turn to display a more focused involvement in sport and other life activities.

Summary

Very little research has been done at the global level with athletes or individuals engaged in physical activity. Future research with athletes could examine the role of parents and coaches in the development of global motivation and, in turn, how global motivation leads to different outcomes through the various functions it serves.

RESEARCH ON INTEGRATIVE STUDIES

Certain studies have looked at motivation and outcomes in a more integrated fashion either within the confines of an integrated sequence or by looking at how various motivations at two and three levels of generality are connected. Such research is reviewed in this section.

A Social Factors → Psychological Mediators → Motivation → Consequences Sequence

One of the key hypotheses of the HMIEM is that the impact of the environment on individuals takes place through a causal chain of processes which can be presented as follows: Social Factors → Psychological Mediators → Motivation → Consequences (see Vallerand, 1997; Vallerand & Losier, 1999). This sequence can take place at all three levels of the hierarchy. Following the lead of research on high school dropout (Vallerand & Bissonnette, 1992; Vallerand, Fortier, et al., 1997), some studies have provided support for this causal sequence with respect to sport dropouts at the *contextual* level (Pelletier et al., 2001; Sarrazin et al., 2002). For instance, in the Sarrazin et al. study, task- and ego-involving climates were found, respectively, to positively and negatively predict perceptions of competence, autonomy, and relatedness, which positively predicted self-determined motivation. In turn, self-determined motivation predicted intention to persist in handball, which led to actual persistence 21 months later. Pelletier et al. obtained similar results showing that coaches' autonomy-supportive behavior influenced self-determined motivation, which prevented dropout in swimming over 22 months.

Research on the integrated causal sequence at the contextual level has also been tested in exercise settings. Such research reveals that different learning structures (Ntoumanis, 2001a), motivational climates (Ferrer-Caja & Weiss, 2000; Standage, Duda, et al., 2003), autonomy support from friends (Wilson & Rodgers, 2004), and the physical education teacher (Ntoumanis, in press) positively influence self-determined motivation through their impact on perceptions of competence, autonomy, and relatedness. Finally, self-determined motivation positively predicts a variety of contextual cognitive, affective, and behavioral outcomes, including teacher-rated assessment of behavior (Ferrer-Caja & Weiss, 2000; Ntoumanis, in press).

It appears that only one study has provided support for the proposed sequence at the situational level in sport. In this study with master swimmers (Kowal & Fortier, 2000), it was shown that motivational climates predicted perceptions of competence, autonomy, and relatedness, which in turn led to self-determined situational motivation, which finally led to the experience of flow. Clearly, additional research is needed to test the validity of the integrated sequence in sports and physical activity settings at the situational level.

The results of these studies provide strong support for the proposed sequence in a variety of settings and activities. Future research is needed, however, with prospective or longitudinal designs at the contextual level, and experimental designs at the situational level, to provide more clarity regarding the direction of causality among the various variables of the causal sequence (see Grouzet, Vallerand, Thill, & Provencher, 2004, for such a test using an experimental design at the situational level with a cognitive task). There is also a need to look at other types of consequences, such as creativity and learning, as well as interpersonal outcomes such as quality of relationships and friendships.

Motivation at Two or Three Levels of Generality

A key aspect of the HMIEM is that motivation at a given level of generality reflects the relative influence of individual differences through the top-down effect and that of social factors. Brunel and Vallerand (2005) tested the relative influence of the top-down effect from contextual motivation and the impact of situational factors on situational motivation over time. These authors reasoned that when put in a new situation (practicing their sport on university premises with new coaches), athletes who usually practice in civic clubs should see their contextual motivation provide the main influence on their situational motivation toward practice because participants are not used to the social factors conveyed in such new settings. However, months later, when the meaning conveyed by situational factors is clearer, the latter should have a more potent influence on situational motivation than contextual motivation. Results of a study (Brunel & Vallerand, 2005) with French athletes provided support for the hypothesis.

Research has also started to look at how contextual motivation sets things in motion at the situational level so that affective outcomes can be experienced at that level. For instance, Amiot, Gaudreau, and Blanchard (2004) showed that self-determined contextual motivation toward sport led to the use of situational adaptive cognitive skills, which, in turn, facilitated reaching goals during a game. Finally, reaching one's goals led to an increase of positive affect after the game. The opposite picture emerged for athletes with a non-self-determined motivation, as it led to the use of poor coping skills and failing to reach one's goals and to experience less positive effect. Future research is needed to determine if the impact of contextual motivation on situational-level coping skills takes place through the top-down effect from contextual to situational motivation.

Another dimension of the HMIEM that has attracted attention is the bottom-up effect (Postulate 4). More specifically, motivation experienced at a lower level (e.g., the situational level) can produce over time a recursive effect on motivation at the next higher level (e.g., contextual motivation toward sport). Blanchard, Amiot, Saint-Laurent, Vallerand, and Provencher (2005) conducted a study to test this interplay between the contextual and situational levels leading to changes in contextual motivation toward basketball over time. Measures of contextual motivation toward basketball were obtained before the first and second games of the tournament and 10 days after the tournament. Moreover, measures of situational motivation (using the SIMS) were obtained immediately after the two games of a tournament. Finally, players' assessment of personal and team performance as well as objective results of the games were collected to test the role of situational factors in the prediction of situational motivation. Results from a path analysis showed that contextual motivation for basketball predicted situational motivation during each of the two basketball games during the tournament (the top-down effect). Moreover, situational motivation for both basketball games was also predicted by team and personal performance (the situational factors). In turn, situational motivation influenced contextual motivation subsequent to each game, as well as 10 days after the tournament (the recursive bottom-up effect). In sum, Blanchard et al. tracked down the flow of psychological processes through which changes in motivation at the contextual level take place over time while providing support for several of the corollaries proposed by the HMIEM. Future research on Postulate 4, especially over the course of a whole season, would be fruitful.

Other studies have looked at the interplay between the motivations stemming from two life contexts and the outcomes that may be derived from such an interface. For instance, research has shown that conflicts between two life contexts, such as work and family for working adults (Senécal, Vallerand, & Guay, 2001) or education and leisure for students (Ratelle, Senécal, Vallerand, & Provencher, in press), lead to poor psychological adjustment. In exercise settings, Hagger and Chatzisarantis and their colleagues (e.g., Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, in press; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003) have shown that having a self-determined motivation toward physical activity at school facilitates self-determined motivation toward physical activity during one's leisure time. Future research is needed to pursue this line of scientific inquiry to determine when facilitative and conflicting motivational effects will be obtained between two life contexts and determine the types of outcomes that will be experienced by elite athletes and adult exercisers as a result.

Finally, to the best of my knowledge, only one study has integrated motivation at the three levels of the hierarchy in the context of sport and physical activity. In this study, Vallerand et al. (2005, Study 3) tested the interplay among motivations at the three levels of the hierarchy with participants in a fitness program. Results from a path analysis revealed that global motivation at the beginning of the fitness program influenced contextual motivation toward exercise 4 weeks later. In turn, contextual motivation toward exercise influenced situational motivation, which determined situational consequences of concentration and enjoyment while exercising.

Summary

Research in this section highlights the dynamic relationships that can take place between motivation at different levels of generality, as well as among different life contexts. Future research along those lines in sport and physical activity could provide not only a deeper understanding of the motivational processes at play, but also a better prediction of different outcomes experienced by athletes and physical activity participants.

INTERVENTION STRATEGIES

At least two major types of intervention have been conducted within the intrinsic/extrinsic motivation paradigm. One seeks to increase the autonomy-supportive behavior displayed by coaches toward the athletes. Based on the findings that an autonomy-supportive style is teachable (Reeve, 1998), Pelletier and his colleagues (2006) developed an intervention program to help swim coaches become more autonomy-supportive and consequently facilitate their athletes' motivation. Results from this 18-month intervention program revealed that the program was highly effective in leading athletes to perceive their coach as less controlling and more autonomy-supportive and to experience higher levels of perceived competence and intrinsic motivation. Of major interest is the fact that attendance at practice increased markedly and dropout was reduced significantly. A recent intervention study with adult exercisers has shown similar results with respect to the important role of autonomy support from the fitness leader in exercisers' motivation (see Edmunds, Ntoumanis, & Duda, in press).

A second line of intervention studies takes into consideration the fact that some activities may not be inherently interesting and focuses on providing individuals with a rationale to engage in a specific behavior. However, how the rationale is presented is crucial. To be effective, the rationale must be presented in a noncontrolling way, while providing some form of choice and acknowledging the person's feelings (Deci et al., 1994; Koestner et al., 1984). For instance, the fitness instructor may say something like "The reason we're focusing on these exercises is because they're the ones that will lead you to gain the most from your training (rationale). I know that it may feel uncomfortable at first (acknowledgment of the person's feelings). However, it is entirely up to you if you want to do some or all of them today (choice)." Such instructions lead the person to "*wanting* to do what *should* be done" (Berg, Janoff-Bulman, & Cotter, 2001, p. .982). Research by Simons et al. (2003) in physical education settings has shown that similar instructions regarding rationale on a basketball task led to higher levels of intrinsic motivation, enjoyment, effort, time on task, and performance than conditions where students are told that they have to engage in the task simply because they will be tested on it.

In sum, advances have taken place recently with respect to interventions oriented at improving intrinsic motivation and self-determined motivation and creating positive consequences in athletes and exercisers. Future research is needed to determine if such interventions are applicable to a variety of tasks and situations, some interesting (e.g., playing games) and some less so (e.g., running suicide drills in practice; to this end, see Green-Demers, Pelletier, Stewart, & Gushue, 1998; Reeve, Jang, Hardre, & Omura, 2002).

CURRENT TRENDS AND FUTURE DIRECTIONS

Several trends have started to emerge in the literature. One pertains to the testing of different postulates and propositions of the HMIEM. Of these, the one that has received the most attention is the Social Factors → Psychological Mediators → Motivation → Consequences causal sequence. As presented earlier, much support has been garnered for this sequence, especially at the contextual level. Much research remains to be done with respect to a number of other aspects of the HMIEM, including the interplay of motivation at different levels of generality, the conflict versus facilitative effects of different contextual motivations on situational motivation and outcomes, and the different functions of global motivation in athletes' and exercisers' contextual and situational motivations and ensuing outcomes. Future research on these issues would appear promising.

A second area where much action has taken place is the integration of different theories in leading to a better understanding of motivational processes. For instance, following the lead of Duda, Chi, Newton, Walling, and Catley (1995) and Brunel (1999), researchers have started to explore the relationships between elements of achievement goal theory (Nicholls, 1984) and those from SDT (Deci & Ryan, 2000; see also Ntoumanis, 2001b). Typically, researchers have looked at the motivational impact of different learning structures (Ntoumanis, 2001a) and motivational climates (Ferrer-Caja & Weiss, 2000; Kowal & Fortier, 2000; Standage, Duda, et al., 2003) and have shown that mastery (or learning, or task) climates and structures facilitate the satisfaction of participants' needs for competence, autonomy, and relatedness, which in turn lead to self-determined motivation and adaptive outcomes. On the other hand, performance (or ego) climates have been found to trigger a maladaptive motivational sequence.

Another integrative attempt has been conducted by Hagger et al. (in press), who have integrated SDT, the theory of planned behavior, and the HMIEM to better understand how the constructs and processes of each model can better predict the generalization of physical activity from formal to informal settings (for a review, see Hagger & Chatzisarantis, in press). Basically, the transcontextual model posits that autonomy support from the physical education teacher facilitates self-determined motivation toward physical activity at school. Such motivation (especially intrinsic motivation and identified regulation) generalizes to leisure contextual motivation, which in turn influences attitude and perceived behavioral control toward exercise. Finally, attitude and control lead to the intention to exercise during leisure time, which leads to actual exercise behavior.

These two integrative efforts are important from both theoretical and applied standpoints. Clearly, such research must continue, as it can lead to theoretical advances with respect to a better understanding of the contribution and limits of each theory as well as a better prediction of outcomes promoted in sport and physical activity settings.

Another area of active interest has been the use of cluster analyses to look at how the different types of motivation can be best integrated in both sport and physical activity settings (Matsumoto & Takenaka, 2004; Ntoumanis, 2002; Vlachopoulos, Karageorghis, & Terry, 2000; Wang & Biddle, 2001; Wang, Chatzisarantis, Spray, & Biddle, 2002; Weiss & Amorose, 2005). Research so far reveals the presence of different numbers of clusters in different studies, presumably because of methodological differences. However, a constant across the various studies is the presence of a high-self determined motivation cluster and the positive outcomes associated with it. Future research is needed to systematically compare clusters within sports and physical activity settings and determine which ones are predictive of positive outcomes in each type of setting.

Two other issues deserve mention, as they represent important research agendas for the future. The first is the role of unconscious (or implicit) motivational processes. Much research in social cognition has now shown that behavior can be influenced by factors outside of our awareness (see Bargh, 2005). Along these lines, Lévesque and Pelletier (2003) showed that presenting primes dealing with intrinsic or extrinsic motivation out of awareness is sufficient to induce the situational motivation implied by the primes. In an even more provocative study, Hodgins, Yacko, and Gottlieb (2005, Study 3) showed that priming members of a university rowing team with self-determined words (e.g., "choose," "freedom") led to faster times on a rowing machine than priming members with non-self-determined (e.g., "must," "should") and amotivational (e.g., "passive," "uncontrollable") words. In other words, priming self-determined motivation outside of awareness increases performance! Finally, as described earlier in the Ratelle et al. (2005) study, it may not be necessary to use primes related to motivation to induce the actual motivation. Priming certain environmental cues associated with aspects of the activity (e.g., sounds) can trigger by their mere unnoticed presence certain types of contextual motivation, which, in turn, will subsequently influence situational motivation. For obvious theoretical and practical reasons, it is believed that sport psychologists would do well to start exploring the role of such unconscious motivational processes.

A final issue pertains to the effect of culture on motivational processes. The role of culture in human behavior has attracted a lot of attention lately (see Kitayama, Markus, & Kurokawa, 2000; Nisbett, 2003). Among other perspectives, it has been hypothesized that cultures that are more individualistic (e.g., Western society) promote the development of an independent self, whereas collectivistic cultures (e.g., East Asia) facilitate an interdependent self. This has led to some interesting motivation research by Iyengar and Lepper (1999), who have shown in two studies that Asian American children (with an interdependent self) displayed higher levels of situational intrinsic motivation on tasks that were chosen by their mother than on those chosen by themselves, whereas the opposite took place for Anglo-American children. These results are puzzling because much research has shown that variables related to autonomy and choice posited by SDT do operate in various cultures, including collectivistic ones (e.g., Chirkov, Ryan, Kim, & Kaplan, 2003). Because sport and physical activity are engaged in most, if not all, cultures, it is imperative to determine if culture affects motivation in sport and physical activity settings. And if so, what are the processes through which such effects take place? Sport psychology has typically neglected cultural issues (Duda & Hayashi, 1998). The time has come to move forward and to correct this important oversight.

CONCLUSION

The purpose of this chapter was to review the extant literature on intrinsic and extrinsic motivation in sport and physical activity using the HMIEM as an organizing framework. The present review has shown that such research is vibrant, as it deals with a variety of issues at different levels of generality. A number of future research directions have also been proposed. To this end, it is important to reiterate that the hierarchical model proposes that it is desirable to progress from the mere study of athletes (or exercise participants) to that of whole individuals who, in addition to being athletes (or exercise participants), are also students (or workers) and part of a social matrix (see Vallerand, 1997; Vallerand & Grouzet, 2001). Specifically, this means that if we are to better understand an individual's motivation toward sport or exercise and ensuing outcomes, we need to know more about his or her motivations in other life contexts as well as his or her motivational orientation at the global level. Furthermore, we need to pay attention to factors that may operate out of the person's level of awareness and those that may affect motivation differently as a function of culture. It is believed that future research framed in line with the HMIEM should lead to a more comprehensive understanding of the psychological processes underlying motivational phenomena taking place in sport and physical activity settings, eventually contributing to the development of a more adaptive environment for all participants.

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CHAPTER 4

The Psychology of Superior Sport Performance

A Cognitive and Affective Neuroscience Perspective

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The aims of the present chapter are (a) to provide a neurobiological model to explain peak performance in sport based on a review of neuroimaging studies primarily employing electroencephalography (EEG) during self-paced and reactive psychomotor performances; (b) to discuss how distress interferes with these processes and, consequently, alters the quality of motor performance (i.e., skeletal muscle action); and (c) to describe a strategy for the management or amelioration of such stress-induced perturbations. A general principle, based on the scientific evidence reviewed, is also offered to practitioners such as coaches and sport psychologists in their efforts to guide athletes to high-quality performance. Such a principle provides a parsimonious perspective, or "neurophilosophy," that may help coaches and athletes to understand *how* and *why* psychological processes influence physical performance. The level of analysis used to describe brain processes throughout this chapter is that of cognitive and affective neuroscience. In essence, this approach seeks to understand the neurobiology underlying higher mental processes (i.e., cognition, or thinking, and emotion, or feeling), as opposed to basic molecular and cellular activity on which the system-level processes certainly depend, and typically employs neuroimaging tools such as EEG, magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), and positron emission tomography (PET) to capture these events in human subjects.

The chapter begins with a description of the essential economical or efficient action nature of mental processes during peak performance, which follows from the physiological descriptions of cardiovascular, metabolic, and musculoskeletal activity in trained athletes. This description is followed by an overview of the neuroimaging tools used by cognitive neuroscientists, with an emphasis on EEG as it has been the most widely used methodology to assess mental processes in the sport psychophysiology literature. Subsequently, a number of sections summarize the literature on cerebral cortical activity during motor behavior (see Hatfield, Haufler, Hung, & Spalding, 2004, and Hatfield, Haufler, & Spalding, 2006, for a detailed review of this literature). The summaries begin with the early studies of regional brain activity during self-paced visuomotor performance (i.e., the aiming period during marksmanship as well as archery, golf, and karate). The conceptual basis of these studies rests on the pioneering split-brain investigations of Roger Sperry and Michael Gazzaniga. The functional differences in brain regions noted by these investigators, such that the left temporal/parietal is associated with phonological processes and the homologous right regions are associated with visual-spatial processes, were considered to achieve cognitive inferences from simultaneous records of left and right hemispheric cortical activity during motor performance. Subsequent sections in the chapter illustrate the concept of mental economy as a marker of superior performance by (a) contrasting cortical activity (i.e., EEG spectral content) in expert and novice target shooters, (b) describing the changes or evolution of cerebral cortical activity as a function of practice, and (c) contrasting networking patterns or cortico-cortical communication in marksmen who differ in competitive performance ability. More recent studies of cortical dynamics during reactive motor behavior are then described using both spectral and event-related potential (ERP) measures. These recent developments are important as they extend the findings on brain activity and sport performance beyond the constraints of the self-paced paradigm and open up the range of findings to be more inclusive of the types of conditions in which athletes perform. Of particular importance, the linkage between the observed cortical activity and psychomotor performance in a number of studies is discussed and interpreted within the framework of an inverted-U relationship.

A major development, still in its infant stages, is that of affective neuroscience applied to sport psychology. In essence, this involves the assessment of brain activity during stress or while performing psychomotor tasks under pressure. Surprisingly little work has been done in this area of research, although it is strongly established in the area of exercise psychology. A neurobiological model of stress-related brain dynamics is described and based largely on a marriage of concepts from LeDoux (1996), on the central role of the amygdala in fear-related processes, and the work of Davidson (1988, 2002, 2004) on the role of frontally mediated processes in the regulation of emotion. The pivotal role of frontal cortical activity in the management of emotion (e.g., fear and anxiety) is described in the context of the model; a simple yet powerful metric, frontal asymmetry, can then be employed during neurofeedback such that a number of physiological (i.e., mind-body) consequences or sequelae that would likely disrupt motor performance may be attenuated or reduced in magnitude. The model describes how the brain would be affected by stress and how motor performance would be affected. Empirical support is provided by the various studies described throughout the chapter. Finally, the chapter outlines the future directions or research emphases of this emerging field of study, the relationship between sport and military psychology, signal processing developments that will enable more sophisticated extraction of brain activity information from neuroimaging data, the emergence of realistic virtual reality environments within which to study the working brain during sport performance, and practical implications of the research.

EFFICIENCY OF MENTAL PROCESSES DURING SKILLED MOTOR PERFORMANCE

One of the essential characteristics of skilled athletic performance is efficient movement (Hatfield & Hillman, 2001; Lay, Sparrow, Hughes, & O'Dwyer, 2002). Efficient movement can be described in terms of energy cost of work output (Sparrow, 2000). Simply stated, skilled athletes perform with minimal effort as constrained by the task demands. In this manner, the athlete may be engaged in an intense activity, such as sprinting in a 100-meter dash, but optimal performance would be characterized by work output *limited* to the prime mover muscles (e.g., gluteal and upper hamstring action) in the absence of any unnecessary tension or motor unit recruitment in the prime movers as well as any nonessential muscles (i.e., those that do not directly contribute to moving the performer's center of mass in a rectilinear manner toward the finish line). To illustrate, the muscular actions of Carl Lewis, the great American sprinter, have been described as a state of "relaxed explosiveness."

Evidence has been provided to support this notion for a number of physiological parameters. For example, deVries (1968) discussed the concept of efficiency of electrical activity of muscle, a measure derived from electromyographic (EMG) recordings during force production. In essence, a muscle with a higher capacity to produce force (i.e., a stronger muscle) will exhibit lower levels of integrated EMG (IEMG), an index of motor unit recruitment, during similar absolute levels of submaximal work when compared to the levels of IEMG produced by a muscle with less capacity (i.e., a weaker muscle; deVries & Housh, 1994). In this manner, a stronger muscle accomplishes a given amount of work with fewer motor units. Such a quality may be a result of genetic endowment but is more likely an adaptation from resistance training.

According to the general adaptation syndrome advanced by Selye (1976), repeated negotiation of a stressor results in the stage of adaptation—a state that allows a biological system to respond to the stressor with less strain or cost because of anabolic adaptations in the tissue. As such, the notion of more efficient work in a trained muscle is entirely consistent with the fundamental principle of stress adaptation outlined by Selye. On a more global level, Sparrow (2000) stated that the dynamics of coordinated muscle activity are organized on the basis of minimization of energy expenditure in a process of adaptation to constraints imposed by both task and environment. Lay et al. (2002) recently provided empirical evidence for this notion by assessing EMG activity in a group of subjects who underwent several sessions of training on a rowing ergometer. Training clearly resulted in reduced EMG activity in the vastus lateralis and biceps brachii muscles during rowing stroke production, greater coordination between muscle groups, and greater consistency or stability in movement pattern.

In addition, Daniels (1985) advanced the related notion of running economy, a metabolic characteristic of superior endurance performers. That is, superior runners, in a group characterized by homogeneity of aerobic capacity, exhibit lowered oxygen consumption (expressed as ml O_2/kg/minute) than that shown by slower members of the group when engaged in similar submaximal absolute work. In this manner, the superior runner consumes less O_2 than the less accomplished runner (per kilogram of body weight) when both run at the same speed at the same grade. Such relative economy may well be due to minimization of unproductive and unnecessary muscular activity (e.g., excess circumduction of the pelvis or abduction of the upper extremities). As such, numerous examples exist in the physiological domain that provide evidence of the ubiquity of economy of highly trained biological systems. The utility of such energy-saving adaptation is the reduction of stress and the opportunity for enhanced survival due to less load and wear and tear on the organism. The focal question that guides the present review is this: Does such a state also characterize the central neural processes of the skilled performer?

Phenomenological reports of high-performance athletes support such a position. Williams and Krane (1998) described a number of psychological qualities associated with the ideal performance state that largely related to a sense of effortlessness, not thinking during performance, and an involuntary experience. Such subjective experience is also consistent with the notion of automaticity in skilled motor behavior advanced by Fitts and Posner (1967). Accordingly, Fitts and Posner described three progressive stages that the learner experiences, evolving from the beginning stage of cognitive analysis, to the intermediate stage of association during which conscious regulation of motor processes is required, and finally to the advanced stage of automaticity in which the performer negotiates task demands without conscious effort.

In essence, one could speculate that the association areas of the cerebral cortex become relatively quiescent with practice and enhanced skill level so as to minimize potential interference with the central motor control processes responsible for neuromuscular activity. The cortical association areas that deal with cognitive processes are intricately interconnected to the motor loop, which is largely composed of the striatum (caudate nucleus and putamen), globus pallidus, and ventro-lateral nucleus of the thalamus with projection to the motor cortex in order to enable depolarization of the appropriate cell bodies for ultimate activation of skeletal muscle motor units (Kandel & Schwartz, 1985). Refinement of associative processes from practice may result in more specific networking and possible reduction of interference with the motor structures, thereby reducing the complexity in the organization of the musculoskeletal actions. Hatfield and Hillman (2001) described this quality of cognitive-motor processing as psychomotor efficiency. Less complexity in the processes associated with motor control or a reduction in the degrees of freedom of relevant neural network actions may lead to greater consistency of the resultant motor performance because of less variability in the orchestration of movement preparation. Evidence to support this notion is provided later in the chapter.

NEUROIMAGING: TOOLS USED TO EXAMINE THE WORKING BRAIN

Cognitive and affective neuroscience, as opposed to other levels of analysis of mental processes (e.g., cellular and behavioral neuroscience), seek to understand the neural mechanisms responsible for higher levels of human mental activity, such as attention, executive functioning, and language (Bear, Connors, & Paradiso, 2001). In this manner, brain activation or neuroimaging measures allow one to see the brain at work and include assessment of regional activation and metabolic activity of brain structures such as the cerebral cortex, the amygdala (a subcortical structure that mediates emotional processes such as fear), and specific regions of the cortex such as the frontal lobes, which mediate executive or planning processes, as well as emotional states such as approach and avoidance/withdrawal. In essence, such measurement is detailed and further enables the sport scientist to detect changes in cognitive function and emotion occurring as a result of practice or imposed stress that would be invisible with behavioral observation.

The brain processes that mediate cognition and affect may be detected with a high degree of temporal and spatial resolution by employing electrophysiological and neuroimaging techniques. Temporal resolution refers to the sensitivity of a measure to detect changes in brain activity as a function of time and is high in EEG and MEG. Spatial resolution refers to the ability to detect the locations of brain structures and processes and is characteristic of MRI, fMRI, PET, and SPECT (Tomporowski & Hatfield, 2005). Although a number of tools are available for seeing the brain at work, EEG has the advantage over all other techniques of ecological validity, or use in unconstrained settings (i.e., real-world tasks or virtual reality environments as opposed to confined spaces).

Electroencephalography

EEG recordings represent time series of electrical activity recorded from the brain by placing electrodes at selected sites on the scalp. Figure 4.1 illustrates standardized EEG recording sites (a) and a marksman being monitored for EEG during the attention-demanding aiming period (b). The standard electrode placement system specifies electrode locations based on anatomical landmarks on the head, referred to as the International 10–20 system (Figure 4.2), which allows for comparison of results from var-

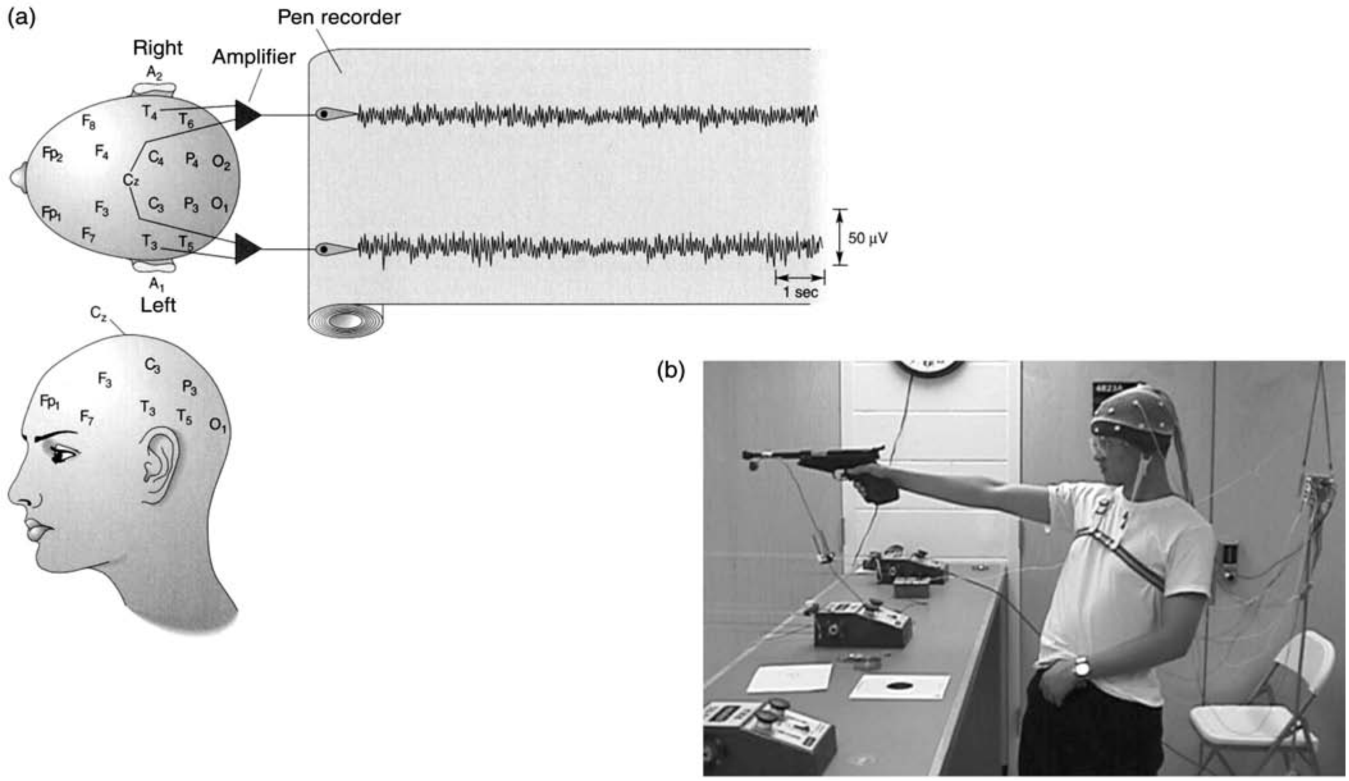

Figure 4.1 (a) EEG recording and (b) marksman being monitored for EEG and eye movements during the motionless aiming period. *Note:* A = auricle (or ear), C = central, Cz = vertex, F = frontal, Fp = frontal pole, O = occipital, P = parietal, T = temporal. Wires from pairs of electrodes are fed to amplifiers, and these drive pen recorders.

ious laboratories and clinical settings (Jasper, 1958). As discussed in Hatfield et al. (2006) the EEG sensor detects the transient or fluctuating summation of excitatory and inhibitory postsynaptic potentials (currents) from tens of thousands of neurons, and possibly glial cells, located below the scalp surface within the cortex of the brain, which collectively generate an electrical charge or potential. The current detected by the EEG sensors is manifest on the order of millionths of volts, or microVolts (μV). The transient continuous potentials or analog signals, changing in magnitude over time, are sampled and converted to digital values by an analog-to-digital (A-D) converter and amplified 20 to 50 thousand times although the amplification can be much less with the employment of high-resolution A-D converters because of the ability to discriminate very small increments in voltage. The current is then subjected to differential amplification, a process by which the resultant EEG actually creates a record of the difference in voltage between the recording sites and a reference site that is typically placed on a nonbrain region, such as the earlobe, mastoid, or tip of the nose. The differential amplification process enables rejection of any signals common to the two sites, thought to be nonbrain in origin, so that the amplified time series is reflective of brain electrical activity.

The EEG record is a two-dimensional time series of voltage fluctuations (see panel a, Figure 4.1) characterized by amplitude and frequency. The frequency range or spectrum extends from 1 to approximately 50 cycles per second (Hz), with higher frequencies indicative of greater activation. In essence, the raw EEG signal is composed of a mixture of the frequencies in the spectrum; it can be decomposed into its primary ingredients or sinusoidal frequency components to determine the degree of activation. The decomposition of the complex record or EEG wave for a given time period or epoch is termed spectral analysis, and is accomplished mathematically by fast Fourier transformation (FFT). In this regard, lower frequencies, such as the high-amplitude delta (i.e., 1 to 3 Hz), theta (i.e., 4 to 7 Hz), and alpha (i.e., 8 to 13 Hz) bands, are indicative of a relaxed state, whereas higher frequencies, such as the lower-amplitude beta (i.e., 13 to 30 Hz) and gamma (i.e., 36 to 44 Hz) bands are indicative of localized activation (Figure 4.3). Synchronous activity results in higher amplitude potentials and is likely

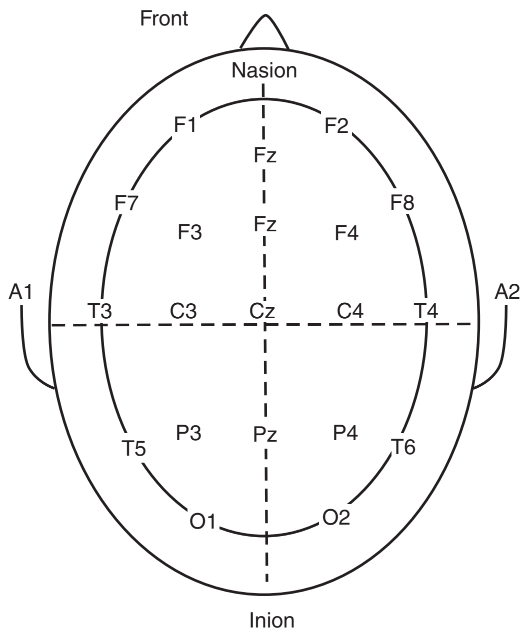

Figure 4.2 The international 10–20 system for standard EEG sensor placement on the head, enabling the acquisition of differential amplification and the resulting time series of fluctuating voltages. The nomenclature is based on the fact that electrode placements are based on fixed percentages (10% and 20%) of the distances between standard landmarks, such as nasion (bridge of nose) and inion (occipital bone protuberance). More recent recording montages contain up to 256 sensors for source localization, or solving the inverse problem.

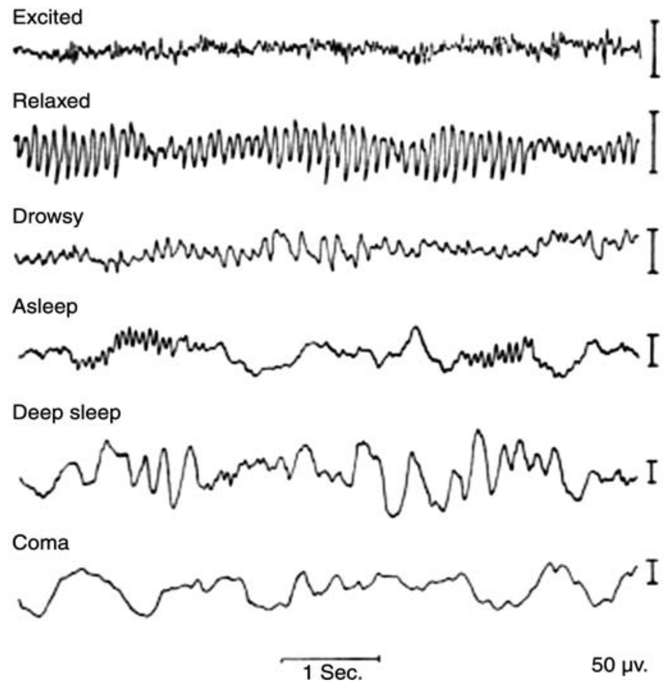

Figure 4.3 EEG frequency and associated arousal states. The excited time series is composed primarily of beta and gamma frequencies; the relaxed time series is composed mainly of alpha frequencies; while the drowsy time series is composed largely of delta and theta frequencies.

the result of similar neuronal states in the brain region of interest (ROI). In regard to alpha power, a similar state of neuronal assemblies is likely to occur during *a relaxed state,* resulting in summation of postsynaptic potentials (and alpha synchrony) due to similarity of neuronal states (e.g., similar to members of a chorus singing in unison). Conversely, a dissimilar state of neuronal assemblies is likely to occur during active task engagement, resulting in differential assignment of neurons and desynchrony or reduced alpha power or amplitude.

The advantage of EEG is that it not only captures fast-changing events, but it can also be used to detect the timing of communication between different cortical regions by means of coherence analysis. Similarity in the spectral content of EEG recorded at different sites (i.e., high coherence) is assumed to indicate cortico-cortical communication. Only EEG and MEG can be used to definitively assess the timing or sequencing of events of hypothesized network models. A major limitation of EEG, however, is the problem of volume conduction, or the spreading of electrical charge throughout the liquid medium of the brain so that the signal is also detected (albeit with reduced influence) by sensors beyond those overlying the tissue or ROI. For this reason, EEG is said to be relatively poor in spatial resolution compared to neuroimaging techniques such as fMRI and PET. However, both EEG and MEG are superior to all other neuroimaging techniques for temporal resolution.

Recent advances in EEG technology have improved spatial resolution by using dense electrode recordings involving up to (and beyond) 250 recording sites. Such dense electrode or sensor arrays allow for computation of the inverse solution, that is, estimation of the location of brain sources that are responsible for, or are likely candidates for, determining the surface-recorded EEG. The recordings from such dense arrays can also be coregistered with structural MRI scans to individualize the precise locations of the neural generators or sources of the surface-recorded EEG. In this manner, dense electrode arrays for EEG recording enable spatial resolution of cortical sources while simultaneously capitalizing on the superior temporal resolution. In addition, *EEG is the only technique that allows study participants to be tested in nonconfining settings and even naturalistic environments* *through the use of portable recording systems or larger systems used in conjunction with virtual reality settings.* All of the other neuroimaging techniques require confinement of the study participant such that movement must be minimized while lying in a closed environment. Movement must be minimized for artifact-free EEG recording, too, but the restrictions are significantly reduced relative to all of the other techniques. In terms of cost, the economy of EEG is far superior to the other techniques.

To further capitalize on temporal resolution, a derivative of the EEG can be used to assess basic sensory and attentional processes. This is the event-related potential, and it provides a precise chronometric index of neural processing. This index is derived from averaging a number of EEG epochs that are time-locked to repetitive stimuli (i.e., basic auditory, visual, or tactile stimuli). The resultant ERP time series (Figure 4.4) consists of early or exogenous components (50 to 150 ms) related to obligatory processing of sensory information and later endogenous components (300 to 800 ms) related to basic cognitive processing such as detection of a new stimulus or target stimulus—a process termed context updating. The P300 component of an ERP elicited during a detection task is a positive-going wave with a midline parietal maximum amplitude showing peak amplitude between 300 and 800 ms (longer latencies occur with aging). The latency of the P300 indexes the speed of elementary cognitive processing, and the amplitude indexes the neural resources devoted to task processing (Polich, 1996). In this manner, the amplitude and latency of the P300 can provide a simple yet powerful index of basic cognitive function that can be assessed in relation to age, fitness status, and task specificity as well as basic decision-making in sport performers.

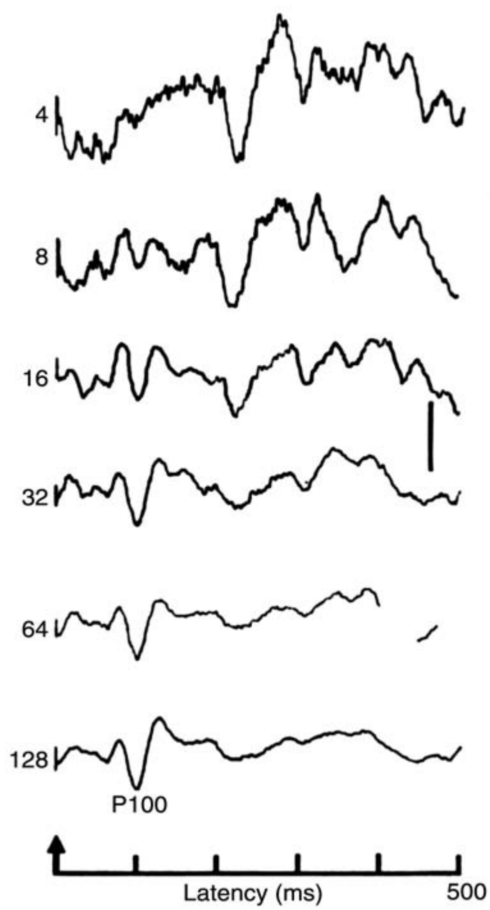

Figure 4.4 Averaging process to generate averaged event-related time series—event-related potentials (ERPs).

A need for precise localization of brain activity calls for a technique such as fMRI. For example, in clinical medicine, the final location of the site of a tumor for surgical intervention is best determined by fMRI. On the other hand, a cognitive neuroscientist interested in the sequence, timing, and coordination of neural events from different brain regions during a cognitive test would be best served by EEG or MEG coherence for assessing cortico-cortical communication patterns (Wang et al., 2001). In addition, comparisons of metabolism in the amygdala of individuals who vary in their genetic predisposition to stress would be well served by employing fMRI or PET such that the appropriate neuroimaging technique is always determined by the research question addressed by the neuroscientist.

Early Electroencephalography Studies of Regional Cortical Activity in Expert Performers

One of the earliest studies of cortical activity during psychomotor performance was conducted by Hatfield, Landers, Ray, and Daniels (1982), who assessed EEG activity at four recording sites (T3, T4, O1, and O2, all referenced to Cz) during the aiming period in 15 elite world-class competitive marksmen while in the standing position just prior to trigger pull. The study was based on a preliminary report by Pullum (1977), who observed heightened EEG alpha power in skilled marksmen during the aiming period compared to resting period, which suggested that superior performance was associated with mental relaxation. Based on the classic notions of hemispheric asymmetry or lateralization in cognitive function (Galin & Ornstein, 1972; Springer & Deutsch, 1998) Hatfield et al. to investigated one of the major issues in sport psychology from a cognitive neuroscience perspective: the notion of attenuated self-talk or avoidance of excessive analytical thinkin during superior performance (Gallwey, 1974;

Meichenbaum, 1977) by recording EEG from the left and right regions. Because EEG alpha power is indicative of relaxation—the concept of cortical idling later advanced by Pfurtscheller (1992)—the investigators predicted that left temporal alpha power would be relatively higher than that observed in the right temporal region in such highly skilled performers. Such a finding would (a) offer objective evidence for attenuation of covert self-instructional activity or verbal-analytic processing in highly skilled athletes and (b) be consistent with attainment of the stage of automaticity. The study participants exhibited a marked elevation in left temporal (T3) alpha power averaged across three successive 2.5-second epochs during the aiming period just prior to trigger pull, relative to the level observed during rest. This pattern in the left hemisphere was accompanied by relative desynchrony (i.e., less power) of EEG alpha in the right temporal region (T4; see Figure 4.5) and indicative of a primary emphasis on visuospatial processing, a strategy entirely consistent with the specific demands of target shooting. Such a refinement of strategic neural processes accompanied by less reliance on analytical feature detection of environmental cues with experience seems entirely consistent with the formation of a memory-based internal model that guides skillful movement (Contreras-Vidal & Buch, 2003; Contreras-Vidal, Grossberg, & Bullock, 1997; Kinsbourne, 1982). In this manner the EEG evidence supports a regional relaxation effect in expert performers such that they refine brain activity processes to exclude nonessential processes.

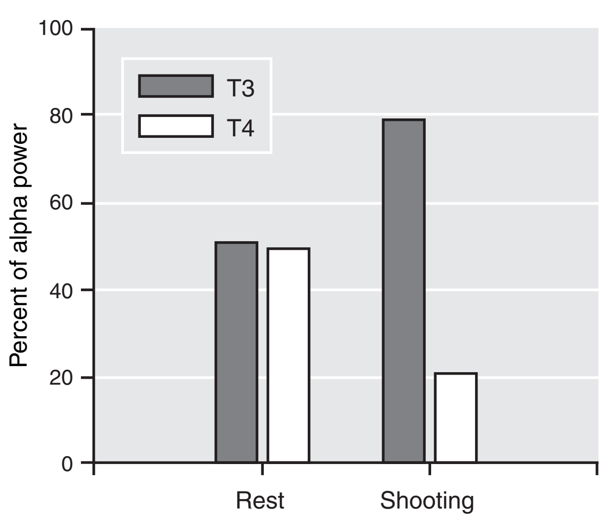

Figure 4.5 Percentage of alpha power averaged for 12 elite marksmen in the left and right temporal regions (T3 and T4) during rest and the aiming period of target shooting up to the time of trigger pull.

The early EEG studies with marksmen provided a classic paradigm for subsequent investigations of other self-paced activities (e.g., archery and golf) that was defined by recording EEG at homologous sites during the final 3 to 8 seconds of the preparatory period immediately prior to the self-initiated action (e.g., arrow release or putting). Typically, several performance trials are examined and the power spectrum estimates from each trial are then averaged to achieve a stable estimate of EEG activity. Although such a preparatory or readying state is present in numerous sports (e.g., addressing the vault in gymnastics, preparing to pitch in baseball, and addressing the bar in high jumping), aiming tasks lend themselves best to EEG recording, owing to the minimization of movement-related artifact while preserving ecological validity since they represent real-world sport tasks.

Using this paradigm, Hatfield, Landers, and Ray (1984) conducted a two-part study in which they replicated the results of Hatfield et al. (1982) in Study 1, and extended that work in an attempt to derive cognitive inference from the observed EEG recordings in Study 2. Specifically, in Study 1 EEG recordings at sites T3, T4, O1, and O2, commonly referenced to Cz, were observed in 17 right-handed and ipsilateral eye-dominant elite-level marksmen who executed 40 shots with an air rifle on a regulation 50-foot indoor range. EEG alpha was defined as average band power from 8 to 12 Hz. In addition, EEG temporal and occipital asymmetry metrics in the form of T4:T3 and O2:O1, respectively, were also generated such that higher alpha asymmetry scores (greater than 1) are indicative of greater relative left hemispheric activation; lower scores (less than 1) are indicative of greater relative right hemispheric activation. A successive change in magnitude over time indicates an increasing or decreasing trend toward left activation depending on whether the metric is rising or falling, respectively. Artifact-free EEG was typically evident prior to the trigger pull for at least 7.5 seconds across the various trials; these recordings were further divided into three successive 2.5-second epochs to assess the dynamic change in cortical activity as the athlete achieved the state of psychological readiness to take the shot. Furthermore, the 40 shots (or trials) were blocked into four successive sets of 10 trials to assess stability of brain activity in theses highly skilled performers. The temporal asymmetry scores revealed a progressive decline in magnitude across the blocks of shots that was consistent across the blocks of trials. The decline in temporal asymmetry scores across the three epochs during aiming was a result of relative stability in T4 alpha, accompanied by a progressive

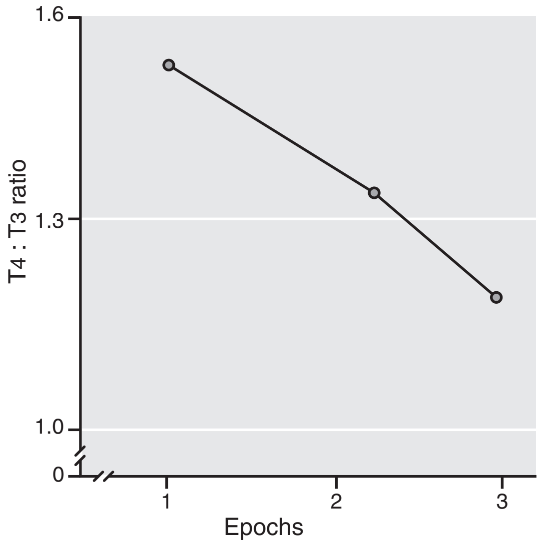

Figure 4.6 Averaged mean EEG alpha (8 to 12 Hz) asymmetry scores across three consecutive 2.5-second epochs immediately preceding the trigger pull exhibited by 17 elite marksmen.

rise in T3 alpha power (see Figure 4.6). In essence, the results of Study 1 revealed a steady decrease in left temporal activation from the early phase to the later phase of the aiming period. The magnitude of asymmetry was not evident at the occipital sites, which was expected in light of the relative similarity of neural processes at the homologous occipital sites compared to the disparity of neurocognitive processes associated with the homologous temporal sites. The findings implied that such elite performers were less and less reliant on verbal-analytical processes associated with the left temporal region as they successfully approached the trigger pull although such cortical associative activity (i.e., verbal-analytic) was prevalent during the early phase of the preparatory aiming period, perhaps to guide the marksman during the initiation of the performance. Furthermore, the similarity in the pattern of change across the aiming period over the course of the 40 shots (i.e., the nonsignificant effect for the blocks of trials) is consistent with the widely held position that elite athletes are mentally consistent.

Cognitive Inference

Although the results of Study 1 were suggestive of the cognitive processes involved during skilled visuomotor behavior, Hatfield et al. (1984) conducted Study 2 to validate the merit of such inference. In essence, the EEG signature during the aiming period, was compared to other EEG signatures recorded during known referents or defined tasks characterized by verbal-analytic or visual-spatial processing to determine similarities and differences. By comparing EEG during shooting to that recorded during the well-defined mental challenges, Hatfield et al. subscribed to a cognitive inference strategy described by Cacioppo and Tassinary (1990). Specifically, the investigators replicated and extended Study 1 with a group of intercollegiate marksmen by employing the shooting task and additionally challenging the subjects with verbal-analytic tasks (i.e., paragraph comprehension and arithmetic problem solving to engage left temporal region) and visual-spatial tasks (i.e., geometric puzzle solving to engage right temporal/parietal region). These additional challenges were presented to the participants to deduce whether the mental processes involved during highly skilled marksmanship were more similar to the verbal-analytic or the visual-spatial domain. The participants also executed the comparative cognitive challenges, which were presented via images projected on a screen, while they assumed the same posture as employed during the shooting position. This was done to equalize the motor demands of the tasks and any cardiovascular effects on central nervous system processes (Lacey, 1967). EEG recorded during the cognitive challenges was also divided into three successive 2.5-second epochs to contrast it to the temporal dynamic of the EEG derived during target shooting. Again, temporal asymmetry metrics in the form specified in Study 1 were generated for analysis.

The results revealed stable asymmetry scores across the epochs during the comparative cognitive challenges, with higher scores as predicted during the left hemisphere challenges compared to those observed during the right hemisphere challenges. However, those derived during the target-aiming period revealed a dramatic shift over time (see Figure 4.7). In fact, the asymmetry scores during the initial 2.5-second epoch of aiming on the target were similar to those observed during the verbal-analytic challenge, and significantly higher than that observed during the visual-spatial tasks, but they were significantly reduced in magnitude during the final two epochs just prior to trigger pull. By the third and final epoch the asymmetry scores during the shooting task were reduced relative to those during verbal-analytical processing and similar to those during visual-spatial processing (although lower in magnitude). Such a shift in temporal asymmetry, in conjunction with inspection of EEG alpha power at the individual homologous sites, suggests that the expert marksman explicitly controls attention during the early

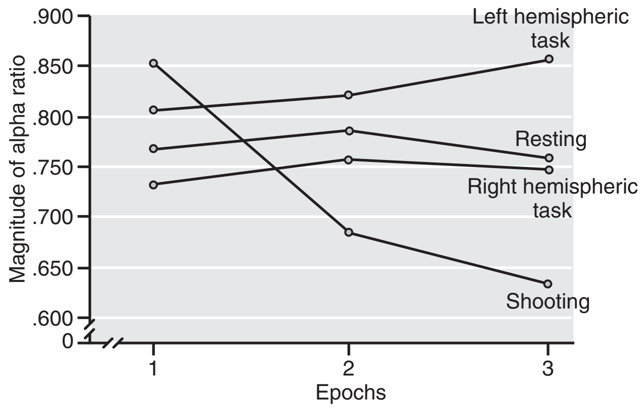

Figure 4.7 Mean EEG alpha (8 to 12 Hz) asymmetry scores (T4:T3) across three consecutive 2.5-second epochs immediately preceding the trigger pull in a rifle-shooting task and in three comparison conditions. Alpha asymmetry scores in the shooting condition were significantly lower in Epochs 2 and 3 as compared to Epoch 1. Asymmetry scores did not change across epochs in the nonshooting tasks.

part of the aiming period that quickly drops out with increased reliance on visual-spatial processing. The finding further suggests a refinement of nonessential cortical processes, or the simplification of the strategic approach to shot execution. Such a refined strategy may underlie the physical consistency (i.e., hitting the center of the bull) demonstrated by elite performers.

The interpretation of the results offered by the authors also appears consistent with phenomenological reports by athletes. Hall of Fame football player Walter Payton of the Chicago Bears was quoted by Attner (1984, pp. 2–3) as follows:

> I'm Dr. Jekyll and Mr. Hyde when it comes to football. When I'm on the field sometimes I don't know what I am doing out there. People ask me about this move or that move, but I don't know why I did something, I just did it. I am able to focus out the negative things around me and just zero in on what I am doing out there. Off the field I become myself again.

As discussed by Hatfield et al. (2006), it appears that the phenomenological and the psychophysiological levels of analysis are entirely consistent with the notion of automaticity of skilled performance (Fitts & Posner, 1967). The quote by Payton suggests a reduction of left temporoparietal activation during performance, as he reported "no thinking" while other areas of the cortex involved in kinesthetic awareness and spatial processing were specifically engaged. Excessive rumination and self-talk could cause performance degradation by generating nonessential brain activity and interfering with task-specific (e.g., rushing in football) attentional and motor processes. Because the various regions of the brain and cortex are highly interconnected (i.e., a neural network) it is likely that activity in one domain (e.g., cognitive) can influence that in another (e.g., motor). In support of this position, Rebert, Low, and Larsen (1984) observed EEG alpha power in left temporal and parietal regions recorded during the performance of a video game that demanded intense visual-spatial processing. Remarkably, the study participants exhibited increasing right temporal activation during the course of the rallies, which began to decline or reversed direction just prior to the commission of an error that terminated the rally (see Figure 4.8). Of note, the temporal and parietal asymmetry profiles were absent during the intervening rest intervals. It seems that the increased left temporal activation (increased verbal-analytic processing), observed just prior to initiation of error, resulted in an attentive state that was inconsistent with the task demands of the video game. The shift in hemispheric activation may have interfered with essential visuomotor processes due to overthinking the task demands and resulting in choking.

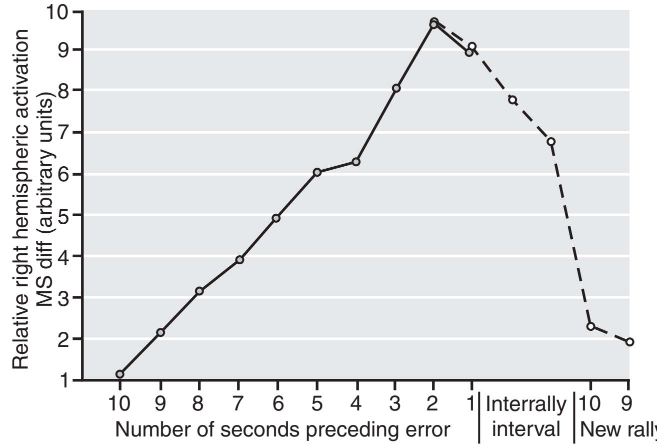

Figure 4.8 Changes in temporal EEG alpha power asymmetry during Pong rallies and interrally intervals. Asymmetry metrics were calculated by which increasing magnitude implied relative right activation. The horizontal axis shows the progressive rise in relative right hemispheric activation during the 10-second rally period and the reversal in this trend just prior to the occurrence of an error at second 1.

CONFIRMATION OF THE COGNITIVE BASIS OF ELECTROENCEPHALOGRAPHY DURING MOTOR PERFORMANCE

Other investigators have similarly observed EEG alpha band synchrony, or idling, in the left temporal region of the cortex during the preparatory period prior to the execution of movement during archery and rifle or pistol marksmanship (Bird, 1987; Hatfield et al., 1987; Hillman, Apparies, Janelle, & Hatfield, 2000; Janelle et al., 2000; Kerick, Douglass, & Hatfield, 2004; Kerick, Iso-Ahola, & Hatfield, 2000; Landers et al., 1991, 1994; Loze, Collins, & Holmes, 2001; Salazar et al., 1990). Although some investigations did not reveal EEG alpha synchrony during karate and golf putting performances in this specific region of the brain (Collins, Powell, & Davies, 1990; Crews & Landers, 1993), they did reveal alpha synchrony in other cortical areas. It may be that the specific demands of the sport tasks imposed on the subjects in these investigations (i.e., karate and golf putting) resulted in the allocation of different neural resources and that the quiescence of left temporal activation noted during target shooting may have been inappropriate or irrelevant during these particular tasks. The principle of psychomotor efficiency, as described by Hatfield and Hillman (2001), would apply, although the specific brain regions affected would likely vary from task to task (i.e., the principle of specific adaptation to imposed demand).

Although the studies of self-paced visuomotor performance have typically revealed greater EEG alpha synchrony in the left temporal region relative to that observed in the right homologous region, there is a need to substantiate that the change in cortical activation observed at site T3 is, in fact, a valid indicator of regional activity and is not simply due to measurement error owing to the relatively poor spatial resolution and volume conduction problem of EEG when compared to other neuroimaging techniques (e.g., MEG and fMRI). To address this concern, Salazar et al. monitored EEG at sites T3 and T4 in 28 elite right-handed archers during the period before the release of the arrow as well as three comparative conditions. The condition of interest involved a full draw of the bow and arrow release after the preparatory aiming period with a regulation-weight bow (14 to 22 kg). Another condition was designed to mimic the physical demands of the task but excluded the aiming process such that the participants held the arrow at full draw while simply looking at the target. Another condition involved a similar task with a light-weight bow (2 kg) and a final condition simply consisted of no draw while looking at the target. The authors observed relative EEG alpha synchrony in the left temporal region only during the aiming and shooting condition with the standard weight bow, but not during the other comparative conditions. They concluded that the T3 alpha synchrony was, in fact, due to strategic refinement and relaxation of nonessential cognitive events and not due simply to motoric processes.

A similar conclusion was reached by Kerick and colleagues (2001), who recorded EEG activity in elite rifle marksmen in the left and right central and temporal regions during three comparative conditions. The participants performed 40 shooting trials on a standard indoor rifle range with air rifles aimed at a target distance of 50 feet and assumed the same postural and gun-holding positions in the other two tasks; however, one involved trigger pull with no aiming on the target, and the other was absent any trigger pull. EEG records were examined over 8-second epochs prior to trigger pull (or an 8-second period without triggering, in the case of the last described comparison condition). The authors noted the oft-described progressive EEG alpha synchrony in the left temporal region as the trigger pull approached, and relative stability and less average power over the aiming period was noted in the right. The synchrony effect at T3 was not noted during either of the two comparative conditions and, more important, was distinct in pattern from that observed from the left motor cortex (C3). As such, the synchrony of EEG alpha in the left temporal region was not simply a reflection of ipsilateral motor cortex processes. Both of these investigations strengthen the notion that the observed EEG activity in the left temporal region is, in fact, indicative of cognitive processes and may well be due to the suppression of irrelevant cognitive processes.

EXPERTS VERSUS NOVICES: CONTRASTS OF ELECTROENCEPHALOGRAPHIC ACTIVITY DURING PSYCHOMOTOR PERFORMANCE

In one of the few studies of brain activity as function of motor skill ability, Haufler, Spalding, Santa Maria, and Hatfield (2000, 2002) compared regional cortical activation in expert marksmen and novice rifle shooters and predicted that experts would demonstrate less global cortical activation during the aiming period prior to the trigger pull based on the notion that experience results in the pruning of irrelevant neural processes (Bell & Fox, 1996).

More specifically, EEG was recorded at homologous frontal (F3, F4), central (C3, C4), temporal (T3, T4), parietal (P3, P4), and occipital (O1, O2) sites (referenced to averaged ears) in 15 expert marksmen (i.e., having national and international competitive experience) and 21 novice volunteers (i.e., having little to no experience with firearms and no experience with position shooting), who were all right-hand and ipsilateral eye dominant. Experts demonstrated higher shooting scores as compared to their novice counterparts ($M = 339.8$ and $M = 90.7$, respectively, out of a possible 400 points). Furthermore, Haufler et al. (2000) also challenged the participants with verbal and spatial tasks, with which the groups were equally unfamiliar, while recording the EEG in the shooting task posture.

Figure 4.9 illustrates comparative spectral plots (1 to 44 Hz) for the experts and novices recorded at the left temporal site during the shooting task. As predicted, the expert marksmen showed higher levels of alpha power (8 to 12 Hz) and lower levels of beta and gamma activation (14 to 44 Hz) as compared to that observed in the novice volunteers during the shooting task. Figure 4.10 illustrates the relative economy of cortical activation in the experts during aiming (i.e., reduced gamma power in the frontal and temporal regions); no such group difference was observed during the comparative tasks supporting the specificity of cortical adaptation to cognitive motor challenge. A Group × Task × Hemisphere interaction was also revealed, such that the expert marksmen demonstrated greater alpha power in the left hemisphere during the shooting task compared to their novice counterparts and similar alpha power in the right.

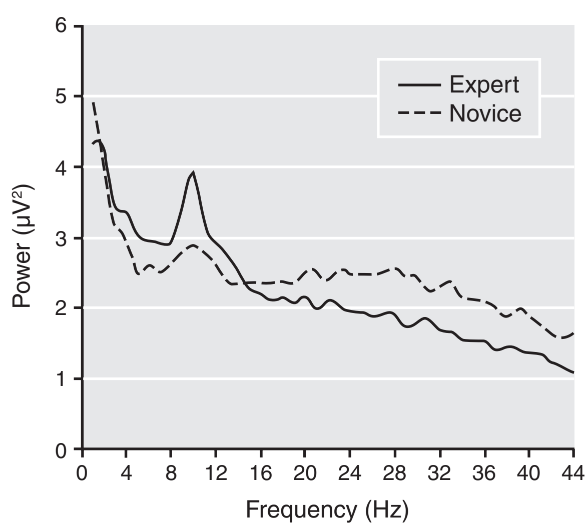

Figure 4.9. Comparative group spectral plots of expert marksmen and novice target shooters showing greater synchrony of EEG alpha (8 to 13 Hz) and relative desynchrony of beta and gamma EEG power (14 to 44 Hz inclusive) in the experts.

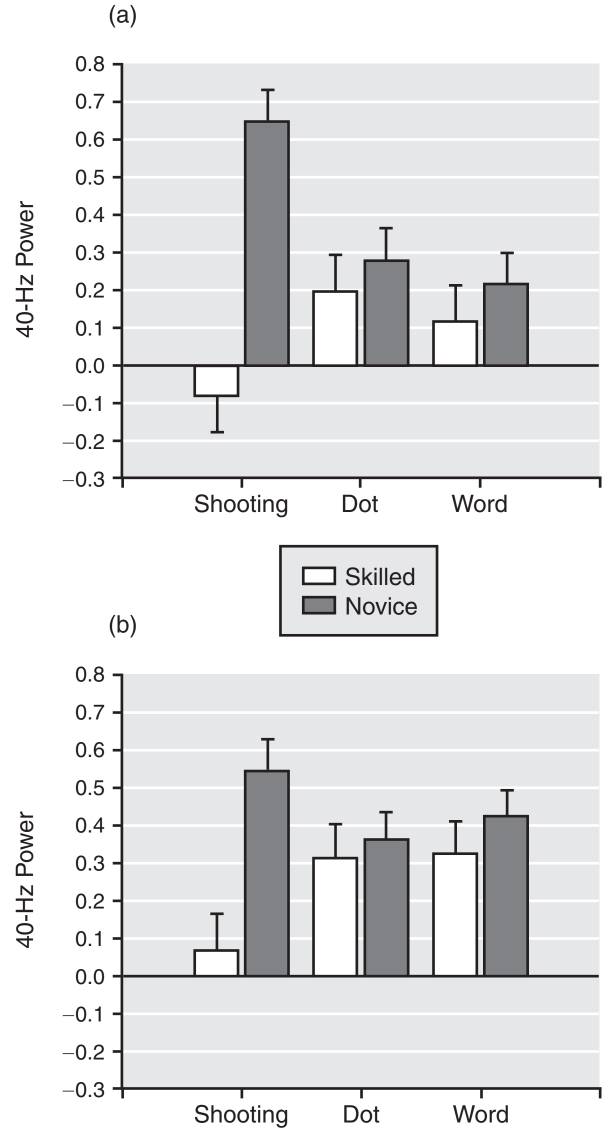

Figure 4.10 (a) Log-transformed EEG gamma power averaged across left and right frontal sites for expert marksmen and novice target shooters during the aiming period of target shooting and the comparative spatial (i.e., dot) and verbal (i.e., word) tasks. (b) Log-transformed EEG gamma power averaged across left and right temporal sites for expert marksmen and novice target shooters during the aiming period of target shooting and the comparative spatial (i.e., dot) and verbal (i.e., word) tasks.

In a related study, Di Russo, Pitzalis, Aprile, and Spinelli (2005) contrasted the amplitudes of movement-related cortical potentials (MRCPs) recorded from the left and right motor cortex regions (C3 and C4, respectively) in expert and novice rifle shooters while performing separate finger flexion tasks with the right (i.e., trigger) and left index fingers. The amplitude of the MRCP indicates the magnitude of neural activation required to perform the tasks such that lower amplitude is characteristic of efficiency or economy of effort. Of particular importance, the amplitudes recorded from the contralateral motor cortex (C3) to the right finger (or trigger finger) were significantly lower in the experts, whereas no such difference was noted at C4 for finger movements performed with the left finger. The authors also employed dense EEG recording to enable source localization of the potentials, which revealed that the signals were generated in the motor cortex. As such, the contrast between expert and novice marksmen clearly supported the notion of specific adaptations in the cerebral cortex as a function of practice characterized by economy or efficiency of effort.

Overall, the findings of Haufler et al. (2000) and Di Russo et al. (2005) revealed that experts exhibited less cortical activation compared to the novices, which clearly supports the notion of increasing economy of cerebral cortical processes with task-specific practice. Differences were observed in cortical activation patterns both by slow potential amplitude and by a broad range of spectral power estimates providing convergent evidence of psychomotor efficiency. Of particular importance, no differences in EEG were observed while the participants performed the comparative tasks, with which the groups were equally familiar, implying a high degree of specificity in brain-related adaptations to skill training.

Training Studies

The majority of investigations of cortical processes during psychomotor performance have been cross-sectional in nature (Bird, 1987; Crews & Landers, 1993; Hatfield et al., 1984; Hatfield, Landers, & Ray, 1987; Haufler et al., 2000; Hillman et al., 2000; Janelle et al., 2000; Loze et al., 2000; Salazar et al., 1990). This type of study design leaves open the possibility that any differences in brain activity may be inherent in the performers as opposed to an adaptation resulting from practice and learning.

In an attempt to determine the causal influence of training on cortical activation, Landers et al. (1994) conducted a study with novice archers in which EEG was recorded from sites T3 and T4 during the aiming period just prior to arrow release before and after 12 weeks of instruction that involved 27 sessions with an Olympic-caliber coach. Although no differences in spectral power were noted between the left and right temporal sites at the time of the pretest, relative synchrony at site T3 was noted during the aiming period after the training, which supports a causal influence. Performance also significantly improved over the course of instruction. No difference in EEG power was noted during the resting trials either before or after training supporting task-specific brain-related processing.

Kerick et al. (2004) replicated and extended this finding with 11 midshipmen at the United States Naval Academy who underwent pistol training to become members of a competitive shooting team. The participants had little or no experience with firearms prior to 12 to 14 weeks of supervised instruction with a qualified coach. EEG was recorded from 11 sites (F3, Fz, F4, C3, Cz, C4, T3, T4, P3, Pz, P4) to determine practice induced changes in activation. Mean alpha power and its rate of change were hypothesized to increase in the left temporal region during aiming from early to late season as participants improved their accuracy and reduced cognitive effort. EEG was recorded over a 5-second aiming period during target shooting (40 trials) and two comparative tasks that involved either seated rest or shooting with no trigger pull. A high level of temporal resolution of the spectral estimates was achieved by subscribing to a signal-processing technique employed by Pfurtscheller (1992) called event-related alpha power (ERAP) that enabled a more refined assessment of temporal dynamics during the aiming period. Although the previous studies in this area of research examined successive epochs in the range of 1 to 2 seconds of temporal resolution the present technique allowed for 125-millisecond precision such that 40 successive estimates of alpha power were examined over the 5-second aiming period. This sampling strategy allowed for a line of fit to be applied to the EEG power estimates so as to determine both a slope and average power measures. This allowed for much greater precision in the detection of change in brain activity.

The mean levels of (ERAP) increased at T3 from the beginning to the end of the training period during both the shooting and postural simulation conditions but not during the resting baseline. Interestingly, the magnitude of change in right temporal (T4) activation was reduced probably due to the maintenance of visual-spatial processing. Figure 4.11 illustrates the overall topographical EEG alpha power (i.e., distributed across the entire scalp) across the aiming period and the comparative baseline periods at the beginning and at the end of the training period. The global synchrony or increase in the ERAP during the marksmanship task attests to a rather widespread change (i.e., reduction) in cortical activity and seems consistent with the phenomenological reports of well-practiced athletes that performance becomes effortless. In this regard, the human brain is highly plastic and seems to undergo significant change in response to the

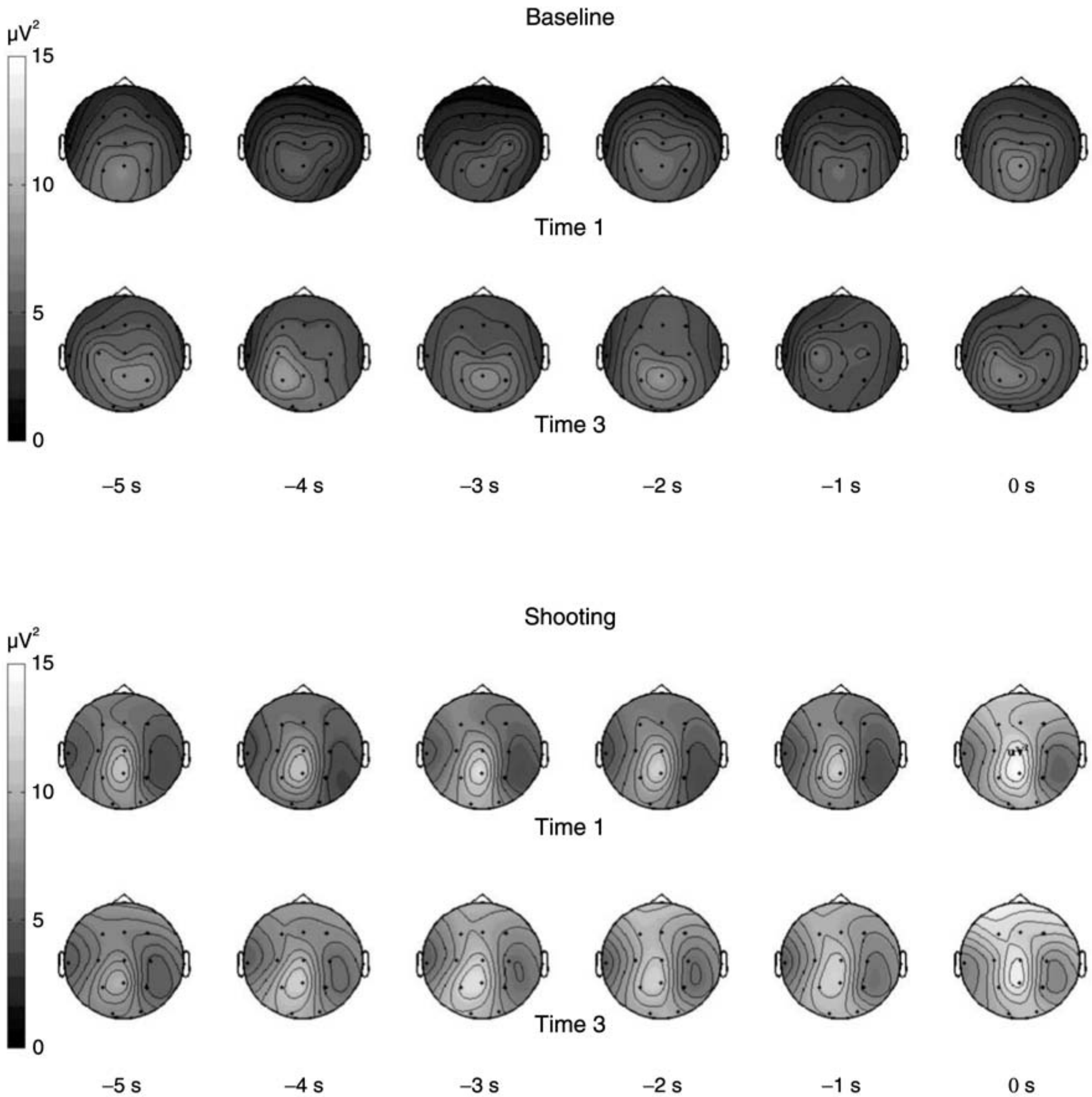

Figure 4.11 Topographical maps of event-related alpha power (ERAP) for successive 1-second periods during baseline and target shooting before (Time 1) and after (Time 3) marksmanship training. The magnitude of alpha power is indicated by the scaling bars illustrated on the left side of the panels. The shading is darker during the baseline periods, relative to that during shooting shown in the lower panel, and shows little change during the 6-second aiming periods and before and after 3 months of training. Note that during the shooting task (lower panel), the brain maps become progressively lighter in shade over the 6 seconds prior to the trigger pull (i.e., 0s) after 3 months of practice (Time 3), relative to the progressive change observed at the beginning of training (Time 1), indicating higher levels of EEG alpha power and cortical relaxation as the trigger pull is approached.

practice- and performance-related demands that are imposed on it (Elbert, Pantev, Wienbruch, Rockstroh, & Taub, 1995). Using fMRI technology of cortical and subcortical processes, economical brain activity has also been shown with performers in other sports (Milton, Small, & Solodkin, 2004). Such a notion is also consistent with PET imaging studies of the change in cortical activity of motor skill learning (Haier et al., 1992). Although the time period in which such change was demonstrated was appreciable in these studies, such change can occur in relatively short order (i.e., hours; Etnier, Whitever, Landers, Petruzzello, & Salazar, 1996), as observed during a pursuit rotor motor tracing task.

THE RELATIONSHIP BETWEEN CEREBRAL CORTICAL ACTIVITY AND MOTOR PERFORMANCE

In one of the first investigations of cortical activation and target shooting performance, Bird (1987) conducted a case study in which an expert marksman, monitored at a single recording site (T3), executed superior shots when he exhibited less high-frequency EEG activity. Such a preliminary finding is consistent with the notion of quiescence of the left temporal region resulting in less interference with essential attentional or motor processes. To further assess the relationship between cortical activation and performance Salazar et al. (1990) contrasted EEG spectral content at T3 in archers during the aiming periods associated with best and worst shots. In contrast to their expectation, they observed higher amplitude of spectral power at 6, 12, and 28 Hz in the left hemisphere during the period prior to the worst shots. Similarly, Landers et al. (1994) observed higher alpha power during worst shots in novice archers. As such, it would seem that the findings from these studies are more consistent with an inverted-U type relationship between performance and left temporal activation as opposed to a positive linear relationship such that excessive relaxation is associated with a decline in performance. In support of this position Hillman et al. (2000) reported a study in which they monitored EEG alpha and beta power in seven skilled marksmen at the left and right frontal, central, temporal, and parietal sites (F3, F4, C3, C4, T3, T4, P3, P4; referenced to Cz) during 4-second aiming periods prior to successfully executed shots. The observed activity was contrasted to that occurring in the period preceding the decision to abort or terminate a shot. The latter refers to an inability by the participant to achieve a state of readiness. Alpha power was typically higher at T3 than at T4, thus replicating the temporal asymmetry observed in other studies, but the rejected preparatory intervals were characterized by higher power than that observed during the period prior to executed shots (see Figure 4.12). The authors theorized that the decision to reject a shot was characterized by a failure to allocate the appropriate neural resources specifically associated with successful task execution. Kerick et al. (2004) also noted a curvilinear relationship between ERAP and pistol-shooting accuracy such that higher accuracy was associated with greater ERAP up to an optimal level, beyond which further increases in power were associated with reductions in accuracy. In summary it seems that better performance is associated with elevated but limited temporal alpha power.

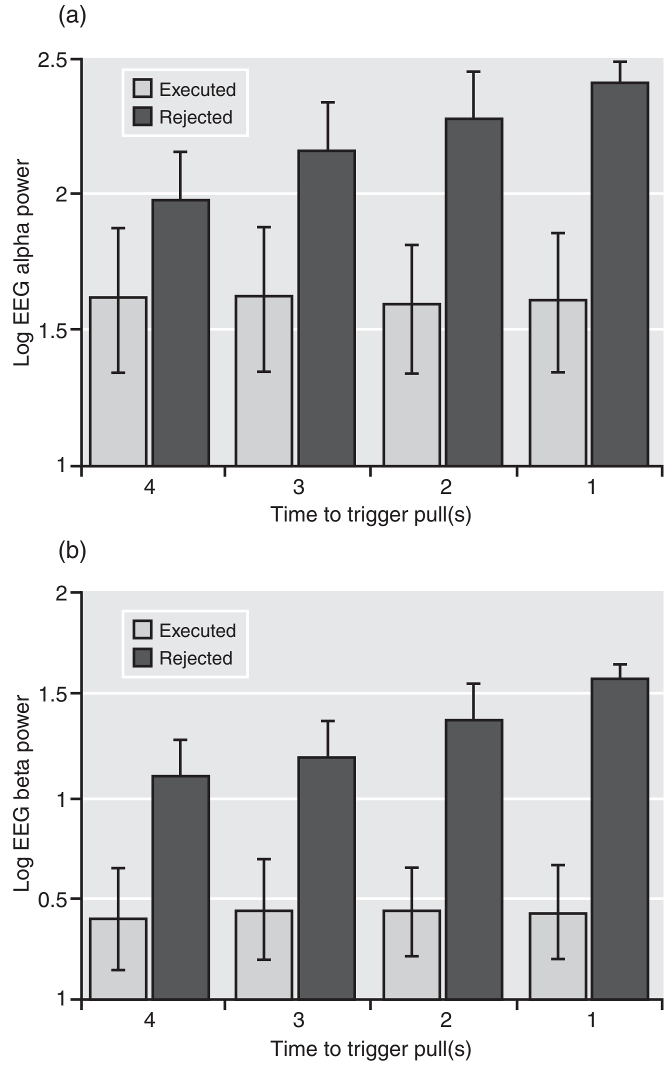

Figure 4.12 Differences in alpha (a) and beta (b) spectral power during the 4-second period prior to trigger pull and the decision to reject or terminate a shot.

However, the nature of the relationship may be critically related to the skill level of the athlete. In this regard, each of the studies discussed previously involved participants who typically were at lower levels of skill. In contrast, Crews and Landers (1993) noted that expert golfers who showed more alpha power (reduced activation) in the right motor cortex during the last second of preparation demonstrated superior golf-putting performance or less error. A positive association between occipital alpha power and performance was also reported by Loze et al. (2001), who examined cortical activity in expert air-pistol shooters. The shooters were monitored for EEG at midline occipital (Oz) and left and right temporal (T3 and T4) locations during a 60-shot match. The EEG alpha power recorded over three successive 2-second epochs during the five best shots was contrasted to that during the five worst shots. The data clearly revealed a significant rise in alpha power at Oz over epochs prior to the best shots, whereas a progressive reduction in power was associated with the worst shots. Furthermore, superior performance was associated with a rise in alpha power during the last two epochs, and a reduction was associated with worst shots. The right hemisphere revealed lower levels of alpha power with no differentiation between best and worst performance. The positive linear relationship noted by Loze et al. may have been due to superior self-regulation in such highly skilled performers compared to the participants in the other studies. That is, the experience of the elite shooters may have largely prevented states of inattention and excessive synchrony of EEG alpha, thus precluding the detection of an inverted-U relationship.

Finally, in a more definitive assessment of the causal link between cortical activation and target-shooting performance, Landers et al. (1994) conducted the only study published to date in which biofeedback was used to alter brain activity in an attempt to facilitate archery performance. Accordingly, 24 preelite archers underwent one of three treatment conditions: One group received a single session of correct feedback to reduce left hemispheric activation, a second group received incorrect feedback to reduce right hemispheric activity, and a third group rested and received no feedback. Comparison of pretest and posttest performance scores revealed that only the correct feedback group improved target-shooting accuracy after treatment, whereas the incorrect feedback group declined in performance. Although the study did not address the nature of the relationship between the magnitude of cerebral cortical activity and performance (i.e., curvilinear versus linear) it provided strong evidence for the causal influence of regional cortical relaxation on sport performance.

NETWORKING BETWEEN CORTICAL ASSOCIATION AND MOTOR REGIONS

Assessment of regional cerebral cortical activity is informative in regard to the relationship between brain activity and motor performance, but additional insight can be attained by examining functional interconnectivity or cortico-cortical communication between specified topographical regions. Such networking activity can be quantified by deriving coherence estimates between selected pairs of electrodes or recording sites. As summarized by Hatfield et al. (2006), Busk and Galbraith (1975) monitored EEG at occipital (Oz), motor cortex (C3 and C4), and motor planning areas (Fz) in participants before and after practice trials on a pursuit-rotor task, which involves a high level of eye-hand coordination. The authors noted that coherence between pairs of electrodes over areas known to have strong neuroanatomical connections (such as the motor planning region and the motor cortices) revealed the highest estimates, which provided a validation check of coherence estimates as indicative of cortico-cortical communication. Overall coherence estimates between the recording sites were significantly reduced as a result of practice, implying greater regional autonomy or specialization as a result of training. Such a finding can also be framed within the context of efficient adaptation to imposed demand, as the change in coherence may well imply a pruning or refinement of neural processes with visuomotor practice (Bell & Fox, 1996). In this manner, novice performers may be heavily engaged in feature detection of the environment to guide their actions. As such, heightened communication between visual processing and motor planning areas would be necessary prior to the formation of memory traces or an internal model to guide the neuromuscular apparatus. Such heightened activity would not only be more metabolically demanding (i.e., less efficient) but may well result in greater variability of network activity, thereby resulting in less consistency of performance.

In a more recent study, Deeny, Hillman, Janelle, and Hatfield (2003) extended the work of Busk and Galbraith (1975) by assessing coherence estimates in skilled marksmen between motor planning (Fz) and association regions of the brain by monitoring EEG at sites F3, F4, T3, T4, P3, Pz, and P4 as well as the motor cortex (C3, Cz, C4) and visual areas (O1 and O2). More specifically, EEG coherence was assessed during the aiming period just prior to trigger pull in two groups of participants who were similar in terms of years of training but differed in competitive performance history. One group was labeled experts and exhibited superior performance during competition; the other group was labeled skilled shooters and was characterized by relatively poor performance during the stress of competition. Both groups were highly experienced (approximately 18 years of experience in each group). Given that specialization of cortical function occurs as domain-specific expertise increases, experts were predicted to exhibit less cortico-cortical communication, especially between the cognitive and motor areas, relative to that observed in the lesser skilled group. The primary analysis involved a comparison between the groups of the coherence estimates between Fz and the lateral sites examined in each hemisphere. Interestingly, in terms of alpha band coherence, there were no differences between the groups at any site except for the Fz-T3 pairing in the left hemisphere, at which the experts revealed significantly lower values. Lowered coherence between Fz-T3 in the experts was also observed for the beta band (13 to 22 Hz; see Figure 4.13). The authors interpreted the findings to mean that the experts were able to limit or reduce the communication between verbal-analytic and motor control processing. On a more global level, this finding would imply that those who performed better in competition did not overthink during the critical aiming period.

Again, the potential importance of this refined networking in the cerebral cortex in regard to motor behavior is the reduction of potential interference from irrelevant associative, affective (e.g., limbic), and executive processes with the motor loop (basal ganglia) connections to the motor cortex that largely controls corticospinal outflow and the resultant quality of the motor unit activation (Grafton, Hari, & Salenius, 2000). Excessive networking may result in undesirable alterations in the kinematic qualities of limb movement. Refinement or economy of cortical activation would more likely result in smooth, fluid, graceful, and efficient movement. Any reduction of associative networking with motor control processes would also help to reduce the complexity of motor planning and should result in greater consistency of performance.

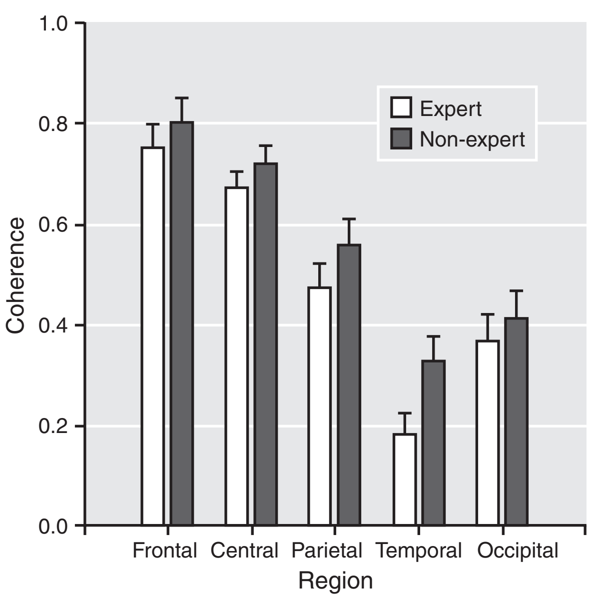

Figure 4.13 Comparative EEG beta coherence measures between Fz and each recording site within the left hemisphere for expert and lesser skilled marksmen.

SLOW POTENTIAL ELECTROENCEPHALOGRAPHIC RECORDING DURING SELF-PACED MOTOR PERFORMANCE

It seems tenable that the superior athlete would adopt a neurocognitive strategy by which he or she learns not to interfere with essential motor control processes and that he or she extracts information from the environment in an efficient manner (i.e., extracting only cues that are relevant to the intended performance). A related line of research by Konttinen and colleagues (Konttinen & Lyytinen, 1992, 1993a, 1993b) using slow potential (SP) recordings from the motor planning, motor cortex, and visual areas offers further support for this notion. Slow potential recordings are time-averaged potentials that precede a self-initiated event such as the trigger pull in marksmanship. The averaging period is typically accomplished for the 2- to 3-second period prior to the motor act (i.e., preparatory period). The SP is achieved by a time-averaging process to enhance the signal-to-noise ratio. Slow-going negativity, relative to a preceding baseline period, is typically interpreted as increasing readiness to respond, whereas increasing positivity is typically interpreted as inhibition of neuromotor activity or a controlled decrease in activation.

Konttinen and Lyytinen (1992) recorded EEG from three expert and three novice marksmen at sites Fz, C3, C4, and Oz to determine whether there were differences in the SPs recorded during best and worst trials in a series of shots. Sites C3 and C4 were assessed to determine any differences in laterality. Slow potentials were computed as change scores, or the difference between the mean value of the first 1.5-second baseline window and the mean values of each of the subsequent windows up to the trigger pull. Shooting scores were divided into best and worst categories. In general, the findings showed increasing negativity at C3 and C4, a logical result given that the participants were preparing for a motor act, but surprisingly, no lateralization effect was revealed. In the expert participants, the negativity associated with motor preparation was attenuated in the case of the best shots, suggesting a fine-tuning of the preparatory response. The attenuated negativity with superior performance implies a more efficient strategy as the goal was accomplished with lessened motor preparation.

A more recent report by Konttinen, Landers, and Lyytinen (2000) suggested that elite rifle marksmen are characterized more by a rifle-balancing strategy than relying primarily on visual processing as compared to lesser skilled individuals. It seems that the elite marksman has developed a strong internal model based in long-term memory that guides the performance with less reliance on visual feature detection. As such, a reduction in cognitive load would be experienced as far as a search for external cues is concerned and the execution of the task is relatively automatic. The participants have a feel for the task that guides their effort and do not have to think about it. It would be interesting to assess temporal-parietal spectral content during these investigations to determine if, in fact, the expert performer also shows relative quiescence of left temporal activation.

BRAIN PROCESSES DURING REACTIVE PSYCHOMOTOR PERFORMANCE

The vast majority of the research in this area has examined cortical activity during self-paced performance (performer controls initiation of the act), as opposed to reactive sports (performer responds to events initiated by environment or an opponent). Such a limitation on the nature of the tasks studied has been restrictive, but studies are beginning to appear in the literature in which cortical responses have been examined during such reactive sport situations as baseball batting and table tennis performance. Radlo, Janelle, Barba, and Frehlich (2001) recently employed ERP measures to assess decision making in 10 advanced and 10 intermediate baseball players who were presented with a type of oddball task. More specifically, 400 trials consisting of video images of baseball pitches were presented via a large projection screen (200 fastball images and 200 curveball images). The participants were administered a cost-benefit precuing paradigm in which 75% of the cues were valid. The participants were required to attend carefully to the stimuli and discriminate the nature of the pitch type by pressing an appropriate button. The intermediate players showed heightened P300 amplitudes, longer reaction times, and fewer correct responses relative to advanced batters. The authors concluded that the intermediate batters were less efficient in their perceptual decision making.

Electroencephalographic Power during Reactive Visuomotor Performance

Using a military psychology setting, Kerick, Hatfield, and Allender (2006) recently designed a study to examine cortical dynamics of soldiers during a reactive shooting task in which targets appeared in random locations and were exposed for various durations (2 to 6 s) in a simulated field environment. The soldiers' task was to correctly identify targets as enemy or friendly and then make a decision whether to aim and fire the weapon (enemy) or disengage from the target (friendly). This reactive shooting paradigm differs from the self-paced shooting paradigm in many respects. First, the shooter does not know when or where a target will appear. Second, once the shooter detects a target, he or she must identify the target as enemy or friendly. Third, the shooter must make a decision whether to engage or disengage from the target depending on its identification. Fourth, the shooter does not know how long the target will be exposed, and therefore does not know how much time is available to execute the correct response. In addition to examining the cortical dynamics of soldiers during the performance of a reactive shooting task, Kerick et al. (2006) also examined the effects of increased task demands by manipulating three factors: task load (single, dual task), decision load (enemy only, enemy or friendly targets), and response time demands (short, long target exposure time). Cognitive workload is defined as the difference between the capacities of the information-processing system that are required for task performance to satisfy performance expectations and the capacity available at any given time and must take into account the interaction between the task and the person performing the task.

Changes in theta power during the preparatory period of self-paced target shooting has been reported only by Haufler et al. (2000), who found no changes over the seconds preceding the trigger pull. However, for many tasks, theta increases during the encoding of sensory information and in response to increased task difficulty and cognitive load (Dussault, Jouanin, & Guezennec, 2004; Hankins & Wilson, 1998; Klimesch, 1996, 1999; Klimesch, Doppelmayr, Russegger, & Pachinger, 1996). Upper alpha power (11 to 13 Hz) typically increases during the seconds preceding the trigger pull for self-paced shooting tasks (Hatfield et al., 1984; Haufler, Spalding, Santa Maria, & Hatfield, 2000; Kerick et al., 2001; Kerick et al., 2004). For many cognitive and motor tasks, however, alpha exhibits a task-specific decrease in power (Pfurtscheller, 1992; Pfurtscheller & Lopes da Silva, 1999). This apparent discrepancy in alpha responses between shooting and other spatial and motor tasks may be related to the complexity of a realistic task, such as shooting versus controlled laboratory tasks. The increased alpha observed prior to trigger responses in shooters is thought to reflect widespread inhibition of task-irrelevant cortical areas that may interfere with execution of the shot (Hatfield & Hillman, 2001).

Kerick et al. (2006) predicted that the higher shooting demand conditions (i.e., dual-task load, choice-decision load, and short target exposure time scenarios) would require higher cortical effort, as indicated by higher theta power and lower alpha power during the aiming period from target onset to the time of the trigger response. This study was the first to investigate both stimulus- and response-related cortical dynamics of soldiers during the performance of a reactive shooting task, as well as to investigate the cortical dynamics of shooting as a function of varied task demands. The findings revealed both similarities and differences in the cortical dynamics associated with a reactive shooting task compared to that observed during self-paced shooting tasks.

Across all shooting conditions, theta power exhibited an early stimulus-related peak that occurred shortly after the onsets of targets (~1,060 ms) and a later response-related peak that occurred approximately coincident with the time of the trigger response (~3,050 ms). Kerick et al. (2006) suggested that the functional significance of the early theta peak is to encode target stimuli in working memory (i.e., detecting and identifying targets) and to retrieve matching stimulus-response associations from long-term memory, whereas the functional significance of the late theta peak is sensorimotor integration (i.e., coordinating the timing of the trigger response with target alignment). Further, the early peak varied by decision and task load demands in the expected direction (i.e., higher peak amplitude for choice-decision load scenarios and longer latency for dual-task demand scenarios). A significant positive relation was also observed between the latency of the late theta peak and shooting accuracy. The findings of increased theta power with increased task demands during shooting are consistent with research revealing increased theta power in response to working memory demands for encoding information (Burgess & Gruzelier, 1997; Klimesch, 1996, 1999; Klimesch, Doppelmayr, Russegger, & Pachinger, 1996) and processing multitask demands (Dussault, Jouanin, & Guezennec, 2004; Hankins & Wilson, 1998). Relative to that observed in the theta band, power in the alpha band exhibited a less distinct early stimulus-related peak but a similar late response-related peak that coincided with the trigger response (~3,055 ms). Of particular importance, the response-related alpha power increase observed during reactive shooting is consistent with that observed during self-paced shooting.

In summary, the findings suggest that the different oscillatory patterns in theta and alpha frequency bands were sensitive to different mental processes and task load variations (i.e., stress levels). Specifically, the early theta peak appears related to stimulus encoding and sensorimotor integration, whereas the late theta peak and both alpha peaks appear related to motor planning and execution. A functional relation between theta and alpha appears to underlie reactive shooting such that theta oscillations increase during the encoding of target stimuli, and at the same time alpha oscillations increase as the shooter orients toward the target. For enemy targets, activity in both frequency bands continues to increase, perhaps reflecting functional communication among networks for detecting and identifying targets, recalling stimulus-response associations from memory, and preparing the appropriate action in parallel (i.e., engaging the target). For friendly targets, the appropriate action is to disengage the target, which would require less sensorimotor integration for executing the perception-action cycle. Future efforts are under way to determine whether unique components account for the unique demands imposed by the different task demand factors and to more precisely classify stimulus-locked, response-locked, and nonphase-locked components of the EEG (Jung et al., 2001). The present findings confirm that attention is of limited capacity, is temporally and spatially distributed among cortical networks oscillating at different frequencies to enable both parallel processing of sensorimotor information and sequential processing of cognitive demands, and is influenced by task demands and perceived effort.

AFFECTIVE NEUROSCIENCE: BRAIN PROCESSES DURING DISTRESS

Although a robust corpus of work has been developed on the cortical concomitants of skill level and practice during self-paced and reactive motor performance, there has been a relative dearth of published studies of cortical concomitants of motor performance under psychological stress with the exception of the study by Kerick et al. (2006). Bear et al. (2001) recently summarized the neural structures involved in a system or circuit, which mediates the psychological and physiological response to stress. Generally, the stress response is orchestrated by the limbic system, but the central components of this functional circuit are the amygdalae, small almond-shaped structures located bilaterally and anterior to the hippocampi on the inferior and medial aspect of the temporal lobes (Bear et al., 2001). Multiple sensory pathways converge in the basal lateral nuclei of the amygdalae so that environmental events are immediately processed (Pare, Quirk, & LeDoux, 2004). Depending on the valence of the stimuli, the lateral nuclei then communicate with the central nucleus in each amygdala, and subsequent connections travel to critical forebrain, brain stem, autonomic, and endocrine structures that mediate the expression of emotion. Specifically, there are interconnections from the central nuclei to the (a) hypothalamus, which results in sympathetic arousal and stimulation of stress hormones via the hypothalamic-pituitary-adrenocortical (HPA) axis; (b) the periaqueductal grey, which results in motor responses; and (c) the cingulate cortex, which results in additional communication with neocortical association regions such as the temporo-parietal regions. Additionally, interconnections to pontine nuclei in the reticular formation result in an increase in overall arousal. Orchestrated sequelae occur in response to a stressful environment, which, collectively, can change the performer's mental and physical state in a profound manner. For example, heart rate and cortisol levels rise, as does muscle tension, and athletes may concomitantly experience excessive self-talk and "too much thinking" such that their attention is compromised and the execution of normally automated psychomotor skills such as marksmanship become explicitly managed. Timing and coordination are then altered and likely reduced in quality and attention shrinks. In support of the overthinking hypothesis, Chen and colleagues (2005) recently provided psychophysiological evidence of increased networking between the left temporal region and the motor planning regions of the brain, by assessment of T3-Fz alpha EEG coherence levels, when study participants were asked to perform a dart-throwing task under the pressure of social evaluation. Relative to a nonstress control condition, the increased traffic in the brain was accompanied by heightened reports of state anxiety and lower self-confidence. As expected, and consistent with the psychomotor efficiency principle, the accuracy of performance was also reduced (see Figure 4.14).

The notion that heightened cognitive load and induced anxiety states can alter the quality of motor performance is clearly supported by the work of Beuter and Duda (1985) and that of Weinberg and Hunt (1976). The former study revealed that kinematic qualities of gait were marked by a decrease in efficiency of motion in the lower limbs of young children who were subjected to a stressful intervention. The authors reported that the task of stepping, which was controlled automatically in a low-stress condition, became less smooth and efficient as volitional control took over under heightened stress. In a similar vein, Weinberg and Hunt observed heightened motor unit activation and co-contraction (reciprocal inhibition and failure of complete relaxation in the antagonists) of the involved muscles in an overhead throwing motion in college students who were also subjected to stress. The link between cognitive-affective states and the quality of motor performance is causal in nature, but the central mechanisms of effect from such studies are unclear. One compelling possibility is heightened cross-talk between cortical association and motor regions, as described earlier in the section on networking between brain regions.

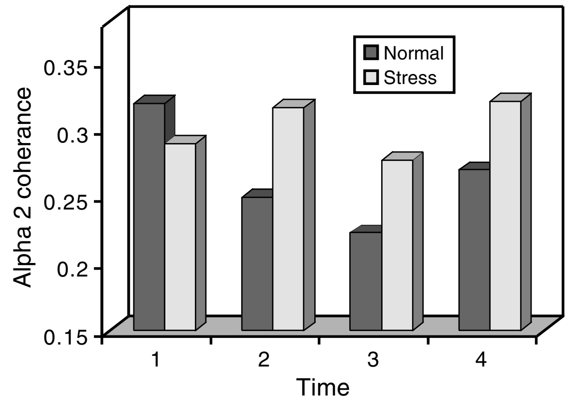

Figure 4.14 Coherence estimates between sites T3 (left temporal region) and Fz (motor planning region) during practice-alone and stressed conditions during the preparatory period for a dart-throwing task. Coherence was significantly elevated during stress.

In light of the mental and physical alterations that occur, the activation of the left and right amygdalae serves as a pivotal event in the manifestation of stress, and the control of activity in the amygdalae would exact a powerful influence on the athlete's or soldier's mental and physical state. Beyond the structures and processes outlined by Bear et al. (2001), a critical component of the neurobiology of fear (see Figure 4.15) is the frontal control (medial and orbitofrontal regions) over limbic function and subcortical emotional circuits, which is housed anatomically in the frontal regions of the forebrain. Particularly important, the anterior cortical regions have extensive anatomical connections, with several subcortical limbic structures implicated in emotional behavior, particularly the amygdala (Davidson, 2002, 2004).

Davidson and colleagues (Davidson, 1988; Tomarken, Davidson, Wheeler, & Doss, 1992) have generated a significant body of literature that clearly shows a positive association between greater relative left frontal activation and positive affect and, conversely, greater relative right activation during negative affect. Although the lateralization of frontal activation is robustly related to the valence of

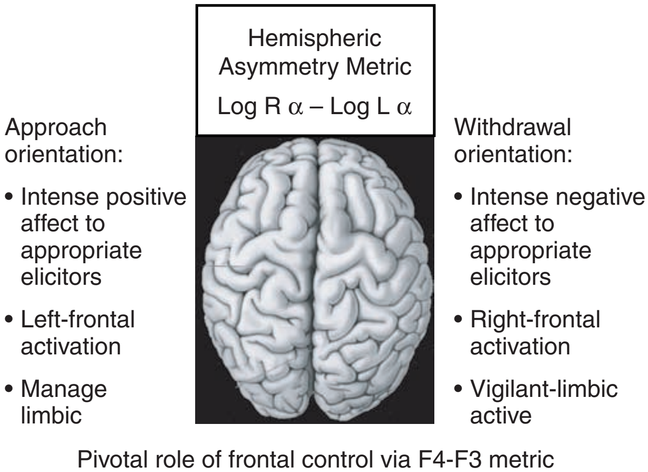

Figure 4.15 Frontal asymmetry metric.

emotion as described earlier, recent evidence points to a more fundamental association such that left frontal activation mediates approach-oriented behavior and right frontal activation is associated with avoidance or withdrawal-oriented behavior (Davidson, 2004; Jackson et al., 2003). For example, left frontal activation is manifest during hostile behavior, which is certainly not a positive affective state but most definitely involves approach toward an intended target. Whether positive in nature, approach-oriented, or a combination of the two, it would appear that such a neurobiological state would be highly adaptive for the soldier, who must control his or her arousal during active engagement with challenging tasks while under great pressure. Because EEG alpha power is inversely related to activation (i.e., relaxation), R – L alpha power (Log right frontal alpha power – Log left frontal alpha power), a positive value for this metric implies greater relaxation in the right region, or, in other words, a relative state of left frontal activation. Hence, positive numbers for this metric imply left activation and executive control over emotion structures and processes. Conversely, a negative value implies greater relaxation in the left region and a lack of executive control over limbic circuits. Therefore, this EEG metric provides an opportune target for neurofeedback training to enable a heightened level of executive control over emotional response and task engagement during challenge.

Model of Stress-Induced Cortical Dynamics

Figure 4.16 provides a schematic model of the processes and outcomes underlying stress reactivity and integrates affective and cognitive activity with psychomotor performance. A central tenet is that lack of frontal executive control over subcortical processes would result in heightened emotional influence (limbic structures) that, in turn, disrupt higher cortical association processes and the activation of the motor loop—the frontobasal ganglia structures that initiate and execute movement. Such disregulation interferes with attention and the motor loop connections (i.e., basal ganglia) to the motor cortex that largely control corticospinal outflow and the resultant quality of the motor unit activation (Grafton et al., 2000). Excessive networking in the cortex may result in undesirable alterations in information processing as well as inconsistency of motor performance. If the motor cortex becomes busy with excessive input from limbic processes via increased neocortical activity in the left hemisphere, then inconsistent motor behavior will likely result (Deeny et al., 2003). Refinement or economy of cortical activation would more likely result in enhanced attention and smooth, fluid, graceful, and efficient movement. Any reduction of associative networking with motor control processes would also help to reduce the complexity of motor planning and should result in greater consistency of performance.

According to this model, individuals under high stress will exhibit reductions in prefrontal asymmetry, as identified in Box 1 of Figure 4.16, compared to a low-stress condition implying a lack of frontal executive control over the medial frontal-meso-limbic circuit. Consequently, participants will experience heightened activation of the limbic region (amygdala; Box 6). The resultant emotional reactivity, in turn, will result in EEG alpha desynchrony, particularly in the left temporal (T3) and parietal (P3) regions (Box 8) along with increased noise or nonessential cortico-cortical communication between these regions and the motor planning centers (Box 4). Such disregulation of the cerebral cortex will be expressed as inconsistent input to the motor loop (Boxes 2 through 5), resulting in inconsistent corticospinal output and motor performance (motor unit activity—trigger pull; Boxes 9 and 10). It is well established that attention capacity shrinks with arousal; consistent with this notion, the excessive cortico-cortical networking during heightened stress, as proposed here, would compromise information processing (Easterbrook, 1959). In addition, cardiovascular activity (vagal tone) will be inversely related to the activity in the central nervous system such that vagal tone will be reduced in the high-stress condition. Cortisol levels will rise, as indicated in Box 10, by the predicted alteration in endocrine function (i.e., primarily indexed by increased activation in the HPA axis). The magnitude of change specified in the model will

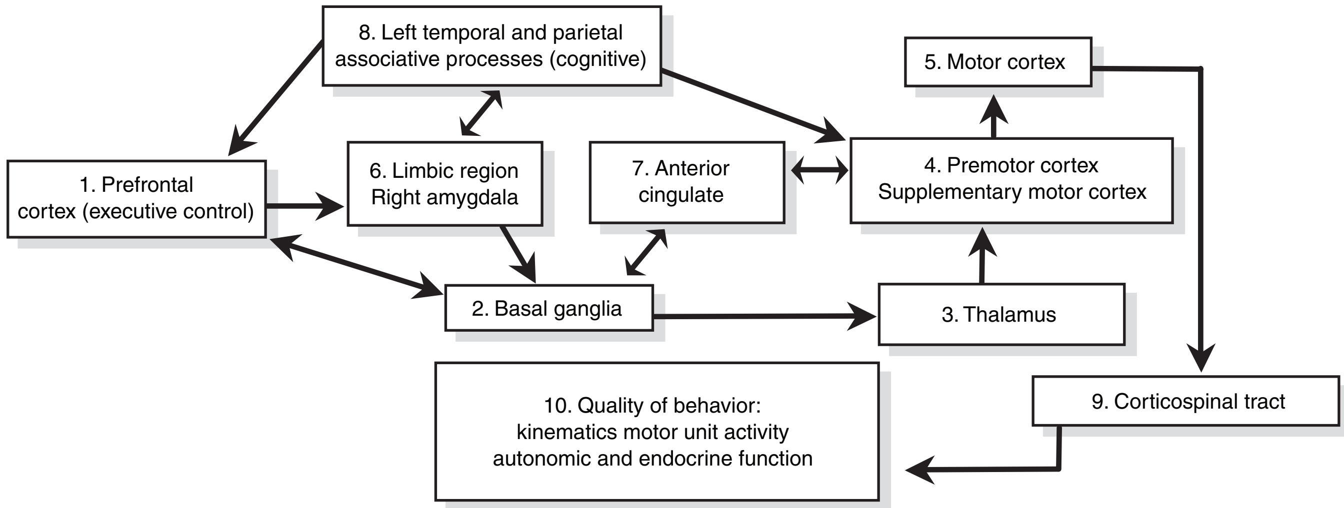

Figure 4.16 Neurobiological model of the fear circuit, with central roles of the amygdala (Box 6) and medial and orbital frontal regions (Box 1) in the expression and management of anxiety. The amygdalae (left and right) are largely responsible for the orchestrated response to fear-eliciting stimuli; however, the action of these important brain regions is affected by the prefrontal cortex (dorso-lateral, medial and orbital frontal regions) as well as the anterior cingulated region (Box 7) such that the higher centers can exert inhibitory control for the purpose of emotional regulation. Lack of control or hyperactivity of the amygdalae may cause interference and noise in the motor loop (basal ganglia and thalamus), resulting in unintended alterations in motor behavior.

be related to sport performance based on the nature of the changes and whether they are adaptive or maladaptive in relation to the task demands.

GENETIC BASES OF INDIVIDUAL DIFFERENCES IN STRESS REACTIVITY

There are individual differences in reactivity of the amygdalae in response to stressful events based on genetic factors. Variation in anxiety-related personality traits is 40% to 60% heritable. The disregulation of cortical processes with presentation of stress may be particularly problematic for carriers of the short alleles of the serotonin (5-HT) transporter gene (5-HTT), as this gene variant is strongly associated with hyperactivity of the amygdala during emotional tasks (Hariri et al., 2002). The genotypes are distributed according to the Hardy-Weinberg equilibrium as follows: LL—32%, LS—49%, and SS—19%. As such, there is a high degree of prevalence of this anxiogenic or anxiety-producing S allele. The S-type allele of the 5-HTT promoter region holds significant implications for information processing and motor control and is a critical component of a proposed individual differences model of the stress response. A more efficient response to stress in the L carriers would lead to enhanced information processing, more decisive decision making, and improved coordination of motor skills (a more intelligent response to stimuli). In military settings this biologically based disposition could increase performance under stress and survivability. In essence, S carriers may be considered stress-prone, whereas L carriers may be considered stress regulators. Recently, it has been well documented that the promoter region of the serotonin transporter gene is polymorphic such that those with the short allele (about 50% of population) show heightened activation of the amygdalae to emotion-eliciting stimuli, and those carrying the long allele show attenuation of fear (Hariri et al., 2002). This would imply that frontally mediated executive control of the "fear circuit" is critical for a large segment of the population who are predisposed to be especially reactive. In addition to such biologically based differences in anxiety response, genetic variation or polymorphism in neurotrophic factors such as brain-derived neurotrophic factor and nerve growth factor would imply that some individuals could experience adaptive alterations in the brain due to neural plasticity from practice and performance to a greater extent than others. This would imply that some individuals have an advantage in altering the architecture of the central nervous system to reap any advantages from practice and training such as efficiency of neural networks.

CONCLUSION

The present review began with the theme of economy of effort as a marker of superior psychomotor performance. The study by Haufler et al. (2000) offered powerful evidence for this phenomenon by contrasting the EEG spectral content during rifle marksmanship in experts versus novices. In line with the position advanced by Sterman and Mann (1995), in which EEG alpha is inversely related to cognitive load, experts showed remarkably reduced cerebral cortical activation relative to the novices. Such a finding of reduced cognitive load is consistent with the decreased cerebral metabolic profiles (using PET) associated with skill learning as reported by Haier et al. (1992). Furthermore, there seems to be a degree of specificity, in that this effect is largely related to reduced activation in cortical association areas that are nonspecific to the visuospatial task demands. For example, several authors have reported relative synchrony in the left temporal area during target shooting in high-skill performers and relative activation in the right posterior regions, which seems logical in those who have reached the stage of automaticity. Smith et al. (1999) showed a similar effect during the playing of a video game (Space Fortress) such that EEG alpha synchrony was noted in the left hemisphere during the visual-spatial challenge, whereas right posterior parietal activity was characterized by relative desynchrony or activation. In this regard, the participants seem to be characterized by specific allocation of neural resources to the task demands; that is, experience with the task results in an appropriate fit of neural resources to demand and a reduction in irrelevant processing. Such a process seems entirely consistent (albeit much more complex) with the concept of specific adaptation to imposed demand evidenced in other physiological systems and is essential to the process of focused attention, adaptive cognitive motor behavior, and high-quality motor performance.

In addition to conceptual models of cortical function in skilled performers, a number of technical advances may help to clarify the manner in which the cerebral cortex orchestrates superior motor performance. In particular, the sport performance EEG research has typically employed few electrode sites, although dense electrode arrays consisting of 32, 64, 128, or 256 sites allow for greater spatial resolution and dipole or source localization. Such spatial resolution along with the superior temporal resolution of EEG allows for a powerful measurement tool to assess dynamic cortical function during psychomotor preparation and performance. But such measurement sophistication needs to be applied with study designs that allow for cognitive inference (such as employed by Hatfield et al., 1984, Study 2), as opposed to simple description of regional activation patterns. Furthermore, the neural structures involved in skillful motor behavior are much more extensive than those considered in the sport EEG research.

In addition, this field of research is largely undeveloped in terms of studies in which psychological stress is applied to participants to determine the manner by which cerebral cortical processes are disrupted or perturbed by anxiety and tension. In particular, fMRI studies with the spatial resolution to detect subcortical limbic activity during the imposition of stress need to be conducted. In this regard, Milton et al. (2004) described reduced activity in the amygdala of expert golfers compared to novices while imaging the golf stroke; this difference was likely due to a reduction in self-awareness and, possibly, anxiety in the advanced performers. Although deep neural structures such as the amygdala cannot be assessed with surface EEG, future studies using this technology are needed that assess the complex networking relationships between relevant cortical regions during stress, such as the frontal executive processes and anterior and posterior cingulate, in addition to temporal and parietal activity.

In this regard, specified personality types, or genotypes that underlie such phenotypic expressions as trait anxiety, may be differentially responsive to stress manipulations such that defined categories of cortical networking patterns may begin to emerge. Such process-oriented studies, as opposed to outcome-oriented studies, may allow for understanding of the central neural mechanisms by which personality and stress are related to skilled motor performance. To elicit emotion, meaningful cognitive-motor challenges also need to be carried out in realistic environments that engage the study participants. Virtual reality technology offers exciting possibilities by which critical environmental events can be simulated and presented to athletes and military personnel who are likely to engage the tasks in a serious manner. Such environments are conducive to EEG recording while performing under pressure so that sensory, attentional, cognitive, emotional, and motor processes can be monitored. For example, EEG recording could be conducted with military personnel in simulated warfare environments to assess brain responses to enemy combatants as a function of military experience, personality, and genetic characteristics. Such measurements may also enable assessment of treatment effectiveness using cognitive-behavioral and neurofeedback interventions.

Hopefully, the lessons learned from such studies will transfer to the real world and increase the effectiveness of soldiers in the field as they perform challenging mental and physical tasks under extreme conditions. Ultimately, with the advent of high-quality telemetry of brain activity we will be able to assess brain activity in the field. One can only imagine the exciting possibilities for the acquisition of knowledge if the classic studies on emotion regulation in sport parachutists as conducted by Fenz (1975) had included brain activity in addition to the peripheral physiological measures of heart rate, skin conductance, and respiration. Advances in engineering applied to telemetry of EEG would allow incredible insights into the workings of the brain under stress. The theoretical model discussed earlier and supported by the studies conducted to date (i.e., regional relaxation, efficient networking, and psychomotor efficiency) may provide a benchmark or target profile by which to gauge the effectiveness of the brain of the soldier or athlete to engage and execute his or her responsibilities.

Finally, studies are needed that incorporate multiple measures in addition to cerebral cortical assessment. For example, stress-related studies that examine cortical dynamics, EMG activity, autonomic activity, and kinematic analyses of limb movement are needed to determine how cognitive-motor behavior is controlled from a systems perspective. This kind of approach has been attempted by some investigators who have observed the relationship between EEG during skilled motor behavior and other aspects of performance, such as the quality of limb movement (Contreras-Vidal & Buch, 2003) and concurrent eye movements or gaze behavior (Janelle, Hillman, Apparies, Murray, et al., 2000). At the present time, such studies are generally lacking but are needed to see how cortical activity covaries with other biological systems to explain the linkage of nervous system activity to the quality of motor behavior and further explain variability in performance.

The relevance of this work to the sport practitioner lies in the overwhelming support in the scientific literature for the notion that high-level performance is marked by economy of brain activity that underlies mental processes. Coaches should structure the practice environment to facilitate the emergence of this state. That is, instructional strategies should be simple and focus on correct ways of executing skills as opposed to emphasis on what not to do. In addition, the teaching style should be primarily based on reinforcement rather than punishment. Coaches should focus on elements of skill learning that the athlete is doing correctly and reward appropriately rather than emphasizing the reduction of mistakes. In this manner leadership style may be profoundly related to the neural dynamics associated with effective skill learning and the scientific literature can provide the coach with a concrete rationale, or neurophilosophy, for the adoption of a coaching style that helps the athlete to achieve high-quality performance.

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PART II

Social Perspectives

CHAPTER 5

Leadership in Sports

PACKIANATHAN CHELLADURAI

This chapter outlines the major initiatives that have been undertaken in the study of leadership in sports. The first section discusses the various models of leadership that have been advanced and the associated measures of leadership. As extensive reviews of this leadership research have recently appeared (e.g., Chelladurai, 1990, 1993; Chelladurai & Riemer, 1998; Horn, 2002), this section provides a general overview of two of the models; readers are well advised to peruse the above reviews for more in-depth perspectives on the research in question. The second section describes the additions and modifications to existing models and measurement scales as well as the newer models and scales of leadership. The final section advances the notion that pursuit of excellence/expertise calls for forms of leader behavior that are distinct from those that have been described in the sport literature.

THE MEDIATIONAL MODEL OF LEADERSHIP

The original mediational model of leadership (R. E. Smith, Smoll, & Hunt, 1978) consisted of (a) coach behaviors, (b) players' perceptions and recollections of those behaviors, and (c) players' evaluative reactions. The cognitive processes of perceptions, recall, and reactions are as important as the behaviors themselves. Research on this model led the authors to revise it to include the situational and individual difference variables that influence coach behaviors, player perceptions and recollections, and players' evaluative reactions (Smoll & Smith, 1989). The complete model is shown in Figure 5.1.

The situational factors influencing the central elements of the model (i.e., coach behavior, players' perceptions/recollections of those behaviors, and reactions to them) are the nature of the sport, practice sessions versus games, previous team success/failure, current status in competitions, level of competition (i.e., recreational versus competitive), and interpersonal attraction within the team. The relevant coach characteristics include personal goals and/or motives, behavioral intentions, instrumentalities (i.e., perceived probability that a valued outcome will occur as a consequence of a behavior), the perceived norms associated with the role of the coach, inferences regarding player motivation, self-monitoring, and the coach's gender. Finally, the player individual difference variables are age, gender, perception of coaching norms, the valence attached to coaching behaviors, sport-related achievement motivation, competition anxiety, general self-esteem, and athletic self-esteem. The fundamental thrust of the mediational model was well articulated by Smoll and Smith (1989, p. 1532) when they said that "a truly comprehensive model of leadership requires that consideration be given not only to situational factors and overt behaviors, but also the cognitive processes and individual difference variables which mediate relationships between antecedents, leader behaviors, and outcomes." Hence, the emphasis is placed on player recall and evaluation of coach behaviors.

Measures of Leadership and Member Reactions

In conjunction with proposing their model, R. E. Smith, Smoll, and their associates also developed measures of leader behavior (observational method), athlete's perceptions and recollections of leader behavior (interview), athlete's affective reactions to the sport experience (interview), and coach's perceptions of own behavior (paper and pencil). The Coaching Behavior Assessment System (CBAS) is an observational scheme where 12 categories of leader behaviors (shown in Table 5.1) are observed and recorded.

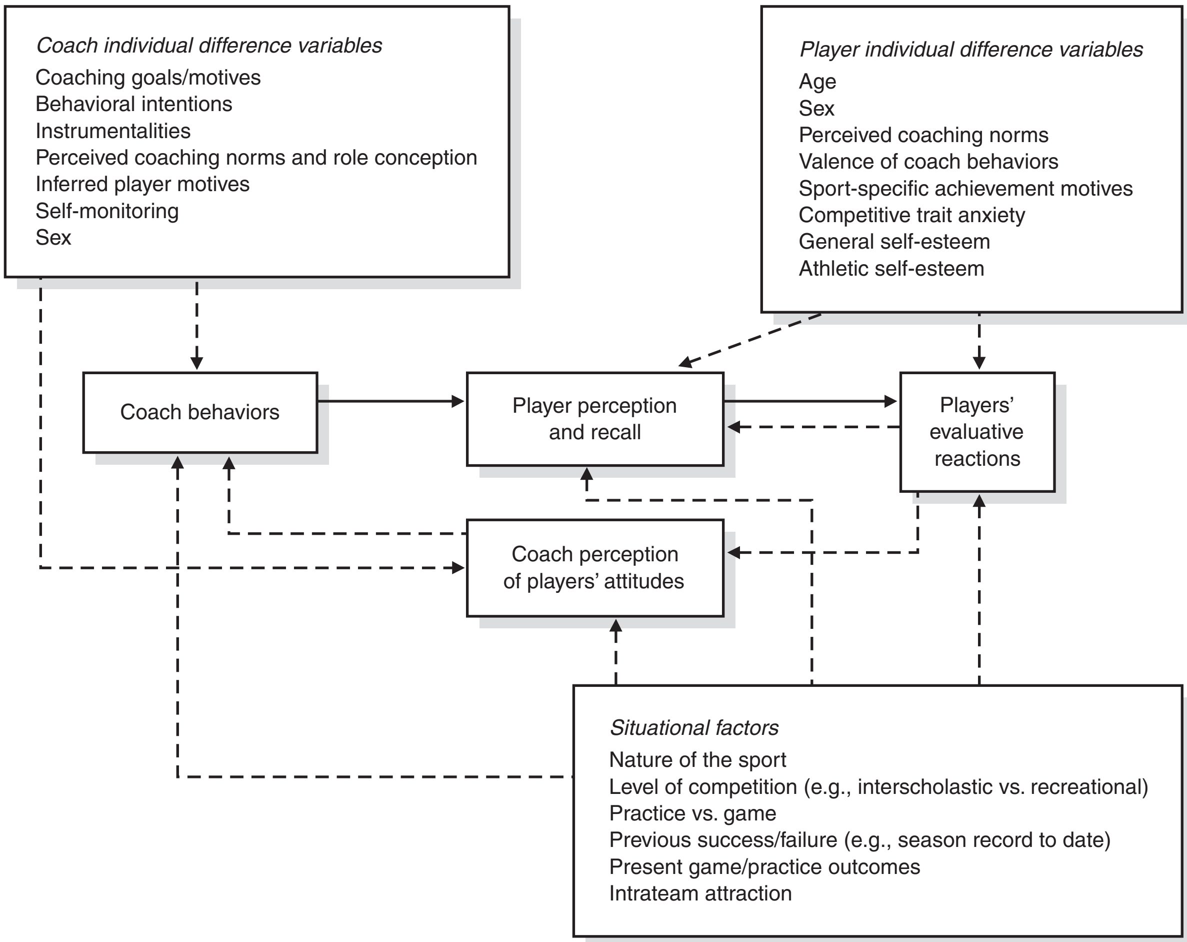

Figure 5.1 The mediational model of leadership. *Source:* "Leadership Behaviors in Sport: A Theoretical Model and Research Paradigm," by F. L. Smoll and R. E. Smith, 1989, *Journal of Applied Social Psychology, 19,* pp. 1522–1551. Reprinted with permission.

Some of these categories are reactive in that they are responses to immediately preceding player/team behaviors, such as desirable performances, mistakes, or misbehaviors. Other categories are spontaneous behaviors that are initiated by the coach without reference to any immediately preceding events. These spontaneous behaviors may be either game-related behaviors of technical instruction, encouragement, and organization, or game-irrelevant behaviors of general communication (R. E. Smith et al., 1977).

The frequencies with which a coach exhibits each one of the 12 categories of leader behaviors is the measure of actual behavior. One or more observers record the number of times a coach engages in a specified form of behavior. The steps taken to ensure the reliability of the coding system included extended study of a training manual (R. E. Smith, Smoll, & Hunt, 1977), group instruction in the use of the scoring system using a training videotape (R. E. Smith, Smoll, Hunt, & Clarke, 1976), written tests that require defining the 12 categories and scoring behavioral examples, scoring videotaped sequences, and extensive practice and reliability checks in actual field settings (R. E. Smith et al., 1977; R. E. Smith, Zane, Smoll, & Coppel, 1983). Additional assessment included the extent of agreement between two individuals in coding the leader behaviors or between two time-lagged codings by the same individual. With such rigorous steps, the agreement among raters in coding ranged from 87.5% to 100% (R. E. Smith et al., 1977, 1983). Interrater reliability has also been operationalized as the correlation of the coding frequencies between a pair of observers across the 12 categories. These correlations ranged from .77 to .99 for a mean of .88 in one study and from .50 to .99 for a mean of .88 in the second study reported by R. E. Smith et al. (1977). R. E. Smith et al. (1983) further reported that the correlations of the frequencies of observed leader

Table 5.1 Response Categories of the Coaching Behavior Assessment System

	Class I: Reactive Behaviors
Responses to Desirable Performance	
Reinforcement	A positive, rewarding reaction, verbal or nonverbal, to a good play or good effort
Nonreinforcement	Failure to respond to good performance
Responses to Mistakes	
Mistake-contingent encouragement	Encouragement given to a player following a mistake
Mistake-contingent technical instruction	Instructing or demonstrating to a player how to correct a mistake
Punishment	A negative reaction, verbal or nonverbal, following a mistake
Punitive technical instruction	Technical instruction given in a punitive or hostile manner following a mistake
Ignoring mistakes	Failure to respond to a player mistake
Response to Misbehavior	
Keeping control	Reactions intended to restore or maintain order among team members
	Class II: Spontaneous Behaviors
Game-Related	
General technical instruction	Spontaneous instruction in the techniques and strategies of the sport (not following a mistake)
General encouragement	Spontaneous encouragement that does not follow a mistake
Organization	Administrative behavior that sets the stage for play by assigning duties, responsibilities, positions, etc.
Game-Irrelevant	
General communication	Interactions with players unrelated to the game

Source: "A System for the Behavioral Assessment of Athletic Coaches," by R. E. Smith, F. L. Smoll, and E. B. Hunt, 1977, *Research Quarterly, 48,* pp. 401–407. Reprinted with permission.

behaviors in a field setting by an observer and an expert ranged from .85 to .98 (median = .96) across all the behavioral dimensions except nonreinforcement and ignoring mistakes. Other authors have also provided evidence of a high degree of agreement between raters (e.g., Chaumeton & Duda, 1988; Horn, 1985).

To assess players' perceptions of coach's behavior, Smith, Smoll, and Curtis (1978) developed the CBAS Perceived Behavior Scale (CBAS-PBS). In the scale, the players are provided with a verbal description and example of each of the 12 behavioral dimensions and then asked to indicate how frequently the coach engaged in each of those behaviors on a 7-point scale (1 for "almost never" to 7 for "to almost always"). Similarly, coaches are asked to indicate on 7-point scales (1 for "almost never" to 7 for "to almost always") the extent to which they engage in each of the behaviors. As these are single-item scales, reliability cannot be established. For a critique of these measures, see the review by Chelladurai and Riemer (1998).

With regard to players' evaluative reactions, players were asked to respond to a number of questions, varying from 6, to 8 (Barnett, Smoll, & Smith, 1992; Smoll, Smith, Barnett, & Everett, 1993), to 10 (R. E. Smith & Smoll, 1990; Smoll, Smith, Curtis, & Hunt, 1978), and finally to 11 items (R. E. Smith, Smoll, & Curtis, 1979). The items were scored on a 7-point Likert-type scale. Although there has been a report of the emergence of two factors from these items labeled *attraction toward the coach* and *attraction toward and cooperation with teammates* (Smoll et al., 1978), they have not been emphasized in subsequent research.

Although the 12-category CBAS is much more comprehensive than other leadership scales in sport (e.g., Chelladurai & Saleh's, 1980, Leadership Scale in Sport; to be discussed later), R. E. Smith and Smoll (1990, p. 991) have cautioned that the CBAS does not tap into important aspects of "coaching behaviors, such as verbal and nonverbal responses, magnitude of reinforcement, quality and duration of instruction, and so forth." In their review of the work of R. E. Smith, Smoll, and associates, Chelladurai and Riemer (1998) concluded that their comprehensive 12-dimensional scheme captures most of the meaningful coaching behaviors and commended them for developing measures to assess the variables of the study. It is noteworthy that R. E. Smith, Smoll, and associates have measured leadership from three different sources: the observers, the players, and the coaches themselves. Such an approach also highlights the difficulties emanating from the discrepancies among the three sets of scores. An important finding from their research is that coaches tended to behave consistent with their own goals and instrumentalities (their perceptions of what behaviors would lead to what goals). As noted by Chelladurai and Riemer, this finding underscores the need to assess coaches' goals in any attempts of training and development of coaches. In fact, R. E. Smith, Smoll, and associates have developed training programs for coaches and have found that such training has positive impact on coaches and players (e.g., R. E. Smith & Smoll, 1997; R. E. Smith, Smoll, & Barnett, 1995; R. E. Smith, Smoll, & Christensen, 1996; Smoll et al., 1993).

Recent Questionnaire Measures of the Coaching Behavior Assessment System

As the mediational model of leadership has great appeal for researchers and practitioners, it is not surprising that there have been two significant efforts to improve the measurement of some of the key concepts of the model. These are described next.

Coaching Feedback Questionnaire

A fundamental edict of Smoll and Smith (1989, p. 1527) is this:

> The ultimate effects of coaching behaviors are mediated by the meaning that players attribute to them. In other words, cognitive and affective processes serve as filters between overt coaching behaviors and youngsters' attitude toward their coach and their sport experience.

Yet, player evaluative reactions were not adequately measured in earlier research by Smoll and Smith and their associates. Amorose and Horn (2000) expanded and modified earlier scales to develop the Coaching Feedback Questionnaire (CFQ) to measure athletes' perceptions of the types of feedback provided by their coaches.

The CFQ contains 16 items to measure eight categories of feedback, including three categories of responses to players' performance successes in terms of *praise/reinforcement, nonreinforcement,* and *reinforcement combined with technical instruction,* and five categories of responses to errors reflected in *mistake-contingent encouragement, ignoring mistakes, corrective instruction, punishment,* and *corrective instruction combined with punishment.* As Amorose and Horn (2000) note, these categories correspond to those of the CBAS, specifically the reactive behaviors outlined by R. E. Smith et al. (1977). The respondents are required to indicate how typical it is for their coach to give them that particular type of feedback during practice and games on a 5-point scale ranging from "very typical" to "not at all typical."

Factor analysis of these 16 categories resulted in three meaningful factors: Positive and Informational Feedback, Punishment-Oriented Feedback, and Nonreinforcement/Ignoring Mistakes. The alpha values were .72, .83, and .78, respectively. Amorose and Horn (2000, p. 69) administered both the Leadership Scale for Sports (LSS) perceived version and the CFQ to their respondents, university-level athletes, because "the LSS provides a more general measure of leadership styles, while the CFQ provides a more specific measure of coaching behavior with regard to feedback patterns." They found that respondents high on intrinsic motivation perceived their coaches to be high on training and instruction and democratic behaviors and low in autocratic behavior (dimensions of LSS). In addition, intrinsically motivated athletes perceived their coaches to be high on positive and information-based feedback and low on punishment-oriented and ignoring behaviors (dimensions of CFQ). It is unfortunate that Amorose and Horn did not report the relationships between the dimensions of LSS and CFQ. Recently, L. S. Smith, Fry, Ethington, and Li (2005) factor-analyzed the CFQ items with the data of female high school basketball players and derived three factors: Positive Feedback (4 items), Punishment (6 items), and Ignoring Mistakes (2 items). They found that all three dimensions were significant in explaining 38% of the variance in perceived task climate, and positive feedback and punishment explained 27% of the variance in perceived ego-involving climate. (See Chapter 1 for discussion of task and ego climates.)

Coaching Behavior Questionnaire

To study the relationship of anxiety and self-confidence with the evaluation of coaching behaviors, Kenow and Williams (1992) developed their 28-item Coaching Behavior Questionnaire (CBQ); 21 are substantive items and 7 are filler items. The response format is a 4-point Likert scale ranging from 1 ("strongly disagree") to 4 ("strongly agree"). These items purported to measure athlete's perceptions of the coach's ability to communicate, the confidence displayed by the coach, the coach's composure and emotional control, and the effects of the coach's arousal level on athletes. These authors used the composite of the 21 items as a measure of coaching behavior. They found that higher levels of trait anxiety and state cognitive anxiety and lower self-esteem among athletes were associated with more negative evaluation of the coach's behavior. In a later study, Kenow and Williams (1997) derived five factors from the substantive items: Cognitive/Attentional Effects of Coach's Behavior, Supportiveness, Emotional Control and Composure, Communication, and Somatic Effects of Coach's Behavior. They found significant correlations between state somatic anxiety and coach's emotional control and composure, and between cognitive anxiety and perceived somatic effects of coach's behavior.

In the most recent refinement of the CBQ, Williams et al. (2003) noted that R. E. Smith and Smoll's mediational model provided the theoretical framework for the CBQ, which was focused on measuring athlete perceptions and evaluative reactions to both positive and negative coaching behaviors. They first carried out an exploratory factor analysis (EFA) with a random half of the responses to the CBQ by 484 college and high school athletes. They accepted two-factor and three-factor solutions as tenable. Then they used the data of the other half of the sample to carry out a confirmatory factor analysis (CFA). In the CFA, the two-factor model emerged as the best (compared to single-factor and three-factor models). The first factor, Negative Activation, contains 7 items reflecting the effects of leader behavior on athletes (e.g., "My coach's behavior during a game makes me feel tight and tense"; "My coach makes me feel uptight"). The second factor, Supportiveness/Emotional Composure, has 8 items to measure athletes' perceptions of coaching behavior (e.g., "My coach is appropriately composed and relaxed"; "My coach shows support for me even when I make mistakes"). The internal consistency estimates (Cronbach's alpha) were .82 and .83, respectively.

The latest version of the CBQ (Williams et al., 2003) measures both the behavior of the coach (i.e., Supportiveness/Emotional Control) and the effects of such behavior (i.e., the Negative Activation dimension). This is in contrast to R. E. Smith, Smoll, and associates' approach to measuring these two constructs through separate measures and separate methodologies. It is also different from Amorose and Horn's (2000) CFQ, which measures only the feedback provided by the coach. It is intriguing, however, that Williams et al. resorted to EFA to derive new factors when the data could have been subjected to CFA with the a priori factor structure proposed by Kenow and Williams (1992) or the 5-factor structure derived in Kenow and Williams (1997).

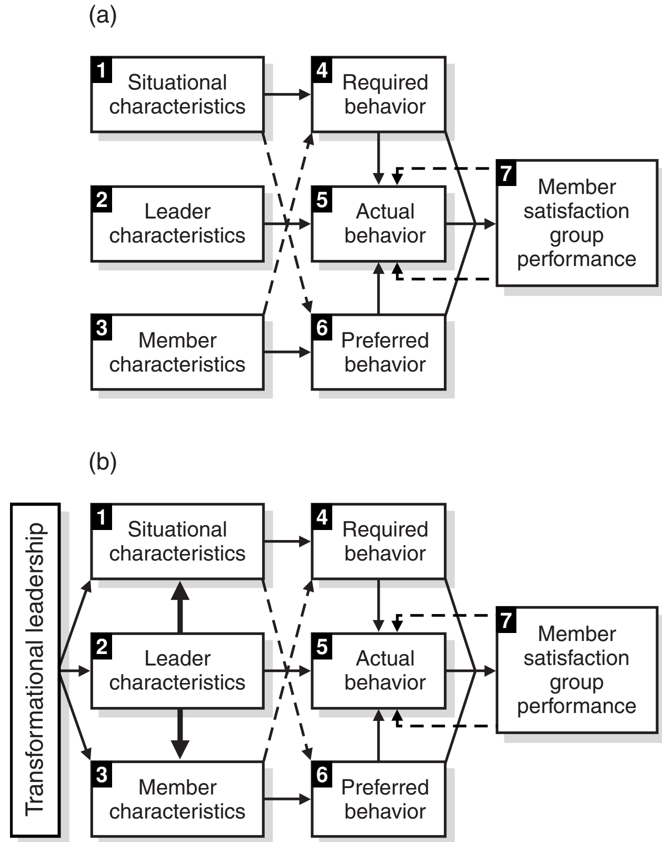

Figure 5.2 (a) The multidimensional model of leadership; (b) Transformational effects of leader behavior in the multidimensional model of leadership.

THE MULTIDIMENSIONAL MODEL

Chelladurai's (Chelladurai, 1978, 1993; Chelladurai & Carron, 1978) multidimensional model (shown in Figure 5.2a) incorporates three states of leader behaviors: *required* (Box 4), *preferred* (Box 6), and *actual* (Box 5). It is envisaged that the *situational characteristics* (Box 1), composed mainly of the goals of the group, the type of task (e.g., individual versus team, closed versus open tasks), and the social and cultural context of the group, set the parameters for the required behavior. That is, these situational characteristics place some prescriptions on the kinds of behaviors the leader should engage in and also some proscriptions on the kinds of behaviors that should be eschewed. For example, the leader should be demanding and directing when coaching an elite team of adults (e.g., a university athletic team) but be gentle and soft when leading a youth sports team.

Preferred behavior (Box 6) refers to the preferences of members for instruction and guidance, social support, and feedback. These preferences are largely a function of member characteristics (Box 3), including personality (e.g., need for achievement, need for affiliation, cognitive structure) and ability related to the task. It is acknowledged in the model that the members of the group also recognize the situational requirements. Therefore, their preferences for specific forms of behavior from the leader will be partly shaped by those situational contingencies. By the same token, the required behavior will be partly defined by the nature of the group. Whereas preferred behavior is a reflection of individual differences within the group, the group as a whole may differ from another group in terms of gender, age, skill level, and so on. Thus, the leader behavior required in the context of one group (e.g., collegiate team or a men's team) may be different from those required in the case of another group (e.g., youth sports team or a women's team).

The actual behavior (Box 5) is largely a function of the leader's characteristics, including personality, expertise, and experience. The multidimensional model, however, stipulates that the actual behavior will also be shaped by the required behavior and the preferred behavior. That is, the leader will be cognizant of the prescriptions and proscriptions imposed by the situation. At the same time, the leader will be attuned to the preferences of the members of his or her group. In sum, the three factors of leader's personal characteristics, situational requirements, and member preferences underlie the actual behavior.

Congruence Hypothesis

The major proposition of the theory is that the degree of congruence among the three states will influence the outcome variables of performance and member satisfaction (Box 7). That proposition underscores the need for the leader to juggle and balance the demands imposed by the situation and the preferences of the members. There are two feedback loops from performance and member satisfaction to actual behavior. A leader is likely to alter behavior based on the relative attainment of the outcome variables. If the performance of the group fails to reach expectations, the leader is likely to emphasize task-oriented behaviors to enhance the performance capabilities of the group. If the leader perceives that the members are not satisfied with the leader and/or the group and their involvement, the leader is likely to focus more on those behaviors that would foster warm interpersonal interactions between the leader and members and among the members.

Value versus Perceptual Congruence

In their study of leadership and cohesion in sport, Shields, Gardner, Bredemeier, and Bostro (1997) conceived of two types of congruence, *value congruence* and *perceptual congruence,* relating to member preferences for leadership, their perceptions of leadership, and leader's perception of his or her own leadership. Value congruence refers to the congruence between athletes' perceptions and preferences. Athletes "are likely to interpret the discrepancy in terms of a gap between how the coach and the athlete value a particular behavior" (pp. 198–199). Perceptual congruence refers to the extent to which the athlete and the coach agree on the behavior of the coach. Noting that research in other areas has shown that perceptual disagreement has been associated with interpersonal problems such as marital distress and communication disruptions, these authors assumed that "perceptual congruence is an important construct to consider in investigating the relationship between sport leadership and team cohesion" (p. 199). They found that higher levels of task-oriented behaviors (i.e., training and instruction, positive feedback, and democratic behavior) were more strongly associated with task cohesion. (Please see Chapter 6, for a discussion of task and social cohesion.) They also found that although both types of value and perceptual congruence were strongly associated with cohesion, the association was stronger in the case of perceptual congruence. They conclude that "it is more important for athletes to agree with their coach on what 'is' than to share common opinion regarding what 'ought to be' " (p. 208).

Analytical Issues with Congruence

Finally, the congruence hypothesis fundamental to the multidimensional model poses some analytical issues. The common conception that the discrepancy scores adequately represent congruence is fraught with danger, as discrepancy scores have been shown to be unreliable (e.g., Johns, 1981). Therefore, it is suggested that hierarchical regression analysis be employed to test the congruence hypothesis (Chelladurai, 1993; Chelladurai & Riemer, 1998). That is, the main terms (e.g., preferred and perceived leadership) should be entered first, followed by the interaction term of the main terms (i.e., preferred × perceived scores) in the second step. If the contribution of the interaction term to the explained variance is significant, then the congruence hypothesis is supported. This was the approach taken by H. Reimer and Chelladurai (1995) in their finding that the congruence hypothesis was supported.

In contrast, Reimer and Toon (2001) did not find support for the congruence hypothesis employing the same technique. Riemer and Toon studied the effects of leader behaviors as measured by the LSS on four facets of satisfaction as measured by Riemer and Chelladurai's (1998) Athlete Satisfaction Questionnaire: training and instruction satisfaction, personal treatment satisfaction, team performance satisfaction, and individual performance satisfaction. In their study of collegiate tennis players, the preference scores were higher than perceptions in all dimensions except autocratic behavior. More important, they used the technique of hierarchical regression analyses to test the congruence hypothesis. As the interaction terms in the regression analyses were not significant, they concluded that the congruence hypothesis was not supported in any of the chosen facets of satisfaction.

Outcome Variables

The inclusion of performance and satisfaction as the outcome variables is justified on the basis that one reflects group goals and the other relates member reactions to their experiences. As Courneya and Chelladurai (1991) noted, several of the measures related to performance (e.g., win-loss percentage, the difference between points scored for and against the team, and the ratio of final score of the two contestants) are contaminated by random chance, opponent's outstanding performance, strategic choices made by the team/coach, and officials' wrong calls. One way to avoid this pitfall is to use player perception of individual and team performance (e.g., Chelladurai, 1984; Horne & Carron, 1985). Another way is to assess players' satisfaction with their own performance and that of the team. These two facets have been highlighted as related to product (Chelladurai & Riemer, 1997) and are included in the recently developed Athlete Satisfaction Questionnaire (Riemer & Chelladurai, 1998). In this regard, Chelladurai and Riemer (1998) pointed out the difficulty of player perceptions of performance being closely related to their affective reactions to such perceptions (i.e., satisfaction). Thus, it may prove problematic to separate the two measures, perceived performance and satisfaction thereof, particularly if a study includes both performance and satisfaction as outcome measures.

From a different perspective, the outcomes need not be confined to performance and/or member satisfaction. Coaching behavior can affect several other outcomes related to the athlete and/or the team. For instance, Price and Weiss (2000) have shown that coach's level of burnout influenced his or her behavior, and that coach's behavior had an effect on players' psychological responses. More specifically, coaches who were more emotionally exhausted were perceived by their players as more democratic and less autocratic and as providing less training and instruction and social support on the LSS dimensions. More germane to the present context is that coaches who were perceived to be less democratic and more autocratic and lower on training and instruction, social support, and positive feedback had players who were higher on anxiety and burnout and lower on enjoyment and perceived competence.

Gardner, Shields, Bredemeier, and Bostrom (1996) found that coaches perceived to be high on training and instruction, democratic behavior, social support, and positive feedback and low on autocratic behavior had teams high on task cohesion. Social cohesion was significantly associated with only training and instruction and social support. In a recent study of the relationships among leadership (LSS dimensions), cohesion (task and social), and outcome, Trail (2004) found that the leadership effects on outcomes (i.e., winning percentage, perceived success of team, satisfaction with team performance, and satisfaction with individual performance) were fully mediated by team cohesion. That is, leadership explained 38.8% of the variance in team cohesion, which, in turn, explained 39.8% of the outcomes. Trail noted that his results did not support Chelladurai's multidimensional model because the direct effect of leadership on outcomes was not significant.

Trail (2004) alerts us to an important issue. Although the multidimensional model specifies that the congruence of the three states of leader behavior leads to performance and satisfaction, it does not preclude such congruence to influence any mediating factors that would, in turn, influence outcomes. For instance, good leadership may enhance member ability and self-efficacy (i.e., member characteristics in the multidimensional model of leadership), which could result in better performances, as was the case with cohesion in Trail's study. For another example, consider Amorose (in press). In his review of the literature linking leadership styles (as measured by the LSS) and Ryan and Deci's (2000) self-determination theory, Amorose noted that, in general, the coaching behaviors measured by the LSS had significant influence on intrinsic motivation of athletes. In addition, these behaviors affected the three psychological needs of competence, autonomy, and relatedness which, in turn, influenced intrinsic motivation (Hollembeak & Amorose, 2005). Such intrinsic motivation should ultimately be related to enhanced performance and satisfaction. Hence, researchers need to be cognizant of other mediating and moderating variables that impinge on the general effects of leadership congruence on performance and satisfaction.

Leadership Scale for Sports

The LSS was developed in conjunction with the proposal of the multidimensional model of leadership so that the constructs of the model can be adequately tested. It consists of 40 items representing five dimensions of leader behavior: Training and Instruction (13 items), Democratic Behavior (9 items), Autocratic Behavior (5 items), Social Support (8 items), and Positive Feedback/Rewarding Behavior (5 items). These dimensions of leader behavior are described in Table 5.2.* Two of these dimensions (Democratic and Autocratic Behaviors) refer to the coach's style of decision making (i.e., the extent to which athletes are allowed to participate in decision making); two other dimensions (Training and Instruction and Positive Feedback) are task-oriented, and the fifth dimension (Social Support) is oriented toward creating a friendly and positive group climate. The response format refers to the frequencies of the behavior exhibited by the coach in five categories: (1) always, (2) often—75% of the time, (3) occasionally—50% of the time, (4) seldom—25% of the time, and (5) never.

Three versions of the LSS have been used to measure athletes' preferences for specific leader behaviors, athletes' perceptions of their coaches' leader behaviors, and/or coaches' perceptions of their own behavior.

Table 5.2 Dimensions of Leader Behavior in Sports

Dimension	Description
Training and instruction	Coaching behavior aimed at improving athletes' performance by emphasizing and facilitating hard and strenuous training; instructing them in the skills, techniques, and tactics of the sport; clarifying the relationship among the members; and structuring and coordinating the members' activities.
Democratic behavior	Coaching behavior that allows greater participation by the athletes in decisions pertaining to group goals, practice methods, and game tactics and strategies.
Autocratic behavior	Coaching behavior that involves independent decision making and stresses personal authority.
Social support	Coaching behavior characterized by a concern for the welfare of individual athletes, positive group atmosphere, and warm interpersonal relations with members.
Positive feedback	Coaching behavior that reinforces an athlete by recognizing and rewarding good performance.

Source: Manual for the Leadership Scale for Sports, by P. Chelladurai, 1989, Unpublished manuscript, University of Western Ontario, London, Canada.

Internal Consistency Estimates for the Leadership Scale for Sports Dimensions

The internal consistency estimates from selected studies are provided in Table 5.3. Although the estimates are adequate for four of the five dimensions, they were rather consistently low (<.70) for Autocratic Behavior. Estimates lower than .70 suggest that the items may not be measuring the same construct (i.e., the items are not from the same sampling domain). However, these values were .60 or higher in several studies listed in Table 5.3, a value considered marginal but acceptable for scales with fewer items (Amorose & Horn, 2000). But the problem may be more substantive than the mere number of items. Chelladurai and Riemer (1998, p. 239) pointed out:

> Two of the items in Autocratic Behavior refer to the aloofness of the coach (i.e., work relatively independent of the athletes; keep to him/herself), two refer to how he or she handles issues/decisions (i.e., not explain his or her action; refuse to compromise a point) and one seems to deal with how the coach addresses players (i.e., speaks in a manner not to be questioned). They certainly do not reflect autocratic behavior in the traditional sense (i.e., the opposite end of the continuum from democratic behavior).

So Chelladurai and Riemer suggested that the subscale be renamed "aloof behavior, authoritarian behavior, or inflexible behavior." But renaming (an easy process) does not solve the issue of low internal consistency of the items. Despite these low estimates, Autocratic Behavior with the same items emerged as a distinct factor in four different data sets. Accordingly, it would be wise to retain the dimension and strengthen it by adding more homogeneous items or split the dimension into two specific forms of behavior, such as aloofness and inflexibility (Chelladurai & Riemer, 1998). In their study of coach behaviors, coach burnout, and athlete burnout, Price and Weiss (2000) adopted the former strategy and added three more items to the Autocratic Behavior dimensions: (1) does not take into account athletes' suggestions when making decisions, (2) controls what athletes can do and cannot do, and (3) makes decisions regardless of

*Chelladurai (1993) noted that for the most part the content of the 12 behavioral categories of the CBAS (see Table 5.1) and the five dimensions of the LSS (see Table 5.2) are related. In the most recent study on the topic, Cumming, Smith, and Smoll (2006) empirically verified the parallel nature of the two instruments. They found "considerable convergence between measures of perceived coaching behaviors that originate from different theoretical and methodological traditions [i.e., the LSS and the CBAS-PBS], and their areas of convergence are also reflected in their relations with athletes' evaluative responses to their coaches" (p. 212). The players' evaluative responses related to their liking to play for the coach, coach's knowledge of the sport, and coach's teaching ability.

Table 5.3 Internal Consistency Estimates for the LSS Dimensions

Source	Dimensions				
	TI	DB	AB	SS	PF
Chelladurai and Saleh (1980):					
Canadian athletes	.83[a]	.75	.45	.70	.82
	.93[b]	.84	.79	.86	.92
Chelladurai et al. (1988):					
Japanese athletes	.81[a]	.72	.55	.72	.73
	.89[b]	.81	.57	.84	.81
Canadian athletes	.77[a]	.67	.55	.78	.77
	.88[b]	.76	.59	.84	.91
Isberg and Chelladurai (1990):					
Swedish athletes	.78[a]	.77	.44	.60	.57
	.88[b]	.72	.54	.86	.77
Kim, Lee, and Lee (1990):					
Korean athletes	.81[a]	.74	.61	.76	.66
	.86[b]	.83	.64	.80	.72
Iordanoglou (1990):					
Greek soccer players	.86[b]	.73	.11	.59	.60
H. Riemer and Chelladurai (1995):					
American university football players	.83[a]	.79	.57	.72	.80
	.89[b]	.85	.61	.83	.84
Gardner et al. (1996):					
Scholastic baseball/softball players	.88[b]	.83	.65	.81	.85
Price and Weiss (2000):					
American university female soccer players	.83[b]	.83	.71[d]	.80	.88
Amorose and Horn (2000):					
American university athletes	.89[b]	.83	.65	.82	.87
Riemer and Toon (2001):					
American college tennis players	.85[a]	.82	.67	.81	.81
	.88[b]	.86	.59	.78	.87
Shields et al. (1997):					
Baseball and softball players	.85[a]	.84	.62	.78	.85
	.88[b]	.83	.65	.81	.85
Baseball and softball coaches	.83[c]	.78	.62	.78	.68
Sullivan and Kent (2003):					
American and Canadian collegiate coaches	.83[c]	.79	.34	.51	.83
Trail (2004):					
American high school basketball players	.87[b]	.78	.46	.81	.86
Hollembeak and Amorose (2005):					
American university athletes	.91[b]	.85	.66	.78	.86

Note: TI = Training and Instruction; DB = Democratic Behavior; AB = Autocratic Behavior; SS = Social Support; PF = Positive Feedback.

[a] Athletes' preferences.

[b] Athletes' perceptions.

[c] Coaches' perceptions of own behavior.

[d] With three more items.

what athletes think. With these additional items, the alpha value for this dimension was .71.

Subscale Structure of the Leadership Scale for Sports

Several scholars have verified the subscale structure of the LSS (e.g., Iordanoglou, 1990; Isberg & Chelladurai, 1990; Kim, Lee, & Lee, 1990; Lacoste & Laurencelle, 1989; Serpa, Lacoste, Pataco, & Santos, 1988) but only through analysis of item-to-total correlations, a less rigorous technique. Chelladurai and Riemer (1998) employed the more rigorous method of confirmatory factor analysis to examine the construct validity of the preferred and perceived versions of the LSS (n = 317 and 217, respectively). They found the fit between the data provided by university football players and the measurement model was adequate as the selected indices met the acceptable standards ($\chi^2/df < 2$; root mean square error of approximation [RMSEA] = .06 and .062, respectively for the preference and perception versions). But two other indices were less than adequate (i.e., Bollen's, 1989, fit index of .78 and .85, respectively, and Tucker-Lewis Index of .77 and .83). More recently, Trail (2004) reported that although the test of close fit was rejected in the data of high school basketball players' perceptions, there was a reasonable fit (RMSEA = .058; $\chi^2/df = 1.65$) between the data and measurement model, indicating adequate construct validity for the LSS.

Chelladurai and Riemer (1998) noted that although there was enough evidence of adequate psychometric properties of the LSS, there was also the need to revise the scale in terms of its subscale structure. One area where such efforts may focus is to make the LSS more comprehensive such that it taps all the dimensions of critical coaching behavior. More specifically, Chelladurai and Riemer suggested that the essence of transformational leadership needs to be incorporated in the scheme. In the transformational process, coaches are expected to (a) incite the higher order needs of members, (b) motivate them to perform beyond expectations, (c) express confidence in members, and (d) empower them (e.g., B. Bass, 1985). This perspective is discussed in greater detail later in this chapter.

Revised Leadership Scale for Sports

Zhang, Jensen, and Mann (1997) modified and revised the LSS to include more dimensions and items. They kept the original five dimensions, the instructions, and response format of the LSS, as well as the same three versions, but they proposed two new dimensions of leader behavior: Group Maintenance Behavior and Situational Consideration Behavior. Group Maintenance Behaviors were "aimed at clarifying the relationship among the team members, structuring and coordinating the athletes' activities, and improving the coach-athlete relationship and team cohesion" (p. 109). Situational Consideration Behaviors were "aimed at considering the situation factors (such as the time, individual, environment, team, and game); setting up individual goals and clarifying ways to reach the goals; differentiating coaching methods at different stages; and assigning an athlete to the right position" (pp. 109–110). These authors began with interviews of 18 intercollegiate coaches and generated 240 new items to represent the seven dimensions. Then three linguistic experts perused the items and corrected them for proper English usage. In the next stage, 17 experts determined the appropriateness and clarity of the proposed factors and placed each of the 280 items in one of the seven dimensions. Based on the criterion of 70% agreement among these experts, 120 items were retained under the seven factors. The responses of (a) 696 athletes from NCAA Divisions I, II, and III on the preferred version, (b) 661 of the 696 athletes on the perception version, and (c) 206 coaches on the self-report version were subjected to factor analysis (unweighted least squares extraction with equamax rotation), which resulted in the emergence of six factors and the retention of 60 items to measure those six dimensions (8 to 12 items in the dimensions). The proposed Group Maintenance Behavior did not emerge as a distinct factor in the 6-factor solution. Noting that the items from this dimension loaded on other factors, Zhang et al. wrote, "In addition, many doubts exist regarding the actual existence of such a factor" (p. 113). It is not clear why they would have included the dimension in the first place if there were doubts about it.

The intercorrelations among the subscales were all less than .30. The internal consistency estimates were higher than .80 in all dimensions in all three versions except Autocratic Behavior, where it was .59 for the preference version, .48 for the perception version, and .35 for the coaches' self-report version. It is noteworthy that the dimension of Autocratic Behavior with added items in the Revised Leadership Scale for Sports (RLSS) continued to emerge from factor analyses of three different data sets, yet the internal consistency estimates remained as low as in other, earlier studies despite having more items. However, Jambor and Zhang (1997) subsequently reported that the alpha values were .84 for Training and Instruction; .66 for Democratic Behavior; .70 for Autocratic Behavior; .52 for Social Support; .78 for Feedback; and .69 for Situational Consideration.

As these authors proposed a 7-dimensional scheme of leader behaviors and had generated items to measure each dimension, it would have been most appropriate to have conducted confirmatory factor analyses instead of exploratory analyses. Further, it is unfortunate that Zhang et al. (1997) did not compare the RLSS to the original LSS, nor has there been any other investigation of the relationships between the two versions. Given that five of the six factors in the revised RLSS are same as the five dimensions of the LSS definitionally, the internal consistency estimates have not improved to any extent, and the substance of the emergent sixth factor in the RLSS could be subsumed by the five dimensions of the LSS, we have to await future studies employing both scales to demonstrate that the RLSS is superior. In the absence of such evidence, parsimony would dictate continued use of the shorter, 40-item, 5-dimensional LSS.

Horn's (2002) Model of Coaching Effectiveness

The foregoing advances relate to the measurement of the variables of the two dominant leadership models in sport. Taking a different approach and in an attempt to bridge the literature on the mediational model and the multidimensional model, Horn (2002) has advanced her coaching effectiveness model, shown in Figure 5.3. While it appears to be more complex than either of the previous models, Horn summarizes the salient points of her model: (a) Identifiable antecedents, shown in Boxes 1 to 3, influence a coach's behaviors (Box 5) as mediated by that coach's expectancies, values, beliefs, and goals (Box 4); (b) a coach's behaviors affect athletes' performance and behavior directly (Boxes 5 and 6), as well as indirectly through athletes' perceptions, interpretation, and evaluation of coach's behaviors (Box 8), which influence athletes' self-perceptions, beliefs, and attitudes (Box 9), which, in turn, influence athletes' level and type of motivation (Box 10). Horn claims that she has drawn the constructs of the model and the linkages among them from several theories, including achievement goal theories, attribution theory, competence motivation theory, the expectancy-value model, self-determination theory, self-efficacy theory, and the sport commitment model.

The sociocultural context and organizational climate in Horn's (2002) model may be subsumed under the situational characteristics in Chelladurai's multidimensional model, and coach's personal characteristics and coach's expectancies, values, and beliefs are tantamount to leader characteristics in the multidimensional model. Similarly, athletes' personal characteristics, athletes' level and type of motivation, and athletes' self-perceptions, beliefs, and attitudes are implicitly included in members' characteristics in the multidimensional model. Horn has adapted the mediational processes of Smoll and Smith's (1989) model

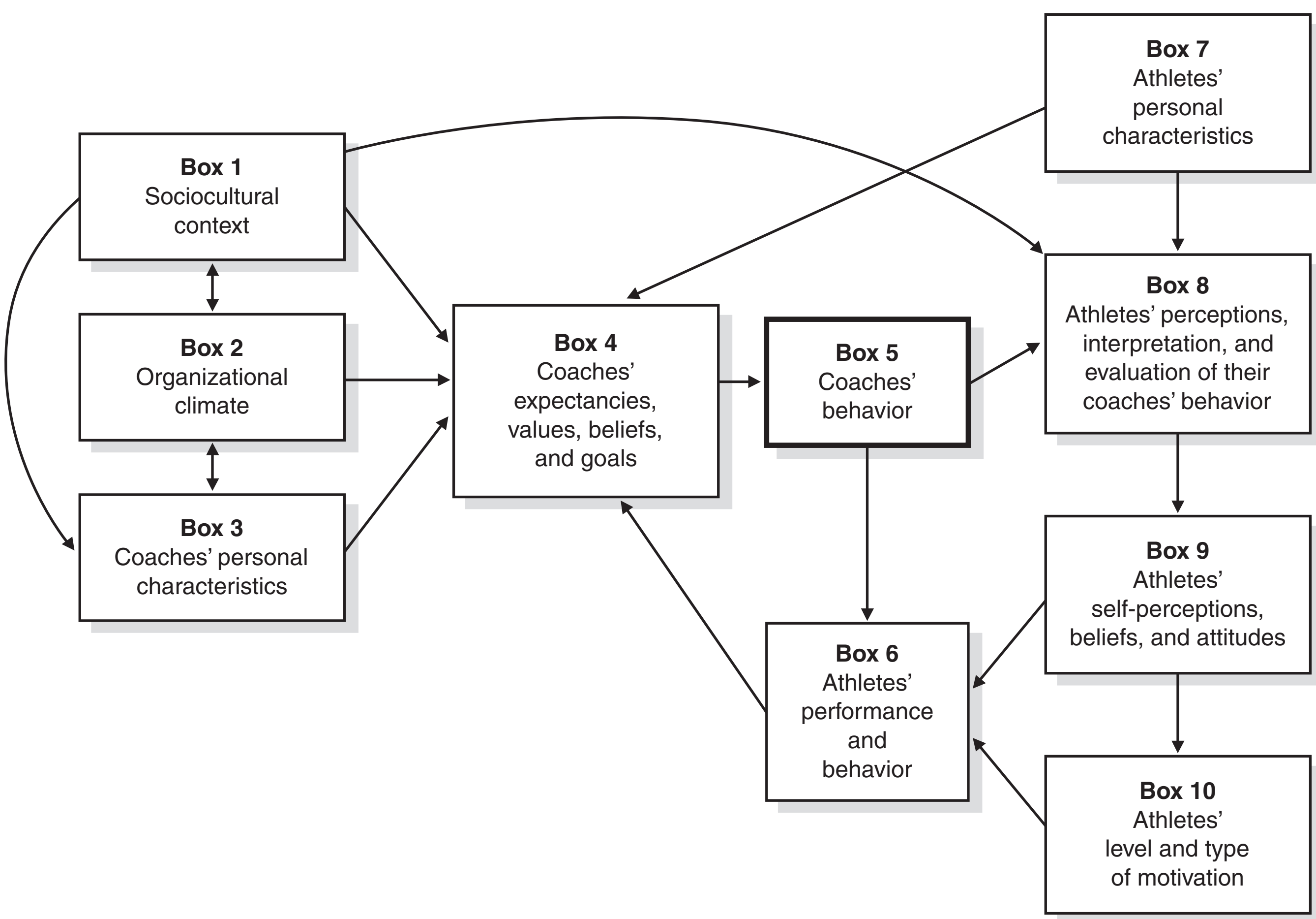

Figure 5.3 The coaching effectiveness model.

and articulates them as sequential outcomes of leader behaviors that influence athletes' performance and behavior. The efficacy and utility of Horn's coach effectiveness model have yet to be verified through empirical research.

LEADERSHIP IN YOUTH AND ADULT SPORTS

Although the multidimensional model of leadership and the mediational model of leadership are similar in many respects and dissimilar in others, a more fundamental difference between the two models is purported to be in their applicability to youth and adult sports. There is a general belief that the multidimensional model is applicable to adult sports, and the mediational model is applicable to youth sport. This belief is substantiated by the fact that most of the research on the multidimensional model was carried out with adult samples, whereas only youth samples were used in the research on the mediational model. Further, the writings by R. E. Smith, Smoll, and their associates implicitly suggest that their model is more suited to youth sports. Other scholars on leadership in sports have confirmed this view (e.g., Duda, 1994, 1996).

The problem here is the confounding of (a) the conceptual frameworks (i.e., the two models in question), (b) the measurement systems (i.e., the LSS and the CBAS), and (c) the populations in which the frameworks were developed and tested. Although it is useful to compare and contrast these three aspects of the two models, it is counterproductive to lump them together in suggesting that one aspect necessarily implies the other two. For instance, there is nothing in the multidimensional and mediational models to suggest that they are restricted to either adult sports or youth sports. Similarly, the models themselves do not proscribe the use of any measure of leadership. For instance, the CBAS can be used in conjunction with the multidimensional model and the LSS can be used in testing the mediational model.

Irrespective of this argument over the contexts in which the two measures (CBAS and LSS) are relevant, neither measurement scheme considers a critical distinction between sport as pursuit of pleasure and athletics as pursuit of excellence (Chelladurai, 1998, 2005a). That is, the behavioral dimensions measured and/or observed do not encompass the qualitatively different and conceptually distinct dimensions of leader behavior that may be most relevant to pursuit of excellence. In this section, I outline the critical differences in purposes and processes of these two enterprises and then identify some of the leadership behaviors relevant to the pursuit of excellence.

Purposes of Sport Participation

Keating (1964) distinguished between athletics and sport. The term *sport* is derived from the French word *desporter,* meaning a diversionary activity to carry away from work, and whose purpose is maximizing pleasure for all participants. The term appeared in old French during the thirteenth century, and it meant any means to spend time pleasantly, such as conversation, recreation, bantering, and games (J. Camy, personal communication, December 4, 2005). Later, the term was modified in England to *disporten* and subsequently to *disport,* to refer to "frolicsome diversion" ("Disport," 2005) in physical activities "that involve a degree of physical strength or skill" ("Sports," 2005a). Sport is characterized by *spontaneity* (i.e., it does not need any preparation or training), *moderation* (i.e., it is not practiced in excess), and *generosity* (i.e., being generous to other participants, particularly one's opponents). Such participation is a *cooperative effort to maximize the pleasure for all participants.* The term *athletics,* on the other hand, is derived from the Greek words *athlos* (a contest), *athlon* (a prize), and *athlein* (to contend for a prize). It is a *competitive* and *agonistic* activity to establish the superiority of one over others in seeking the coveted prize. It is characterized by a very high degree of devotion and commitment to the pursuit, extraordinary efforts over a prolonged period of training, and considerable personal sacrifice.

Given the fundamental differences in their purposes and processes, participants need to display different attitudes and behaviors in the two enterprises. For instance, the cliché "It's not whether you win or lose but how you play the game" is applicable to and meaningful in pursuit of pleasure but irrelevant to and irrational in pursuit of excellence (Keating, 1964). Moreover, the athlete (e.g., the prize-fighter) would lose sight of his or her purpose and insult opponents if he or she displays generosity and magnanimity, which is essential to the pursuit of pleasure (i.e., sport). Keating (1964, p. 28) summarized the distinction between sport and athletics as follows:

> In essence, sport is a kind of diversion which has for its direct and immediate end fun, pleasure, and delight and which is dominated by a spirit of moderation and generosity. Athletics, on the other hand, is essentially a competitive activity, which has for its end victory in the contest and which is characterized by a spirit of dedication, sacrifice, and intensity.

As the term *athletics* refers to one form of physical activity in the international context (e.g., track and field), I have been using in my writings Keating's other labels—*pursuit of pleasure* and *pursuit of excellence*—to refer to these contrasting enterprises.

It must be noted that whereas *to excel* is to surpass others (Keating, 1964; Sternberg, 1993), the others in question are one's peers. An outstanding athlete in the junior ranks who surpasses his or her peers may not be outstanding when compared to senior athletes. Similarly, an excellent female javelin thrower would not be considered excellent when compared to male throwers. Thus, excellence is defined as performance at the highest levels within each comparative group of participants, and it is established through victories in organized competitions.

It must also be noted that excellence denotes an attained status, whereas *pursuit of excellence* refers to a process whereby one attempts to attain excellence, which is the focus of this section. Such pursuit of excellence may go through three stages: *initiation, development,* and *perfection* (B. S. Bloom, 1985). In the initiation phase, the performer is joyful, playful, and excited. Correspondingly, the mentor/coach is kind, cheerful, and caring. In the developmental stage, the performer is hooked and committed to the endeavor, and the mentor/coach is strong and demanding. Finally, in the perfection stage, the performer is obsessed and responsible, and the mentor/coach demands even more from the performer in terms of commitment and effort and becomes emotionally bonded with the performer.

Common Processes in Distinct Purposes

The clear distinction between these two purposes of sport participation becomes blurred because of two processes that are common to both: *skill acquisition* and *competition* (Chelladurai, 1998). Pursuit of skill is fundamental to the pursuit of both pleasure and excellence. In pursuit of pleasure, such pleasure is maximized to the extent the participants are skilled in that activity. We must also note that the pleasure in sport is maximized when both contestants are *equally* skilled. It is obvious that developing and mastering the skills is also fundamental to pursuit of excellence. The critical function of enhanced skills in pursuit of excellence is to ensure a victory in a contest, that is, demonstration of excellence. In other words, establishing *inequality* in skills is a legitimate and dominant way to demonstrate excellence.

Competition is also an essential component of both pursuit of pleasure and pursuit of excellence. However, in sport as pursuit of pleasure, the *process of winning* (trying hard to win a point) is the ingredient that contributes to pleasure. It is immaterial if, in fact, one wins that point or not. Such pleasure is maximized when both contestants engage with equal intensity in the process of winning. In pursuit of excellence, however, the outcome of the competition is critical. That is, one can establish excellence only by defeating the opponents in the contest. It will not matter if the opponents are of lesser caliber. What matters is the victory in the contest. Although skill acquisition and competition facilitate the goals in both pursuit of pleasure and pursuit of excellence, the conceptual and functional distinction between the two should not be overlooked.

This distinction between pursuit of pleasure and pursuit of excellence is not fully captured by other dichotomies that we use, such as youth sports versus adult sports, mass versus elite sport, or competitive versus recreational (noncompetitive) sport. In the first case, the distinction rests on the age of the participants. In the second case, the distinction refers to the obtained status (i.e., elite athletes are those few who have attained a very high level of proficiency) and/or the number of participants (i.e., mass sport involves a large number of participants). In the third case, the relative emphasis placed on competition is the distinguishing characteristic. Thus, the distinction between pursuit of pleasure and pursuit of excellence is even more critical because it highlights the different purposes and processes of the two enterprises without reference to age, attained status, or the competitive element.

Sport Expertise

Recent literature (e.g., Ericsson, Krampe, & Tesch-Römer, 1993) employs terms such as "sport expertise," "expert performance," and "elite performance" to refer to excellence in sport. (See Chapters 9 to 14 in Part III on Sport Expertise.) The study of expertise in sport had taken great strides in the past 2 decades (e.g., Baker, Côté, & Deakin, 2005; B. S. Bloom, 1985; Côté, 1999; Côté, Baker, & Abernethy, 2003; Durand-Bush & Salmela, 2002; Gould, Dieffenbach, & Moffett, 2002; Holt & Dunn, 2004; Salmela & Moraes, 2003; Soberlak & Côté, 2003; Vallée & Bloom, 2005; Vernacchia, McGuire, Reardon, & Templin, 2000; Wolfendon & Holt, 2005). The recent publication of *Expert Performance in Sports: Advances in Research on Sport Expertise* (Starkes & Ericsson, 2003) is a testament to these efforts. That this handbook includes six chapters on sport expertise is a further indication of the growing prominence of the study of sport expertise.

In general, research on the topic has focused on (a) the process of gaining expertise/excellence, (b) the person seeking expertise, and (c) the role of the family and/or coach. As for the process of gaining expertise, Ericsson (2003) and Ericsson et al. (1993) echo Keating's (1964) view that athletics is characterized by dedication, sacrifice, and intensity, emphasizing that the route to expertise is through deliberate practice. They claim that meticulously planned deliberate practice over a lengthy period of time is both *necessary* and *sufficient* to become an expert. Although the sufficiency hypothesis is questioned (e.g., Abernethy, Farrow, & Berry, 2003; Baker et al., 2005), there is consensus that deliberate practice is necessary. As Deakin and Cobley (2003, p. 116) paraphrased:

> Practice activities were considered to be deliberate practice if they were structured to improve current performance, if they were highly relevant to the particular domain, if they were substantial enough to require concerted effort to complete, and if they were not inherently enjoyable.

As for the time taken for deliberate practices, Lavallee, Kremer, Moran, and Williams (2004) reported that on an average, karate experts spent 26.2 hours per week in training, figure skaters spent 28 hours per week in training, and wrestlers trained for 24.9 hours per week. Deliberate practice has been studied in the context of specific sports such as figure skating and volleyball (Deakin & Cobley, 2003), elite hockey (Soberlak & Côté, 2003), and ultra endurance events (Baker et al., 2005). Thus, the notion of deliberate practice sets apart pursuit of excellence from pursuit of pleasure.

Another focus of research on expertise is on the person seeking expertise or one with such expertise (e.g., Holt & Dunn, 2004; Janelle & Hillman, 2003). For example, Janelle and Hillman suggest that, to become an expert, a person must excel in no fewer than four dimensions: *physiological, technical, cognitive,* and *emotional.* In addition, an overarching requirement is that the person masters the *psychological skills* of motivational and goal-setting strategies, imagery and mental training, and interpersonal skills.

A third focus has been on the coaches who facilitate the pursuit of excellence/expertise (e.g., G. A. Bloom, Stevens, & Wickwire, 2003; Côté, Salmela, Trudel, Baria, & Russell, 1995; Côté & Sedgwick, 2003; Fahlstrom, 2005; Isberg, 2005; Salmela & Moraes, 2003; Wolfenden & Holt, 2005). Several scholars studying the development of talent and giftedness have noted that the mentor (i.e., the coach, in our context) is quite instrumental in both the identification and development of talent (e.g., B. S. Bloom, 1985; Ericsson, 1996; Heller, Mönks, & Passow, 1993; Hemery, 1986; Salmela & Moraes, 2003). Van Rossum (1995) found that his sample of national-level Dutch athletes identified their coaches along with their parents as the most important persons in their athletic careers. Even more significant, their respective coaches were most instrumental in identifying them as talented individuals. Based on the premise that most contexts of pursuit of excellence in sport are guided and controlled by coaches, and based on the extant literature, I present next a model of the pursuit of excellence and a set of leader behavior categories best suited to facilitate the pursuit of excellence.

Leadership in the Pursuit of Excellence

The model of pursuit of excellence in sport is illustrated in Figure 5.4. In brief, the person with the relevant talent, dispositions, and beliefs engages in deliberate practice to master the skills and gain the strategic and tactical knowledge

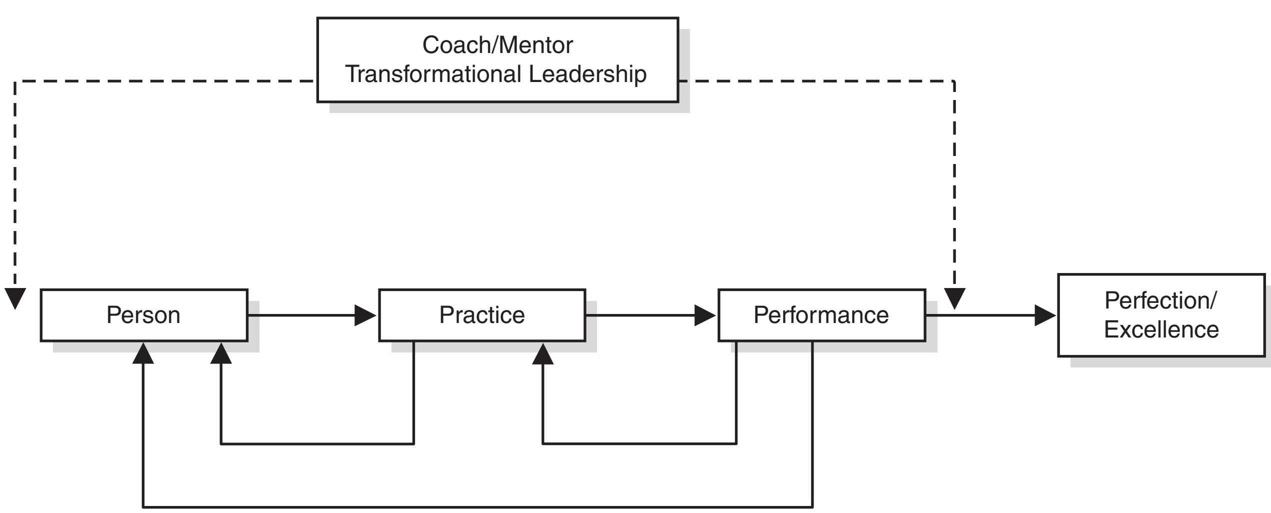

Figure 5.4 A model of pursuit of excellence in sport.

to perform well. The performance successes will, in turn, indicate the level of perfection or excellence achieved. The coach's most intense and deepest involvement in pursuit of excellence is at the practice stage. Through planned, deliberate, and meaningful practice, the coach is able to most effectively shape the person's skills and abilities, attitudes, and beliefs (i.e., person's characteristics) that will facilitate pursuit of excellence. In addition, the coach has a significant role at the performance stage, where he or she helps the athlete concentrate on the task at hand and keep control of thoughts and emotions thereof. Insofar as the stages of deliberate practice and performance are generally guided and monitored by a coach, the salient behaviors of the coach in planning and directing the deliberate practice and managing performance become critical.

By definition, pursuit of excellence is characterized by progressive increases in physical, mental, and emotional capabilities, which, in turn, lead to performance increments. In the process, the person is transformed from an easy-going, playful individual to a dedicated, committed, and hardworking athlete. The leadership influences or behaviors that facilitate this metamorphic process are not fully captured by the existing instruments of leadership in sports. Hence, there has been a call for revising the LSS to include dimensions of transformational leadership (Chelladurai, 1998, 2005a; Chelladurai & Riemer, 1998). There has been only one study dealing with transformational leadership in sports. Charbonneau, Barling, and Kelloway (2001) found that intrinsic motivation mediated the effects of transformational leadership (measured by B. M. Bass & Avolio's, 1995, Multifactor Leadership Questionnaire from organizational psychology) in university sports. Recently, Vallée and Bloom (2005) related their findings of behaviors of expert coaches to aspects of transformational leadership in providing *inspirational motivation, idealized influence,* and *intellectual stimulation.* The following sections describe some of the leader behaviors that are deemed essential to foster and facilitate pursuit of excellence.

Creating a Vision

As the typical novice in the pursuit of excellence is drawn from the general population, his or her vision of performance and excellence and his or her capacities may be somewhat limited due to previous socialization. It becomes the responsibility of the coach to create a new vision for the performer by setting new objectives and instituting new strategies. In addition, the coach needs to convince the performer of the viability of the new vision and express his or her confidence that the performer is capable of fulfilling that vision. It is also important to secure the commitment of the performer to the new vision. In their qualitative study of expert coaches (interviews with five Canadian female coaches), Vallée and Bloom (2005) found that their coaches' creation of vision (i.e., goals and direction) and selling of that vision to the players were fundamental to their building a successful program. Earlier, Desjardins (1996) also noted that expert coaches tend to establish a mission and transform it into a mission statement for the team to bear in mind and endeavor to achieve it.

Inspirational Communication

Pursuit of excellence is a process in which the athlete strives to continuously improve his or her performance, that is, perform beyond previously demonstrated capacity. To B. Bass (1985), this is performance beyond expectations. One critical function of leaders in this regard is to inspire their athletes to extend themselves to achieve excellence. Such leader behavior includes stimulating enthusiasm, building confidence, instilling pride, enhancing morale, setting examples of courage and dedication, and sharing the hardships. These behaviors cumulatively result in what B. Bass calls the "Pygmalion effect," a performance-stimulating effect. That is, those who are led to expect that they will do well will do better!

Intellectual Stimulation

A component of talent development is to engage the intellect even in those activities dominated by psychomotor abilities. That is, the performer should be able to see his or her activity in its totality and understand the scheme of things surrounding the performance. The coach can stimulate the intellect of the athletes by challenging existing assumptions and attitudes, encouraging creativity and innovation, and presenting holistic perspectives. In other words, the coach facilitates the conceptualization, comprehension, and discernment of the problems and contemplation and thought prior to action (B. Bass, 1985).

Individualized and Supportive Leadership

The coach's talent development efforts are facilitated if he or she bestows individualized attention on the athletes. One-on-one interactions and communications make the coach a mentor in the true sense. The coach can fill the role by individualized and personal attention to the athletes and their needs, treating them individually, expressing appreciation, providing corrective feedback, assigning special responsibilities, counseling, and being empathetic, caring, concerned, and supportive. The coach makes frequent contacts with an athlete and communicates informally but generously (B. Bass, 1985; Rafferty & Griffin, 2004).

Personal Recognition

Most athletic performances are public, so the athlete is likely to be recognized for good performances by the family, the fans, and the media. However, the deliberate practice sessions are carried out privately, with specific preplanned goals. The achievement of these practice goals is critical to the pursuit of excellence, and an athlete's persistence in such activities is contingent on such achievements being recognized and rewarded. The coach, as the most significant other (perhaps the only significant other in the context), needs to recognize those small achievements and provide rewards such as praise.

Demanding and Directive Leadership

As noted, deliberate practice in sport can be boring and tiring both mentally and physically. Hence, it is conceivable that some of those in pursuit of excellence will give up on the practice. The coach needs to demand that they persist in the planned training regimen and direct them to carry out the activities (Salmela & Moraes, 2003). The essence of this form of behavior is what is meant when a coach is described as a hard taskmaster or a slave driver.

Promotion of Self-Efficacy and Self-Esteem

Coach behavior should also be focused on cultivating athletes' *self-efficacy,* that is, "judgments about what one can accomplish with those skills" (Feltz & Lirgg, 2001, p. 340). The coach attains this objective by extolling the talents and skills of the performer, expressing confidence in the person's capacity to achieve higher levels of performance, and encouraging the performer to even greater efforts (Feltz & Lirgg, 2001). In the same vein, it is important that *self-esteem* is also enhanced. Self-esteem is centered around a belief in the self, respect for the self, and confidence in the self (B. Bass, 1985).

In our context, an equally important component of self-esteem is *esteem from others.* That is, the respect and admiration others bestow on a performer is equally motivational. Because pursuit of excellence is a comparative process, esteem by others is reflective of one's performance. Hence, it is critical that the performer seeks esteem from others. The coach needs to instill in the performers the desire for esteem from others.

Emphasis on Winning

A necessary ingredient of the pursuit of excellence is winning in competitions against opponents. That is, the way sport is structured and practiced around the world, excellence can be demonstrated only through victories in contests. So it is necessary for the coach to emphasize performance and victories in competitions. The cliché "Winning isn't everything, it is the only thing" is relevant to the pursuit of excellence in sport. Following dictionaries that define *cost* as "time, labor, and money involved in an enterprise" and *means* as "that by which a result is brought about," I would like to distinguish between "winning at all costs" and "winning by any means." Pursuit of excellence is a costly affair in terms of time spent, energy expended, and money, due to immediate outlay of cash and forgone income. Going to a competition or spending a few more hours in practice are additional costs. If such expenditures are likely to ensure winning, this is winning at all costs. On the other hand, winning by any means includes means not inherent in the activity or sanctioned by convention and policy (i.e., winning by foul means). Such activities include doping, cheating on the rules, and willfully injuring an opponent either in competition or outside of it. Obviously, the coach should instill in the athlete the difference between winning at all costs and winning by any means. While encouraging the former, the coach should strongly denounce the latter and ensure that the athlete does not engage in such shady activities.

Cultivating Self-Interest

Those in the pursuit of excellence should be highly selfish to seek the rewards of their efforts for themselves, even when their efforts may deprive another of the rewards. That is, self-interest is fundamental to the pursuit of excellence. But as Locke (Avolio & Locke, 2002) argues, egoism (i.e., self-interest) should be constrained and governed by a moral code defined by rationality and associated virtues. That is, athletes in pursuit of excellence, while seeking the rewards of competition for themselves, should be honest in their efforts (i.e., not doping oneself), respect opponents, and seek justice so that all contestants are treated fairly. It is equally important that athletes recognize excellence in others and respect such excellence.

It is the responsibility of the coach to reinforce this self-interest in the athlete, convince the athlete that self-interest is morally defensible, and show that such self-interest is foundational to the pursuit of excellence. It is equally important to educate athletes about the immorality of any act that violates the essence of the pursuit of excellence (e.g., doping, cheating on the rules). According to Locke (Avolio & Locke, 2002), acting in one's own interest refers to the fact that individuals must be the beneficiary of their own actions subject to virtues of honesty, integrity, independence, productiveness, justice (with regard to other people), and pride (in being a self-made soul). The coach needs to foster this rational self-interest while at the same time cultivating the sense of justice and fairness to all, including competitors.

Fostering Competitiveness

Gill (1993, p. 314) viewed competitiveness as simply an "achievement orientation toward competitive sport, or a sport-specific form of achievement orientation." She identified and measured three dimensions of sport orientation in her Sport Orientation Questionnaire. The first and most dominant dimension is *competitiveness:* "an enjoyment of competition and a desire to enter and strive for success in competitive sport achievement settings" (p. 318). The second dimension is the *win orientation:* "a focus on interpersonal comparison and winning in competition" (p. 318). The third and final dimension is *goal orientation:* "a focus on personal performance standards" (p. 318). It should be recognized that the last two dimensions parallel the concepts of task and ego orientation referred to earlier. The point here is that those who pursue excellence should be high on all three dimensions of sport orientation. Accordingly, a coach has to emphasize the importance of all three competitive orientations in the pursuit of excellence and spur the athlete to be growth-oriented, competitive, and focused on winning.

Instilling Task and Ego Orientation

Individuals also differ in their orientation toward achievement situations. Scholars have suggested that achievement situations elicit either task or ego orientations. Task-oriented individuals believe that concerted and continued effort can gain the necessary ability and competence. They judge their success in the activity by the extent of their learning and improvements they have made. As their conception of success and failure is self-referenced, they enjoy the intrinsic value of learning and mastery of the task. In contrast, ego-oriented individuals judge their success by how well they have done in comparison to others. To them, success is a function of high ability and not effort, and losing after trying hard demonstrates lack of competence.

A major responsibility for the coach is to cultivate and reinforce the task orientation of those who pursue excellence. That is, any individual pursuing excellence should be constantly striving to progressively improve personal performance. However, pursuit of excellence in sport also requires that one performs better than one's peers to demonstrate superiority. So the idea of external referents in performance is as important as the internal or self-based referents. The challenge for the coach is to instill in the athlete a focus on external referents without the associated detrimental and debilitating aspects of ego orientation such as the belief that ability is innate and that effort is a demonstration of ability. In other words, pursuit of excellence in sports requires a simultaneous focus on both internal and external referents on performance.

Task- and Ego-Involving Climates

The literature in this regard also distinguishes between the task-involving climate and the ego-involving climate. Newton, Duda, and Yin (2002) have developed the Perceived Motivational Climate in Sport Questionnaire to measure six dimensions of perceived motivational climate. Three of the dimensions—cooperative learning, important role, and effort/improvement—reflect a task-involving climate. The other three dimensions—punishment for mistakes, unequal recognition, and intrateam member rivalry—reflect the ego-involving climate. Many scholars recommend that creating and maintaining a task-involved climate is beneficial, and the other form of climate is detrimental to member satisfaction, enjoyment, and commitment to participation.

When we juxtapose these two forms of climate with the distinction between pursuit of pleasure and pursuit of excellence, we can see that a greater focus on task-involving climate is germane to pursuit of pleasure and that the ego-involved climate is antithetical to the essential thrust of that enterprise. When we look at pursuit of excellence, however, a task-involved climate is the bedrock of that enterprise. Nevertheless, the ego-involved climate also contributes to the pursuit of excellence. For example, when a coach expresses disappointment over a mistake at a crucial juncture in a competition, it is a punishment (reflecting an ego-involving climate), but it is legitimate and required in the context of the pursuit of excellence.

The issue of unequal recognition may be problematic in pursuit of pleasure, but in the pursuit of excellence, unequal recognition is part of the process. Those who perform better than others are recognized and accorded appropriate status. The distinction between starters and substitutes in basketball is unequal but equitable recognition. The processes of tryouts, team selection, and drafting underscore the excellence achieved by those who are selected. But the same selection process also excludes others who have not achieved the same level of excellence as those who were selected. From this perspective, pursuit of excellence is an exclusionary process, and therefore, the leaders and coaches in pursuit of excellence should not be faulted for not bestowing equal recognition on all.

Intrateam rivalry is also a necessary condition for pursuit of excellence in team sports. That is, the coach should encourage every athlete to be better than others, including teammates. The striving by everyone to be better than teammates with a view to getting on the starting line-up ensures that everyone gets better, so that the whole teams gets better.

There is considerable discussion over the conceptual and measurement issues related to the task and ego orientation as well as task- and ego-involving climates in sport (Harwood & Hardy, 2001; Harwood, Hardy, & Swain, 2000; Treasure et al., 2001). However, there is agreement that the task and ego orientations are orthogonal and represent two different continua and that "an individual can fluctuate from one state of involvement to another depending on his or her perception of the momentary situational cues and dispositional tendencies" (Treasure et al., 2001, p. 321). Harwood et al. (2000) cited competitive sport and recreational sport as situations with different cues calling for different goal orientations. Given that pursuit of excellence consists of both practice and performance stages, it is posited here that task involvement needs to be paramount in the practice stage and ego involvement in the performance stage. This is consistent with Treasure et al.'s view that "one particular focus dominates at any given time" (p. 321).

Training Behavior

Training behavior focuses on developing *technical, cognitive,* and *emotional* skills. It must be noted that the content and the relative significance of these forms of training may vary from sport to sport.

Technical Training. Technical training refers to training in the skills and movement patterns of a given sport (Janelle & Hillman, 2003). It includes the coach's instruction and directives toward increasing athletes' physical and physiological capacities (Janelle & Hillman, 2003). This category of behavior parallels the dimension of training and instruction in the LSS.

Cognitive Training. Cognitive training focuses on tactics and strategies and an understanding of their appropriateness in different circumstances (Janelle & Hillman, 2003). The attention to and interpretation of cues and the decision making thereof are also central to cognitive training.

Emotional Training. Emotions have a significant impact in pursuit of excellence in sport at the practice stage, and more so at the performance stage. It is incumbent on the coach to understand his or her emotions and regulate them to make the coaching process more effective. It is equally, if not more, important that the coach trains the athlete in recognizing and regulating personal emotions. By the same token, the athlete needs to learn to recognize the emotions of the opponent and to manipulate and exploit them to personal advantage.

Facilitating the Flow Experience

As noted, Ericsson et al. (1993) argued that deliberate practice is not intrinsically satisfying. The Greeks associated the term *agonia* with the term *athlos,* meaning that the pursuit of excellence is an agonistic process involving not only the mind but also the body (Keating, 1964). This is reflected in the common slogan "No pain, no gain." Although many subscribe to this perspective, there is a contrasting perspective that experts in sport performance actually enjoy their intense training, particularly those training activities that most relate to actual performance (e.g., Helsen, Hodges, Van Winckel, & Starkes, 2000; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996). This view is echoed in the concept of *runner's high,* which suggests that runners do enjoy and get a kick out of running.

The recent application of the concept of *flow* in the sporting context sheds some light on the experience of joy in agonistic practice. Flow is a "very positive state that typically occurs when a person perceives a balance between the challenges associated with a situation and her capabilities to accomplish or meet these demands" (Kimiecik & Jackson, 2002, p. 505). And "flow, as an optimal state, represent those moments when everything comes together for the performer; it is often associated with high levels of performance and a very positive experience" (Jackson & Eklund, 2002, p. 133). The most significant aspect of the flow experience is the felt balance between the challenge faced by the athlete and his or her skills. The coach can design the training sessions and the competitions in such a way that the challenge of the task increases progressively with the skills mastered by the athlete. That is, the coach can match the athlete's skills with the difficulty of the tasks assigned. This process over weeks, months, and years would culminate in the highest challenges being matched with requisite mastery of skills.

Summary

The foregoing categories of leader behaviors in the pursuit of excellence are aimed at transforming both the person in terms of personal attributes (e.g., ability, self-efficacy, self-interest, and competitiveness) and the situation in terms of vision and goals. These transformational effects of leader behavior are not fully captured in Chelladurai's original multidimensional model of leadership. Recently, Chelladurai (2001, 2005b, 2006) has modified the multidimensional model to include the effects of transformational leadership on situational and member characteristics for application in organizational settings where there are hierarchical levels of administrators. As shown in Figure 5.2b, the transformational leader influences the situation and the members as well as the subordinate leaders. This scheme would apply to sport teams such as baseball and football, where there are subordinate coaches to supervise specialized tasks (e.g., pitching in baseball and special teams in football). If there is only one leader involved, the transformational effects of the leader are indicated by the block arrows from Box 2 to Box 1 (situational characteristics) and Box 3 (member characteristics).

CONCLUSION

I have outlined two significant thrusts that have been undertaken in the study of leadership: Smoll and Smith's (1989) mediational model of leadership and Chelladurai's (1978, 1990, 1993) multidimensional model of leadership. In addition, I have discussed the measurement schemes associated with each of these models (i.e., the CBAS and the LSS), and the improvements thereof. Departing from these traditional approaches, I have drawn attention to Keating's (1964) distinction between sport as pursuit of pleasure and sport as pursuit of excellence. Having noted that these two pursuits are distinctly different enterprises, I have identified a set of leadership behaviors that are most relevant to pursuit of excellence. Some of these categories are drawn from the literature in organizational behavior and organizational psychology; others are derived from the literature in sport psychology. It will be easily recognized that some of the listed behaviors are antithetical to the pursuit of pleasure. This list of categories of leader behavior is neither exhaustive nor nonoverlapping, but it does point to the need for researchers and practitioners to be clear about the purposes of the two enterprises and resist imposing a set of processes appropriate to one enterprise on the other.

As noted earlier, many scholars have studied the acquisition and maintenance of expertise from interviews of coaches and players and through other forms of qualitative research. The present conceptual exercise is partly based on that literature. It is time to build on that tradition by consolidating the findings and developing refined models of the pursuit of excellence that can be subjected to empirical verification and confirmation. This step needs to be followed with the development of sound measures of the variables of the new models.

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CHAPTER 6

Who Cares What Other People Think?
Self-Presentation in Exercise and Sport

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"You can't live your life worrying about what other people think." Certainly most of us have heard this advice at some point in our lives, usually from well-meaning friends or family trying to downplay the importance of other people's evaluations and impressions. In reality, however, what other people think of us really *does* matter. The impressions that we make—for instance, that we are smart, hard-working, and physically attractive (or, conversely, ignorant, lazy, and ugly)—have important implications for how we see ourselves, how other people treat us, and our success at obtaining valued material and social outcomes in life (Leary & Kowalski, 1990). Even in everyday social interactions, such as dinner parties and staff meetings, each person's response to another is based, in part, on one's impression of the other's personality, abilities, beliefs, and other attributes. Indeed, there are few social situations in which people can afford to completely disregard how others perceive and evaluate them (Leary, 1995).

Because the impressions people make on others can have important consequences, it is understandable that people sometimes behave in ways intended to create certain impressions in other people's eyes. *Self-presentation,* also referred to as *impression management,* refers to the processes by which people monitor and control how they are perceived and evaluated by others (Schlenker, 1980). The term *impression management* may suggest pretense and deliberate attempts to convey false images of oneself, but in actuality, the images people try to convey are usually consistent with how they see themselves. That is, self-presentation typically involves the selective presentation of self-relevant information and characteristics that will make desired impressions and the selective nondisclosure of information and characteristics that will create undesired impressions (Leary, 1995). Although people may be concerned with self-presentation in virtually any social context, the focus of this chapter is on self-presentation in physical activity contexts.

HISTORICAL BACKGROUND

The study of self-presentation has roots in Irving Goffman's (1959) seminal work, *The Presentation of Self in Everyday Life.* As a sociologist, Goffman wrote about the importance of self-presentation to social interactions and the construction of self-identity. He observed that in day-to-day social intercourse, we all behave like actors on a stage, employing various techniques to maintain our "performances" and to guide and control the impressions that others form of us. During the 1960s, Edward E. Jones extended the study of self-presentation to psychology (Leary & Kowalski, 1990). Jones and his colleagues were interested in the tactics people use to control others' impressions of them, such as ingratiation and the disclosure of personal information. His group generated considerable empirical data and knowledge regarding self-presentation processes. They also developed key conceptual, methodological, and empirical foundations that have guided self-presentation research for nearly 40 years.

Within the domains of sport and exercise psychology, social psychologist Mark Leary sparked interest with his 1992 review paper highlighting the pervasiveness and potency of self-presentational motives among athletes and exercisers. Leary cogently argued that self-presentational

This chapter was written with the support of a Canadian Institutes of Health Research (CIHR) New Investigator Award, held by the first author. We extend our appreciation to Heather Strong and Spero Ginis for their research assistance.

processes could affect several aspects of sport and exercise, including motivation, performance, and affective responses. Prior to the publication of Leary's paper, a self-presentational perspective had been applied to only a handful of sport and exercise studies. But since then, the self-presentational approach has gathered momentum as investigators have applied it to an expanding array of sport- and exercise-related phenomena such as competitive anxiety, sport fan loyalty, exercise setting and attire preferences, and adherence.

This upsurge of research activity was recognized in a special issue of the *Journal of Applied Sport Psychology* (Prapavessis, 2004). Readers are referred to this special issue for literature reviews on self-presentation in sport, exercise, and health contexts. Rather than simply reiterating these reviews, in this chapter, we take a generational approach to organizing the existing research and identifying research gaps. A generational approach conceptualizes research progress in terms of the types of research questions that have been asked about a particular phenomenon (Zanna & Fazio, 1982). Utilizing this approach, the goals of our chapter are to characterize the development and current state of research on self-presentation in sport and physical activity contexts and to identify future research directions.

A GENERATIONAL APPROACH TO CHARACTERIZING AND EVALUATING SELF-PRESENTATION RESEARCH

Three generations of research questions have been observed in social psychological research (Zanna & Fazio, 1982). *First-generation questions* are typically "is" questions—questions that ask whether there is a phenomenon, an effect, or a relationship present. For example, exercise psychologists might ask "Is there an effect of self-presentational concerns on exercise adherence?" Sport psychologists might ask "Is there a relationship between self-presentational concerns during competitions and sport competition anxiety?" The goal in first-generation research is simply to describe a phenomenon, its correlates, and its effects.

Second-generation research questions are "when" questions that ask about the conditions under which (a) the effects of the phenomenon emerge and (b) associations between the phenomenon and its correlates hold. Examples of second-generation questions are "Under what conditions do fitness classes elicit self-presentational concerns?" and "When do impression management strategies affect an athlete's performance?" In short, second-generation questions aim to identify moderator variables.

Third-generation research questions are "how" questions. For example, "How does the presence of other exercisers elicit self-presentational concerns?" and "By what mechanisms do self-presentational concerns affect sport performance?" These are questions of mediation that aim to get at the underlying psychological processes that drive self-presentational phenomena and their sequelae. It is important to note that it is not necessary for second-generation questions to be answered before third-generation questions, or even separately from third-generation questions. Nevertheless, we see a trend in sport and exercise psychology, similar to that observed in areas of social psychology (Zanna & Fazio, 1982), whereby mediator questions are addressed after moderator questions, if they are ever addressed at all (Baranowski, Anderson, & Carmack, 1998).

THE STATE OF SELF-PRESENTATION RESEARCH

A computerized search of published English-language studies was conducted (excluding dissertations and published abstracts) to identify studies that (a) addressed a self-presentational phenomenon in a physical activity context or (b) used a self-presentational approach or measures of self-presentation constructs to study a physical activity phenomenon. The studies were then grouped according to common themes and topics and coded to indicate if they addressed a first-, second-, or third-generation research question or a measurement question (see Table 6.1). Despite efforts to be comprehensive, it is possible that some studies were missed in our search. Nevertheless, our findings provide an overview of the landscape of self-presentation research in physical activity contexts. The following sections describe

Table 6.1 Number of Published English-Language Studies of Self-Presentation Topics in Sport and Exercise Contexts

Themes/Topics	Generation 1st	Generation 2nd	Generation 3rd	Measurement
Impression motivation and construction	19	3		4
Impression formation	8	5		
Social anxiety	3	1		
Sport competition anxiety	5	1		2
Social physique anxiety	36	13	2	13
Self-handicapping	10	8	3	7
Self-presentation confidence/efficacy	6	2		5

Note: For studies that have examined more than one generation of research question, the study is classified according to the highest generation question examined. Some measurement studies also addressed hypotheses regarding generational research questions. These studies were counted in both the Measurement column and the appropriate Generation column.

this landscape in greater detail as we discuss the generations of research addressed for each self-presentation topic identified in Table 6.1. In a subsequent section, we review measurement studies for each topic.

Impression Motivation and Construction

In 1990, Leary and Kowalski published a model delineating variables that affect impression management (see Figure 6.1). According to their two-component model, impression management involves two discrete processes: impression motivation and impression construction.

Impression motivation reflects the desire to create particular impressions. This desire is fueled by three situational determinants: the relevance of creating a particular impression in order to fulfill one's goals, the value placed on these goals, and the discrepancy between the image that one has already made (or believes has been made) and the image that one wants to make. In addition, dispositional tendencies can also influence impression motivation. For instance, people who are particularly attuned to others' perceptions of them (e.g., high in public self-consciousness), concerned with behaving in accordance with situational norms (e.g., high self-monitoring), or worried about social approval and disapproval (e.g., high fear of negative evaluation) may be particularly motivated to impression-manage.

Impression construction involves putting impression motivation into action, that is, choosing an impression to create and then utilizing tactics to convey it. This process is influenced by the self-concept (i.e., how people see themselves), ideas about what types of impressions are desirable and undesirable, role constraints, the perceived values and preferences of significant others (i.e., the types of impressions that are most likely to be met with approval or other desired outcomes), and beliefs about how one is

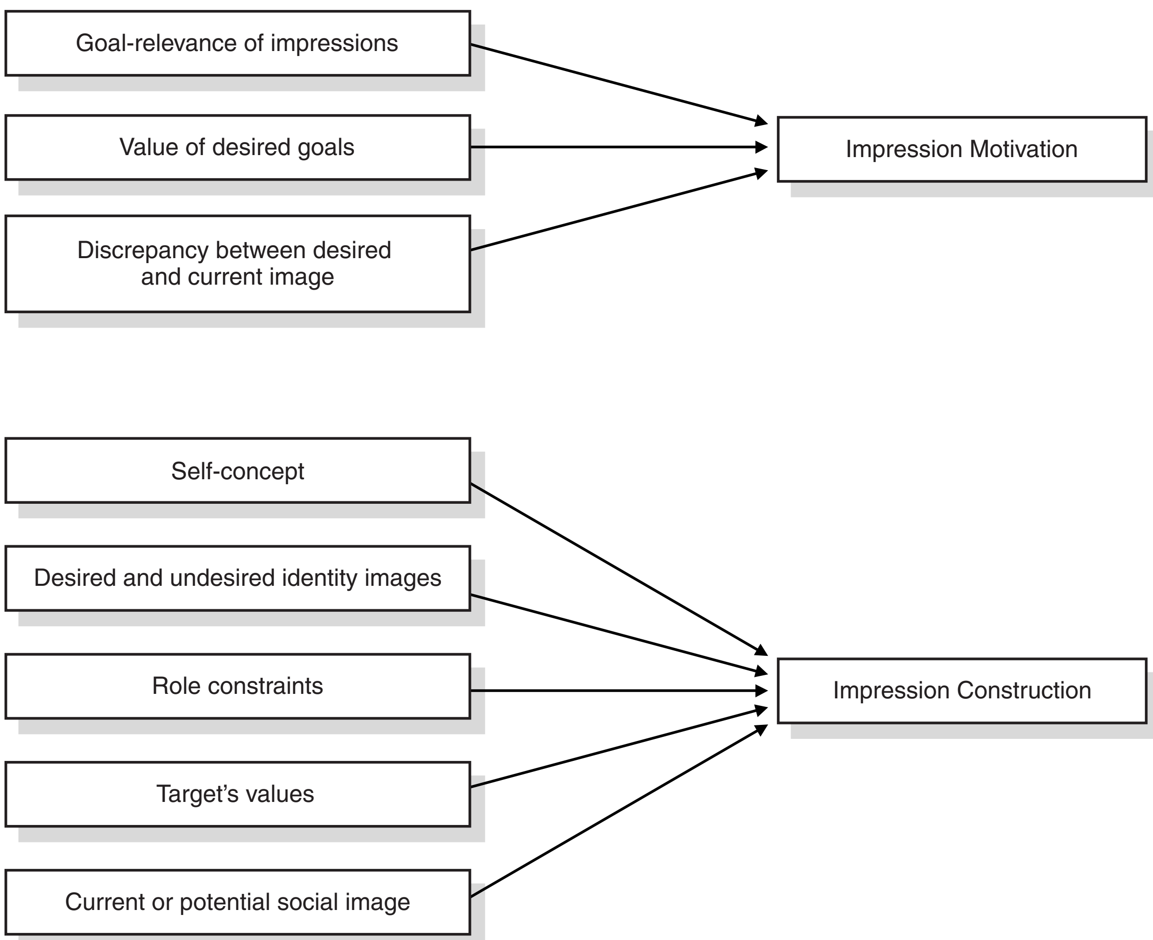

Figure 6.1 Schematic representation of Leary and Kowalski's (1990) two-component model of impression management.

currently perceived or could be perceived. Although impression construction is considered conceptually distinct from impression motivation, it is often difficult to tease apart these two processes in both real-world situations and experimental designs (Leary & Kowalski, 1990). Our literature review reflects this overlap.

Most of the physical activity research on impression motivation and construction has been conducted in exercise contexts. Of the few studies conducted in sport contexts, all have addressed first-generation research questions. In general, these studies have not directly measured impression motivation or construction; rather, they have used these processes to explain sport-related phenomena such as the home-field disadvantage (Baumeister & Steinhilber, 1984), sports fandom (Wann, Royalty, & Roberts, 2000), aggressive behavior (Wann & Porcher, 1998), and athletes' attributions for success and failure (Grove, Hanrahan, & McInman, 1991). For instance, Wann and Porcher found that college hockey and football teams who wore their names on their uniforms were more aggressive than teams who did not wear their names on their uniforms. To explain these findings, the authors suggested that athletes with names on their jerseys are more motivated to impression-manage than those without (because they are identifiable), and, as such, they use aggression as an impression-construction strategy to create valued identities.

A relationship between valued identities and sport participation has been shown in other first-generation studies. One study found that people's reasons for engaging in sport and their sport preferences were directly related to salient aspects of their identity. Respondents who placed greater importance on personal identity emphasized personal reasons for engaging in sports and preferred to participate in individual rather than team sports. In contrast, those who placed more importance on social aspects of identity more strongly endorsed social reasons for participating in sports and expressed a greater preference for team sports (Leary, Wheeler, & Jenkins, 1986). Furthermore, it seems that an important reason for sport participation is the motivation to claim the social identity of an athletic person (Grove & Dodder, 1982). This should not be particularly surprising, given that people can gain a great deal of attention, praise, and other social rewards for being athletic (Leary, 1992).

The specific types of impressions constructed by athletes can influence how other people respond to them. An international study found that athletes' self-presentational styles influenced the support and attention they received from sport physiotherapists (Ford & Gordon, 1997). Physiotherapists indicated that they preferred injured athletes who had a "balanced" self-presentational style, characterized as self-reliant and open with the therapists about their distress, rather than athletes who conveyed the impression of being cool and unaffected, withdrawn, or negative and pessimistic. The issue of athletes' self-presentational styles and their consequences is an intriguing matter that would benefit from further exploration. Self-presentational styles could have a profound impact on how athletes interact with other personnel, such as sport psychologists and coaches, and the assistance and support derived from these sources.

With regard to research conducted in exercise contexts, first-generation studies have examined the importance that people place on self-presentational reasons for exercise and have shown that impression motivation and construction function as both incentives and disincentives for physical activity. For example, the desire to convey the impression of being physically attractive or a person with an active lifestyle can motivate people to exercise regularly. Conversely, the desire to avoid making negative impressions, such as being out of shape or uncoordinated, can deter exercise (Martin, Leary, & O'Brien, 2001). Preliminary data suggest cross-cultural differences in the strength of these motives. One study found that American students were more likely than Irish students to exercise for self-presentational reasons (Martin Ginis, O'Brien, & Watson, 2003). Furthermore, the strength of self-presentational exercise motives are related to trait levels of impression motivation and monitoring. People who score high on measures of public self-consciousness, self-monitoring, and fear of negative evaluation are more likely to exercise or avoid exercise for self-presentational reasons than people who score low on these indices (Martin et al., 2001).

Trait levels of impression motivation have also been shown to predict future intentions to exercise when considered in conjunction with social pressure to exercise (Latimer & Martin Ginis, 2005). Specifically, in a second-generation study couched within the theory of planned behavior (Ajzen, 1985), fear of negative evaluation moderated the relationship between subjective norms and intentions. People with high fear of negative evaluation showed a significant positive relationship between subjective norms and intentions, whereas those with low fears showed no relationship between the constructs. These findings suggest that people who are highly fearful of negative evaluations are more likely to base their intentions to exercise on what they think other people want them to do (i.e., subjective norms) than those people who are not as concerned with what others think.

In addition to trait influences, first- and second-generation studies have addressed situational influences on impression motivation and construction. Several studies have shown that exercisers put forth greater effort when they know that other people are watching them (Rhea, Landers, Alvar, & Arent, 2003; Worringham & Messick, 1983) and, presumably, when they think that increased effort or exertion will create a desired impression (Leary, 1992). Other studies have shown that some situational factors can have the opposite effect, prompting exercisers to claim low levels of exertion in order to make a desired impression. For example, in exercise-testing situations involving very heavy workloads, men have been shown to report lower exertion when a woman conducts the test than when a man conducts the test (Boutcher, Fleischer-Curtian, & Gines, 1988). Likewise, people report lower ratings of perceived exertion when they exercise next to a person who gives the impression that the exercise is very easy than when they exercise alone (Hardy, Hall, & Prestholdt, 1986). It would seem that in situations where workloads (i.e., 75 to 85% of VO_2 max) can be sustained for longer periods because they are largely supplied by aerobic energy pathways, the desire to be perceived as physically fit prompts exercisers to claim that an objectively hard workout does not actually feel all that difficult.

Although both trait and state approaches have been used to examine impression motivation and construction in exercise, there has been little attempt to use interactionist (i.e., trait by state) methodologies. This criticism also applies to the approaches used in sport-related studies. Second- and third-generation studies are needed to identify variables that attenuate and drive relationships between self-presentation and physical activity-related thought, feelings, and behaviors. The concurrent examination of trait and state variables would aid such endeavors.

We also encourage further research into the dark side of impression motivation and construction. Martin Ginis and Leary (2004) have suggested that self-presentational motives can prompt athletes and exercisers to engage in a variety of potentially dangerous, health-damaging behaviors. For example, there is anecdotal evidence that professional hockey players often continue to play while they are injured, at the risk of further exacerbating their injury, because they want to avoid being perceived as a "wimp" who sits out games. In a similar vein, recreational weight lifters have admitted to attempting to lift more weight than they believe they can safely lift in order to impress other people in the gym (Martin & Leary, 2001). Surprisingly, few attempts have been made to apply a self-presentational perspective to study these types of health-damaging behaviors. We propose that a self-presentational approach would be valuable for explaining, and perhaps even assuaging, health-risk behaviors among athletes and exercisers.

Impression Formation

Whereas studies of impression motivation and construction focus on the actor's (i.e., the athlete's or exerciser's) thoughts, feelings, and behaviors, studies of impression formation focus on what the *observer* thinks of the actor. Impression formation is a complex cognitive process that involves combining new information about a person with existing information and beliefs (including stereotypes) to formulate an overall impression (Baron & Byrne, 1997). Studies of impression formation provide data regarding the implications of people's self-presentational tactics. For example, studies can indicate if dressing a particular way or conveying certain attitudes and beliefs influences how we are perceived by others.

With respect to sport, a number of first- and second-generation studies have examined inferences that people make about athletes who participate in certain sports. For example, in one study (Sadalla, Linder, & Jenkins, 1988), participants were asked to give their impressions of tennis, golf, snow skiing, bowling, and motocross racing athletes. In general, respondents' impressions of bowlers were least positive. Specifically, they found bowlers less active and daring compared to skiers and racers. Another study examined the stereotypes of female athletes who competed in one of five sports: basketball, golf, tennis, softball, and volleyball (Linder, Farrar, Sadalla, Sheets, & Bartholomew, 1992). Participants' perceptions of the targeted athletes differed in terms of both athleticism and attractiveness. Specifically, basketball players were deemed the most athletic, and golfers were deemed the least athletic. Tennis players were thought to be the most attractive. Perceptions of female athletes were also examined during interviews with 12 female professional boxers (Halbert, 1997). The interviews revealed that women pugilists are subject to numerous stereotype labels (e.g., husky, butch, ugly, and lesbian). Taken together, these studies indicate that information about one's sport participation can have a profound impact on how one is perceived by others.

Second-generation research has shown that both behavioral (e.g., body language, choice of clothing) and demographic (e.g., age, gender, race) characteristics of an athlete can moderate the effects of sport information on impression formation (Greenlees, Buscombe, Thelwell, Holder, & Rimmer, 2005; Stone, Perry, & Darley, 1997). For instance, in one study (Stone et al., 1997), White men and women evaluated a male basketball player while listening to a radio broadcast of the game. From the broadcast it was clear that the target athlete played well. Half of the participants were led to believe that the target player was White, and the other half were led to believe he was Black. Results showed that the Black target player was perceived to have more natural athletic ability but inferior court smarts and hustle. In contrast, the White target athlete was perceived to have superior court smarts and hustle but less athletic ability. This study provides convincing evidence that stereotypes based on athlete characteristics (particularly race) moderate the effects of performance information on impression formation. It is not known, however, if characteristics of the *observer* moderate impression formation. Indeed, it would be interesting to determine if these findings would hold if the study were replicated using Black rather than White observers.

There have not been any third-generation studies of impression formation in sport. An important third-generation research question is whether impression formation mediates the treatment of athletes. Halbert's (1997) study of female boxers suggests this may be the case. With findings reminiscent of scenes depicted in Clint Eastwood's *Million Dollar Baby,* Halbert reported that female pugilists face widespread discrimination at gyms from trainers and managers who refuse to assist them and at matches from spectators who issue verbal sexual harassment. Her findings also suggest that the use of self-presentational tactics may be mediated by a desire to bring others' impressions in line with the athlete's desired impression. For instance, female boxers reported deliberately wearing feminine uniforms in the ring, emphasizing feminine aspects of their appearance (e.g., wearing makeup and having long hair), and concealing information about their sexuality to avoid undesired impression formation.

With regard to exercise, a handful of first- and second-generation studies have examined the types of impressions associated with being an exerciser (e.g., Martin, Sinden, & Fleming, 2000; Martin Ginis, Latimer, & Jung, 2003). Borrowing a methodology used in stereotype studies, these investigations have involved presenting respondents with a written description of a male or female target. Information about the target's exercise habits is embedded in the description and manipulated across conditions (e.g., the target is described as an exerciser or a nonexerciser, or no exercise information is given). After reading the description, respondents rate the target on a series of physical (e.g., ugly/good-looking, physically sickly/healthy, underweight/overweight) and personality (e.g., sad/happy, afraid/brave, lazy/works hard) dimensions. Responses are compared across the conditions to determine the effects of exercise habit information on impression formation.

The results of these studies clearly indicate that there are self-presentational advantages associated with being an exerciser. Respondents consistently rate habitual exercisers more favorably than nonexercisers and control targets (i.e., targets for whom no exercise information is given) on a wide array of attributes. For example, on physical attribute ratings, Martin and colleagues (2000) found that exercisers were considered fitter, stronger, healthier, more muscular, and more physically attractive than both nonexerciser and control targets. In terms of personality attributes, they found that exercisers were considered more independent, braver, friendlier, kinder, happier, neater, more intelligent, and more sociable and to have more friends than nonexercisers. Exercisers were also considered to be more self-confident, to have greater self-control, and to be harder workers than both nonexercisers and controls.

Interestingly, many of the characteristics attributed to exercisers—such as being smarter, friendlier, and braver—are not directly influenced by physical activity participation. The tendency to rate exercisers favorably on activity-unrelated dimensions is indicative of a *halo effect* (Thorndike, 1920). The halo effect (also known as "halo error") reflects the tendency for raters' global impressions of a person to influence their evaluations of that person on individual, disparate attributes. Presumably, respondents hold generally good impressions of exercisers, and these impressions influence evaluations of exercisers on unrelated dimensions. By contrast, there seems to be a *devil effect* (Thorndike, 1920) for nonexercisers, such that respondents hold relatively unfavorable impressions of sedentary people, which taint subsequent evaluations along discrete dimensions.

Exercise-related halo and devil effects exist for both male and female targets and have been observed in samples of Canadian (Martin Ginis et al., 2003), American (Mack, 2003), and Swedish university students (Lindwall & Martin Ginis, 2006). These effects do not appear to be influenced by the rater's sex or exercise habits. However, people who are highly motivated to self-present as exercisers rate exercising targets more favorably on physical attributes (but not personality attributes) than those less motivated

(Lindwall & Martin Ginis, 2006). It is important to note that, to date, exerciser impression formation studies have utilized university-age participants. It is not yet clear whether other segments of the population, such as older adults or people who do not have particularly favorable attitudes toward exercise, form similar impressions of exercisers and nonexercisers. As well, research is needed to determine whether the halo and devil effects generalize beyond healthy, student-age targets to targets such as older adults or people with physical disabilities.

It is also unknown if the impression formation process mediates other behaviors. For example, prompting people to think about characteristics associated with exercisers and nonexercisers may elicit changes in their own exercise behavior, as they try to bring their exercise habits in line with their impressions of exercisers and nonexercisers. Impression formation may also mediate how one subsequently interacts or treats another person. For instance, health practitioners may interact differently with exercisers than with nonexercisers; they may devote less time to helping nonexercisers change their health habits if they have formulated the impression that sedentary people are lacking in self-control. These third-generation questions represent interesting avenues for future investigation.

Social Anxiety

When people are motivated to make a desired impression on others but are not certain that they will do so, they may experience social anxiety. Unlike other forms of anxiety (e.g., anxiety about flying in an airplane or being alone in the dark), social anxiety is precipitated by concerns about others' evaluations (Leary & Kowalski, 1995). In fact, social anxiety is sometimes referred to as "evaluation anxiety" (Beck & Emery, 1985). People who experience high levels of social anxiety may avoid participating in sport and exercise activities because they are worried about how others will perceive them (Pinto & Sarkin, 1996). Certain aspects of the exercise environment can even trigger social anxiety if they make people feel watched and evaluated by other exercisers or the exercise leader (Martin & Fox, 2001).

Because many physical activity settings provide opportunities for public scrutiny and evaluation (e.g., sport competitions, group exercise classes), a self-presentational perspective can be valuable for studying and understanding specific types of social anxiety that are experienced in these contexts. Indeed, in sport, a self-presentational perspective has been applied to study and understand *sport competition anxiety.* Using this perspective, competitive anxiety is conceptualized as a subclass of social anxiety that is specific to sport competition (Leary, 1992).

Sport Competition Anxiety

Insofar as first-generation research questions are concerned, James and Collins (1997) conducted a qualitative, retrospective study of male and female athletes to identify important sources or causes of anxiety experienced during a recent competition. They found that social evaluation and self-presentational concerns were one of eight general dimensions of sources of anxiety/stress. Likewise, quantitative studies have found that athletes experience a variety of self-presentational concerns relevant to sport competition, such as concerns about appearing fatigued, unable to handle stress, or being incompetent (M. Williams, Hudson, & Lawson, 1999; Wilson & Eklund, 1998). These descriptive studies indicate that self-presentational concerns are indeed a significant source of competitive anxiety.

In studies of the relationships between sport competition anxiety and measures of self-presentational constructs, competitive *trait* anxiety has been shown to correlate with social physique anxiety and physical self-presentation confidence, but only among female athletes (Martin & Mack, 1996). The moderating influence of sex has been attributed to differences in how men and women are socialized regarding the importance of physical appearance. Other studies have shown that self-presentational concerns are more strongly related to cognitive than somatic trait anxiety (Hudson & Williams, 2001; Wilson & Eklund, 1998). With regard to competitive *state* anxiety, a small study of young Alpine skiers showed that precompetitive cognitive state anxiety was positively correlated with concerns about social evaluations of one's performance, whereas somatic anxiety was positively correlated with concerns about social evaluations of nonperformance aspects of ski racing (Bray, Martin, & Widmeyer, 2000). Together, these studies fit nicely with Leary's (1992) conceptualization of competitive anxiety as a subclass of social anxiety. However, it must be acknowledged that not all sport anxiety is self-presentational in nature. For example, anxiety can sometimes stem from fears of being injured or, in the case of professional athletes, not winning enough money to pay the bills.

Other than the Martin and Mack (1996) study, we are unaware of any second-generation studies of moderators of the relationship between self-presentational concerns and competitive anxiety. Likewise, there have been no attempts to address the third-generation research question of why self-presentational concerns elicit sport anxieties. These questions require empirical scrutiny to advance knowledge and theory with respect to the role of self-presentational concerns in competitive sport anxiety and to develop interventions to allay the impact of self-presentation concerns on sport competition anxiety.

Social Physique Anxiety

Another form of social anxiety with relevance in physical activity contexts is *social physique anxiety* (SPA). Social physique anxiety is the anxiety experienced in response to the real or imagined evaluation of one's body by others (Hart, Leary, & Rejeski, 1989). As shown in Table 6.1, SPA is by far the most studied self-presentational concept in the sport and exercise psychology literature and is only one of two topic areas where all three generations of research questions have been examined. (For comprehensive reviews of the SPA literature, see Hausenblas, Brewer, & Van Raalte, 2004; Prapavessis, Grove, & Eklund, 2004.)

First-generation studies have examined a plethora of SPA correlates among athletes and exercisers. These correlates are summarized in Table 6.2. In most studies, SPA has been conceptualized as a trait variable and has shown fairly consistent associations with psychological constructs that capture thoughts and feelings about the self as well as risk factors for psychopathologies such as depression, eating disorders, and compulsive exercise. A few studies have conceptualized SPA as a state construct and have shown that characteristics of the exercise environment can elicit SPA, such as the presence of members of the opposite sex (Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004).

In sport studies, most SPA research has focused on the relationship between trait SPA and eating disorder symptomatology. In general, these studies have shown that SPA is a significant, positive correlate of athletes' eating disorder tendencies. Second-generation studies have shown that sex, but not sport type, moderates this relationship. Specifically, Haase, Prapavessis, and Owens (2002) found SPA to be related to disordered eating attitudes in female athletes but not male athletes. However, in a study of women competing in three different types of sports—physique-salient, weight-restricted, and physique-nonsalient—sport type did not moderate the relationship between SPA and disordered eating attitudes (Haase & Prapavessis, 2001). Among men, SPA has been shown to be related to steroid use. A study of male competitive body builders found that those who used anabolic steroids had significantly less SPA than those who did not use steroids (Schwerin et al., 1996), indicating that some men use steroids as a strategy for dealing with self-presentational concern about their body.

In exercise studies, much of the SPA research focus has been on the relationship between trait SPA and exercise behavior. Initially, cross-sectional investigations produced a mixed bag of findings, with some studies showing a positive relationship between SPA and exercise, other studies showing a negative relationship, and others showing no relationship. These inconsistent findings prompted consideration of factors that may moderate the SPA-exercise relationship, such as sex, depression, and age. For instance, the results of a couple of second-generation studies suggest that age is a significant moderator, such that SPA is negatively correlated with exercise in younger adults but unrelated to exercise in older adults (Lantz, Hardy, & Ainsworth, 1997; Treasure, Lox, & Lawton, 1998). However, to complicate this issue, older women's SPA levels may be moderated by self-presentation efficacy. In one study, SPA was negatively correlated with activity among older women with high or moderate self-presentation efficacy for exercise, but was unrelated to activity in older women with low self-presentation efficacy (Woodgate, Martin Ginis, & Sinden, 2003). Together, these findings speak to the complexity of the SPA-physical activity relationship. To further elucidate the nature of this relationship, researchers need to focus their efforts on exploring demographic, dispositional, and situational moderators, rather than continuing to search for a seemingly nonexistent direct relationship between SPA and exercise.

There is also a need to explore the relationship between SPA and exercise at different stages of the exercise initiation-maintenance continuum. We suspect that SPA exerts its greatest influence on exercise adherence when people are contemplating and initiating exercise programs; during these critical junctures, SPA can be a significant exercise deterrent. But once people gain some experience with exercise equipment and skills, and after repeated exposure to the exercise environment, our hunch is that self-presentational concerns become less salient and other self-regulatory and experiential factors become more potent determinants of continued exercise participation (e.g., barrier self-efficacy, outcome satisfaction, enjoyment). This notion may help explain why SPA scores were lower in a convenience sample of undergraduate women who exercised regularly (Eklund & Crawford, 1994) when compared to undergraduate women who exercised much less (Crawford & Eklund, 1994).

Table 6.2 Correlates of Social Physique Anxiety Examined in Studies of Exercisers and Athletes

Variable	Relationship[a]
Demographics	
Age	−
Sex (female)	+
Body composition (body fat, BMI)	+
Exercise-Related Thoughts, Feelings, and Behaviors	
Exercise frequency/adherence	M[b]
Exercise intensity	+
Exercise commitment	−
Exercise enjoyment	−
Exercise avoidance	+
Exercising for health reasons	−
Exercising for appearance reasons	+
Self-presentational efficacy for exercise	−
Exercise Preferences	
Preference for exercising alone	+
Preference for exercising with others	−
Preference for exercising in same-sex environment	+
Preference for exercising in mixed sex environment	−
Preference for exercising at the back of the exercise class	+
Preference for wearing conservative exercise attire	M
Sport Participation	
Level of sport participation (elite)	−
Participation in physique-salient sports	M
Participation in physique-nonsalient sports	M
Psychopathology and Health Risk Behaviors	
Eating disorder symptomatology	+
Excessive exercise	+
Steroid use	−

Note: − = Negative association; + = Positive association; M = Mixed findings.

[a] Values in the Relationship column are based on tallies of observed relationships and do not take into account study sample sizes or the magnitude of observed correlations.

[b] The SPA-exercise relationship appears to be a moderated rather than direct relationship, which accounts for the mixed findings.

Another second-generation question that has received some research attention is whether SPA moderates psychological responses to exercise. The extant data indicate that self-concept and mood changes following aerobic exercise are unrelated to SPA levels (Focht & Hausenblas, 2001; McInman & Berger, 1993). However, women with high SPA may be more prone to experience anxiety during exercise if they work out in public rather than private settings (Focht & Hausenblas, 2003).

In terms of the effects of exercise on SPA, several studies have shown that participation in an exercise training program is associated with decreases in SPA (e.g., McAuley, Bane, Rudolph, & Lox, 1995; P. A. Williams & Cash, 2001). But given the lack of experiments utilizing randomly assigned, nonexercising control conditions, it is not yet possible to conclude that exercise causes reductions in SPA. Nevertheless, some training studies have attempted to identify mechanisms by which exercise might reduce SPA. These third-generation investigations have identified changes in objective and subjective measures of fitness and physical function as potential mediators of the effects of exercise training on SPA (Martin Ginis, Eng, Arbour, Phillips, & Hartman, 2005; McAuley, Bane, & Mihalko, 1995; McAuley, Marquez, Jerome, Blissmer, & Katula, 2002).

Summary

In reviewing the SPA literature, it is encouraging to see research activity at all three generational levels, but there is an obvious imbalance across the generations. Clearly, it is time for researchers to move beyond first-generation studies examining correlates of SPA and to examine second-generation questions regarding variables that moderate these relationships. A greater emphasis is also needed on the study of mechanisms by which exercise decreases trait SPA and the mechanisms by which aspects of the sport and exercise environment trigger state SPA. By addressing these questions, researchers can start to develop interventions to alleviate SPA and its impact on athletes and exercisers.

Self-Handicapping

In their classic 1978 study, Berglas and Jones demonstrated that people who were worried about failing on a personally meaningful task sometimes chose to impair their performance by ingesting performance-debilitating drugs. They labeled this phenomenon "self-handicapping" and defined it as "any action or choice of performance setting that enhances the opportunity to externalize (or excuse) failure and to internalize (reasonably accept credit for) success" (p. 406). By self-handicapping before a performance, people create a no-lose situation. On the one hand, if they perform poorly, then the failure can be attributed to the performance impediment rather than their ability or competence. On the other hand, if they perform well, they create the impression of being especially competent and talented because success was achieved despite obstacles. In short, self-handicaps blur the relationship between ability and performance and provide a strategy for protecting or even enhancing the performer's self- and public image.

When considering self-handicaps, it is important to note the distinction between behavioral and self-reported self-handicaps (Leary & Shepperd, 1986; Snyder, 1990). *Behavioral handicaps* refer to deliberate, overt acts that would make success on a task more difficult, such as ingesting drugs or alcohol, withholding effort, and choosing to perform in suboptimal conditions. Conversely, *claimed handicaps* are verbal claims about performance impediments such as being injured, ill, socially anxious, in a bad mood, or a victim of traumatic life events (cf. Prapavessis et al., 2004).

With respect to first-generation research questions in sport, several studies have examined the types of claimed self-handicaps most used by athletes. In a synthesis of these studies, Prapavessis et al. (2004) identified seven categories of self-reported impediments. School activity commitments followed by physical states, injury, and illness were the impediment categories most frequently reported, representing half of all self-handicapping claims.

Studies have also examined correlates of athletes' dispositional tendencies to self-handicap. Athletes' scores on the trait Self-Handicapping Scale (Jones & Rhodewalt, 1982) have been shown to correlate negatively with levels of team cohesion (Carron, Prapavessis, & Grove, 1994), practice effort (Rhodewalt, Saltzman, & Wittmer, 1984), and global self-esteem (Prapavessis & Grove, 1998) and to correlate positively with impression management concerns (Hudson, Williams, & Stacey, 1998), precompetitive state anxiety (Ryska, Yin, & Cooley, 1998), mood states (Prapavessis & Grove, 1994), and the use of emotion-oriented coping strategies (Prapavessis, Grove, Maddison, & Zillmann, 2003).

Field studies and controlled experiments have examined factors associated with the use of self-handicaps prior to competitive or evaluated events. These factors include lower self-efficacy and self-esteem (Martin & Brawley, 2002), high perceived event importance (Rhodewalt et al., 1984), and elevated competitive state anxiety (Ryska at al., 1998). It is not clear, however, what effects (if any) self-handicapping has on athletic performance. In the only study to examine this issue, self-handicapping had a positive impact on running performance among children in a physical education class who had relatively low self-confidence, but not children with high self-confidence (Ryska, 2002).

With regard to second-generation studies, some experiments have looked at variables that moderate self-handicapping. For example, Rhodewalt et al. (1984) found that high levels of trait self-handicapping were related to reduced practice effort and attendance among competitive golfers, but only when an upcoming competitive event was perceived as important. Other second-generation studies have shown that self-handicaps are most likely to occur in competitive situations when athletes expect their performance to be compared with others (Coudevylle & Famose, 2005; Thill & Cury, 2000). For example, in an experiment couched in achievement motivation theory, experienced basketball players performed an evaluated basketball drill either in a private *mastery climate* that emphasized personal accomplishments and improvements, or a public *performance climate* that emphasized competition and performance social comparisons (Coudevylle & Famose, 2005). Prior to performing the drill, players were given the opportunity to take as many practice shots as they desired and to indicate any possible performance impediments. Analyses indicated that players in the performance climate took significantly fewer practice shots (a behavioral self-handicapping strategy) and listed significantly more performance impediments (a claimed self-handicapping strategy) than players in the mastery climate. These effects were moderated by sex; compared to women, men were more likely to use behavioral (i.e., reduced practice time) but not claimed self-handicaps. Coudevylle and Famose's findings speak to the potential moderating effects of both individual and situational factors on self-handicapping.

In a similar vein, from a third-generation research question perspective, researchers examined whether threat to self-esteem mediated the effects of task involvement goals versus social comparison goals on self-handicapping prior to a golf putting task (Thill & Cury, 2000). They found that task involvement goals were negatively related to self-handicapping and social comparison goals were positively related to self-handicapping, but neither of these relationships was mediated by a threat to self-esteem. In contrast, Prapavessis and Grove (1994) examined the mediating effects of self-esteem on the relationship between trait self-handicapping and the use of claimed self-handicaps (i.e., potential impediments to competitive performance). In male competitive golfers, self-esteem served as a negative mediator between the trait of self-handicapping and potential handicaps. Together, these findings suggest that among golfers with a dispositional tendency to handicap, the actual use of self-handicaps is driven by low self-esteem. However, threat to self-esteem does not appear to underlie the use of self-handicaps in situations with mastery versus performance climates.

With regard to self-handicapping in exercise contexts, we are aware of only three studies that have examined this issue, and two dealt with measurement. Shields and colleagues (Shields, Paskevich, & Brawley, 2003) identified a variety of self-handicapping claims that were used by exercisers. Interestingly, these were qualitatively similar to self-handicaps employed by athletes, for example, claims about scheduling problems, compromised health and physical functioning, and exercise facility barriers. Overall, exercisers used self-handicaps infrequently, and the incidence of self-handicapping was unrelated to age, sex, or preferred exercise setting. In one study, self-handicapping had virtually no impact on exercise performance (J. A. Smith, Hauenstein, & Buchanan, 1996), but it may influence other exercise-related outcomes such as social anxiety and mood states (cf. the effects of self-handicapping in sport contexts).

To characterize the self-handicapping literature as a whole, this topic has the most third-generation research (albeit with just three third-generation studies) and the best balance across the first-and-second research generations. Nevertheless, there are still several important first-generation questions that have not been adequately addressed. One such question is whether the use of claimed and behavioral self-handicaps affect athletic performance. Presumably, behavioral handicaps would impede performance to a greater extent than claimed handicaps, but this assumption has not yet been verified. Another important question is whether self-handicaps affect performance-related variables such as self-efficacy and anxiety. Given that self-presentational concerns are a significant source of competitive anxiety (Wilson & Eklund, 1998), and self-handicapping is used to manage self-presentational concerns, it makes sense that self-handicapping could help to alleviate sport competition anxiety (or, at least, those aspects of anxiety that reflect self-presentational concerns). First-generation questions such as these have significant implications for interventionists. If self-handicapping is detrimental to an athlete's psychological readiness and performance, then sport psychologists must devote efforts to preventing it. But if self-handicapping is beneficial, then there may be no need to intervene.

The mix of trait, situational, and interactionist approaches is also a noteworthy feature of the self-handicapping literature. Initially, sport researchers focused on establishing relationships between dispositional self-handicapping tendencies and various sport-related phenomena. But it soon became clear that these relationships were weak at best. Sport investigators then moved relatively quickly to develop methodologies to facilitate the study of situation-specific uses of self-handicaps. These methodologies also facilitated the study of situational factors that might elicit self-handicapping or interact with trait variables to produce self-handicapping. The relatively brisk shift from trait to situational and interactionist approaches may explain why this area of research has made the best progress across the three generations of research.

Self-Presentational Efficacy and Confidence

When people are motivated to impression-manage, they have an expectancy regarding the likelihood of conveying desired impressions to others (Leary & Kowalski, 1995). For example, an athlete who wants to impress a new coach will have a sense of the likelihood of presenting herself as a fit, competent team player. Perceptions of one's self-presentational capabilities have been defined as both *self-presentational efficacy* (Leary & Kowalski, 1995) and *self-presentation confidence* (Ryckman, Robbins, Thornton, & Cantrell, 1982).

Couched in the broader frameworks of self-efficacy and social cognitive theory (Bandura, 1997), self-presentational efficacy (SPE) reflects expectations about one's ability to perform the behaviors or present the images that lead to desired outcomes (Maddux, Norton, & Leary, 1988). As with other types of self-efficacy, SPE is considered situation-specific. By comparison, self-presentation confidence, at least in the physical domain, has been conceptualized as a trait construct and reflects one's level of confidence in displaying physical skills and having these skills evaluated by others (Ryckman et al., 1982).

Research on physical self-presentation confidence (PSPC) and SPE has addressed both first- and second-generation research questions in sport and exercise. With regard to PSPC, it has been shown that team sport athletes show greater self-presentation confidence than individual sport athletes (Wong, Lox, & Clark, 1993) and that PSPC can be enhanced through exercise training interventions (Lox, McAuley, & Tucker, 1995). However, it is not known why or how the sport context and exercise participation influence self-presentation confidence. Likewise, although it has been shown that greater PSPC is associated with greater persistence and endurance on a running task (Tenenbaum et al., 2005), it is not yet known how self-presentational confidence influences these behaviors.

With regard to SPE, first-generation studies have shown that prior to a physical fitness test, lower SPE is associated with lower levels of general and physical self-esteem, lower task self-efficacy, and greater use of claimed self-handicaps (Martin & Brawley, 2002). In exercise settings, lower levels of SPE for exercise are associated with higher levels of SPA, greater appearance anxiety and social anxiety, and lower exercise frequency (Gammage, Hall, & Martin Ginis, 2004; Gammage, Martin Ginis, & Hall, 2004). Physique-salient exercise environments, the presence of a male observer in the exercise setting, and "perfect-looking" exercise instructors have all been shown to decrease SPE for exercising in public settings. A couple of second-generation studies have examined prior exercise experience as a moderator of exercise environmental influences on SPE, but the results have been equivocal (Fleming & Martin Ginis, 2004; Gammage, Martin Ginis, et al., 2004).

Although research on SPE is still in its infancy, we suspect that like the broader self-efficacy construct from which it was derived (cf. Bandura, 1997), SPE will emerge as an important construct in second- and third-generation research. Indeed, as previously noted, SPE has already been identified as a significant moderator of the relationship between SPA and exercise frequency (Woodgate et al., 2003), and it could moderate other trait influences on affective and behavioral responses to physical activity. Given the potential for interactionist (trait by state) approaches to explain self-presentational phenomena in physical activity contexts (cf. Martin Ginis & Leary, 2004), we encourage further study of SPE as a situation-specific moderator. For example, SPE could moderate the effects of fear of negative evaluation on sport competition anxiety; people with greater evaluative fears and lower SPE may be more likely than fearful people with high SPE to experience sport competition anxiety. We also encourage third-generation research to address whether SPE mediates the effects of situational factors (e.g., the presence of an evaluative audience, physique-salient environments) on self-presentational outcomes (e.g., impression construction, social anxiety). In a similar vein, it would be worthwhile to examine whether exercise-induced changes in SPE mediate the effects of exercise interventions on trait self-presentation measures such as SPA and PSPC.

MEASUREMENT

The availability of valid and reliable measures of self-presentation constructs is crucial for the advancement of knowledge. As shown in Table 6.1, a considerable number of sport and exercise studies have dealt with measurement issues. In this section, we review studies that have attempted to develop, test, and refine indices of self-presentational constructs for use in physical activity contexts, critically evaluate this literature, and suggest some future directions.

Impression Motivation and Construction

There have been no attempts to develop a measure of impression motivation or construction for use in sport contexts. The four measurement studies cited in Table 6.1 pertain to the Self-Presentation in Exercise Questionnaire (SPEQ; Conroy, Motl, & Hall, 2000). Using the two-component model as its conceptual framework, the SPEQ was designed to assess impression motivation and impression construction with regard to exercise. Conroy et al. found that an 11-item, two-factor measurement model demonstrated closer fit to their data observations than their originally proposed 14-item, two-factor model. More recent studies have proposed a 9-item, two-factor model (Conroy & Motl, 2003) or different versions of an 8-item, two-factor model (Gammage et al., 2004; Lindwall, 2005). Some of these studies have also found support for partial or tight cross-validity, sex invariance of the factor structure, and slightly higher latent mean scores for men than women on one or both dimensions (Conroy & Motl, 2003; Lindwall, 2005). To date, the SPEQ has undergone minimal construct validation. Extant data indicate that SPEQ scores are weakly correlated with theoretically meaningful constructs such as social physique anxiety, physical self-presentation confidence, and exercise behavior (Conroy et al., 2000; Lindwall, 2005) but moderately correlated with exerciser identity (Lindwall, 2005).

Critique

Although a two-factor, 8-item model of the SPEQ has been upheld in two studies (Gammage et al., 2004; Lindwall, 2005), there are concerns about the face and construct validity of the Impression Motivation (IM) and Impression Construction (IC) subscales that emerged from these analyses. Specifically, most of the IC items tap into both a behavior and an underlying motive (e.g., "I wear exercise clothes that are flattering or revealing so others can tell that I am fit and/or attractive"). Because the IC items are confounded by IM, people's responses to the items could reflect their reaction to the impression construction component of the item (e.g., *wearing* flattering or revealing clothes) or the impression motivation component (e.g., wearing the clothes *to look fit and attractive to others*). Another concern is that IC items assess only a single impression construction strategy: altering one's physical appearance to make one look like an exerciser. In fact, three of the four IC items pertain to wearing athletic attire. Impression construction can take many other forms (e.g., verbal self-descriptions, choices of activities), but these are not measured. With regard to construct validity, it is not yet clear whether the SPEQ subscales measure what they are purported to measure. Overall, they have not been shown to be as strongly related to theoretically meaningful constructs as might be expected.

Summary and Recommendations

With the SPEQ, Conroy and his colleagues (2000) have provided a nice demonstration of how to develop a measure by linking a conceptual model with a measurement model and empirical observations. Nevertheless, concerns remain about the SPEQ's face and content validity. It is very difficult to tease apart, operationalize, and measure impression motivation and construction (Leary & Kowalski, 1990); unfortunately, these difficulties have not yet been overcome by psychometricians working with the SPEQ. Further work is needed to improve the scale's content validity. With the two-component model as its conceptual foundation, researchers can use the model as a basis for making decisions regarding scale improvement. These efforts should be followed by factorial and construct validation of the scale in various populations. When possible, we also encourage investigators to compare latent mean differences when conducting between-groups comparisons of SPEQ scores in order to yield a more accurate picture of between-groups differences (Lindwall, 2005).

Anxiety

In this section, we examine measures of self-presentational concern as they relate first to sport competition anxiety, and then social physique anxiety.

Self-Presentation Concerns and Sport Competition Anxiety

Two questionnaires have been used to assess self-presentational concerns in sport. Both are based on Leary's (1992) conceptualization of sport competition anxiety as a special form of social anxiety. The Self-Presentation in Sport Questionnaire (SPSQ) is an exploratory instrument that Wilson and Eklund (1998) created to test their hypotheses about the relationship between self-presentational concerns and competition anxiety. Factor analyses of the SPSQ items yielded four factors interpreted as self-presentational concerns about (1) performance/composure inadequacies, (2) appearing fatigued/lacking energy, (3) physical appearance, and (4) appearing athletically untalented. The SPSQ scores were moderately correlated with fear of negative evaluation and sport competition anxiety. Similarly, the Competitive Self-Presentation Concern Inventory (CSPCI; M. Williams et al., 1999) measures (a) concerns about others' impressions, (b) fear of appearing incompetent, (c) fear of appearing unable to cope with pressure, and (d) concern over current form. The a priori specified four-scale structure was supported by confirmatory factor analyses, and the subscales demonstrated acceptable internal consistency and test-retest reliability over 5 weeks. Correlations between scale scores and other measures of self-presentation concern were very weak.

Critique. By attempting to measure a variety of self-presentational concerns among athletes, the SPSQ and CSPCI represent important attempts to broaden conceptualizations of self-presentation anxiety beyond the concept of social physique anxiety. Both measures have a robust conceptual foundation and provide a clear link between theory and data. Their primary limitation is a lack of published psychometric evaluation. Factor structures have been validated only for university and college students in one country, and construct validation has been minimal. Furthermore, because Wilson and Eklund (1998) created the SPSQ specifically for their study (and not necessarily as a generic research tool), the SPSQ will require additional psychometric testing before it can be used to address other investigators' research questions.

Summary and Recommendations. The SPSQ and CSPCI are in the early stages of development and need to be used in more studies and tested on a more diverse range of populations before conclusions can be made about their psychometric integrity. We also note some overlap between the questionnaires (i.e., two subscales of the CSPCI seem to measure concepts similar to those measured by two of the SPSQ subscales). Perhaps a combination of SPSQ and CSPCI items and scales would result in a psychometrically stronger measure of self-presentational concerns than either instrument alone.

Social Physique Anxiety

The Social Physique Anxiety Scale (SPAS; Hart et al., 1989) measures people's dispositional tendencies to become anxious when others observe or evaluate their physique. In their original paper, Hart et al. proposed a 12-item, unidimensional scale. Some researchers subsequently proposed a two-factor model (e.g., McAuley & Burman, 1993), but this model was largely an artifact of negatively worded, inappropriate scale items. More recent studies support a unidimensional 9-item (Martin, Rejeski, Leary, McAuley, & Bane, 1997) or 7-item model in both adult and adolescent English-speaking (Motl & Conroy, 2000b; A. L. Smith, 2004) and non-English-speaking populations using translated versions of the SPAS (Isogai et al., 2001; Lindwall, 2004). Yet, although the 7-item model seems to provide the closest fit to the data, there is not yet consensus regarding *which* 7 items best fit the data, as different investigators have provided support for different 7-item models.

Researchers have also begun to look at the sex invariance of the SPAS factor structure and sex-differences in SPAS scores using latent means rather than observed means. Studies of English-speaking samples have found the factor structure of the 7-item model to be invariant across men and women (Motl & Conroy, 2001). In contrast, using a Swedish translation of the SPAS, Lindwall (2004) found that the factor structure for the 7-item Motl and Conroy model differed between men and women, suggesting the need for more studies on the sex invariance of translated versions of the SPAS. With regard to construct validity, as shown in Table 6.2, research has demonstrated SPAS scores to be correlated with a variety of theoretically relevant constructs.

Critique. The SPAS is the most widely used and investigated self-presentational instrument in sport and exercise psychology research. Its considerable development and refinement have resulted in a generally robust and psychometrically sound scale. But despite several studies reporting a consistent pattern of dimensionality and ideal number of items (i.e., a unidimensional scale of 7 items), results are inconsistent regarding *which* items should be included in a 7-item SPAS. Such inconsistencies are largely due to the use of data-driven model modification processes rather than conceptual and theory-driven processes. Ideally, adjustments to any scale should be consistent with the scale's underlying theoretical rationale, but the SPAS conceptual framework has never been clearly delineated. The lack of a conceptual blueprint for guiding measurement refinements (along with differences in study samples and translations of the SPAS) likely contributes to differences in the proposed 7-item models. Furthermore, very few psychometric studies have investigated samples other than physically active adolescents and college-age students. Little is known about the SPAS's psychometrics in other populations, such as the elderly, low-socioeconomic-status groups, or sedentary samples.

It should also be noted that the SPAS assesses only the cognitive manifestations of SPA. Presumably, like other forms of social anxiety, SPA also has somatic manifestations. For instance, people who experience high levels of SPA may blush or experience an increase in their heart rate or breathing rate in situations where they believe their body to be scrutinized by others. These types of symptoms are not captured by the SPAS.

Summary and Recommendations. Inconsistencies in the observed item structure of the 7-item models can leave researchers wondering just which 7 items they should administer to assess social physique anxiety. Given the lack of consensus, we recommend continued use of the 9-item version of the SPAS to prevent the exclusion of items that may be relevant for a particular sample. Research is still needed to validate and cross-validate the SPAS in different populations and cultures, and until that time, it seems premature to discard items that may be pertinent for a particular group. Consideration should also be given to expanding the SPAS to include items that tap into the somatic manifestations of SPA. We encourage continued efforts to translate the SPAS into other languages and to validate it outside of North America, as such psychometric advances will facilitate cross-cultural studies and expand our knowledge of cultural influences on SPA. When possible, latent means are recommended for comparing group differences in SPAS scores.

There is also a need to further examine whether SPA is best conceptualized and measured as a trait or state phenomenon in physical activity settings. Many researchers forget that the SPAS was developed as a generic, trait measure of social physique anxiety; it was not designed specifically to assess physique anxiety in sport and exercise contexts. Like other forms of social anxiety (e.g., sport competition anxiety), physique anxiety levels can vary across situations. Measures of SPA that are specific to sport and exercise situations, or that assess physique anxiety as a state variable, may provide stronger predictive and explanatory power in studies of physical activity phenomena than the generic SPAS. In recognition of this issue, some researchers have attempted to modify the original SPAS to measure state SPA (e.g., Kruisselbrink et al., 2004). This measurement approach appears promising, but further psychometric evaluation is needed.

Self-Handicapping

The Self-Handicapping Scale (SHS; Jones & Rhodewalt, 1982) was developed in academic achievement settings to measure dispositional tendencies toward making excuses and reducing effort as self-handicapping strategies. Unfortunately, the SHS was shown to lack reliability and validity when used to measure self-handicapping in sport and exercise settings (e.g., Martin & Brawley, 1999; Shields & Paskevich, 2001). As a remedy, some sport researchers have combined an open-ended approach with a standard psychometric approach to tap athletes' use of self-handicaps. For example, participants may be asked to list any disruptive events to training or preparation for competition that occurred over the past week and then to rate the strength of each impediment and the importance of each impediment for the person and for the team as a whole (Carron et al., 1994). Other researchers have measured claimed self-handicapping through a 7-item scale where participants indicate the extent to which seven different impediments (e.g., being tired, injured, having a sore body, or being untrained) are present and will interfere with their performance (Coudevylle & Famose, 2005; Martin & Brawley, 2002).

In the exercise domain, the Self-Handicapping Exercise Questionnaire (SHEQ; Shields et al., 2003) was developed to measure three types of claimed self-handicaps: inability to incorporate exercise into one's routine, discomfort or difficulty with training in exercise facilities, and poor health and physical functioning. Minimal psychometric data have been generated for these sport- and exercise-specific measures.

Critique. Although studies indicate that the sport self-handicapping indices are sensitive to manipulations of known antecedents of self-handicapping, the primary limitation of these measures is the lack of published psychometric data. With regard to the SHEQ, the preliminary psychometrics are promising, with a reasonable fit between measurement model and data. Yet, as its developers acknowledge, it has passed only the first testing stage and needs refinement. The lack of a clear conceptual foundation could be a barrier to this objective.

Summary and Recommendations. The different approaches used to measure self-handicapping in sport and exercise reflect the absence of a single, psychometrically sound instrument for measuring the construct. The varied approaches may also reflect the multifaceted nature of self-handicapping and a need to understand and assess it from different measurement perspectives. Continued psychometric testing should be a priority for all of the sport and exercise self-handicapping measures. With regard to the SHEQ in particular, having survived the first stage of development, its psychometric properties should be tested among different samples, and its three-factor structure needs to be cross-validated with larger samples.

Self-Presentational Confidence and Self-Efficacy

The Physical Self-Efficacy Scale (PSES; Ryckman et al., 1982) consists of two subscales purported to measure perceived physical ability and physical self-presentation confidence. In recent years, the scale has been criticized for its factor structure, content validity, and failure to measure self-efficacy at a situation-specific level (e.g., Hu, McAuley, & Elavsky, 2005; Motl & Conroy, 2000a). To address the last concern, some researchers have created measures of self-presentational efficacy for use in specific experimental contexts, such as physical fitness tests (Martin & Brawley, 2002) and group exercise classes (Gammage et al., 2004). These measures were designed according to Maddux and colleagues' (1988) recommendations, with self-efficacy and social anxiety theoretical frameworks at their foundation.

Critique

The PSES has been criticized for violating the basic tenets of self-efficacy scale construction (Bandura, 1997) and the key assumption that self-efficacy is situation- or task-specific. For example, PSPC items such as "I am never intimidated by the thought of a sexual encounter" and "Sometimes my laugh embarrasses me" do not assess self-presentational efficacy with specific reference to physical activity contexts, nor do they tap hierarchical levels of self-efficacy in the face of difficulties or aversive stimuli. Furthermore, several PSPC items do not assess any self-presentational construct whatsoever, let alone self-efficacy (e.g., "I find that I am not accident prone"; "I am sometimes envious of those better looking than myself").

With regard to the situation-specific self-presentational efficacy scales, these measures have demonstrated good internal consistency and generated some evidence of construct validity. Their primary limitation is that new situation-specific scales have to be developed and pilot-tested for use in new experimental situations. This can be a deterrent to investigators looking for a quick and dirty measurement solution. It should be noted, however, that Gammage and her colleagues (2004) have created a 5-item scale for measuring self-presentational efficacy among exercisers, which has been modified for different exercise research contexts simply by changing the instruction set. For example, prior to completing the scale, Fleming and Martin Ginis (2004) asked participants, "Think about yourself participating in physical exercise activities such as aerobics, jogging, cycling, hip-hop dancing, and strength-training," whereas Woodgate et al. (2003) instructed study participants to "think about exercising with a group of older adults" before responding to the scale items. In both studies, the scale demonstrated strong internal consistency and significant correlations with theoretically meaningful constructs.

Summary and Recommendations

Given the weaknesses of the PSES, alternative approaches are needed to measure self-presentation confidence. But despite our criticisms of the PSES, there may be some value in measuring general confidence in the ability to make desired impressions regarding one's physical capabilities. To measure general confidence, investigators will have to start from scratch and carefully consider both underlying conceptual and measurement models as they develop a new measure. Also, the situational self-efficacy scales would benefit from further psychometric testing, particularly with regard to discriminant validity. It would be reassuring to demonstrate that they do not overlap with more global measures of aspects of the self such as physical self-concept and self-esteem.

PULLING IT ALL TOGETHER

Overall, the sport and exercise self-presentation research can be characterized as first-generational. The vast majority of studies have addressed first-generation research questions, with most topic areas showing just a couple of studies at the second-generation level. Social physique anxiety and self-handicapping are the only topic areas where research questions have been examined across all three generations. It is no coincidence that these two areas have also generated the greatest number of measurement studies. This pattern speaks to the importance of valid and reliable research tools for advancing knowledge.

Chaos in the Brickyard?

Self-presentation is a hot topic among sport and exercise psychologists. Our review indicated a linear increase in the number of self-presentation studies published over the past 20 years. But an increase in research activity does not necessarily mean an increase in substantive, cumulative knowledge about the role of self-presentation in sport and exercise. In contemplating this issue, we are reminded of Bernard Forscher's (1963) allegorical tale of scientist "brickmakers" who forget that a primary goal of science is to construct edifices (or theories) and who instead become obsessed with making large quantities of individual bricks that do not fit with other bricks to build anything substantial. When the research landscape consists of one-off studies that fail to make systematic linkages and fail to build on existing knowledge, the terrain will more closely resemble a chaotic brickyard than a functional structure. Self-presentation researchers must take stock when designing their studies and determine if they are contributing to theory development or simply tossing bricks into the brickyard.

Theory Development in the Self-Presentation Literature

Theories provide a systematic view of a phenomenon by specifying relations among variables to explain and predict events. Much of the research in sport and exercise psychology should be concerned with constructing, refining, and testing theoretical frameworks, but unfortunately, most studies of self-presentational phenomena have been atheoretical.

This shortcoming may partly reflect the absence of formally defined theories of self-presentation. Although physical activity studies often make reference to "self-presentational theory" (e.g., Focht & Hausenblas, 2003; Marquez & McAuley, 2001), in actuality, no comprehensive theory of self-presentation exists. In fact, the self-presentational approach has been characterized more as a "metatheoretical framework within which one can formulate and seek answers to questions on the causes and consequences of human social behavior" rather than a theory in and of itself (Tetlock & Manstead, 1985, p. 62).

One example of a self-presentational framework is Jones and Pittman's (1982) taxonomy of strategic self-presentation strategies. Their taxonomy delineates five classes of self-presentational strategies, each linked with the type of impression desired by the person using the strategy (see Table 6.3). Jones and Pittman's objective was to provide a conceptual framework that would organize and relate self-presentational phenomena and provide a basis for theory-building research in the area. Their taxonomy was not conceived as a theory in and of itself.

Likewise, the goal of Leary and Kowalski's (1990) two-component model was to bring coherence to the self-presentation area by reducing myriad self-presentation variables to a small set of conceptually meaningful factors. As shown in Figure 6.1, their model delineates factors contributing to the underlying self-presentation processes of impression motivation and construction. The two-component model elegantly captures and organizes the many processes involved in impression-relevant behavior and is an excellent conceptual framework to use as a basis for self-presentation research. However, it does not yet provide (nor does it claim to provide) the predictive and explanatory powers associated with more fully developed and delineated theories.

As an alternative to self-presentational frameworks, some physical activity researchers have cast their studies in theories and models that are frequently used in sport and exercise psychology. For example, social cognitive theory (Bandura, 1997) has been applied to understand the relationship between exercise and social physique anxiety (McAuley et al., 2002; Woodgate et al., 2003). Achievement motivation theory (Ames, 1992) has been used to understand athletes' use of self-handicaps (Coudevylle & Famose, 2005). In addition, a few studies (e.g., Latimer & Martin Ginis, 2005; Marquez & McAuley, 2001) have attempted to integrate self-presentational concepts with theories such as the theory of planned behavior (TPB; Ajzen, 1985) and social cognitive theory. For example, Latimer and Martin Ginis (2005) showed that within the TPB, the relationship between subjective norms for exercise and intentions to exercise is moderated by level of impression motivation. It should be noted, however, that these types of integrative attempts have focused on using self-presentational concepts to advance a theoretical understanding of activity-related thoughts, feelings, and behaviors in general, rather than advancing theory regarding *self-presentation* in sport and exercise in particular.

Building Plans for the Future

As a starting point, we suggest that attention be devoted to synthesizing existing data. To date, there have been virtually no published attempts to compile comprehensive summaries of self-presentation data from sport and exercise studies. For instance, a plethora of first-generation studies have produced data on correlates of self-presentational phenomena, but this information has yet to be synthesized in a way that brings order and understanding.

Table 6.3 Jones and Pittman's (1982) Taxonomy of Self-Presentational Strategies

Strategy	Impression Sought	Negative Impression Risked	Emotion to Be Aroused	Prototypical Actions
Ingratiation	Likeable	Sycophant, conformist, obsequious	Affection	Self-characterization, opinion conformity, other enhancement, favors
Intimidation	Dangerous (ruthless, volatile)	Blusterer, wishy-washy, ineffectual	Fear	Threats, anger, breakdown
Self-promotion	Competent (effective, "a winner")	Fraudulent, conceited, defensive	Respect (awe, deference)	Performance claims, performance accounts, performances
Exemplification	Worthy (suffers, dedicated)	Hypocrite, sanctimonious, exploitive	Guilt (shame, emulation)	Self-denial, helping, militancy for a cause
Supplication	Helpless (handicapped, unfortunate)	Stigmatized, lazy, demanding	Nurturance (obligation)	Self-deprecation, entreaties for help

Adapted from "Toward a General Theory of Strategic Self-Presentation" (pp. 231–262), by E. E. Jones and T. S. Pittman, in *Psychological Perspectives on the Self,* J. Suls (Ed.), 2000, Hillsdale, NJ: Erlbaum. Copyright 1982 by Lawrence Erlbaum Associates. Adapted with permission.

Table 6.2 provides a very rudimentary catalogue of potential correlates of social physique anxiety. This information could be used as the framework for a proper meta-analytic synthesis of the correlates of SPA and other self-presentational phenomena. A meta-analysis was beyond the scope of this chapter, but it would allow researchers to take stock of the existing bricks in the self-presentational brickyard. We would then be able to see if any linkages exist between conceptually meaningful categories of correlates (e.g., behavioral, environmental, demographic) and different types of self-presentational phenomena. Identification of linkages would guide the selection of variables for studies of antecedents and consequences of self-presentation, which, in turn, would allow for the establishment of basic theoretical principles regarding causes and effects of self-presentation.

Data synthesis would also allow investigators to determine how best to proceed with theory development. For example, should we try to fit sport- and exercise-related self-presentational phenomena into existing self-presentation models (e.g., two-component model)? Should we develop new theories to explain phenomena specifically in the context of physical activity (e.g., a theory of self-handicapping in sport)? Or should we try to integrate sport- and exercise-related self-presentational processes into other theories (e.g., social cognitive theory)? Regardless of which approach is chosen, theory development must be a priority. Without theory, scientists do not have a blueprint to aid in study and measurement design, and practitioners do not have guidelines for developing effective interventions.

As well, we believe that it is time to move beyond first-generation research questions. Instead of merely assessing whether the correlation coefficient between self-presentation and some other variable is statistically significant, investigators must begin to treat these correlations as if they were any other dependent variable and determine what factors affect their strength (cf. Zanna & Fazio, 1982). The identification of moderating and mediating variables (i.e., second- and third-generation research questions) is a vital step in the process of theory development. Likewise, the continued development and assessment of sport- and exercise-relevant measures of self-presentation is crucial to the advancement of knowledge.

When taking these steps forward, it is imperative that investigators articulate the manner in which studies build on one another. For example, research reports should state explicitly how a given study advances what is currently known about a particular theory (cf. Weinstein & Rothman, 2005). Paying attention to the bigger self-presentation research picture will aid investigators in designing studies that answer vital questions and fill in knowledge gaps. This should be a priority for all sport and exercise researchers. After all, nobody wants to convey the impression of being a brick tosser.

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PART III

Sport Expertise

CHAPTER 7

Methodological Review and Evaluation of Research in Expert Performance in Sport

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Through an analysis of experts' performances and careers, the constraints on performance and the mechanisms and processes providing the expert advantage in sport can be appreciated. The study of domain experts provides insights into motor control and learning processes, enabling us to understand how high performance in motor skills is achieved and how to facilitate skill development. The study of expertise and skill acquisition has often been driven by advances in measurement. The aim of this chapter is to provide a review of sport expertise research, with a particular focus on how methods, technology, and measurement have developed to help address questions in the field. Advances in measurement have not necessarily been driven by technology; rather, new questions and a rephrasing of old ones have often led to the development of new methods to explore expertise-related issues.

This method-focused review is structured by three major themes that underpin research in expertise. The first theme is how expert athletes are able to make fast and accurate decisions, culminating in actions, compared to their less skilled counterparts. We first briefly review the various techniques that have successfully differentiated across skill levels and address particular questions relating to the measurement of decisions and the ecological validity of these techniques. These methods are then reviewed in relation to two overlapping, but what we evaluate as different research questions. The first question concerns the type of knowledge structures that underlie performance; the second question addresses the type of perceptual information affording the expert advantage. In the second theme we evaluate methods and measurement techniques that have been used to examine how skilled performers control their actions. Specifically, we explore characteristic movement features and control strategies that define expert performance across various levels of the motor system, including the examination of cognitive strategies and biomechanical/behavioral features. In the third theme we examine methods that have been used to explore how expertise is achieved across the careers of experts and how variables such as gender and age impact on the development and maintenance of high-performance skill. It is our goal to provide a comprehensive review of the methods that have been used to address fundamental questions in expertise research. Where space does not allow for in-depth discussion, we have provided references for further reading. In some sections more detailed reviews are provided than in others, which typically reflects the popularity of the measures as well as our wish to avoid duplication with other chapters in this book.

ASSESSING THE EXPERT ADVANTAGE IN DECISION MAKING

There is a multitude of good review chapters and a number of special journal issues on the issue of decision making in sport (e.g., McPherson, 1993; Ripoll, 1991; Starkes & Allard, 1993; Tenenbaum, 2003). Decision making in sports requires the actor to decide how to (re)act to environmental demands to achieve various performance goals, such as winning a point. Decision skills differentiate across

Support for writing this chapter was provided to the first author by the Social Sciences and Humanities Research Council of Canada (SSHRC Grant 410-05-0224) and to the third author by the Natural Sciences and Engineering Research Council of Canada (NSERC Grant 3700–2001).

skill levels among young children in tennis (McPherson & Thomas, 1989) and basketball (French & Thomas, 1987) and consistently among adult experts in sports such as field hockey (Starkes & Deakin, 1984), volleyball (Allard & Starkes, 1980), and soccer (Ward & Williams, 2003). In general, skilled performers make more accurate and faster decisions compared to less skilled players. Decision skills have been assessed using a number of different methods, summarized in Table 7.1. In the early research, decision accuracy was assessed through written responses following the presentation of static schematics or photographs from real games (e.g., Allard & Burnett, 1985; Starkes & Deakin, 1984), where athletes were required to watch and select the best move within time constraints. Dynamic video presentations are now commonly used for assessing decision skills (e.g., Ward & Williams, 2003; Williams, Hodges, North, & Barton, 2006), and efforts are under way to more closely simulate live game situations under controlled settings through 3D virtual reality (discussed later in the chapter).

Besides the method of presentation, the method of response has also evolved. Measurement of response outcomes (i.e., speed and accuracy), and the processes underpinning this outcome (i.e., how a decision was reached), began with written or verbal responses (e.g., Starkes & Deakin, 1984), including more recent situational probability methods whereby participants are asked to indicate the probability of an event, such as the best passing option in soccer (e.g., Alain & Sarrazin, 1990; Ward & Williams, 2003). More recently, measurement has been accomplished via a key-press response connected to a reaction timer (e.g., Franks & Hanvey, 1997); a voice-activated timer (e.g., Starkes & Deakin, 1984); a joystick response, enabling a measure of response corrections as the action unfolds (e.g., Savelsbergh, Williams, van der Kamp, & Ward, 2002); ground reaction time pads interfaced with switches for full body movements (e.g., Ward, Williams, & Bennett, 2002); and real-time analysis of movement and live game scenarios (e.g., Bootsma & van Wieringen, 1990; Rodrigues, Vickers, & Williams, 2002). Thus, over the years, the stimuli as well as the response modes have generally increased in ecological validity, leading to more sensitive measures of expert-novice differences.

The importance of ecological validity of the response mode was underscored by Oudejans, Michaels, and Bakker (1997), who found expert-novice differences in baseball catching judgments only when actual catching was required. The ecological validity of the perceptual stimulus also affects the observation of expert-novice differences in decisions. Féry and Crognier (2001) concluded that ball trajectories are harder to see in film clips than in real-life scenarios. It is likely that in two-dimensional presentations with a limited viewing angle, depth cues or peripheral information, which could be used in decision making, become obscured. The validity of stimulus presentations could be enhanced with virtual reality, which also affords more stimulus control than real-life game situations (see Williams & Ericsson, in press). A drawback of this method is the introduction of a time delay when coupled to the observer's action in real time. In a meta-analytic review of the expertise literature, J. R. Thomas, Gallagher, and Lowry (2003) showed that effect sizes tended to be larger when ecological

Table 7.1 Methods for Assessing Decision Accuracy and Speed according to the Type of Stimulus, Response, Measurement Validity, and Information about the Response, Including Speed, Accuracy, and the Decision Process

Stimulus/Response Mode	Ecological Validity	Outcome	Process
Stimulus Type			
2D static slides/schematics	Low		
2D dynamic video	Medium		
3D virtual reality	High		
Live game	High		
Response Type			
Verbal/written/situational probabilities	Low	Accuracy	Yes
RT timer (key press or microphone)	Low	RT and accuracy	No
Joystick response	Medium	RT, MT, and accuracy	Yes
Floor pads	High	RT, MT, and accuracy	No
3D body kinematics	High	RT, MT, and accuracy	Yes
Live game video analysis	High	MT and accuracy	Yes

Note: MT = Movement time; RT = Reaction time.

validity was high, although skill effects did not covary significantly with the degree of ecological validity.

One of the most valid methods of assessing the quality of expert decisions is to assess them during competitive play (in either concurrent observation or video analysis; French & Thomas, 1987; McPherson & Thomas, 1989). The appropriateness of a decision depends on many factors, and as such, assessing the accuracy of a decision is not trivial, particularly for team games. French et al. (1996) showed that a skill that cannot be performed would not be considered an option in a game. Therefore, assessing decision accuracy in the absence of knowledge of an individual's skills is misleading. Also, contextual information likely impacts future decisions, such that the inability to beat a defender in an earlier situation might dictate a better decision to pass on subsequent attempts. Coaches are typically asked to rate the best decisions under relatively unconstrained time conditions. Moreover, whether coaches are actually better decision makers than elite players is questionable (e.g., Franks, 1993). The quality of decisions has also been determined from the results of a particular game scenario, but even a desired result does not imply the action was the best (albeit sufficient) decision. One way to perhaps circumvent this problem is for players to reanalyze their own decisions (similar to situational probabilities).

Probing the Knowledge Structures That Underpin Expert Decisions/Actions

There have been a variety of methods over the past 30 years or so that have been used to determine what type of knowledge guides the decisions of experts. One of the simplest, in terms of equipment requirements at least, is that of questioning and analysis of verbal protocols. This has been an important tool for understanding when and what knowledge is accessed to aid performance as well as how it is organized. This method is particularly insightful when coupled with other methods such as categorization tasks. Perhaps the most popular approach has been the recall paradigm, whereby performers are given a limited period of time to observe and recall various game and non-game related scenarios. These various techniques are discussed in turn below.

Verbal Protocol Analysis

The mechanisms underpinning expert performance have been illuminated by think-aloud protocols, in which performers verbalize their thoughts and plans during or after an action. Verbalizations of skilled performers offer insights into the knowledge structures that are accessed and used to make decisions and perform tasks. This technique was popularized by de Groot (1965/1978), who required chess players to think aloud when deciding a chess move. Protocol analysis seems particularly suited to tasks that are not time-constrained and involve few if any motor skills, such as solving physics problems or playing board games. In sport, the seemingly automatic nature of decisions creates problems for analysis of explicit verbalizations, and it has been suggested that reports might be introspections, judgments, or wishes rather than representative cognitions (see K. T. Thomas & Thomas, 1994). Therefore, the methods to obtain verbal protocols, discussed in depth by Ericsson and Simon (1993), are important for obtaining valid data. The methods are designed to elicit thinking aloud either concurrently ("What are you thinking right now?") or retrospectively ("What were you thinking about while engaging in the task?") to uncover what is attended to as a performer plans and performs. The most appropriate measure is task-dependent. For example, if verbal reports significantly slow task performance, then it is more appropriate to elicit the thought processes after the play.

Much of the early work on protocol analysis in sports was conducted by McPherson, French, Thomas, and colleagues (see McPherson & Kernodle, 2003, for a recent review). Their aim was to understand the relationship between *knowing,* referred to as declarative knowledge (see Anderson, 1982), and *doing,* referred to as procedural knowledge. French and Thomas (1987) elicited the knowledge and skills underlying skilled performance in young basketball players through multiple-choice questions, observation, and open-ended interviews where players were asked to discuss possible outcome and decision alternatives for various basketball scenarios. Verbal reports were collected in situations where players were prompted with images about specific game instances and in between points to assess knowledge and future plans. Basketball knowledge related strongly to decision skills throughout the season, and both developed more quickly than motor skills (see also McPherson, 1999a, 1999b; McPherson & Thomas, 1989).

More recent research using verbal protocol analysis led McPherson and colleagues (see French & McPherson, 1999; McPherson & Kernodle, 2003) to differentiate action plans from current event profiles. Action plans are memory structures used to activate rule-based responses (i.e., condition-action mappings or if-then productions). Current event profiles enable features of the task and environment (e.g., opponent characteristics, the success of particular shots) to be incorporated into the action plans. Similarly, Sève, Saury, Theureau, and Durand (2002), from interview analysis of a table-tennis player during a World Cup match, showed how cognitively active the table-tennis player was in using past knowledge about the opponent's weaknesses and strengths to update and construct new knowledge both during and across games. This dynamic nature of decisions in relatively short-term scenarios questions earlier views about tight links between conditions and actions, at least at very high levels of skill.

Sorting Tasks and Categorization

An additional method for ascertaining the knowledge structures underpinning expert performance, introduced by Chi, Feltovich, and Glaser (1991), is through picture sorting or categorization tasks in conjunction with structured interviews. Performers group or categorize domain-related problems, presented in written or picture format, based on individually determined, shared characteristics. This method aims to provide a window into the depth of the domain knowledge and, by inference, the level of understanding of various problem situations. Because performers are not required to motivate their choices, this method provides insight into knowledge that might be less declarative or explicit than that ascertained through techniques such as protocol analysis and explicit recall. A common finding in these tasks is that skilled performers in sport, like experts in other domains, sort problems into categories that share functional similarities (such as techniques that result in similar outcomes), rather than sharing more superficial features (such as a similar number of players; e.g., Allard & Burnett, 1985).

In an attempt to further understand the tacit knowledge structures underpinning movement skills, not just general classes of movements, Schack and colleagues developed this grouping approach to analyze the knowledge representations of various sport skills, including tennis (Schack & Mechsner, in press), windsurfing (Schack, 1999), and volleyball (Engel & Schack, 2002). A psychometric analysis of the ordering and relations across key actions involved in a movement is conducted. The categorization of various action components is compared across skills and also with biomechanical models to determine how these components functionally relate. Engel and Schack found that skilled volleyball players were relatively consistent and hierarchical in the manner in which actions were represented, such that actions were matched to functional demands (i.e., the arms are lifted to increase height of a jump). This was not the case for less skilled athletes. This analysis is expected to aid in our understanding of the usually nondeclarative motor representations underlying expert performance in fast, complex coordinative actions and in identifying the problems novices encounter in understanding motor problems. It will be interesting to examine how well these statistically determined representations concur with verbal protocols and to investigate these representations before and after an action can be performed to determine whether "understanding" precedes or follows action development.

Recognition and Recall Paradigm

There have generally been two types of scenarios where measures of recall and recognition have been applied to assess expertise. Although the methods applied in both scenarios assess memory and hence cognitive skills, in game scenarios more emphasis is placed on perceptual skill than for movement sequencing skills such as dance. Recent attempts to differentiate across the types of knowledge which underpin expert performance have led to the recall paradigm being applied to assess memory for movement episodes and the procedures involved in action execution, which has produced some unexpected results.

Game Scenarios. One of the most commonly used methods to explore the knowledge structures underlying expert performance has been the recognition and recall paradigm. Here, performers' memory is tested following earlier presentation of domain-relevant information. Based on research in chess, in particular that of Simon and Chase (1973), researchers across a range of domains have consistently demonstrated a specific expert memory advantage for the recall and recognition of structured scenes or game plays (for reviews in sport, see Abernethy, Burgess-Limerick, & Parks, 1994; Starkes & Allard, 1993; Starkes & Ericsson, 2003; K. T. Thomas, 1994). This memory advantage is mostly domain-specific (but see Abernethy, Baker, & Côté, 2005; Smeeton, Ward, & Williams, 2004), and research has indicated that perceptual-cognitive skills are an integral component of motor-skill expertise (see Williams & Davids, 1995). Methods of recall have yielded insights into not only the size of the memory advantage (i.e., how many pieces or players are recalled), but also the perceptual organization (i.e., the type and size of units that are recalled). There is debate, however, concerning how memory for structured sequences is facilitated. Chase and Simon (1973) suggested that experts' "chunk" across units of information through pattern-recognition processes, enabled by a vast memory for domain-specific patterns (see also Gobet & Simon, 1996). Ericsson and Kintsch (1995) argued that the memory advantage results from an increased working memory capacity, achieved through superior encoding and retrieval mechanisms. Vicente and Wang (1998) argued that with experience, structural features of the stimulus become "automatically" linked to decisions or actions, known as the constraint-attunement hypothesis. Because these theories make similar predictions, it is difficult to distinguish among them empirically (see Weber & Brewer, 2003).

Much of the research using the recall and recognition paradigms in sport has been designed to uncover how expert performance is mediated by superior cognitive skills, under what conditions this advantage is seen, and how it is moderated by different demands. The major difference between board games like chess and sport skills is the physical nature of the response and the dynamic nature of the stimuli. Nevertheless, schematic representations elicit expert-novice differences in sports such as basketball and field hockey (Allard, Graham, & Paarsalu, 1980; Starkes & Deakin, 1984), but typically not as well as more ecologically valid representations (Williams & Davids, 1998). These findings suggest that similar processes are activated in artificial as in real-world scenarios. More recently, the conversion of video into dynamic point-light displays (PLDs; see North, Williams, Hodges, Ward, & Ericsson, 2006; Williams et al., 2006), allowing for easier manipulation of the display, has continued to differentiate across skill levels. However, PLDs are generally not as well recognized as video, probably due to the removal of non-game-relevant cues, and are less sensitive to manipulations of structure.

A problem with these methods is how to objectively quantify "structure." The finding that experts show advantages on slides, which are considered nonstructured, might be taken to suggest that a priori judgments of structure are not always valid (see Gobet & Simon, 1996). Typically, structure is determined by the experimenter before testing, through the selection of dynamic goal mouth plays rather than the positions of players at halftime, when the ball is out of play, or during warm-up. These latter, "unstructured" sequences, however, typically show some organization and are not as random as could be achieved through simulation (which awaits implementation). North et al. (2006) have attempted to minimize these problems by using only dynamic game scenarios that have been rated for structure by coaches and thereupon selected for use in the experiment. A more objective means to assess structure could be to analyze scenarios in terms of assumption-free, data-reduction techniques (see later discussion).

There is evidence that the memory advantage in experts reflects a deep level of understanding rather than only perceptual familiarity, as evidenced by recall advantages for players rather than fans, for example (Williams & Davids, 1998). However, Zoudji and Thon (2003) failed to show priming effects, that is, decision time advantages, on game scenarios that had been shown previously, when the structure remained the same but the image was mirror-reversed. Only when identical stimuli were presented were expert-based priming effects observed. These authors argued that incidental, or implicit, memory tests, where memory is unexpectedly tested following a viewing or decision phase, provides a more valid marker of the processes underpinning expertise in team game scenarios. This is because decisions are often arrived at in a dynamic manner and performers have little or no awareness of how past knowledge influences performance. Although there has been evidence to the contrary, and modified expert advantages under conditions where memory tests have been unexpected (e.g., North et al., 2006), there is also evidence that game-relevant information is perceived and encoded without deliberate intention to attend to particular features (e.g., Weber & Brewer, 2003), and hence that both explicit and implicit memory studies are valid indices of expertise.

Memory for Movement Sequences

Skilled performers in dance, martial arts, gymnastics, and figure skating have shown significant advantages in recognition and recall for nonrandom sequences of moves (e.g., Starkes, Deakin, Lindley, & Crisp, 1987; Tenenbaum, Tehan, Stewart, & Christensen, 1999), but also for random sequences of moves (Smyth & Pendleton, 1994; Starkes et al., 1987; Tenenbaum et al., 1999). Expert dancers, for example, are expected to frequently encounter scenarios that require intentional learning for later recall, and are therefore expected to show significant explicit memory advantages. Moreover, dancers, particularly in modern dance, are required to sequence together moves in a semi-random fashion, and hence this type of practice might aid performance on memory tests generally. Because of the additional temporal demands placed on recall of sequences (i.e., what was seen and when), additional insights are provided from these domains into the type of strategies engaged in aiding recall. As with experts in game scenarios, skilled dancers show evidence of chunking moves into units or phrases, and also primacy effects (Poon & Rogers, 2000; Starkes et al., 1987), whereby information presented earlier in a sequence is better recalled.

The nature of the recall process has also informed how skilled performers actively encode information. Experts showed a preference for both physically and verbally recalling actions in test phases, such that verbal labels acted as recall cues. The combining of interview techniques with recall procedures (e.g., Ferrari, 1999; Poon & Rodgers, 2000) has also shown that experts have more insight into the methods that aid recall than their less skilled counterparts, which might further aid recall for unusual moves and sequences. The expert memory advantage has been shown to be robust over time and less susceptible to interference than in novice performance (e.g., Poon & Rogers, 2000; Starkes et al., 1987; Tenenbaum et al., 1999), supporting the conclusion that long-term memory mediates performance in these tasks.

Advances in brain imaging technology, specifically functional magnetic resonance imaging (fMRI) have provided additional analysis of the mechanisms and brain pathways that underpin expert memory advantages. Although fMRI is limited in its applicability, in that only limited movement is allowed, this technology can be used to uncover the pathways that mediate expert decisions on visual tests. Calvo-Merino, Glaser, Grezes, Passingham, and Haggard (2004) presented video stills of dance moves in classical ballet and in Brazilian capoeira dance to experts and a nonexpert control group. A significant domain-specific skill effect was observed in terms of increased brain activation during observation in areas thought to reflect motor simulation/preparation, such as the premotor and parietal cortex (see Decety & Grezes, 1999; Rizzolatti, Fogassi, & Gallese, 2001). Moreover, areas associated with semantic categorization (i.e., middle temporal areas) rather than visual perceptual processing (i.e., occipital cortices) showed the expertise advantage.

Memory for Movement Episodes

One area of research where findings seem to conflict with the expert memory advantage is in memory for the mechanics or procedures involved in skill execution, or so-called expertise-induced amnesia. According to Beilock, Wierenga, and Carr (2002), skilled performers recall recent episodes and the procedures involved in action sequences less well than novices do, such that skilled golfers can remember their scores on the last 10 putts, but have difficulty recalling how these putts were executed. This effect is proposed to be attentional in nature and related to an automatic style of performance characterizing expertise. Recall for episodes involved in an action improved only under conditions that simulated a more novice type of performance control, through the introduction of an unusually shaped putter (see also Beilock & Carr, 2001). This research awaits additional empirical investigation. It might be that the conditions for performance in the laboratory environment by Beilock and colleagues were too simple (both the putting action and the course) to prompt recall, but under game conditions, where difficulty and variety dominate, the action-execution is attended to and better recalled. Moreover, in practice designed to improve performance, attention to the step-by-step aspects involved in the movement might be needed to improve, and hence facilitate recall (see also Gray, 2004).

Summary

Verbal protocol analysis appears to be one of the most useful and simple tools, at least in terms of cost and accessibility, though not necessarily analysis of the data, for gaining insight into how the expert advantage is achieved. The ability to elicit detailed process measures from real-world performance is currently unmatched by other techniques. Potential problems with this approach (e.g., the fact that explicit, verbalizable thoughts might be somewhat artificial in nature and could reflect expectations) have been addressed through the combining of a number of techniques, such as categorization and recall tasks, which help in understanding the more tacit or underlying organization of knowledge. Recall and recognition tests have significantly helped to uncover the knowledge structures underpinning expert performance in sport. There is consistent evidence that tests of memory discriminate across skill levels, and that the expert advantage is mediated by long-term memory structures. The fact that the expert advantage in memory and decision skills remains almost irrespective of the stimuli, the action, or how the stimuli were encoded provides evidence that at least some of the expert advantage can be captured in the laboratory, and hence allows for inferences about the knowledge and processes underlying these decisions. Notwithstanding this observation, skill-related differences come to the fore the more similar the stimuli and action are to what is required in real-world scenarios.

Understanding the Perceptual Information That Guides Expert Decisions and Actions

In this section, we further examine this decision characteristic of expert performance through analysis of the information that guides expert performance. This topic has been addressed by two theoretical approaches, particularly with respect to the distinction between decisions in action (i.e., during continuous play) and out of action (i.e., before or after a point). In the latter case, the information-processing perspective has been applied most extensively through chronometric measurements, that is, measures that indicate how long an action or decision takes, and hence provide an indirect measure of processing speed. In the former case, the information guiding movement, and the laws underlying this guidance, have been examined.

Eye Movement Data

Equipment for gaze tracking, or analysis of fixations and visual search, has become more affordable and practical in the past decade. Eye movement systems range from relatively basic digital video scene cameras, with eye movements superimposed over the scene, capturing data at 60 Hz, to high-speed cameras that can be used in relatively stationary environments (depending on the head-tracking hardware), enabling recordings up to 500 Hz. There have also been developments in mobile eye movement technologies, though these are often less precise and less technically sophisticated. One caveat on the interpretation of eye movement data is that looking and seeing cannot simply be equated. Looking at a location does not necessitate that information is being picked up from this location, and, conversely, optical information may be picked up from the parafoveal and peripheral regions (see Williams & Ericsson, in press). It is also possible that the relevant information is the *empty* space between players (McMorris & Graydon, 1997) rather than the players themselves, such that fixations inform about anticipation of future events.

A significant amount of research suggests that experts' gaze behavior differs from that of nonexperts, allowing them to make faster and more accurate decisions and actions. For instance, fixating certain regions early in the movement (such as body position before a pitch or serve in baseball and tennis; see Abernethy & Russell, 1984; Goulet, Bard, & Fleury, 1989) seems to be most important for task success. Experts typically reveal fewer, but longer, fixations than do novices (e.g., Abernethy & Russell, 1987; Ripoll, Kerlirzin, Stein, & Reine, 1995), perhaps allowing for more detailed processing of task-relevant information. However, the most effective pattern of fixations is likely to be codetermined by the task constraints. For example, Williams and Davids (1998) found that in various soccer scenarios, experts employed more fixations of shorter duration than novices did.

Visual search paths, and their consistency, have also been shown to vary as a function of skill (e.g., Ripoll, 1988; Ward et al., 2002). Search paths are expected to indicate strategies that skilled performers use to gain information about an unfolding event, and as such may provide hints as to the relevance of information from various sources. There is evidence that visual search proceeds in a more proximal (i.e., the trunk) to distal (i.e., the arm and racket) fashion among skilled performers in racket sports (Ward et al., 2002), whereas novices tend to fixate on distal regions and show less consistency in their search paths. Land and McLeod (2000) measured the eye movements of cricket batters during the approach of a ball to be batted. Compared to less skilled players, professional cricketers initiated faster and less variably their anticipatory saccade to the point where the ball was expected to bounce and also showed smooth pursuit tracking of the ball following the bounce. From the gaze recordings, in combination with a physical analysis of the ball trajectory, the authors pinpointed the importance of early information regarding the ball's delivery and bounce for successful batting. Similarly, Amazeen, Amazeen, and Beek (2001) measured the gaze paths of expert and intermediate jugglers during sustained one-ball catching and throwing to determine which part of the ball's trajectory was tracked. Experts used information earlier in the flight path to accommodate to changes in frequency of the throw, and both skill groups looked at the area around the ball's zenith. However, the timing of the eye movements for the skilled group was more variable than that of the intermediate group, suggesting that at elite levels of performance, flexible rather than rigid control and search define performance (see also Huys & Beek, 2002).

Visual Occlusion and Analysis of Errors

A complementary strategy to examine the information used by experts is through spatial and/or temporal occlusion of events (for reviews, see Abernethy, 1987a, 1987b; Williams, Davids, & Williams, 1999). As a rather primitive way to achieve occlusion, researchers have turned out the lights at the point when information was to be removed or covered a particular feature on a viewing screen (e.g., Abernethy & Russell, 1984). More recently, occlusion has been achieved by selectively editing video clips, such as a player in a game or an area on a player's body, and replacing this with background information (see Williams et al., 2006).

In a study of soccer goalkeepers, temporal occlusion was achieved through the removal of vision at four successive periods around ball kick, corresponding to specific events (Williams & Burwitz, 1993). In the preimpact conditions, experts outperformed novices, suggesting that they are better able to use information in an anticipatory fashion. Similarly, Tenenbaum, Sar El, and Bar Eli (2000) examined the moment of information pick-up enabling anticipation of different tennis strokes (serve type and difficulty) across different skill and age groups. The expert advantage was again most pronounced in the early portion of the tennis stroke, particularly for strokes performed near the net. Spatial occlusion techniques, where specific sources of information are removed, have been used to examine performance in racket sports by Abernethy and Russell (1987) and Abernethy (1990, 1993). These techniques have shown that experts are able to use information from the arm movements of their opponents to aid accuracy, whereas novices only show decrements in accuracy when information pertaining to the ball or racket is removed. Occlusion has also been achieved through the transformation of an image into points of light representing joint locations. For example, Abernethy (1993) and Ward et al. (2002) have used this method to show that the perceptual anticipatory advantage remains when structural, body-related information is removed. This finding supports the conclusion that one expert advantage in sports is based on kinematic information and perhaps the relations between body segments, rather than specific features of the body. Further manipulations to PLDs (e.g., in terms of lower or upper body) will help to isolate more exactly the sources of information underpinning this advantage (see Hodges, Hayes, Breslin, & Williams, 2005).

There have also been attempts to occlude visual information under live conditions, such as in tennis (Farrow & Abernethy, 2003; Singer, Cauraugh, Chen, Steinberg, & Frehlich, 1996), volleyball (Starkes, Edwards, Dissanayake, & Dunn, 1995), and juggling (van Santvoord & Beek, 1994), using liquid crystal occlusion goggles. This equipment allows the experimenter to turn vision on and off at any point in the action. Occlusion of vision before or after ball contact on a serve differentiated across skill groups in a way similar to that observed under video manipulation conditions, supporting the validity of these off-court scenarios. However, Farrow and Abernethy found skill-based differences only when a physical rather than a verbal response was required (see also Féry & Crognier, 2001; Oudejans, Michaels, Bakker, & Dolne, 1996).

Obviously, visual occlusion methods (through goggles or otherwise) are not always feasible in situ, in view of methodological and ethical (concerning participants' safety) limitations. An interesting method to determine what information is most useful for performance, using these goggles, was introduced by van Santvoord and Beek (1994). Skilled jugglers wore goggles that rhythmically opened and closed during three-ball cascade juggling. Through adjustments to the frequency and phasing of the juggling, the participants could self-select which part of the ball trajectories they preferred to look at. Participants were able to sustain juggling under these rhythmic conditions, showing flexibility in their sampling and use of information. Juggling performance was most stable in trials where there was a phase locking between the ball trajectories and the opening of the goggles, allowing for the zenith of the ball flight to be observed. Recently, there have been attempts to tie visual occlusion manipulation to specific kinematic events. In basketball, Oudejans, van de Langenberg, and Hutter (2002) used an opto-electronic device to record and synchronize the opening and shutting of the goggles with real-time movement kinematics (i.e., when the arms passed a particular point). The ability to more closely examine when and what information is used for decision accuracy and movement is afforded through these methods.

Summary

Measurement of eye movements, regardless of limitations inherent in their interpretation, as well as occlusion techniques have been successfully implemented to uncover differences in visual search patterns and the sources of information used in sports decisions as a function of skill. Although task-specific constraints prohibit general conclusions as regards expert behavior across sports, certain regularities within related sports have come to the fore. Furthermore, several studies suggest that expertise-dependent differences are more apparent with increasing ecological validity (both stimuli presentation and response type) and that although consistencies within expert groups have been observed, there is evidence that flexibility in search strategies might characterize elite performance.

WHAT IS CONTROLLED? MECHANISMS UNDERPINNING EFFECTIVE CONTROL OF ACTIONS

Related to the question of what information is used to achieve a high level of performance skill is the question of what control processes and strategies (conscious and nonconscious) underpin expert performance. For example, when a person becomes skilled at a sport task, does his or her attentional focus change? Does the use of feedback change? Does the organization of movements change? How are these aspects related? In most sport skills, unlike in cognitive skills, the motor component and the need to adapt to changing environmental demands as the movement unfolds are critical. In these perceptual-motor skills, experts not only make faster and better decisions, but also appear to move in a more stable, coordinated, and fluid manner. The question of how movement is controlled effectively has been addressed both from the dynamical framework, where the emphasis has been primarily on changes in movement stability and coordination across systems, and the cognitive framework, with its emphasis on knowledge structures and attentional processes enabling effective performance. These approaches are discussed next, along with the measures associated with the different approaches.

Attention and Dual-Task Protocols

Manipulation of attentional focus, or task demands, has been used to infer the control strategies of expert performers, either through attention-directing instructions or through secondary-task techniques, which distract attention from the primary task. These methods help us to understand how attention is allocated to specific aspects of performance (either movement- or environment-related), as well as general cognitive demands associated with performance, respectively. Leavitt (1979) examined how stick handling when moving and controlling a puck on the ice was affected by a secondary perceptual discrimination task across ice hockey players of various ages and skill levels. For novice players, in comparison to the older and more skilled players, stick handling deteriorated during secondary-task conditions. However, it was not possible to conclude whether the secondary task interfered at a perceptual level, preventing focus on the stick or the puck, or at a cognitive level, due to limits in processing capacity. This issue has been circumvented through auditory secondary-task manipulations, which do not require a physical change in attentional focus (e.g., Abernethy, 1988; Beilock, Wierenga, et al., 2002). Resource limitations, as a result of memory demands required of the primary task, have been observed following requirements to respond to an auditory stimulus.

Attention has been manipulated to determine how knowledge structures, and hence specific skill-related attention manipulations, affect the control of various sport skills in golf (Beilock, Carr, MacMahon, & Starkes, 2002), soccer (Beilock, Carr, et al., 2002; Ford, Hodges, & Williams, 2005), and baseball (Gray, 2004). In comparison to novice performers, only skilled players were affected when attention was directed to a component associated with the skill, such as the foot in soccer dribbling. In Figure 7.1 we have plotted the mean movement times (for soccer ball dribbling) and timing errors (for baseball batting) across the three laboratories where these skill-based attention manipulations have been examined. There is a consistent trend for skilled participants to be slower and make more errors under the skill-focus manipulations in comparison to the other attention conditions, which is not true of novice performers.

The authors explained these findings by claiming that effective control is achieved through structures that primarily function automatically. Bringing this knowledge into consciousness disrupts performance. Manipulations to the task instructions in terms of speed and accuracy have added further support for these ideas (Beilock, Bertenthal, McCoy, & Carr, 2004). There is also evidence that these performance effects are mediated by the locus of attentional focus (i.e., internal or external). Perkins-Cecatto, Passmore, and Lee (2003) showed that skilled golfers performed more variably under instructions that encouraged attention to the swing (i.e., internal) rather than the putt (i.e., external), whereas the reverse was true for novice performers (i.e., more variable under external versus internal instructions). Ford et al. (2005) showed that irrespective of whether skilled performers attended to the arm or the foot in soccer ball dribbling (both internal features, but only the foot being highly relevant to the skill), performance was disrupted in comparison to control and word-monitoring attention conditions. Despite the evidence that skill execution is more effective when attention is directed externally, or that skilled performance is characterized by this type of focus, research on performance control or coping strategies in running has shown that elite runners adopt internal monitoring strategies in comparison to less skilled runners, who show a tendency to focus on external, nonrelevant features of the run (Nietfeld, 2003). There is clearly a need to understand how knowledge and attentional focus interact with task demands to determine when and how an inward focus on skill-execution processes are harmful or potentially beneficial to performance.

In addition to attempts examining how a skill is controlled online, there have been attempts to examine what is controlled and how subsequent movements are planned. There is evidence to suggest that actions are planned (i.e., selected and initiated) in terms of their end effects or sensory consequences (see Koch, Keller, & Prinz, 2004, for a recent review and implications for sport). Although end-effect control has been discussed in sport, there has been little empirical investigation (but see Ford, Hodges, Huys, & Williams, in press; Hodges, Hayes, Eaves, Horn, & Williams, 2006, who have examined the role of ball trajectory information in planning, executing, and acquiring soccer-related skills).

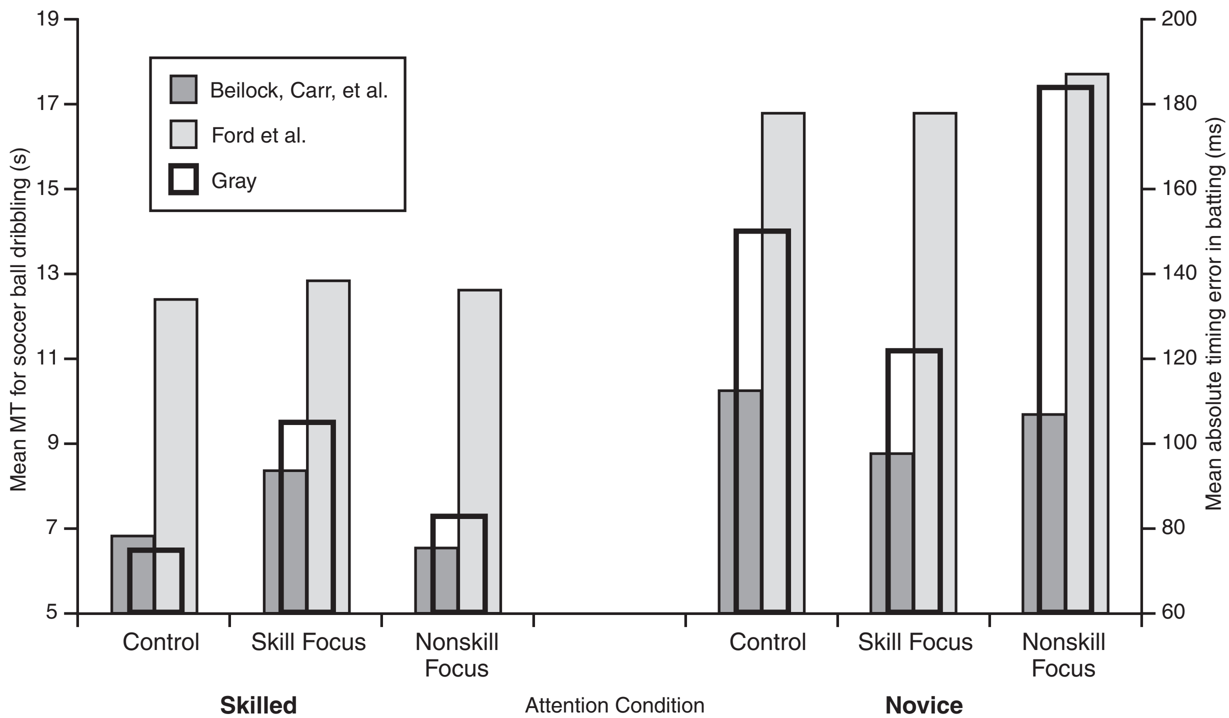

Figure 7.1 Soccer dribbling times (Beilock, Carr, et al., 2002; Ford et al., 2005) and timing errors in baseball batting (Gray, 2004) as a function of attention condition across skilled and less skilled performers.

Occlusion and Perturbations to Visual Information

The processes underlying the control of movement have often been examined through manipulations to the sensory feedback about the movement. If removal of or perturbations to visual feedback have little effect on skilled performance, then one interpretation is that at high levels of skill actions are controlled by "motor programs" that are prepared before the action and can be run without the need to monitor vision (R. A. Schmidt, 1975; R. A. Schmidt & McCabe, 1976). Alternatively, it might be argued that skilled performance is achieved through monitoring of a different source of sensory information, such as proprioception (e.g., Adams, 1971). Under laboratory conditions, where performance on aiming tasks has been examined after a few (200) or many (2,000) trials, there is evidence that with increasing skill, a dependency on vision emerges (e.g., Proteau & Cournoyer, 1990). This has been termed the specificity of practice hypothesis. Despite support for this hypothesis in the laboratory (see Khan & Franks, 2004; Proteau, 1992), real-world experts performing gymnastic skills (Robertson, Collins, Elliott, & Starkes, 1994) or power-lifting (Bennett & Davids, 1995) have been less affected by manipulations to online visual feedback (achieved through occlusion goggles) than have novice performers. Because the way the movement is performed changes when vision is removed, for example, an increase in speed in traversing the balance beam, it has been argued that experts are flexible in their ability to use other sources of feedback to control their movement, rather than perform in a programmed fashion. Indeed, knowledge as to whether vision will be available during practice or performance affects the movement-control strategies that participants adopt (see Khan, Elliot, Coull, Chua, & Lyons, 2002). If performance is required under consistent sensory conditions, then it is likely that a reliance on this sensory information will be seen as a function of practice and increasing skill. However, when the conditions of performance vary and multiple information sources could be used to control the action, then it is likely that skilled performance will be characterized by flexible control strategies (see Huys & Beek, 2002).

Visual Gaze

Eye movement recording techniques have also been employed to gain an understanding of how skilled performers effectively allocate physical attention to prepare and control movement execution, particularly in the face of performance pressures. There is evidence that in comparison to less skilled performers, skilled athletes maintain consistency in their search under anxiety manipulations (Rodrigues et al., 2002; Williams & Elliott, 1999). However, both novices and experts in karate have been found to focus more on peripheral body features under conditions of high stress, although this behavior was more pronounced in novices (Williams & Elliot, 1999). There is also evidence that the spatial and temporal characteristics of gaze during the preparation and execution of skills is related to the expert advantage. Skilled and successful performers have shown a consistent visual gaze phenomenon, termed "quiet eye" (Vickers, 1996; Vickers & Adolphe, 1997). Accordingly, before an action is undertaken, such as a basketball free throw or jump shot (Oudejans et al., 2002; Vickers, 1996), a table-tennis serve (Rodrigues et al., 2002), or golf putt (Vickers, 1992), successful performers steady their gaze onto the target (such as the rim of the basketball net or the golf ball) just before executing the shot. The quiet eye period is believed to reflect cognitive processing activities that take place before the shot. Consistent duration of fixations, as well as consistent fixation points, differentiate across skill class and, more informatively, across successful and less successful shots. Oudejans et al. have suggested that the optimal duration of a fixation is linearly related to execution time.

Measurement of Coordination and Synergies

The qualification and quantification of coordination has often been approached in terms of Bernstein's (1967) degrees-of-freedom problem (i.e., how does control arise in systems with many degrees of freedom). Bernstein sought the answer to this problem in the concept of synergies, or coordinative structures, commonly defined as "a group of muscles often spanning a number of joints that is constrained to act as a single functional unit" (Kugler, Kelso, & Turvey, 1980, p. 17). Traditionally, degrees of freedom were understood in the anatomical/(bio)mechanical sense. Correspondingly, various researchers examined simultaneously the amplitudes of, and degree of coordination between, joints or limb motion (e.g., Temprado, Della-Grasta, Farrell, & Laurent, 1997; Vereijken, van Emmerik, Whiting, & Newell, 1992). For example, Temprado et al. examined the coordination of the shoulder-elbow-wrist linkage during the execution of a volleyball serve across novice and expert players through the cross-correlation function. This is a technique that quantifies the degree of similarity between two time-series as a function of a time lag. A higher degree of skill was accompanied by a lower degree of coordination between joints (indicated by smaller cross-correlations).

With the establishment of coordination dynamics as an approach to the study of coordination, synergies were looked for and examined in terms of collective variables, such as the relative phase between action components, and their stability (Haken, Kelso, & Bunz, 1985; Kelso, 1995; Turvey, 1990). Relative phase reflects the relative timing between two processes. It became established as an important variable capturing coordination after Kelso (1984) showed that when participants cycle their limbs in antiphase and gradually increase their cycling frequency, an abrupt, spontaneous switch to in-phase coordination occurs. In lay terms, this is the shift that occurs when index fingers moving quickly as windshield wipers (antiphase) show an increase in relative phase variability and automatically transit to moving in symmetry (in-phase). The findings of differential stability of these movements and the transitions between them have been observed in the coordination between joints (e.g., Haken et al., 1985) and postural sway (e.g., Bardy, Marin, Stoffregen, & Bootsma, 1999) and visually mediated coordination between persons (e.g., R. C. Schmidt, Carello, & Turvey, 1990). Bardy et al. had gymnasts and nongymnasts track a stimulus oscillating with increasing frequency with their head. Initial in-phase coordination between ankle and hip rotations gave way to an antiphase pattern at a certain frequency. This occurred at a higher frequency for the gymnasts than the nongymnasts, interpreted as a training effect. Larger hip movements, which are penalized by gymnast judges, may occur during antiphase coordination, such that the gymnasts had learned to resist a more natural coordination mode.

The strength of patterns of coordination and the fluidity of movement, often indicative of skilled performance, has also been captured by spectral analysis. Spectral analysis highlights temporal patterning in a continuous movement such as rowing or running, whereby the time series is transformed into the frequency domain, resulting in a power spectral density estimate (Stocia & Moses, 1997). From estimations of the spectral densities of the ball trajectories in three-ball cascade juggling, Huys and Beek (2002) showed that the degree of coordination among the juggled balls was higher in expert jugglers than in intermediate jugglers. A drawback of spectral analysis is that information over time is lost, which sometimes can be of pivotal importance. For instance, during rowing, certain frequency relations between the legs and breathing rates are often observed, especially in well-trained athletes (Bramble & Carrier, 1983; Siegmund et al., 1999). However, these relations are not always fixed during an entire race (or trial). To study the transitions in frequency relations between the movement of the rowing handle on a rowing ergometer and breathing, Daffertshofer, Huys, and Beek (2004) computed spectrograms of the handle force and respiration data from a simulated 2 km race by well-trained rowers. These were obtained by calculating spectral density estimates over a window that was repetitively shifted in time (as illustrated in Figure 7.2). Transitions from a 1:1 to a 1:2 frequency-locking ratio between the rowing action and breathing were observed through this technique.

One drawback of the methods outlined here is that their scope is limited to pairwise comparisons. Excellent performance in real-world settings most often comes about through the coordination and cooperation of a variety of components. One technique that has successfully been applied to capture the degree of coordination among numerous components is principal component analysis (PCA; see Daffertshofer, Lamoth, Meijer, & Beek, 2005; Haken, 1996). In general, a finite number of time series can be effectively described by fewer (temporal) structures. For instance, Haas (1995) studied whole-body movements of people as they learned to ride the pedalo, an odd contraption allowing "gait on wheels." Early in learning, this could effectively be described as a 5-dimensional system. At the end of learning, the learner's dynamics could effectively be described by a 2-dimensional system. This study and others (e.g., Huys, Daffertshofer, & Beek, 2003) suggest that with increasing skill the control structure's dimensionality decreases, with control becoming more effective. However, there is evidence that direction of change in dimensionality is task- or skill-dependent (see Newell & Vaillancourt, 2001).

Principal component analysis allows examination of the structure of variance in a skill; however, due to the makeup of the perceptual-motor system, sport goals may be achieved in various manners. Scholz and Schöner (1999) introduced the uncontrolled manifold (UCM) to address this. In this method, the variability across multiple motor executions is decomposed into two distinct subspaces. The variability in one subspace, the UCM, does not affect task performance and may thus be released from control. In contrast, the variability in the other subspace is critical for task performance, and as such requires control. Scholz and Schöner decomposed the variability in a shooting task into two distinct subspaces (the uncontrolled and the controlled manifold). A skilled marksman can adopt a range of joint combinations, which

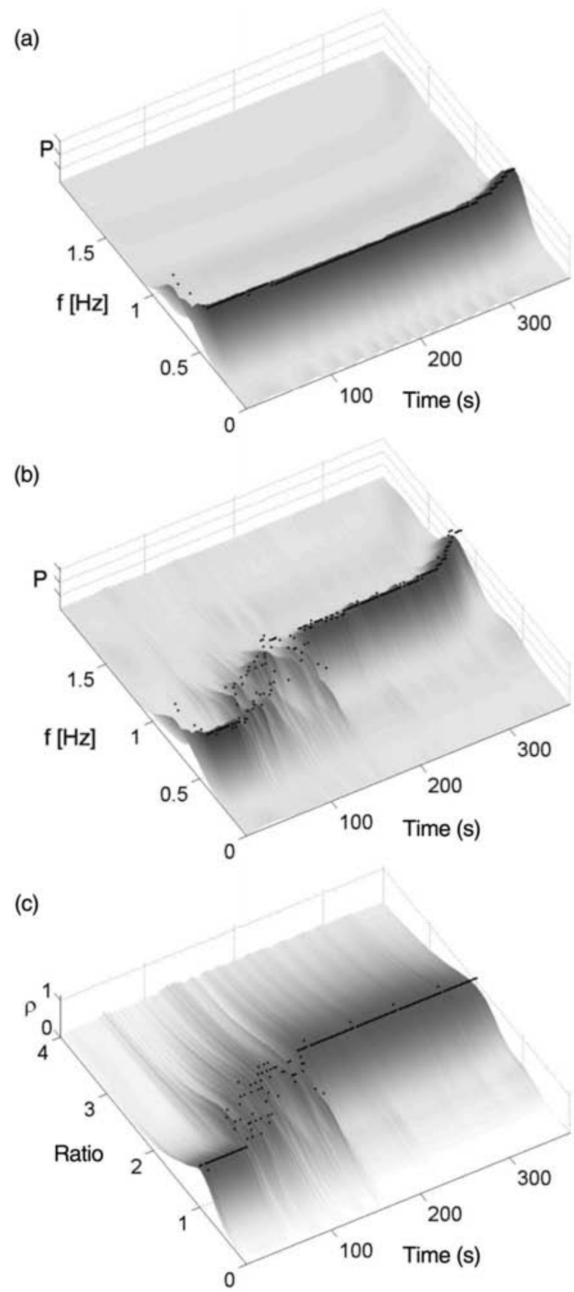

Figure 7.2 Spectrograms for the force data (a) and respiration (b) of a single participant (data from Siegmund et al., 1999). The power spectral density was estimated over consecutive time windows of 10 s. Panel (c) depicts the scaled-cross integral as a function of time. In all panels, time (s) is displayed on the x-axis. In (a) and (b), frequency, f (Hz), is displayed on the y-axis and the spectral power, P (dimensionless), on the z-axis. In (c), the frequency-locking ratio is displayed on the y-axis, and the frequency-locking strength on the z-axis. The relationship between the frequencies with the maximal spectral power, fstroke and fresp, reflect the frequency-locking ratio. Initially, fstroke: fresp = 1;1, and a switch to fstroke: fresp = 1;2 can be observed.

across trials constitutes a space of variability, which leaves unaltered the alignment of the barrel of the gun to the target. The insight that not all variance requires control obviously has important theoretical consequences for the understanding of learning, expertise, and motor control in general. Indeed, it may be worthwhile to examine not just the overall degree of variability, but also the structure within the variability in relation to attainment of a specific goal. One would expect that an expert would have restructured the skill's execution such that the component of the variance that most affects task performance is decreased, at least relative to that of the variance in the UCM. To date, however, the approach has not been applied in expertise research, although a few learning studies that have adopted the UCM approach do point in this direction (Kang, Shinohara, Zatsiorsky, & Latash, 2004; Yang & Scholz, 2005). The strength of the UCM is that it allows for an objective test of explicit hypotheses regarding controlled variables; a limitation of the approach is that to determine the UCM throughout a movement, a continuous goal-state has to be introduced. Reaching the ultimate (task) goal, however, may not require following this time-continuous goal state throughout the movement.

Summary

A number of process measures and techniques can give insights into how movement is controlled at high levels of skill. These range from attention manipulations, to eye movement recording, to whole-body movement kinematics. The sophistication of statistical techniques and methods available to analyze these data is continually growing, allowing for a more holistic, task-relevant description and insight into the variables that enable effective and efficient movements. Although the issue of movement control is complicated when flexible characteristics of performance are considered, there do appear to be general, stable strategies that define skilled performance, including stability in eye movements in the moments before a skill is executed; coordination across subsystems of the body, such as breathing and stroke handling during rowing; decreased variability in components of the movement most related to goal attainment; and a decreased focus on features and rules involved in skill execution.

DETERMINING THE MECHANISMS UNDERPINNING THE LONG-TERM DEVELOPMENT OF EXPERTISE

In this final section we discuss research examining the long-term mechanisms underpinning expertise. In sport, the theory of deliberate practice proposed by Ericsson, Krampe, and Tesch-Römer (1993) significantly impacted the study of expert performance and was in part responsible for the change in emphasis from talent identification (i.e., a search for abilities and characteristics that differentiate across skill levels) to the measurement and evaluation of practice (see also Durand-Bush & Salmela, 2001, for a historical review of this trend). Originally basing their research on musicians, Ericsson et al. devised methods to demonstrate the necessary and, in their view, sufficient role of sustained, effortful, domain-relevant practice for the attainment of high levels of performance. In sports, where physical differences across athletes seem to promote attributions for performance in terms of innate talent, the deliberate practice hypothesis has received much attention (for reviews, see Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Ward, Hodges, Williams, & Starkes, 2004).

The Deliberate Practice Framework and Initial Empirical Evidence

Ericsson et al. (1993) collected retrospectively recalled practice estimates from musicians of various levels of competency in the Berlin Music Academy. The musicians were asked to recall, using interview-based questioning, the number of hours per week they spent practicing alone on either the piano or violin in yearly intervals across their playing careers. They also estimated the time spent on various everyday and musical activities and rated these according to their relevance to improving performance, the effort required, and their enjoyment, independent of the results. Additionally, the musicians kept activity diaries, subsequently organized in terms of the activities just discussed. Practice alone was judged to be most relevant for improving performance and was rated as pleasurable, although not significantly so. Generally, the activities judged to be the most relevant were also the most effortful. Weekly practice alone differentiated the musicians training to be international soloists from those training to be teachers (deemed less skilful). The weekly estimates of practice correlated highly with the diary methods, although participants tended to overestimate. When career retrospective estimates were examined, the number of hours accumulated by age 18 showed a difference of approximately 2,000 hours between groups; the best violinists alone reported 7,500 hours of practice.

The early deliberate practice research in sport was designed to and was able to distinguish across skill groups based on career practice estimates across domains such as Olympic-style wrestling (Hodges & Starkes, 1996), field hockey and soccer (Helsen, Starkes, & Hodges, 1998), figure skating (Starkes et al., 1996), and karate (Hodge & Deakin, 1998). As in music, the skilled athletes consistently engaged in more weekly practice than their less skilled counterparts (either alone or with a team, which was sport-dependent). Although these findings support the claim that practice is necessary for high-level performance, they do not indicate that practice is sufficient. For instance, being young and talented may correlate with practice investment and involvement. Other research and methods are needed to show that domain-specific practice causes, or at least is sufficient for, expertise.

A more valid, more sensitive predictor of performance would be achieved if practice amounts could differentiate at the individual rather than merely the group level. Indeed, Ericsson et al. (1993) reliably differentiated across individual musicians through practice amounts. In sport research, few such attempts have been made because of the need to have an objective measure of performance within a skill domain (which is a challenge even in music). Track events and swimming, however, are good sport environments for evaluating across performers at this more refined level. Hodges, Kerr, Starkes, Weir, and Nananidou (2004) examined the practice histories of club-level through international-level athletes in swimming and triathlon and found a significant linear relationship between performance times and practice factors, at least for the longer distance events. However, the relationship between practice amounts and performance times was similar to that between skill category and practice. Further research in sports enabling this type of predictive analysis is needed to determine how much variance in performance (times) can be captured by practice. On a more practical level, this analysis may provide an index of the amount of practice needed to improve performance (times) by a specific amount (see Sloboda, Davidson, Howe, & Moore, 1996; Starkes et al., 1996).

Quantitative Practice Issues: Counting Deliberate Practice Hours

Retrospective practice estimates are obviously prone to inaccuracies in recall. As the career length increases, the estimate's reliability diminishes. Practice estimates are inflated when athletes recall their weekly practice hours from the start of their career to their most recent year, although this problem is partly overcome by asking people to give estimates for their current year first (see Hodges et al., 2004). A number of reliability and validity measures have been used in combination with practice estimates ascertained through interviews and questionnaires to determine the accuracy of these data (for a recent review, see Côté, Ericsson, & Law, 2005). Diary-based methods have been the most popular, showing moderate to high correlations with questionnaire estimates, although athletes, like the musicians, tend to overestimate in questionnaires (e.g., Helsen et al., 1998; Hodges et al., 2004). Helsen et al. additionally readministered the retrospective questionnaire over a 6-month period, finding test-retest reliability to be quite high. These methods are adequate for examining the reliability of practice estimates for the current year, but not for retrospective recall. Starkes, Weir, and Young (2003) obtained career-long training logs from athletes, which are excellent career checks but difficult to obtain for large samples. The best method to overcome the problems associated with retrospective recall is to collect longitudinal data from aspiring athletes, hoping that some make it to the highest level and that attrition is low. A quasi-longitudinal approach, as adopted by Ward, Hodges, Williams, and Starkes (2006), involving comparison of current and retrospective estimates of eight different age groups of athletes (from 9 to 18 years), is one of the most comprehensive methods available for cross-checking across ages and estimates. However, the young elite may not become adult elite players, and, across age groups, the practice amounts needed to attain expert levels increase (see Ericsson & Lehmann, 1996).

Qualitative Practice Issues: Defining and Capturing Deliberate Practice

To determine more precisely which activities are counted as deliberate practice, researchers have used time-motion analysis (see Starkes, 2000; Starkes et al., 1996). The practice sessions of athletes are recorded and subjected to time and content analysis to determine whether the quality of practice differs across skill levels (e.g., effortful, not inherently enjoyable). Time-motion analysis also allows a reliability assessment of reported weekly practice hours. Across studies (e.g., Deakin, Starkes, & Allard, 1998; Starkes, 2000), skaters, ice hockey players, and wrestlers were found to spend a significant proportion of time practicing already well-learned skills but not performance-improving skills. Ward et al. (2004) suggested that effortful practice on difficult skills might need to be balanced with practice that reinforces a person's belief in his or her abilities. Indeed, skill specificity appears to characterize many elite performers who have trademark moves or skills (e.g., the inch-perfect free kicks of the English soccer player David Beckham). Ericsson (2003) has discussed the development of expertise as the overcoming of various performance goal states, or constraints, associated with different stages of a performer's career. Because the aspects of performance requiring improvement or the most practice are dynamic, the development of expertise may be characterized by skill-specific practice at different stages. Further research and other methods are needed to determine which features of practice change and how this is related to performance (especially as ratings concerning the relevance of various practice activities have typically not differentiated across skill class). For example, although Durand-Bush and Salmela (2002) reported that international athletes notice a shift in their training activities from increasing quantity to better quality, there is little understanding of what quality training entails (but see Côté et al., 2005).

Time-motion analysis has also shown that skilled performers utilize time more efficiently when at practice than less skilled athletes. Deakin and colleagues (Deakin & Cobley, 2003; Starkes et al., 1996) observed that elite figure skaters spent approximately 20% more time practicing jumps, considered most relevant to improving performance, than the less skilled test skaters. Moreover, the elite skaters rested for approximately 14% of each on-ice practice period, in comparison to 46% for the test skaters. Therefore, in terms of the amount of time actually spent practicing, the overestimation in retrospective estimates of practice is more pronounced for less skilled than for skilled athletes.

The quality of practice, and specifically its effortful nature, has also been assessed using measures of sport periodization, indicating how practice is structured throughout the year in terms of time and intensity. Baker, Côté, and Deakin (in press) have used heart rate measures to quantify the intensity of exercise at specific periods throughout a competition year. Similarly, as detailed in Ward et al. (2004), training periods for triathletes were sustained longer and at a reported higher intensity (as determined through questionnaires) for the fastest compared to the slowest athletes. These attempts to measure the effortful nature of practice may also help determine how much practice time should be considered deliberate and whether there are consistencies and limits in the amount of physically effortful deliberate practice that can be sustained in a practice session or across a training year before factors associated with fatigue, injury, boredom, and perhaps burnout set in (see also Ericsson et al., 1993; Starkes, 2000).

One final issue that has prompted debate is that of the enjoyable nature of deliberate practice. Because practice alone was not rated significantly pleasurable in the original research with musicians, practice was defined as a noninherently enjoyable activity, one that is engaged in to improve performance. In subsequent sport studies, nearly all practice activities have received high ratings for enjoyment (see Helsen et al., 1998; Hodge & Deakin, 1998; Starkes et al., 1996). However, there have been inconsistencies in the methods used to assess enjoyment, which appears to mediate the ratings of the activity. When activities have been rated generally, such as running rather than a specific running instance, they receive high ratings for enjoyment and relevance to improving performance. However, when specific instances of activities have been rated, as in a diary, the ratings are moderated and not consistently related to the relevance rating (see Hodges et al., 2004; Ward et al., 2006). Thus, consistent and reliable methods for assessing enjoyment need to be ascertained before statements about the enjoyment of relevant, performance-improving practice can be made. Ward et al. found that younger athletes tended to evaluate their enjoyment of an activity in terms of the actual session itself, whereas older athletes tended to rate enjoyment in terms of its result. Differences like these may have resulted in discrepancies across domains with respect to practice estimates (see also Hodges et al., 2004, who distinguished enjoyment from satisfaction).

Measurement of Other Variables That Contribute to High Performance Skill

There have been two major variables which have been examined with respect to expert performance, that of gender and age. Methods used to explore deliberate practice theory have also been adopted to explore how these variables mediate the attainment of skill.

Gender

Competition performance is nearly always differentiated on the basis of gender, and it is rare to find a sport where women perform at the same standard as or better than males (see Åstrand, Rodahl, Dahl, & Strømme, 2003). In the past, it has been difficult to measure exactly how gender limits performance. Although some chromosomally mediated effects are expected to be enduring (e.g., body shape, strength, height), it has been proposed that most gender effects are mediated by differential opportunities to practice for males and females (see Wells, 1991). Deliberate practice methodology is a useful tool for investigating the contribution of practice amount in accounting for gender differences, or conversely, how much variance in performance times can be accounted for by gender once practice is controlled. Hodges et al. (2004) compared male and female athletes across different events and sports that emphasize either endurance and aerobic fitness (for longer distance events) or anaerobic capacities (for short-distance, sprint events). Significant evidence exists that there are genetic limits with respect to anaerobic activities, but less consistent evidence for limits in aerobic capacities (e.g., Bouchard et al., 1990; Simoneau et al., 1986). Analyses of swimmers and triathletes showed that for the longer events, practice was significantly related to performance times, but that gender did not make a significant contribution to the regression model. However, examination of the sprint events in swimming showed that although 20% to 30% of the variance in these events could be accounted for by practice, it was not a significant predictor. Gender accounted significantly for 30% to 40% of the variance in performance times even after controlling for practice. The fact that gender predicted performance for athletes in the two fastest events suggests that enduring physical differences between individuals, as a result of gender, limit performance for activities with high anaerobic demands that appear to be less amenable to training.

Other efforts to examine gender differences have been conducted by Duffy, Baruch, and Ericsson (2004) in a sport that ostensibly appears to have very little physical attribute advantages, that is, darts. Despite controlling for variables such as arm length, age, years of experience, and the size of the recruitment pool where men and women were selected, performance differences across male and female players were observed. It was concluded that, barring other variables, such as spatial abilities, practice time and quality are the main variables that differentiate gender, although no specific examination of this hypothesis was conducted. The examination of the developmental profiles of athletes as a function of gender might help to uncover differences in the types of practice and experiences of these athletes across the developmental continuum. It would appear most useful to start at a point where performance differences do not differentiate across gender. For example, in sports such as archery, croquet, and ten-pin bowling, samples of women who are matched for equivalent performance to samples of men have been found (e.g., P. R. Thomas, Schlinker, & Over, 1996). It may be that practice experiences as a function of gender are both quantitatively and qualitatively different, with the demands and amount of practice for women athletes being more stringent than those for men to attain a similar level of performance. Moreover, it might be that the relationship between practice and performance changes following puberty, when differences in body proportions, size, and weight more clearly distinguish across gender.

Age

An aging population worldwide has meant a dramatic increase in the number of masters athletes (generally athletes over 35 years, although age of eligibility varies by sport). Deliberate practice methodologies combined with multiple regression techniques have been used to examine the contribution of age-related factors to declines in performance. It is well established that many variables change linearly with age until approximately 60 years, after which the rate of change accelerates and becomes more quadratic (Salthouse, 1992; Stones & Kozma, 1981). The rate of change has typically been greater in cross-sectional (i.e., different age groups) than longitudinal (i.e., performance across an athlete's career) samples, thus painting a less optimistic picture of the aging process (e.g., Weir, Kerr, Hodges, McKay, & Starkes, 2002). Figure 7.3 shows males' performance times for the 10 K run as a function of age from cross-sectional and longitudinal data. The straighter line for longitudinal data suggests that performance is better retained and does not increase in rate of decline until after age 65 (Young & Starkes, in press). Assessment of practice of these master athletes shows that they maintain a large amount of practice to stave off declines, but they

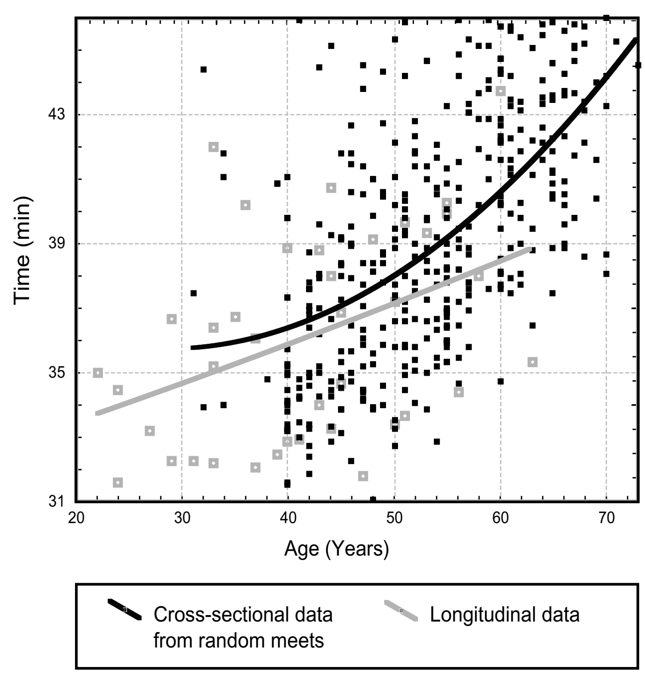

Figure 7.3 Relationship between age and performance for the 10 K race, as demonstrated by cross-sectional versus longitudinal data (Young & Starkes, in press).

may also change the type of practice, engaging in more aerobic activities, potentially to overcome declines in cardiac power (Weir et al., 2002).

There has also been considerable research concerning the type and amount of practice during childhood that best engenders later high-level performance. Following on from the earlier interview-based, case study research of Bloom (1985) with "talented teenagers," Côté and colleagues (Baker, Côté, & Abernethy, 2003; Côté, 1999) have used specialized structured interview techniques to uncover the career paths and the types of early practice that are related to later success. Côté proposed that early involvement in a sport was best characterized by three stages: sampling (6 to 12 years), specializing (13 to 15 years), and investing (16+ years). In contrast to deliberate practice activities, proposed to be effortful and engaged in to improve performance, the sampling years were characterized by engagement in "fun" activities (so-called deliberate play; see Côté & Hay, 2002). Since this initial proposal, Côté and colleagues (e.g., Baker et al., 2003) have shown that the sampling years characterize the career profiles of elite performers and that early specialization, and hence early accrual of deliberate practice hours, is not a necessity for elite performance.

In view of transfer of (psychomotor) skills across sports, the issue of early specialization versus diversification (or sampling) may have important implications for the requirement of many hours of deliberate practice and hence deliberate practice theory. The strong relationship between the amount of deliberate practice and performance suggests that early specialization is important to accrue the necessary practice hours to succeed (Ericsson et al., 1993). However, Baker et al. (2003) have shown a negative correlation between the number of sporting activities an individual has been involved in and the amount of sport-specific training needed to achieve expert levels (in ice hockey, netball, and basketball), suggesting positive transfer from cross-training and diverse sport involvement. In contrast, questionnaire-based findings from Ward et al. (2006) failed to show evidence that elite soccer players from the ages of 8 to 19 are or were involved in more sports than their less elite counterparts; in fact, a trend for the opposite was observed. Although only practice-related activities differentiated across skill levels, examination of soccer-related games and activities primarily engaged in for fun showed that both elite and subelite soccer players showed a steady increase in the amount of hours in playful activities until the age of 15. Indeed, in comparison to individual practice, team practice, and match play separately, more hours were spent in playful activities. The degree of early specialization may in part be a function of culture, as well as the sport's culture and history, and any early advantage likely depends on the degree of skill transfer the sport allows as well as the length of the sport's competitive history. For instance, in women's gymnastics, where performance peaks just after puberty, athletes are forced to specialize early because the overall competitive career length is short.

Summary and Conclusions

The deliberate practice framework for examining the development of elite performance has helped to deepen our understanding of the importance of practice time and has provided some interesting insights into the effects of age and gender on performance in sports. Although the framework was designed to capture the types of practice that best predict performance, this area still requires further attention. Findings indicating that much of practice involves refining existing skills, not just acquiring new skills, suggest that task-relevant practice may involve both motivating activities that reinforce one's sense of competence and more effortful practice designed to improve one's current level. Employing methods that involve multiple measures of performance and abilities (such as speed, decision times, lung capacity, height and weight) are likely to provide a more informative view of performance limits, inasmuch as it will be possible to determine how practice influences these factors at different stages of an athlete's career (see also Côté et al., 2005). Quasi-longitudinal approaches, involving both retrospective and cross-sectional comparisons, are expected to be most informative in this regard.

CONCLUSION

In this chapter, we have discussed a great variety of techniques that have been used to address the three main themes of expert performance in sports. The characteristics of expert decision making and the information and knowledge structures underlying it have been addressed for a range of methods, most notably verbal protocol analysis, recall and recognition tests, eye movement recordings, and visual occlusion techniques. Despite certain, most likely task-specific exceptions in terms of skill-related differences, most evidence suggests that experts make faster, more accurate decisions that are based on different knowledge structures than nonexperts. Experts often search differently for information, and accordingly use different information than the less skilled. Such skill-dependent differences come more clearly to the fore the more ecologically valid the stimulus presentation and response. Indeed, researchers should continue the challenge to create experimental settings that most validly represent the situations in which expertise in situ reveals itself. Skill-related differences are also apparent in the control and planning of movements and actions, which has been addressed through attention manipulations, brain imaging techniques, eye-movement recording, and a variety of time-series analysis techniques. It appears that, to maximize performance, experts better direct their attention to the behavioral goal, whereas the less skilled need to focus inwardly to the manner of goal achievement, suggesting that experts' motor execution has become more automatic. In addition, experts coordinate their movements more stably, yet flexibly, than nonexperts to achieve their goal. Recent evidence also suggests that experts have learned to distinguish between control variables that are relevant versus those that are less relevant in order to achieve task success. These theoretically interesting notions require further investigation and development of appropriate techniques. As indicated, expert performance most often consists of a variety of components, and as such its understanding will benefit from multitask approaches.

The examination of the careers of experts within the deliberate practice framework, mainly studied via quasi-longitudinal approaches and retrospective reports, indicates that experts invest more time, and perhaps better quality time, in developing their skill than the less skilled. Because practice estimates account for less than half the variance in performance, it has been suggested that other, nonpractice factors, such as an athlete's genotype, may play a role in determining performance limits. Evaluation of practice and performance histories across the developmental continuum, in addition to assessment of physical characteristics, will help to elucidate the role of practice in overcoming potential constraints to performance expertise.

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CHAPTER 8

Practice and Play in the Development of Sport Expertise

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There is a long history of interest across a range of skill domains in understanding and cultivating expert performance. Much of the interest has stemmed from attempts to determine the relative contribution of genetic and environmental/experiential factors to high-level human achievement—work that has emanated largely from the nature-nurture distinction first proposed by Sir Francis Galton in 1874. Work on the genetic basis of expert performance in sport is in its relative infancy, and it would be surprising if there were not some significant hereditary contribution to expert performance (e.g., see Bouchard & Malina, 1997; Singer & Janelle, 1999); nevertheless, most researchers accept that the type of experiences athletes have throughout their development is enormously influential in determining to what degree individual potential (or *talent;* Durand-Bush & Salmela, 2001) is realized and expertise is attained.

In this chapter, we examine the role that different developmental experiences play in the realization of exceptional performance in sport. We focus in particular on the respective contributions that both the amount and type of formal and informal learning opportunities may make to the development of expertise. To this end we draw a working distinction between learning activities that may be regarded as *practice* and those that may be more accurately regarded as *play.* We reserve the use of the term *practice* for organized activities in which the principal focus is on skill development and performance enhancement and use the term *play* to describe activities undertaken primarily for intrinsic enjoyment but that may nevertheless ultimately contribute to the acquisition of expertise.

Support for the writing of this chapter was given by the Social Sciences and Humanities Research Council of Canada (SSHRC Grants # 410-05-1949 and 410-04-1207).

The chapter is organized into five major sections. The first two sections examine, in turn, propositions regarding the links between practice and skill development, and play and skill development, introducing key concepts such as Ericsson, Krampe, and Tesch-Römer's (1993) notion of deliberate practice and Côté's (1999) notion of deliberate play. The third and major section of the chapter examines the respective contributions of practice and play to the development of sports expertise, drawing evidence from three major methods for obtaining retrospective profile information from experts: (1) qualitative interviews, (2) training questionnaires, and (3) quantitative interviews. The fourth section briefly discusses issues related to early specialization and early diversification. The fifth section reviews two environmental factors, relative age and birthplace, that have been associated with increased early exposure to sport and the achievement of elite performance. In the final section of the chapter a tentative framework is presented to help integrate existing knowledge on the role of practice and play and provide direction for future research endeavors.

PRACTICE AND SKILL DEVELOPMENT

Practice is uniformly regarded in the motor learning literature as the variable having the greatest singular influence on skill acquisition, yet there remains a host of unsatisfactorily answered questions as to how much and what type of practice is necessary and is best for the development of expertise. Much of the experimental work on the relationship between practice conditions, learning, and performance has been conducted using laboratory tasks in which the changes in performance are recorded over a relatively small number of trials and untrained individuals (novices) are used as participants. Such approaches have proven useful in addressing such issues as variability of practice (e.g., C. H. Shea & Kohl, 1991), distribution of practice (e.g., Stelmach, 1969), segmentation and fractionation of practice (e.g., Wightman & Lintern, 1985), and transfer and contextual interference (e.g., Lee & Magill, 1983; J. B. Shea & Morgan, 1979) for the learning of new skills (see Lee, Chamberlin, & Hodges, 2001, for a comprehensive review) and have also helped to determine the nature of the relationship between the quantum of practice and performance.

One of the most salient relationships in the behavioral sciences is the positive association between time spent in practice and improvement in proficiency. Although alternatives exist, one of the most empirically sound profiles of the relationship between practice and achievement is commonly referred to as the *power law of practice* (Newell & Rosenbloom, 1981). According to this position, the relationship between these two variables follows a power function where rapid increases in achievement are evident during initial stages of practice, but over time these increases become more difficult to sustain. Although practice eventually becomes asymptotic, longitudinal examinations of practice over time indicate that improvements continue even after years of involvement (e.g., Crossman, 1959).

Although laboratory studies of practice have contributed to our understanding of the early phases of acquisition of new skills, such studies have been constrained in what they can contribute to the understanding of expertise. This is largely because expertise may require literally millions of trials and typically a decade or more of regular, sustained practice to acquire (Chase & Simon, 1973)—a time frame that makes typical laboratory studies logistically difficult, if not impossible. Because experimental work examining acquisition of expertise in a prospective, longitudinal manner is fraught with logistical difficulties, the bulk of the knowledge regarding the relationship between practice quantity and type has come, by necessity, from studies in which the practice histories of experts are determined retrospectively. Much of this research has been profoundly influenced by the work of Anders Ericsson, which draws together a fundamental interest in memory performance (e.g., Ericsson, Chase, & Faloon, 1980) with an interest in exceptional performance in applied cognitive tasks such as those underpinning performance in chess and music.

In 1993, Ericsson, Krampe, and Tesch-Römer produced a seminal paper on the role of practice and expert development that shaped a great deal of the research that followed. Their position (based on the work of Simon & Chase, 1973, and others) was that with proper attention to what they called "deliberate practice" one could prevent performance improvements from leveling off, thus circumventing the asymptotic effects that underpin the power law of practice. Deliberate practice was operationalized as any training activity (a) undertaken with the specific purpose of increasing performance (e.g., not for enjoyment or external rewards), (b) requiring cognitive and/or physical effort, and (c) relevant to promoting positive skill development. Ericsson et al. suggested, on the basis of an intensive examination of the training and performance of elite musicians, that the relationship between time spent in deliberate practice and performance was monotonic (i.e., linear) rather than a power function. Moreover, they contended that the primary factor distinguishing performers at different skill levels was the number of hours spent in deliberate practice, thus attributing to deliberate practice a causal role in the attainment of expertise. For instance, in their examination of violinists, experts were shown to have accumulated more than 7,400 hours of deliberate practice by 18 years of age, compared to 5,300 hours for intermediate-level performers and 3,400 hours for lower-level performers.

Despite deriving the deliberate practice proposition primarily from data collected on musicians, Ericsson and his colleagues have repeatedly contended that it also applies to the development of expertise in other domains, including sport (for a recent review, see Ericsson, 2003). There is a growing body of evidence to support this contention from chess (e.g., Charness, Tuffiash, Krampe, Reingold, & Vasyukova, 2005), as well as from some sports (e.g., Deakin & Cobley, 2003; Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996). There is, however, some controversy as to definitional aspects of deliberate practice, especially in relation to the contention that practice must be deliberate to be beneficial, and to the proposition that practice alone rather than in combination with other activities or hereditary factors sets the limits to performance (e.g., see Abernethy, Farrow, & Berry, 2003; Baker & Horton, 2004; Sternberg, 1996).

PLAY AND SKILL DEVELOPMENT

Recognizing that athletes tend to first experience sport through fun and playful games, Côté (1999) coined the term *deliberate play* to characterize a form of sporting activity that involves early developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment. Deliberate play activities such as street hockey and backyard soccer are regulated by rules adapted from standardized sport rules and are set up and monitored by the children or by an adult involved in the activity. Furthermore, it is a form of physical activity that differs from (a) the physical play activities of infancy and early childhood (Denzin, 1975; Pellegrini & Smith, 1998; Piaget, 1962), (b) the specific pedagogical games/play designed to improve performance (Griffin & Butler, 2005; Launder, 2001), (c) the "structured practice" activities typical of organized sport, and (d) deliberate practice activities (Ericsson, 2001; Ericsson et al., 1993).

Deliberate play shares the contextual characteristics of more primitive forms of physical activity play such as running, climbing, jumping, and rough-and-tumble play (Denzin, 1975; Pellegrini & Smith, 1998; Piaget, 1962), yet displays more organized and unique behavioral patterns. Pellegrini and Smith showed that physical activity play such as rough-and-tumble play in young children (a) improves control of specific motor patterns; (b) contributes to children's endurance, strength training, and economy of movement; and (c) contributes to children's regulation of emotions and cognitive performance. In the same way, the learning of motor skills through deliberate play can be illustrated with older children and more complex sport skills. For example, the availability of a basketball hoop in her driveway may incite a 7-year-old to pick up a ball and try to shoot the ball into the hoop. The first attempts at throwing the ball into the hoop will usually be unsuccessful; however, after a few attempts, the child will eventually be successful at shooting baskets. Subsequently, the child will simulate more complex play situations such as running and shooting to keep the activity enjoyable, challenging, and interesting. This playful activity will eventually evolve into more complex games such as shooting baskets with a friend and playing one-on-one and three-on-three basketball. Although not specifically designed to improve performance, learning occurs when children are involved in deliberate play activities, just as learning occurs in more primitive forms of physical activity play seen in younger children (Pellegrini & Smith, 1998).

When compared to organized sport practice and deliberate practice, the informality of deliberate play allows children to play sports with minimal equipment, in any kind of space, with any number of players, and with players of different ages and sizes. This kind of environment is easily created and does not require adult supervision, coaches, officials, specialized equipment, time limits, or uniforms that are characteristic of organized sport and structured practice. Deliberate play situations allow children the freedom to experiment with different movements and tactics and the opportunity to learn to innovate, improvise, and respond strategically. It also allows children to perfect skills that would not be practiced in organized situations where all the players are of similar size and skill level and where the playing surface does not present any natural obstacle. For example, playing a modified form of baseball in a backyard (a surface that is not always smooth) with opponents who are older may incite a child to develop speed, ball-handling skills, and creative moves that would allow the child to be successful and have fun.

Pellegrini and Smith (1998) proposed that in play, children recombine behaviors and develop flexible strategies. This flexibility and creativity become important factors in the development of elite athletes, especially in team sports settings (Côté, Baker, & Abernethy, 2003). From a skill acquisition perspective, deliberate play serves as a way for youth to explore their physical capacities in various contexts and at a minimal cost in terms of resources. Table 8.1 summarizes differences between deliberate play and deliberate practice in terms of disposition, context, and behaviors for children's involvement in sport. The definitions of deliberate play and deliberate practice provided in Table 8.1 were tabulated from the literature on play (Côté et al., 2003; Pellegrini & Smith, 1998; Rubin, Fein, & Vanderberg, 1983; Smith, Takhvar, Gore, & Vollstedt, 1986) and deliberate practice (Ericsson, 2003; Ericsson et al., 1993).

After considering the differences between deliberate play and deliberate practice, one may wonder about the importance of deliberate play in an athlete's development of skill. A recent study (Berry & Abernethy, 2003) focused on the early activities of Australian Rules football players, comparing 17 elite players classified as expert decision makers and 15 elite players classified as nonexpert decision makers. During childhood, the expert decision makers invested a greater amount of time in deliberate play activities compared to structured practice activities, which was not the case for the

Table 8.1 Differences between Deliberate Play and Deliberate Practice

Deliberate Play	Deliberate Practice
Done for its own sake	Done to achieve a future goal
Enjoyable	Not the most enjoyable
Pretend quality	Carried out seriously
Interest on the behavior	Interest on outcome of the behavior
Flexibility	Explicit rules
Adult involvement not required	Adult involvement often required
Occurs in various settings	Occurs in specialized facilities

nonexperts. Moreover, qualitative analyses allowed the authors some insight into the context in which deliberate play took place. For example, Berry and Abernethy reported the following quote from an expert decision maker:

> We used to play out in the backyard, backyard footy, backyard cricket, backyard basketball, and soccer. All types of sport you know, if someone's outside it would be one-on-one marking competition, stuff like that, where you do it, time and time again. (p. 52)

A key area where involvement in deliberate play and structured practice are considerably different is in the amount of time that youth spend actively engaged in the activity. Deliberate play activities involve an engagement of time in physical activities that is difficult to match with any kind of structured practice. When youth play street basketball two-on-two for 1 hour there are few periods of waiting or off-task time such as one would find in a structured practice. The athletes' time on task or actual engagement in physical activities in practice has been investigated in sports such as volleyball (Brunelle, Spallanzani, Tousignant, Martel, & Gagnon, 1989; McKenzie, 1986), ice hockey (Trudel & Brunelle, 1985), soccer (Boudreau & Tousignant, 1991), and tae kwon do (Brunelle et al., 1989). These authors reported that athletes' time-on-task rates varied between 25% and 54% of the total practice time. The time off task during practices usually included athletes waiting around to perform the next drill, coaches setting up equipment, or athletes transitioning from one drill to another. Although there are obvious advantages to having a coach who provides athletes with feedback about their performance, monitors success, and provides immediate instruction, it is unclear whether, during early stages of development, the benefits of this structured environment are superior to the benefits one gains from engagement in deliberate play activities.

From a motivational perspective, children get involved in deliberate play because of their own interest in the activity, as opposed to external reasons such as improving performance and winning medals (Soberlak & Côté, 2003). This type of early involvement in sport may help children become more self-directed in their participation in sport. Motivational theories based on self-regulation (Ryan & Deci, 2000; Vallerand, 2001) support this idea and predict that early, intrinsically motivating behaviors (e.g., play) have a positive effect over time on an individual's overall motivation and ultimately the individual's willingness to engage in more externally controlled activities (e.g., deliberate practice). In a retrospective longitudinal examination of baseball players' training, the amount of deliberate play from ages 6 to 12 was positively related to the amount of specific baseball training after age 13 (Gilbert, Côté, Harada, Marchbanks, & Gilbert, 2002). These results suggest that early deliberate play activities could be beneficial in the development of motivation to pursue intense training in a specific sport.

As reviewed by Pellegrini and Smith (1998), physical activity play during childhood establishes a range of cognitive, motor, and social experiences that have immediate and delayed benefits. As well, sport participation through deliberate play provides children with a broad foundation of motor skills that help them overcome the physical, cognitive, and social challenges of various sports, as well as their main sport (Côté et al., 2003). As sport around the world becomes more institutionalized and organized (De Knop, Engström, & Skirstad, 1996), it is important to provide youth with opportunities to get involved in deliberate play activities.

Because talent detection research has not been able to isolate variables that predict accurately which young athlete will eventually reach the highest level in sport (Durand-Bush & Salmela, 2001), elite athletes can be distinguished only after the fact. Consequently, retrospective studies that analyze playing activities and training patterns of elite athletes remain one of the primary sources of information to enhance our understanding of the development of talent in sport. These studies are reviewed next.

EVIDENCE ON THE RESPECTIVE ROLES OF PRACTICE AND PLAY IN SKILL DEVELOPMENT

Expertise researchers have used a variety of research approaches to trace the training activities and developmental pathways of elite-level athletes. Qualitative interviews, training questionnaires, and retrospective/quantitative interviews are three distinct approaches, each with unique strengths and limitations. A summary of research using these methods is provided in this section.

Qualitative Interviews

In their pioneering research, Bloom and colleagues (1985) interviewed elite tennis players and swimmers. They found that elite athletes started their involvement in sport by trying different sports in a playful and fun environment. This type of environment gradually changed to include specialization in the main sport and more practice time as the athlete moved from the early phases of involvement to the middle and later years. The athletes were provided with stimulating environments at home and with coaches who guided their development.

In a qualitative study of socialization into elite sport, Carlson (1988) analyzed the development of 10 elite tennis players in Sweden and compared their training activities with a control group of 10 subelite players. He found that the players in the control group specialized in tennis at a younger age (age 11) than the elite players (age 14). Furthermore, between the ages of 13 and 15 the players from the control group played more tennis than the elite players did. The elite players practiced more tennis only after the age of 15. Carlson concluded that early specialization and "professional-like training" in tennis did not favor the development of elite players; instead, an all-around sport engagement was more important before adolescence. Similar results were found in Stevenson's (1990) examination of international athletes from Canada and England and Hill's (1993) study of professional baseball players.

Similar to Bloom and colleagues (1985), Côté (1999) identified three stages of development specific to sport from childhood to late adolescence: the sampling years, the specializing years, and the investment years. The qualitative data obtained from athletes and parents were also consistent with sports socialization studies (Carlson, 1988; Hill, 1993; Stevenson, 1990), indicating that play and early diversification were important building blocks of children's physical, cognitive, and emotional development in sport. For a developmentally appropriate approach to elite performance in sport, Côté recommended a progression from play and involvement in various sports during the sampling years to more sport-specific practice activities during the specializing and investment years.

To gain more insight into the later years of elite athletes' training, Orlick and colleagues (McCaffrey & Orlick, 1989; Orlick & Partington, 1988) interviewed international-level athletes to assess their actual practice behaviors and perceptions of their training. The athletes consistently mentioned the need to focus on specific training goals and repeatedly emphasized the importance of "concentration" and "intensity" in practice. This activity, labeled "quality practice" by Orlick and Partington, shares many characteristics with deliberate practice, which was subsequently proposed by Ericsson et al. (1993). In a follow-up study, McCaffrey and Orlick reported that expert golfers' (i.e., professional tour golfers') current practice activities included elements of "quality practice" and were qualitatively different from the activities of other professional, but less skilled golfers (i.e., golf professionals at golf clubs).

In a study of elite athletes who won at least two gold medals at separate Olympics and World Championships, Durand-Bush and Salmela (2002) found early patterns of development that were similar to those found by Orlick and Partington (1988) and Côté (1999). Furthermore, Durand-Bush and Salmela proposed the "maintenance years" as a stage that followed Côté's investment years, in which athletes achieved the highest level in their sport (e.g., gold medal at Olympics). During the maintenance years, the athletes indicated that they focused their effort on improving small aspects of their performance instead of increasing the number of hours in practice.

Overall, qualitative studies on the development of elite athletes show distinct stages of development involving different types of activities and resources. More specifically, the early years of involvement for elite athletes were usually characterized by the introduction to various sports through playful activities that focused on elements of enjoyment and immediate reward. Following this stage was a period that focused more on sport-specific training and more objective measures of achievement and performance. Then a period of investment and maintenance was required, which usually was characterized by individuals' complete submersion in training activities and devotion to developing a high level of performance. Identification of these qualitatively different stages toward elite performance has facilitated more quantitative research investigating the type and structure of activities that elite athletes engage in during their development.

Training Survey Questionnaire

Starkes and colleagues (Hodges & Starkes, 1996; Starkes et al., 1996) initiated a line of research aimed at investigating more precisely the training patterns of athletes at different levels of achievement. To accomplish this task, they designed a retrospective questionnaire, based on Ericsson et al.'s (1993) deliberate practice framework, to gather detailed data on the past practice activities of athletes. In the questionnaire, athletes were asked to estimate how much time they engaged in practice-related activities during their development and to rate different aspects of a large number of specific practice and everyday activities. The activities were rated for "relevance to improving performance" and "how enjoyable the actual activity was" (Hodges & Starkes, 1996, p. 407). Athletes were also asked to rate the activities in terms of physical effort and mental concentration.

This questionnaire was used in studies of international wrestlers (i.e., World Championship or Olympic participants), club wrestlers (i.e., university or provincial-level participants), and members of the Canadian national and junior national figure skating teams (Hodges & Starkes, 1996; Starkes et al., 1996). The results showed that both international wrestlers and elite figure skaters increased their weekly amount of practice per week as they progressed into their careers. International wrestlers had accumulated significantly more practice time with others than club wrestlers at 6 years into their careers. Interestingly, activities that the wrestlers and figure skaters rated as highly relevant to improvement and highly effortful (i.e., concentration or physical effort) were also rated as highly enjoyable. Using a comparable questionnaire, similar patterns of training and ratings of practice activities were found in other individual sports, such as karate (Hodge & Deakin, 1998) and middle-distance running (Young & Salmela, 2002).

In a similar study of team sport athletes, Helsen et al. (1998) examined international-, national-, and provincial-level soccer and field hockey players. Athletes estimated the amount of time they spent practicing during their soccer and field hockey careers and rated sport-specific practice activities and everyday activities on their relevance to performance improvement, physical effort, mental effort, and enjoyment. Results for the soccer players demonstrated that at 15 years of age, total accumulated practice time could be used to distinguish between the international and provincial players, and between all three groups by 18 years of age. For the field hockey players, accumulated practice time could be used to distinguish between the international and provincial players from age 25 on, and between all three groups by age 27. Consistent with the earlier findings with wrestlers, figure skaters, runners, and martial artists, types of practice activities that were rated by the athletes as most relevant for improvement of performance tended to be judged as requiring more concentration and were also rated as being more enjoyable by both soccer and field hockey players.

Although the relationship between hours of training and level of attainment appears robust, Van Rossum (2000) used cross-sectional data of a large sample of elite Dutch field hockey players to demonstrate that estimating the number of hours of sport-specific practice may not be sufficient to account for different levels of performance in sport. Van Rossum highlighted the limitation of retrospective questionnaires that focus only on sport-specific practice activities as the sole determinant of expert performance in sport, an issue that had been previously raised from qualitative studies of elite athletes.

To address this methodological issue, Ward, Hodges, Williams, and Starkes (2004) used a questionnaire that assessed the contribution of organized practice, play, and other activities in the development of young elite and sub-elite soccer players (ages 9 to 18). Their findings showed that play and involvement in non-sport-specific activities did not discriminate between players' skill level; however, the amount of organized practice did. The results of Ward et al. suggest that early specialization with sole involvement in activities that are aimed at improving performance (i.e., deliberate practice) during preadolescence was the most effective path toward the development of elite performance in soccer. These results offer a different perspective from that of Van Rossum's (2000) and other qualitative studies that highlight the importance of play and involvement in other sports in the early development of elite performance in sport.

By focusing mostly on practice activities, retrospective questionnaire studies have provided consistent findings about the training activities of elite athletes that can be generalized across sports. First, athletes start their involvement in their main sport by practicing 2 to 5 hours per week, and this amount increases to approximately 25 to 30 hours a decade later. The consensus from questionnaire studies is that a monotonic relationship exists between the number of hours spent in relevant practice activities and the level of performance attained by the athlete. Second, when answering a retrospective questionnaire, athletes rated practice activities that are high in effort as also being high in enjoyment. Côté, Ericsson, and Law (2005) proposed that the contradictory ratings of enjoyment between these studies and Ericsson et al.'s (1993) study with musicians could be due to the differing methods that were used to elicit the information. Ericsson et al. asked their subjects to ignore the consequences of the activity and to focus on the inherent enjoyment, whereas the questionnaires used in the sport research typically instructed participants to evaluate the "enjoyment derived from the actual activity" (Helsen et al., 1998, p. 18). The latter instructions might measure a different construct, because participants might confuse the enjoyment of the results of the activity (improving performance) with the enjoyment of the activity itself (Ericsson, 1996). Results from a recent investigation by Hodges, Kerr, Starkes, Weir, and Nananidou (2004) support this conclusion.

Retrospective Quantitative Interviews

Because questionnaires may not prompt participants to think about an answer in a way that an interview question does, the responses on a questionnaire can become more reactive and less contextualized. This suggests that when obtaining information retrospectively, it is important to provide participants with cues that will facilitate their recollection of habitual, regulated behaviors represented as either extended events or lifetime periods. Côté et al. (2005) recently discussed these issues and proposed an interview procedure where questions could be adjusted to the particular background and development of the athletes studied, and yet the information would still be collected in a standardized manner. The design of the interview procedure was based on the original study of deliberate practice (Ericsson et al., 1993) and was further guided by the theoretical frameworks of deliberate practice (Ericsson, 1996, 2003) and the developmental model of sport participation (Côté, 1999; Côté et al., 2003; Côté & Hay, 2002). The purpose of this standardized interview approach is to collect retrospective longitudinal data on variables that athletes are known to be able to report accurately.

Using this method, Baker, Côté, and Abernethy (2003b) assessed the developmental activities that led to elite participation among a group of expert decision makers from Australian national teams and a comparative sample of nonexpert decision makers drawn from the same sports. They found that from age 5 to 12 both experts and nonexperts increased their participation in extracurricular activities; however, this was followed by a rapid decrease in other activities from approximately age 13 onward for the expert athletes, marking their entry into the specializing years. A comparable reduction of involvement in various activities after age 13 did not occur for the nonexpert athletes. The reduction of activities for the expert athletes continued until approximately age 17. After age 17, the expert decision makers were involved in an average of three sporting activities. Furthermore, Baker et al. showed that expert athletes accumulated hours of sport-specific training similar to that of nonexperts until approximately 10 years of involvement in their sport (around age 15, or the beginning of the investment years). After age 15, the rate of sport-specific practice accumulation by experts escalated dramatically beyond that accumulated by nonexperts. Consistent with Van Rossum's (2000) data with Belgium field hockey players, Baker et al. also found that the number of hours of reported sport-specific training by expert athletes (4,000 hours, on average) was far short of the 10,000 hours of deliberate practice reported for expert musicians by Ericsson et al. (1993). Baker et al. also indicated that participation in other sports (e.g., sports where dynamic decision making is necessary) during early phases of development may have augmented the physical and cognitive skills necessary for the athletes' primary sport.

The same Australian athletes were asked in a follow-up study to rate their training activities on a scale from 0 (no help) to 3 (very helpful) with respect to perceived usefulness in developing essential component skills in perception, decision making, movement execution, and physical fitness (Baker, Côté, & Abernethy, 2003a). Competition and video training were perceived by players as being the most relevant activities for developing the perceptual and decision-making skills necessary for expert performance in team sports; individual instruction with a coach and practice alone were considered the most relevant activities for developing movement execution skills; and aerobic training and competition were regarded as the most relevant for developing physical fitness. Organized training also ranked consistently as an important activity for developing all four components contributing to successful player performance in team ball sports. Practice alone, individual coach instruction, organized training, video training, and aerobic training are all highly relevant, structured activities that require large amounts of cognitive and/or physical effort and certainly satisfy most, if not all, of the criteria for deliberate practice activities in sport. One important point of contention, however, concerns the athletes' ratings of the significance of competition to skill development. The benefits of participation in competition have not been considered in the deliberate practice studies performed to date, yet in the Baker et al. study, competition (i.e., match play) was rated as the most helpful form of training for the development of perceptual and decision-making skills and was also ranked high for developing skill execution and physical fitness. Although competition does indeed require great amounts of cognitive and physical effort, it is not strictly designed (as deliberate practice is) with either the singular or principal purpose of improving specific components of performance.

Baker, Côté, and Deakin (2005) studied ultra-endurance triathletes, stratified into three groups based on previous finishing times: experts, middle of the pack, and back of the pack triathletes. The results did not support a monotonic relationship between training hours and performance. Instead, the relationship between practice and performance was more akin to a power function (Newell & Rosenbloom, 1981). For example, the middle of the pack and back of the pack athletes were separated by 2,000 hours of practice, and the middle of the pack athletes and experts were separated by 6,000 hours. Because the differences in performance across the groups were similar (i.e., approximately 2.5 hours of overall finishing time), these findings show that performance improvements become more difficult as one progresses in skill level. In addition, experts were not distinguishable from their nonexpert counterparts in terms of their practice hours until after approximately 20 years of age. This suggests that although the deliberate practice framework is quite capable of differentiating expert ultra-endurance triathletes from nonexperts based on total hours of sport-specific training, it is not capable of distinguishing them during early stages of development, at least based on retrospective estimates. The analysis of early stages of development for these athletes suggests a considerable depth of sport experience with the expert and middle of the pack triathletes performing around 5,500 hours of other sport participation and the back of the pack accumulating nearly 3,500 hours in other sports.

Contrary to findings for triathletes and team sport athletes, Law, Côté, and Ericsson (in press) found that two groups of elite rhythmic gymnasts (Olympic group, 2nd in the world, and international group, 17th in the world) were involved in few other sports and play activities throughout their development. The average accumulated hours of gymnastics training (including ballet, technique, routine, and conditioning) at age 16 was significantly higher for the Olympic group than for the international gymnasts. Elite rhythmic gymnasts engaged in long hours of practice at younger ages than subelite gymnasts. However, the cost of this intense training was reflected in the Olympic gymnasts experiencing lower levels of "fun" during training and reporting poorer health and more injuries than the International gymnasts. In sum, the elite gymnasts who specialized at younger ages experienced more negative outcomes in the form of physical injuries and less enjoyment than elite gymnasts who specialized at older ages.

Using a modified version of the Ericsson et al. (1993) interview procedure, Duffy, Baluch, and Ericsson (2004) investigated the training activities of professional and amateur dart players. Results showed that professional players invested significantly more time in solitary practice than did amateur players, and amateur players played league darts significantly more often than professional players. The authors suggested that deliberate practice was the sum of solitary practice and practice with a partner. However, the context of solitary practice and practice with a partner in darts was not described by the authors and may not have met the definitional criteria of deliberate practice.

To clarify athletes' involvement in play or practice throughout their development, Soberlak and Côté (2003) asked professional ice hockey players to define the different contexts of their involvement in the sport. The authors showed that, although professional ice hockey players spent more than 10,000 hours involved in sport and physical activity from age 6 to 20, approximately 3,500 of these hours were spent in play-like activities (deliberate play). In contrast, an average of only 3,072 hours was spent in structured practice hockey activities. Furthermore, these athletes spent approximately 2,300 hours playing other sports and just over 2,400 hours playing organized games. Soberlak and Côté showed that the majority of the athletes' involvement in structured practice activities occurred during the investment years (2,215 hours), and the highest number of hours in deliberate play activities and in other sports was during the sampling years (2,618 and 1,404 hours, respectively). More specifically, the majority of deliberate play hours was accumulated prior to the age of 15, whereas the majority of deliberate practice hours were accumulated after that point.

Ericsson et al. (1993) theorized that it would be impossible for a late starter to overcome the early advantage of someone who began deliberate practice at a young age and maintained a steadily increasing pattern of engagement. However, investment in activities that are high on effort and concentration and low on enjoyment at a young age may also lead to dropout (Baker, 2003; Wiersma, 2000). To further understand the impact of early activities on investment and dropout in training, Wall and Côté (in press) examined the early activities (ages 6 to 13) of two groups of elite ice hockey players; one group was still invested in ice hockey, whereas the other group of players had just withdrawn from participating. The authors interviewed the elite players' parents about their sons' involvement in organized practice, deliberate play, and other sports from ages 6 to 13. Results indicated that both the active and the dropout players enjoyed a diverse and playful introduction to sport. Furthermore, the active and dropout players invested similar amounts of time in organized hockey games, organized hockey practices, and specialized hockey training activities (e.g., hockey camps and hockey play). However, analysis revealed that the dropout players began off-ice training (for the purpose of improving hockey performance) at a younger age and invested significantly more hours per year in off-ice training at ages 12 to 13. These results, along with Carlson's (1988) study of tennis players in Sweden, indicate that engaging in more training activities at a young age may have negative implications for long-term sport participation and the development of expertise in sport.

In a review of retrospective interview studies, Côté et al. (2003) proposed that the structure of deliberate practice and other activities in sports changes qualitatively as a function of the age of the child athlete. Generally, activities associated with the best learning and motivational environment in the early years of an athlete's development are different from optimal learning and motivational activities in the later years. Consequently, it is important to examine the type of activities (i.e., play or practice) that athletes engaged in at various stages of their development and elicit the reasons (i.e., for enjoyment or to improve performance) that athletes engaged in these activities instead of asking for subjective ratings. Studies reviewed in this section show that reducing the acquisition of expert performance in sport to involvement in a single form of activity (i.e., deliberate practice) fails to acknowledge important developmental and motivational assets acquired from involvement in play and other sporting activities.

IMPLICATIONS FOR EARLY SPORT ACTIVITIES: TO SAMPLE OR TO SPECIALIZE?

Support for early involvement in organized practice and deliberate practice is based on two assumptions that have yet to be confirmed. The first is that during early stages of development, future experts distinguish themselves from future nonexperts with regard to training quantity and quality. However, retrospective studies that assess practice patterns throughout development generally indicate that differences between elite and subelite athletes do not occur until later in development. For instance, Hodges and Starkes (1996) found that training-based differences between elite and nonelite wrestlers did not occur until approximately 18 years of age. Further comparisons of expert and nonexpert athletes in soccer (Helsen et al., 1998), field hockey (Helsen et al., 1998), and triathlon (Baker et al., 2005) found that training-based differences did not occur until 13, 15, and 20 years of age, respectively. Prior to these ages, the groups appeared quite similar with respect to training exposure. Exceptions exist in Ward et al.'s (2004) study of young English soccer players and for sports where peak performance occurs at early ages (i.e., before biological maturation), such as women's gymnastics (Law et al., in press) and women's figure skating (Deakin & Cobley, 2003), which indicate differences in sport-specific training between elite and subelite athletes as early as age 7. However, as outlined earlier, this level of involvement during early periods of development can have significant negative consequences for continued sport participation.

A second assumption for promoting investment in sport-specific practice at a young age is that organized practice and deliberate practice are superior to play and involvement in other sporting activities. However, there is evidence from interview studies that some athletes who were involved in play activities and who had a diversified sport background still reached an elite level of performance in sport (e.g., Baker et al., 2003b, 2005; Bloom, 1985; Carlson, 1988). For instance, Baker et al. (2003b) found a significant negative relationship between athletes' involvement in additional sporting activities and the amount of sport-specific training needed to achieve expertise.

Our understanding of the mechanisms by which diversification and play influence skill development is limited, although transfer of learning and cross-training research provides some insight. Thorndike (1914) suggested that "identical elements" between tasks were transferable (see Singley & Anderson, 1989, for a more recent application of Thorndike's theory). On the other hand, a transfer-appropriate-processing view (Lee, 1988) suggests that positive transfer may occur when the processing requirements of the training and practice tasks are similar to those of the competition and performance environment. Schmidt and Wrisberg (2000) suggested that transferable elements could be categorized into movement, perceptual, and conceptual elements, although there is considerable evidence (e.g., Loy, Hoffman, & Holland, 1995) that a physical conditioning category should be added to this list of transferable performance elements (see Table 8.2). Researchers have also

Table 8.2 Classification of Elements That May Be Transferable across Sports

Elements	Transferable Aspects	Example
Movement	Biomechanical and anatomical actions required to perform a task.	Throwing a baseball overhand and an overhand serve in tennis.
Perceptual	Environmental information that individuals interpret to make performance-related decisions.	Field hockey and soccer both require participants to accurately interpret the actions of their opponents in order to be successful.
Conceptual	Strategies, guidelines, and rules regarding performance.	Gymnastics and diving share conceptual elements (e.g., similar rules).
Physical conditioning	Physiological adaptations across similar modes of training.	Short-term interventions of combined run-cycle training are as effective as running alone in increasing aerobic capacity.

Source: Motor Learning and Performance: A Problem-Based Learning Approach, by R. A. Schmidt, and C. A. Wrisberg, 2000, Champaign, IL: Human Kinetics. Reprinted with permission.

suggested that the effects of cross-training and transfer are most pronounced during early stages of involvement (Loy et al., 1995). For instance, any form of aerobic exercise can cause the general physiological adaptations that occur at the onset of a physical training program; however, the more trained an athlete becomes, the smaller the relative improvement from cross-training. By this reasoning, a variable participation during early stages of development may be equally beneficial to specific forms of training in achieving the physiological adaptations necessary for increases in cardiorespiratory fitness.

A diversified approach to early athlete development may not be at odds with monotonic or power profiles of the practice-proficiency relationship. During initial stages of development, increases in performance occur due to rapid improvement in general capabilities. With prolonged practice and training over time, improvements become much more specific in nature and more difficult to attain. During initial exposure to the task, however, the same general adaptations may be produced through similar activities that share the same elements. For instance, Abernethy, Baker, and Côté (2005) recently showed that experts from different sports consistently outperformed nonexperts in their recall of defensive player positions, suggesting that some selective transfer of pattern recall skills may be possible. From a physical conditioning point of view, childhood involvement in running or cycling will produce the same general physiological adaptations (e.g., increases in blood volume and maximal cardiac output) as sport-specific involvement. Once general cognitive or physical adaptations have been made through play and involvement in various sport activities during childhood, training should become more specific. A model of this relationship according to Côté's (1999) stages of sport participation is presented in Figure 8.1.

It is clear from retrospective studies of athletes' development that the amount and type of training performed throughout an expert athlete's development is dependent on the specific demands or capacities underlying performance in the sport as well as the age at which performance of these abilities reach their peak. Sports with abilities that peak later in development can allow greater flexibility during early development than sports with abilities that peak earlier. But eventually, all future expert athletes must adopt a program of training that focuses on deliberate practice, as it appears that without a long-term commitment to high-quality training, athletes will be unable to attain elite levels of performance. However, coaches and parents should consider the consequences of high levels of structured training during early development, as these experiences have a profound influence on involvement in sport and physical activity across the life span.

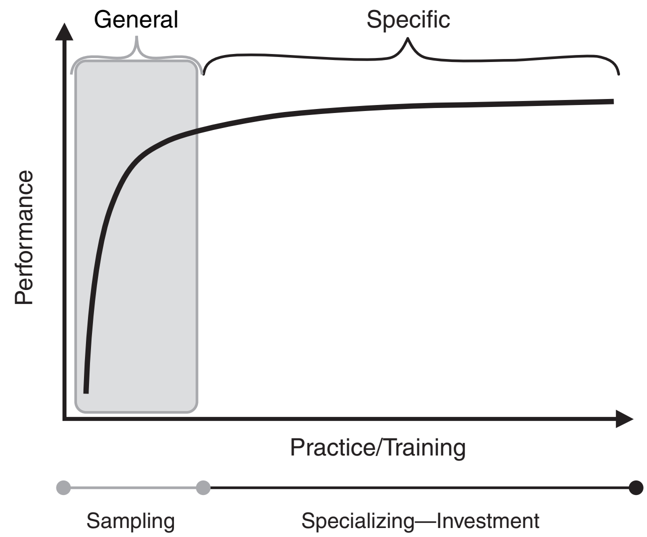

Figure 8.1 Proposed role of diversified early involvement in the development of sport expertise. The power law of practice proposed by A. Newell and Rosenbloom (1981) is represented by the solid line. During the sampling stage (i.e., the shaded area), adaptations are general in nature. Once these general adaptations have taken place, training should become more specific so that positive adaptations are perpetuated (i.e., during the specializing and investment stages). *Source:* "Shifting Training Requirements during Athlete Development: The Relationship among Deliberate Practice, Deliberate Play and Other Sport Involvement in the Acquisition of Sport Expertise" (pp. 93–110), by J. Baker and J. Côté, in *Essential Processes for Attaining Peak Performance,* D. Hackfort & G. Tenenbaum (Eds.), 2006, Oxford: Meyer & Meyer. Reprinted with permission.

The next section reviews environmental variables that have been linked to elite performance in sport and sheds some light on the type of environment that best promotes play and practice in the early years of an athlete's involvement in sport.

ENVIRONMENTAL FACTORS THAT ELICIT AND SUPPORT PRACTICE AND PLAY

Profiles of elite athletes have shown a pattern of training that changes throughout development. Important developmental changes that occur include the number of sporting activities athletes are involved in and the number of hours invested in deliberate play, structured practice, and deliberate practice. Some children will benefit from situations that provide them with more opportunities to get involved in sports at an early age. The relative age effect (see Musch & Grondin, 2001, for a review) and the size of the city or region in which an athlete develops (Côté, MacDonald, Baker, & Abernethy, in press; Curtis & Birch, 1987) are two contextual variables that have been associated with increased early exposure to sport and the achievement of expertise.

Relative Age Effect

The relative age effect shows that the older one is relative to one's peers in the same grouping or junior sport team (i.e., the greater one's *relative age*), the greater the probability of eventually becoming an elite athlete (Baxter-Jones & Helms, 1994; Dundink, 1994; Helsen, Hodges, Van Winckel, & Starkes, 2000). Studies examining birthdates of professional and elite athletes in baseball (Thompson, Barnsley, & Stebelsky, 1991), ice hockey (Barnsley & Thompson, 1988; Boucher & Mutimer, 1994), soccer (Barnsley, Thompson, & Legault, 1992; Dundink, 1994; Glamser & Vincent, 2004; Helsen, Van Winckel, & Williams, 2005), cricket (Edwards, 1994), swimming (Baxter-Jones, 1995), and tennis (Baxter-Jones, 1995) have shown a skewed birth date distribution favoring players that were born in the first half of the sport year.

The most compelling hypothesis about the relative age effect suggests that older children in a group will be provided with environments that facilitate the improvement of their skills early in their development because they are more mature or physically larger (Musch & Grondin, 2001). For example, bigger and more mature athletes may have an early advantage over smaller athletes in several sports because their physical abilities, such as running, throwing, and jumping, are better developed. Accordingly, a coach is likely to select these more mature athletes and put them in more decision-making roles (i.e., point guard, quarterback), where they get more opportunities for playing and practice. Furthermore, because of their early success, athletes that are born in the first quarter of their sport year may receive more encouragement, feedback, and support from parents, coaches, and peers. This type of social environment may motivate them to play and invest more in their sport outside of regular organized practice sessions. In sum, the relative age effect is a phenomenon that favors athletes born early in their sport year by providing them with additional time on task.

Although the relative age effect has been observed in several sports and at different levels of development, the effect has not been found in American and Canadian professional football (Daniel & Janssen, 1987), National Basketball Association players (Côté et al., in press; Daniel & Janssen, 1987), or American professional golfers (Côté et al., in press). Golf is a sport where age-related factors such as size and weight may be less likely to influence performance. In addition, the structure of youth golf in the United States does not have as strict age groupings as other organized youth sports, such as ice hockey and baseball. On the other hand, because American and Canadian football and basketball are sports where size, weight, strength, and coordination are critical elements of success, one would expect the relative age effect to be present. The organizational structure of youth football and basketball in the United States and Canada may explain the absence of a relative age effect in these sports. Typically, young American and Canadian football players are classified into different levels according to weight instead of chronological age, therefore eliminating the evidence of a relative age effect in football. The absence of a relative age effect in U.S. basketball may partially be explained by a "grade fail exemption" rule present in U.S. high school basketball. The grade fail exemption allows three older players per team to play with players of the same grade if they fail a grade. This exemption allows older players to play with younger players and may eventually eliminate the relative age effect in professional basketball. Finally, the beginning of organized play in American and Canadian football (and in golf) is likely to occur at an older age, which would limit the amount of time that footballers (and golfers) can benefit from a possible relative age advantage.

Birthplace Effect

Another environmental variable that has recently received attention in sport expertise research is the city size where elite athletes gain their formative experiences. This variable may have a significant influence on how athletes are first exposed to sports, which, like the relative age effect, can limit or benefit performance.

In his qualitative study of the development of tennis players in Sweden, Carlson (1988) concluded that elite players predominantly came from rural areas and that these areas provided the athletes unlimited opportunities to participate in sports. Another study by Curtis and Birch (1987) examined the city size of the birthplace of Canadian and U.S. Olympic hockey players and Canadian National Hockey League players. They found that for Canadian players, rural areas of fewer than 1,000 inhabitants and cities with more than 500,000 inhabitants were underrepresented in relation to the expected proportions of the population in the same age range. An analysis of the birthplace of 2,240 Canadian and American professional athletes in basketball, baseball, ice hockey, and golf also showed a birthplace bias toward smaller cities, with professional athletes being overrepresented in cities of fewer than 500,000 and underrepresented in cities of 500,000 and over (Côté et al., in press). The best odds of becoming a professional athlete in the United States were found for cities with populations between 50,000 and 99,999.

Drawing on the existing evidence about factors known to be important to expert development in sports, we can propose possible factors and mechanisms that may contribute to the birthplace effect (Côté et al., 2003; Ericsson et al., 1993). The effect could be primarily due to skill acquisition factors related to the quality and quantity of play and practice afforded by the physical environment of smaller cities. The quality of play and practice could be a key factor because the physical environment of smaller cities is more conducive to unstructured play activities between children and adults of different ages and to experimentation with various forms of sporting activities (Kytta, 2002). The quantity of play and practice in smaller cities could also be a factor because smaller cities present fewer safety concerns, easier access to open spaces, and fewer competing sources of leisure time usage by children. Another factor that may contribute to the birthplace effect is the more intimate and, likely, less competitive psychosocial environment of smaller cities. Smaller cities may offer increased opportunities to experience early success in sport, which, in turn, may increase self-efficacy and the motivational drive to play and practice.

The big fish, little pond effect (BFLPE; Marsh, 1987) is a theoretical framework specific to academic self-concept that may be useful in explaining how the psychosocial environment of smaller cities promotes the development of talent in sport. The BFLPE occurs when equally able students have lower academic self-concept when they are put in an environment where they compare themselves with more able students (i.e., at a top academic high school). On the other hand, the same students will have higher academic self-concept when they compare themselves with less able students (Marsh, 1987; Marsh & Tai Hau, 2003). Within the framework of the birthplace effect in sport, a young athlete who excels in sport in an average small city league could be perceived as a "big fish in a small pond" and, accordingly, have a high sport self-concept. This high sport self-concept likely drives the young athlete's commitment to stay involved in sport and facilitates the acquisition of a greater quantum of play and practice. If placed into a more selective sport program, characteristic of bigger urban center sport systems, this same athlete would be in a "larger pond with larger fish" (i.e., other excellent athletes who may be more skilled). This scenario would provide this athlete with a different frame of reference that, according to the BFLPE, would lower his or her sport self-concept and likely reduce his or her commitment to sport. The BFLPE is an appealing hypothesis that is supportive of the birthplace effect data in sport.

Given the contextual similarities between the relative age and birthplace effects, it is plausible that these factors may interact in promoting athlete development. This relationship was examined by Côté et al. (in press), and no evidence of moderation/mediation was found. Furthermore, Côté et al. showed that birthplace has a considerably stronger influence on talent development than relative age in major U.S. and Canadian sports. However, the birthplace effect requires examination in other countries and other sports to determine the generalizability of this effect.

The relative age and birthplace effects highlight the importance of the early years of a child's involvement in sport as a foundation for the development of motivation, skill, and talent. Also, it demonstrates the remarkably enduring effect that early sport experience may have on the likelihood of expertise being ultimately achieved. The relative age and birthplace effects support an environment that provides ample opportunities for youth to experience high-quality play and practice activities in their early involvement in sport. Accordingly, various researchers (Bloom, 1985; Côté, et al., 2003; Wylleman, De Knop, Ewing, & Cumming, 2000) have integrated studies on the development of talent in sport and have proposed models that demarcate the stages in athletes' paths to expertise (Durand-Bush & Salmela, 2001). In the next section, we offer directions for future research and present a working model that has recently been proposed to explain the longitudinal changes that occur in play and practice activities in the development of talent in sport.

TOWARD AN INTEGRATED FRAMEWORK FOR UNDERSTANDING THE ROLE OF PRACTICE AND PLAY IN SKILL DEVELOPMENT

It is clear from this review that studying the development of expertise in sport is a much more complex task than studying learning in controlled laboratory environments. In a recent review of the motor learning literature, Wulf and Shea (2002) distinguished between learning *effectiveness* and learning *efficiency,* both being important issues in the study of complex motor skills and the development of expert performance in sport. Learning effectiveness focuses on factors that influence the acquisition of motor skill; learning efficiency focuses on the factors that influence the acquisition of motor skills at less cost (Wulf & Shea, 2002). Unlike consideration of learning effectiveness, a focus on learning efficiency also considers the psychosocial (i.e., drop out, burn out) and physical (i.e., injury, health) costs associated with training and the development of expertise in sport. An *efficient* model of sport expertise development would limit the costs associated with long-term investment in sport; an *effective* model would focus on learning independent of the costs that may be involved.

The framework of deliberate practice developed by Ericsson et al. (1993) is an example of a model that is based on learning effectiveness. Ericsson et al. suggested that it would be next to impossible for a late starter to overcome the early advantage provided to those who begin deliberate practice at a young age and maintain high amounts of deliberate practice hours over time. The deliberate practice framework largely downplays the psychosocial and physical costs associated with this type of practice, especially in the early years of an athlete's involvement in sport.

Although the positive relationship between training and elite performance is consistent in sport research, several other dimensions of the theory of deliberate practice have not been supported (Abernethy et al., 2003). In particular, research (for reviews, see Baker & Côté, 2006; Côté et al., 2003) has shown that considering only deliberate practice training in athlete development does not adequately characterize the complexity of the relationships among developmental, motivational, and psychosocial aspects of human abilities. One model that does highlight the importance of developmentally appropriate training patterns and social influences is Côté and colleagues' developmental model of sport participation (DMSP; Côté, 1999; Côté et al., 2003; Côté & Hay, 2002).

Côté and Fraser-Thomas (2007) recently proposed a modified version of the DMSP illustrating more clearly the possible sport participation trajectories of the model. These trajectories are outlined in Figure 8.2 as (a) recreational participation through sampling and deliberate play, (b) elite performance through sampling and deliberate play, and (c) elite performance through early specialization and deliberate practice. The different stages within a trajectory are based on changes in the type and amount of involvement in sport, deliberate play, and deliberate practice. Two of these trajectories, recreational participation and elite performance through sampling, have the same foundation from ages 6 to 12. After the sampling years, sport participants can choose to either stay involved in sport at a recreational level (*recreational years,* age 13+) or embark on a path that focuses primarily on performance (*specializing years,* ages 13 to 15; *investment years,* age 16+). These two trajectories have different outcomes in terms of performance but are likely to lead to similar psychosocial and physical health benefits. A third possible trajectory consists of elite performance through early specialization (right side of Figure 8.2). Although this trajectory leads to elite performance, it has also been shown to result in a reduction in both physical health (i.e., overuse injuries) and enjoyment (e.g., Law et al., in press).

Recreational Participation through Sampling

The recreational outcome of the DMSP was examined in a retrospective study of active and inactive adult females (Robertson-Wilson, Baker, Derbyshire, & Côté, 2003). Results indicated that active females participated in significantly more physical activities than inactive females from age 6 to age 18, but no significant differences were found between the two groups in terms of their involvement in other nonphysical structured leisure activities, such as music and art. From ages 6 to 12 (i.e., sampling years) the active females participated in a variety of sports that focused primarily on deliberate play activities. These years were considered essential building blocks for their continued recreational sport participation. The recreational years (age 13+) are usually seen as an extension of the sampling years, with the primary goals being enjoyment and health. Activities during the recreational years can involve deliberate play and deliberate practice, with sport programs being flexible enough to adapt to individual interests and ages. In terms of outcomes, the physical and psychological benefits of recreational participation in sport, such as enhanced health and increased enjoyment, have been consistently supported through various studies (see Berger & Motl, 2001, for a review).

Elite Performance through Sampling

For youth interested in a more performance-oriented path, a second trajectory of the DMSP suggests that specialization begins around age 13, after the sampling years. The specializing years (ages 13 to 15) are seen as a transitional stage to the investment years (age 16+). During the specializing years, youth engage in fewer activities (which include both deliberate play and deliberate practice), whereas during the investment years, youth commit to only one activity and engage primarily in deliberate practice. This trajectory toward elite performance in sport has been supported by various qualitative and quantitative studies (e.g., Baker et al., 2003b, 2005; Bloom, 1985; Carlson, 1988; Côté, 1999; Soberlak & Côté, 2003). Athletes who follow this trajectory tend to experience positive physical and psychosocial outcomes (e.g., physical health, sport enjoyment; Korell & Côté, 2005); however, more studies are needed that directly measure the physical and psychosocial outcomes of elite performers who sampled in their early years in sport.

Elite Performance through Early Specialization

In sports where peak performance is achieved before puberty (e.g., women's gymnastics, figure skating), early specialization is often necessary to reach elite performance. Several studies support early specialization as a suitable path toward elite performance (e.g., Law et al., in press; Ward et al., 2004). Elite performers who specialize at an early age usually skip the sampling years and, consequently, do not always experience the enjoyment associated with sampling and playing (Law et al., in press). In fact, there is reasonable empirical support for the notion that early specialization is associated with higher levels of attrition at all levels of ability (Gould, 1987; Gould, Udry, Tuffey, & Loehr, 1996; Korell & Côté, 2005; Wall & Côté, in press). Furthermore, an early focus on structured training can have negative effects on developing athletes' physical health

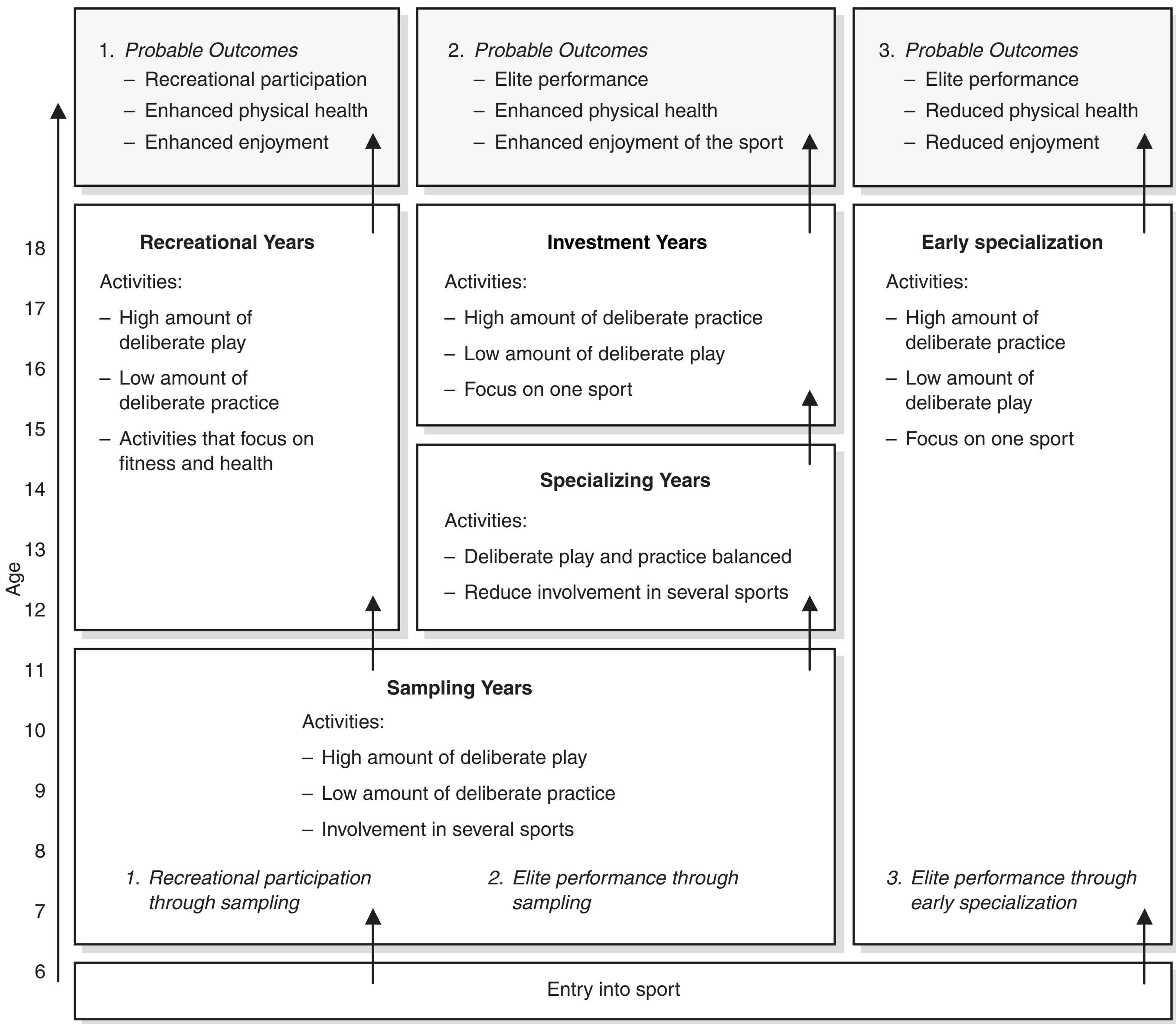

Figure 8.2 Developmental model of sport participation.

(Caine, Cochrane, Caine, & Zemper, 1989; Law et al., in press). For example, excessive forms of training during crucial periods of biological development can significantly increase the risk of overtraining injuries (Caine et al., 1989; Dalton, 1992). More developmental studies that focus on the benefits and costs associated with early specialization are necessary to fully appreciate the value of this trajectory.

Other Trajectories

Opportunities for horizontal movement across stages (e.g., going from investment to recreational) should be provided for participants so that they can change their level of participation at any age if they so desire. Unfortunately, in many sports, it is difficult for a 16-year-old to invest in a sport if he or she has not been specializing in that sport since approximately age 13. However, in some sports, such as ultra-endurance triathlon, investment in adulthood is possible (Baker et al., 2005). Sports with later ages of peak performance, such as ultra-endurance triathlon (peak at approximately age 30), have more flexibility with regard to the type of activities performed during the teenage years. In sum, the differing ages of peak performance in various sports may be a critical constraint on the type of training performed during an athlete's development (Baker & Côté, 2006).

Summary

Overall, the DMSP provides a useful framework to assess the learning environments that lead to various performance and developmental outcomes in children. Although not all the outcomes of each of the different trajectories of the DMSP have been directly tested, enough support exists to suggest developmental patterns that can be further tested through retrospective research. By considering factors other than accumulated amount of practice, the DMSP allows researchers to address questions of learning efficiency and learning effectiveness. A youth sport framework that focuses on learning efficiency should consider the various pathways that children follow in sport and consider the dropout rate of each trajectory. Concerted effort is required from physical education teachers, coaches, and parents to ensure that children learn skills and stay motivated to continue their participation in sport at either an elite or a recreational level.

CONCLUSION

This chapter focused on how expert athletes spend their time in sport throughout their development. We reviewed literature on practice and play, the two fundamental learning activities that have been shown to contribute to children's skill development in sport. Ericsson et al.'s (1993) study of musicians and subsequent studies with athletes (Helsen et al., 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996) strongly support the contention that deliberate practice is a major determinant of expertise. On the other hand, child development research (e.g., Pellegrini & Smith, 1998; Russ, 2004) has consistently highlighted that play activity teaches important adaptive abilities necessary for the acquisition of new skills. The playful environment that expert athletes experience during their early involvement in sport may largely explain their early learning and exceptional motivation, which leads to subsequent learning and involvement in deliberate practice (Côté et al., 2003).

We examined retrospective studies that have been conducted to trace the training profile of athletes' development in sport. Studies using qualitative interviews, questionnaires, and quantitative interviews were reviewed. One consistent finding of these studies was that without a long-term commitment to high-quality training, athletes are unable to attain elite levels of performance. However, results are not consistent when describing the activities that should be favored in the early years of athletes' involvement. Several studies have supported a developmental approach that does not focus solely, in the early years, on sport-specific deliberate practice but emphasizes playing activities and the sampling of various sporting activities. These different trajectories toward elite performance raise questions regarding the optimal environment that should be provided for the early development of elite performance in sport. Accordingly, we presented some implications of early sampling and specializing. Furthermore, we outlined possible mechanisms that could potentially explain how sampling different sports and playing in the early years can lead to elite performance. We provided evidence from two environmental factors, relative age and birthplace, that support a type of early developmental experience in sport that increases children's opportunities for success.

Finally, we presented a model of development in sport that highlights the changing environments of athletes and has implications for the design of sport programs. Different trajectories of sport participation are suggested, with unique outcomes in terms of performance and physical and psychosocial consequences. The trajectories are differentiated by different types of involvement in sport at different ages. In our search to develop elite-level athletes, we need to be conscious not only of the acquisition of sport skills but also of optimizing the health of young athletes through continued participation in sport.

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CHAPTER 9

Anticipation and Decision Making

Exploring New Horizons

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There is growing awareness that perceptual-cognitive skills such as anticipation and decision making are crucial to high-level performance across a range of domains. This increased awareness has resulted in a recent spate of academic texts (e.g., see Ericsson, Hoffman, Charness, & Feltovich, in press; Starkes & Ericsson, 2003; Williams & Hodges, 2004) and special issues of journals (e.g., see Williams, 2002; Williams & Reilly, 2000a) that focus on these or closely related topics. There is empirical evidence to suggest that these skills account for a significant proportion of the variance in performance between elite and subelite athletes (e.g., see Reilly, Williams, Nevill, & Franks, 2000). As performers progress through the ranks, these perceptual-cognitive, as well as technical skills are more likely to discriminate performers than anthropometric and physiological profiles (Williams & Reilly, 2000b).

As there have been several fairly recent and comprehensive reviews of the literature on perceptual-cognitive expertise (e.g., see Starkes, Helsen, & Jack, 2001; Williams, Davids, & Williams, 1999), the aim in this chapter is not to resynthesize this material, but to highlight existing shortcomings in our understanding. We hope to highlight those questions that remain unanswered and propose a research agenda that others in the field may wish to follow in coming years. We do not claim to have superior knowledge, or indeed any more insights than others into how future research in this area should be directed. Our intention is simply to share with the reader some of the ideas that we have openly shared with each other in recent years, typically providing much food for heated discussion and debate in various corners of the globe. The discussion is largely focused on the topic of anticipation rather than decision making per se. This focus on more perceptual aspects of performance is not intended to reflect any bias on our part or, for that matter, any strong conceptual distinction between these two skills, but is merely indicative of the more abundant literature on this topic. Our hope is to share our enthusiasm for the area and encourage others to add to the literature base by challenging them to explore these issues through empirical means.

The chapter is structured into four related sections focusing on the key empirical findings to date, the typical methods and measures that have been employed, the underlying theories and models, and practical issues and interventions. The proposal is to briefly highlight what we know in each of these areas, directing readers to other key references for more detailed reviews of the literature, and then to suggest what we need to find out in coming years. It is typically the case in research that the rearview mirror is always clearer than the windshield, so we make no claims as to the longevity of our suggestions or the extent to which the ideas proposed will see the light of day in future years. We refer to recent empirical findings to help present our arguments whenever possible, whereas at other times, some of the ideas presented are merely flickers of light in some distant corner of our minds. We begin by highlighting how far we have traveled over the past few decades in our understanding of anticipation and decision-making skill in sport.

SUMMARY OF KEY FINDINGS AND ISSUES THAT REQUIRE CLARIFICATION

Although some interesting work was undertaken on either side of the Second World War (e.g., Abel, 1924; Fullerton, 1925; Hubbard & Seng, 1958), a larger body of research on the topic of visual and perceptual-cognitive skill in sport began to emerge in the last few decades of the twentieth century. This line of research was inspired by research that attempted to examine whether skilled individuals could be differentiated on domain-general, basic capacities, and abilities (e.g., Terman & Oden, 1947). In the 1970s and early 1980s, a particular trend was to examine whether skilled performers could be differentiated from their less skilled counterparts based on visual characteristics, such as acuity and depth perception (e.g., see Blundell, 1985; Sanderson, 1981).

Vision and Performance

The notion that skilled performers are endowed with enhanced visual systems has intuitive appeal. For years, anecdotes of the best players possessing great vision have pervaded the locker room, terraces, and popular press. The empirical evidence, however, is at best inconclusive. Some researchers have reported skill-based differences in certain aspects of visual function, such as dynamic visual acuity and size of peripheral visual field (e.g., Blundell, 1985; Sanderson, 1981), yet others have shown no differences or even an advantage in favor of less skilled athletes on the same measures (e.g., Helsen & Starkes, 1999; P. Ward & Williams, 2003). Loran and MacEwen (1995) and Williams and colleagues (1999) provide an extended review of this literature.

What Don't We Know?

Although it is tempting to draw a line under this body of work, there are nonetheless some unresolved issues. A particular concern is that much of the work in this area is poorly designed and piecemeal, with limited attempts to control or manipulate key variables. The measures employed generally lack sensitivity and are rarely reflective of the types of constraints that normally exist during sports performance. Attempts to make these tasks representative of the visual demands of actual competition and to impose realistic performance constraints such as temporal, physiological, and emotional stress would likely increase the sensitivity and validity of existing measures.

Another limitation of this literature is that researchers have often examined the importance of certain components of visual function (e.g., dynamic visual acuity) by using samples of participants from a sport where such components are unlikely to be important (see Gardner & Sherman, 1995). Clearly, each sport has its own unique visual requirements and the demands are likely to change from position to position (see Cockerill, 1981). Sport-specific test batteries may need to be designed to reflect such issues (Williams et al., 1999). It is also important to note that the visual system does not function in isolation from the perceptual-cognitive system; these two components work together in an integrated manner to facilitate effective perception (see Henderson, 2003). It would therefore be interesting to examine how defects in various aspects of visual function (e.g., contrast sensitivity, stereodepth perception, and acuity) and, potentially, changes in environmental conditions (e.g., ambient lighting) may be compensated for by perceptual-cognitive mechanisms, perhaps as reflected by changes in visual search behavior (for an extended discussion, see Williams, Janelle, & Davids, 2004).

Sanderson (1981) provided an excellent illustration of this notion by suggesting that an individual's dynamic visual acuity may impact the manner in which information is extracted from the environment when, for example, attempting to track a ball during flight. A suggestion is that athletes who have good dynamic visual acuity (i.e., their acuity is seen as being velocity-resistant; see Miller & Ludvigh, 1962) are more likely to track a fast-moving ball using a combination of eye and head movements, whereas those with poor dynamic visual acuity (i.e., they are velocity-susceptible) rely on the so-called image-retina system (see Haywood, 1984). It is presently not clear whether use of the eye-head system offers any advantages over the image-retina system during interceptive actions such as in tennis and cricket (see Williams, Singer, & Weigelt, 1998), but this would be an interesting area for further research, with potential implications for training and instruction (e.g., see Long & Riggs, 1991).

Finally, few researchers have examined how visual function develops with age and how maturation may vary as a function of involvement in sport (for an interesting exception, see Blundell, 1985). There is considerable evidence to suggest that expertise emerges as a result of adaptation to the unique demands of the specific sport (see Williams & Ericsson, 2005), but it is as yet unclear whether this notion extends to the visual system or merely to perceptual-cognitive, anthropometric, and physiological subsystems. The maturation of the visual system may act as an important rate limiter in the development of other subsystems and impact significantly on performance (Haywood & Getchell, 2001). This issue could be addressed by monitoring changes in visual function over time (along with other measures, such as perceptual-cognitive skill) using both longitudinal and cross-sectional designs, more sensitive sport-specific measures, higher levels of experimental control, and appropriate statistical procedures (e.g., see P. Ward & Williams, 2003).

Perception, Cognition, and Performance

Since the mid- to late 1980s researchers have focused more extensively on perceptual-cognitive aspects of performance. An extensive research base illustrates skilled performers' superiority over less skilled athletes on tests designed to examine perceptual-cognitive skills that are assumed to be essential for effective anticipation and decision making. These skills include advance cue utilization, pattern recognition, visual search behavior, and the use of situational probabilities. Although such skills are likely to be seamlessly integrated during high-level performance and their relative importance may well change as a situation dynamically unfolds, the majority of researchers have largely examined these perceptual-cognitive skills independently. Consequently, we consider each of these skills in turn.

Advance Cue Utilization

Skilled performers are able to pick up information from an opponent's postural orientation in the moments before a key event, such as football or racketball contact, to anticipate future response requirements. The skilled performer's ability to utilize advance, preevent cues is one of the earliest and most robust findings in the sport expertise literature. This ability has typically been assessed using a temporal occlusion paradigm. The action is filmed from the same viewing perspective as in the competitive situation and then edited to remove all subsequent action and outcome information after a critical point (e.g., 40 ms before football or racketball contact). The participant's task is to determine what happened next and respond accordingly. Skilled performers' superiority over less skilled athletes is most apparent at the earliest, precontact occlusion conditions, implying that the ability to anticipate future events based on advance information is crucial to high-level performance. Haskins (1965) originally introduced this paradigm as a method of training perceptual skill, whereas subsequent researchers have used this approach to examine skill-based differences in sports such as tennis (Jones & Miles, 1978), badminton (Abernethy & Russell, 1987), soccer (Williams & Burwitz, 1993), and field hockey (Salmela & Fiorito, 1979). A more detailed review of this literature is available elsewhere (see Starkes et al., 2001; Williams et al., 1999).

What Don't We Know?

Although this finding is very robust across different fast-ball sports, there have been only limited attempts to identify the underlying mechanisms or even the specific perceptual information that underpins the identification process. A few researchers have combined the temporal occlusion approach with spatial occlusion, eye movement registration, and verbal report techniques in an effort to identify the specific perceptual cues that guide performance in such contexts (e.g., see Abernethy & Russell, 1987; Williams & Davids, 1998). However, such systematic programs of research and efforts to cross-validate findings, and to extend knowledge by combining different measures, are rare in the literature.

In an attempt to identify the specific sources of information that performers use to anticipate opponents' intentions, researchers have converted film images of players in action into point-light displays. Point-light displays were originally introduced by Johansson (1973) as a means of studying the perception of human movement. These displays capture the motion of the major joint centers of the body, which are then displayed as points of light against a black background. The intention is to remove background and contextual information and to present movement in its simplest terms (Cutting & Proffitt, 1982). Several researchers have proposed that the effective pick-up of relative motion (captured by sequences of point-light displays) is an essential component of anticipation skill in fast-ball sports (e.g., see Abernethy, Gill, Parks, & Packer, 2001; P. Ward, Williams, & Bennett, 2002). The argument is that performers determine an opponent's intentions based on their perception of the relative motion between specific bodily features, rather than via the extraction of information from more superficial features or an isolated area or cue. Although this proposal would appear to have merit, there have been only limited efforts to verify initial findings or to identify the specific information that performers extract from such displays. In contrast, such issues have been more routinely explored in the image perception and observational learning literature (e.g., Breslin, Hodges, Williams, Kremer, & Curran, 2005; Dittrich & Lea, 1994; Horn, Williams, & Scott, 2002).

The use of point-light displays could be combined with temporal and spatial occlusion techniques to determine which sources of information experts become attuned to. Images may be temporally occluded at predetermined time points and/or individual or collective markers removed for all or part of a trial (e.g., see Hodges, Hayes, Breslin, & Williams, 2005). Contemporary methods of creating point-light (or stick figure) images using optoelectronic motion capture systems rather than video provide significant advantages in this regard, as it is relatively easy to remove, or even distort, the coordinates for certain markers from the entire sequence as opposed to having to edit out this part of the image on every frame of video (see also Cañal-Bruland, Huys, Hagemann, & Williams, 2006).

Another advantage of using point-light displays to assess the source of information used to anticipate opponents' intentions is that a detailed biomechanical profile of each action can be created from the two- or three-dimensional data and their first- and second-order derivatives. The data may be analyzed descriptively, or statistical and dynamical tools, such as principal component analyses, can be used to identify the key components that differentiate two movements (Williams & Ericsson, 2005). For example, biomechanical differences between the forehand cross-court and down-the-line shots in tennis are illustrated in the point-light images presented in Figure 9.1. The circles highlight

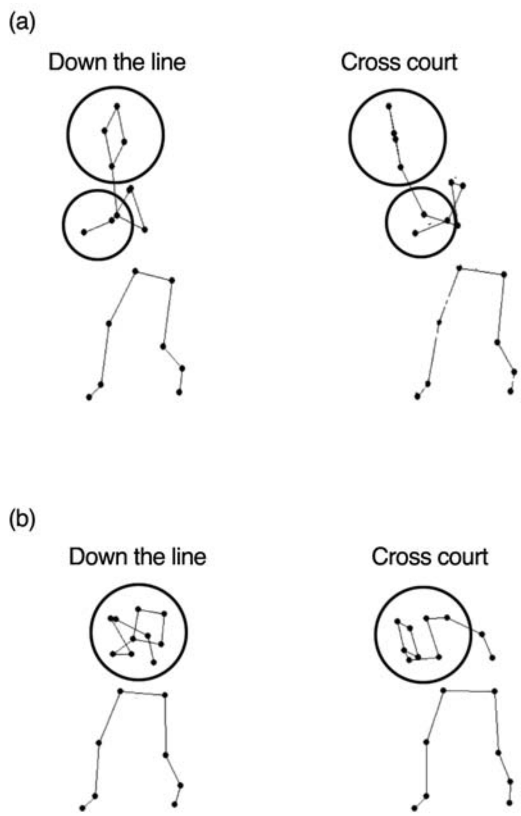

Figure 9.1 Point-light displays of the forehand cross-court and down-the-line shots in tennis. The circles highlight potentially important biomechanical differences between these shots at a point in time either (a) 400 ms or (b) 200 ms prior to ball-racket contact. Data from *Using Principal Component Analysis to Identify Potential Anticipation Cues in Tennis,* by N. J. Smeeton, R. Huys, A. M. Williams, and N. J. Hodges, August 2005, paper presented at the ISSP 11th World Congress of Sport Psychology, Sydney, Australia.

the important biomechanical differences between these two shots and the unique perceptual information presented in each instance.

An interesting issue is the extent to which performers are able to determine discernable differences in opponents' intentions based on subtle changes in relative motion. One would suspect that the sensitivity of the observer for picking up such perceptual information changes with increasing skill level. The use of signal-detection type paradigms may allow researchers to determine whether skilled anticipators become more attuned to this information or are simply biased by their expectations to select one option over another (see Horn, Williams, Hodges, & Hayes, 2006). A related issue currently being examined in our laboratories is the extent to which the relative motion pattern provides information related to the direction of movement (e.g., the location of the goal to which the penalty shooter will kick the ball), whereas the absolute velocity of the end point (effector) within that relative motion pattern (e.g., foot/toe) is more important for predicting the weight or depth of shot. In a similar vein, how important is relative motion of the end effector compared to whole-body relative motion when perceiving an opponent's intentions? There is already evidence to suggest that performers can learn and accurately imitate a particular movement pattern based solely on information from the end point of the action (see Breslin et al., 2005; Hodges, Hayes, Breslin, & Williams, 2005). There is certainly scope to extend this work to the domain of perceptual-cognitive skill in sport.

We offer a note of caution, however: Researchers should be cautious when assuming that the way individuals respond to point-light displays is representative of how they would respond in the real world. Although skill-based differences in anticipation have typically been maintained when individuals are presented with information under the point-light compared with the video format, a decrement in performance is nonetheless reported under the former compared with the latter condition. Unless researchers attempt to take some corresponding measure of cognition (e.g., verbal reports, eye movements) during performance in both conditions, it will be impossible to determine whether the skilled processes used by high-level players in actual game play are also used under point-light conditions. An initial study of visual search during anticipation of normal and point-light displays suggests that both novice and skilled tennis players are prone to change the information they use when moving from normal to point-light conditions, although the skilled players are much less affected than are their novice counterparts (P. Ward, Williams, & Bennett, 2002). In our laboratories, we are currently examining if and how players change their think-aloud report when moving to point-light displays to explain the subtle differences in strategy observed.

A potential difficultly when attempting to identify key postural cues is the notion of perceptual redundancy or flexibility. The rationale underpinning the use of spatial occlusion techniques, whether using film or point-light displays, is that a cue is considered a crucial source of perceptual information only if there is a decrement in performance when the cue is occluded. The difficulty with this interpretation is the possibility that skilled performers may base their decisions on several concurrent and overlapping perceptual cues. If there is no decrement in performance when a particular cue is occluded, this may not imply that performers do not normally extract information from this area of the display when available. An equally plausible explanation is that the same or alternative information was extracted from some other source(s) on this occasion. This perceptual flexibility or redundancy may be an important characteristic of high-level performance in sport and, consequently, merits further clarification via, for instance, multiple measures of cue usage. An interesting corollary exists in the perceptual-motor domain, where there is evidence to suggest that when executing a technical skill, such as controlling a ball in soccer, skilled athletes are able to use several potential sources of sensory information (e.g., vision, proprioception) in an interchangeable manner to facilitate effective performance (see Williams, Harris, Weigelt, & Scott, 2002).

A question not often answered directly in the literature is whether players during performance actually rely on the perceptual cues identified by the advance cue literature. Although researchers have consistently shown that players are able to make use of such sources of information, it is possible that in certain situations skilled performers may decide not to use these cues during actual matches (e.g., see James, Caudrelier, & Murray, 2005). Occasionally the cost associated with anticipation may result in performers adopting a wait-and-see approach rather than embracing the risks that may be involved from incorrectly anticipating an opponent's intentions. This interplay between the costs and benefits associated with the anticipation process merits further consideration and investigative effort.

Pattern Recall and Recognition

The seminal work in this area was carried out in chess (e.g., see de Groot, 1946/1978; Simon & Chase, 1973) and was subsequently extended to the domain of sport by Allard, Graham, and Paarsalu (1980). Compared with less skilled players, when skilled performers are presented with structured sequences of play for brief periods of time, using either slides or filmed stimuli, they are able to more accurately recall players' positions at the end of the viewing period. In contrast, this superiority of recall diminishes when the sequences presented contain unstructured patterns involving, for example, players randomly positioned on the field of play. Allard and colleagues initially showed this effect in basketball; subsequently, researchers have reported comparable observations in volleyball (cf. Allard & Starkes, 1980; Bourgeaud & Abernethy, 1987) and soccer (Williams & Davids, 1995). An alternative approach has been to identify players' ability to recognize whether participants have previously viewed the action sequences in an earlier viewing phase (see Smeeton, Ward, & Williams, 2004; Starkes, 1987; Williams & Davids, 1995). As in the recall paradigm, skilled performers demonstrate superior recognition skill when compared with less skilled athletes.

What Don't We Know?

As in the literature focusing on advance cue usage, there have been few attempts to identify the specific sources of perceptual information that players use to identify patterns of play. Do players recognize patterns based on superficial cues (e.g., color of uniforms, pitch conditions), or is recognition based on the contextual (e.g., postural cues), structural, or higher-order relational information that may exist between players? If the latter, is it the players' relative position on the pitch, field, or court, the relative motion between these players, or the tactical or strategic information conveyed by each player's positioning or movement that is important? Are some players more important than others when attempting to identify patterns? Do players rely more on information from teammates or opponents when making such decisions? Is structure apparent early on in a sequence of play or only during a critical window of time surrounding key events, such as football contact? These questions all warrant investigative effort to help identify the underlying mechanisms that differentiate skilled from less skilled participants. Such information is essential for theoretical development and for creating suitable training protocols.

In our laboratories, we have already made some progress in this regard, with initial findings suggesting that it is the relational information between potentially only a few players that provides each pattern of play with its own unique "perceptual signature" in soccer (see Williams, Hodges, North, & Barton, 2006). A variety of experimental techniques are being employed to address this issue, such as eye movement recording, verbal reports, film occlusion, and point-light displays. For example, using point-light displays, we have shown that skilled soccer players maintain their superiority over less skilled players in pattern recognition performance even when players are presented as moving dots of light against a black background. This finding suggests that skilled soccer players are more attuned than less skilled players to the relative motions between players and/or the higher-order relational information conveyed by such motions. A typical soccer action sequence presented in point-light format is shown in Figure 9.2. Moreover, using a film-based spatial occlusion approach, we have shown that this information may be extracted from only a few key players, such as the main central attackers and strikers (see Williams et al., 2006). The extent to which such findings extend to other team games is an interesting notion that may potentially have implications for the transfer of perceptual-cognitive skills across sports (Smeeton et al., 2004).

It would also be interesting to determine the extent to which pattern recognition skill is related to, or predictive of, anticipation skill in sport. It has been suggested that this pattern recognition ability is one of the strongest predictors of anticipation skill in sport (see Williams & Davids, 1995); in contrast, others have suggested that such measures may not adequately capture the true nature of expert performance (see P. Ward, Farrow, et al., in press). In our laboratories, unpublished data suggest that performance on measures of anticipation and recognition skill are somewhat correlated, although it appears that the underlying processing strategies, as determined by eye movement recording and verbal reports, may differ markedly depending on whether participants are provided with the instruction to anticipate what will happen next or recognize whether the sequence of play was presented during an earlier viewing phase.

In addition to identifying the perceptual-cognitive information underlying pattern recognition, it would be interesting to determine the relative importance of this skill across sports, particularly in relation to other poten-

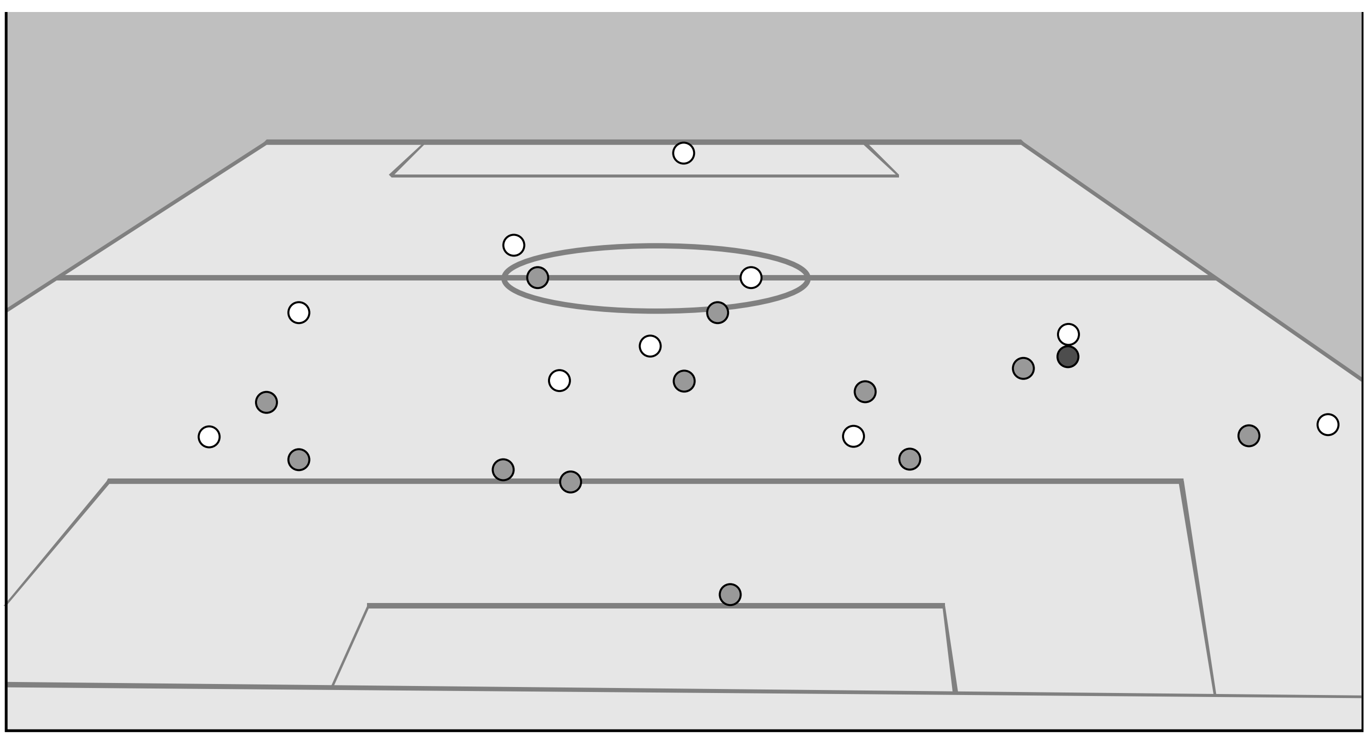

Figure 9.2 A single frame illustrating a point-light representation of an offensive sequence of play in soccer. Adapted from "Identifying Patterns of Play in Dynamic Sport Tasks: The Essential Information Underlying Skilled Performance," by A. M. Williams, N. J. Hodges, J. North, and G. Barton, 2006, *Perception, 35,* 317–332. Adapted with permission.

tially related skills, such as advance cue usage and knowledge of situational probabilities. The relative importance of these different perceptual-cognitive skills may vary across sports, and even across various positional roles within that sport (e.g., see J. D. Ward, Williams, Ward, & Smeeton, 2004).

Visual Search Behavior

The ability of performers to pick up advance visual cues or to identify patterns of play is determined, at least in part, by the manner in which they search the display in an attempt to extract the most pertinent information. A corneal reflection technique is typically used to assess visual search behavior by recording performers' eye movements and interspersed fixations (see Williams et al., 1999). Although researchers have indicated that the observed behavior is constrained by several factors, such as the nature of the task and performers' stress levels, generally skilled performers scan the display in a more effective and efficient manner than less skilled performers (Williams, Janelle, et al., 2004). The assumption is that these skill-based differences are indicative of more refined selective attention processes and enhanced task-specific knowledge structures (Henderson, 2003). The seminal work was carried out by Bard and colleagues (e.g., Bard & Fleury, 1976) in basketball and field hockey, and in recent years several researchers have extended this body of work to other sports (e.g., see Williams, 2002).

What Don't We Know?

The complex interplay between information extraction via the fovea, parafovea, and visual periphery remains an interesting line of research and a valuable area for future work. How do skilled and less skilled performers differ in the extent to which they rely on these different systems, and how does this factor vary with the constraints of the task, environmental conditions, and individual characteristics such as stress and emotion? For example, in soccer, there is evidence to suggest that visual behavior may vary as a function of the task constraints. Skilled defenders employ different search strategies when compared with skilled attackers, and different behaviors emerge when confronted with situations involving more or fewer players (e.g., a one-on-one duel versus three-on-three versus eleven-on-eleven defensive simulations), regardless of players' positional orientation within the team (see Helsen & Starkes, 1999; Williams & Davids, 1998; Williams, Davids, Burwitz, & Williams, 1994). Clearly, team sports are dynamic in nature, with continual transitions from macro- to microstates of play involving varying numbers of players, each of whom have to maintain a balance between defensive and offensive responsibilities. Further research is needed to determine how visual search behaviors alter as a function of these and other constraints and to illuminate the key factors that govern the manner in which performers extract information to guide subsequent action (Williams, Janelle, et al., 2004).

In a similar vein, there is evidence to suggest that maintaining gaze for an extended period of time (the so-called quiet eye period; Vickers, 1996) may be the key issue in self-paced tasks where the accuracy of aiming is important, as personified by the basketball free throw (Vickers, 1996), putting in golf (Vickers, 1992), and when attempting to pot a ball in billiards (Williams, Singer, & Frehlich, 2002). Although the relationship between quiet-eye period and subsequent performance has been established, knowledge as to the underlying mechanisms has not been well articulated. This measure may be reflective of the degree of preprogramming necessary prior to response initiation, or it may equally be indicative of the time needed to develop the appropriate mental set, or feeling of readiness needed to perform the task confidently (Singer, 2000). The difficulty is that in dynamic situations, such as during open play situations in basketball, the requirement to maintain an extended quiet-eye period prior to response initiation is likely to interact with the need to monitor the positions and movements of teammates and opponents and to execute the required action prior to being challenged by an opponent (e.g., see Martell & Vickers, 2004). Such factors illustrate the difficult challenge facing performers who must marry the unique constraints of the task with the need to effectively extract relevant information using the fovea, parafovea, and visual periphery. A combination of measures and approaches may be needed to effectively examine this issue (for an extended discussion, see Williams & Ericsson, 2005).

Similar challenges are presented in interceptive tasks such as in cricket, tennis, and table tennis. The requirement to extract relevant perceptual cues from opponents' actions is coupled with the need to pick up information relating to the ball's flight characteristics. The extent to which the performer relies on information extraction via the fovea, parafovea, and visual periphery remains of interest, along with the potential role of associated eye (and head) movements, such as anticipatory saccades and pursuit tracking (Williams & Starkes, 2002). Although researchers have began to explore this complex interplay and its relationship to skilled performance (e.g., see Land & McLeod, 2000;

Rodrigues, Vickers, & Williams, 2002; Singer et al., 1998), there remains great potential for empirical work.

The perceptual-cognitive skills highlighted in preceding sections are reflective of skilled performers' superior ability to process contextual information present in the display when compared to less skilled players. In sum, skilled players search the display in an efficient manner, are able to recognize patterns of play as they evolve, and are attuned to informative perceptual cues that emerge as a result of opponents' postural orientation. It also appears that skilled performers have more detailed, contextually driven expectations of the likely event outcomes, which have been termed "situational probabilities." These perceptual-cognitive skills interact with each other in a dynamic and evolving manner to facilitate appropriate anticipation and decision making in the competitive setting.

Knowledge of Situational Probabilities

Compared to other areas, there have been few empirical papers on this topic. The majority of early work was undertaken in the laboratory using choice-reaction paradigms and manipulations of stimulus probabilities and dependencies (e.g., see Hick, 1952; Hyman, 1953). Alain and colleagues (e.g., Alain & Girardin, 1978; Alain & Proteau, 1980) attempted to examine the importance of situational probabilities and its relationship with decision making in racket sports, with reasonable success (for a review, see Williams et al., 1999). P. Ward and Williams (2003) extended these notions using the sport of soccer. Participants were required to view soccer action sequences and to predict the likely passing options available to the player in possession of the ball and to rank according to their likelihood of occurring. The final frame of action from a typical film sequence is presented in Figure 9.3. Skilled soccer players were more accurate, as determined by a panel of expert coaches, than less skilled counterparts in highlighting and ranking players most likely to receive a pass from a teammate. The skilled players were better at hedging their bets than less skilled performers, judiciously determining the importance of each potential option presented, effectively priming the search for new information, and ensuring that the most pertinent contextual information was extracted from each area of the display (Anderson, 1990).

What Don't We Know?

There have been very few attempts to design more representative paradigms to examine the role of situational probabilities in sport (e.g., see Crognier & Féry, 2005; Paull & Glencross, 1997; P. Ward & Williams, 2003; P. Ward, Williams, & Ericsson, 2003). This issue needs to be addressed if understanding is to be enhanced. It would be interesting to elaborate on the potentially complex integration of performers' knowledge of situational probabilities with the processing of contextual information. A number of important questions remain to be answered in this regard: Is the integration of contextual information and prior knowledge procedurally determined (e.g., Kintsch, 1988), or do performers depend more on one source of information over the other in particular circumstances? Does this interplay vary as a function of sport, task, and skill level? Are retrieval structures necessarily soft-assembled in real-time, or are these structures preprogrammed and modified to suit? What is the nature of the representation that facilitates building a retrieval structure on the fly? How does prior learning aid the construction of subsequent retrieval structures? How do such structures develop over time? Do they develop at different rates? How are these structures influenced by practice and instruction?

Williams (2000) distinguished general from specific event probabilities. The former refers to the likelihood that opponents will typically act in a certain way given the context in question (e.g., What is the most likely pitch that most players would throw in this situation?), whereas specific probabilities relate to a particular opponent (e.g., What is pitcher X likely to do in this situation?). Clearly, both types of information are likely to be important because players have to regularly play against both familiar and unfamiliar opponents. However, to date, there have been few attempts to identify the relative importance of each type of event probability or to establish how their relative importance may vary as a function of sport, task, and participant skill level.

Several interesting questions remain, therefore, for those interested in defining the nature of perceptual-cognitive skill in sport. It is likely that complementary measures are needed to adequately address these issues. If individuals make situational assessments in a conscious and explicit manner, then the collection of verbal reports may provide the most informative approach given the performers' need to integrate knowledge and processes to effectively plan, act, monitor, evaluate, adapt, predict, and anticipate (e.g., see P. Ward et al., 2003).

METHODS AND MEASURES

In light of the need to use appropriate methods and measures to effectively capture and identify the mechanisms

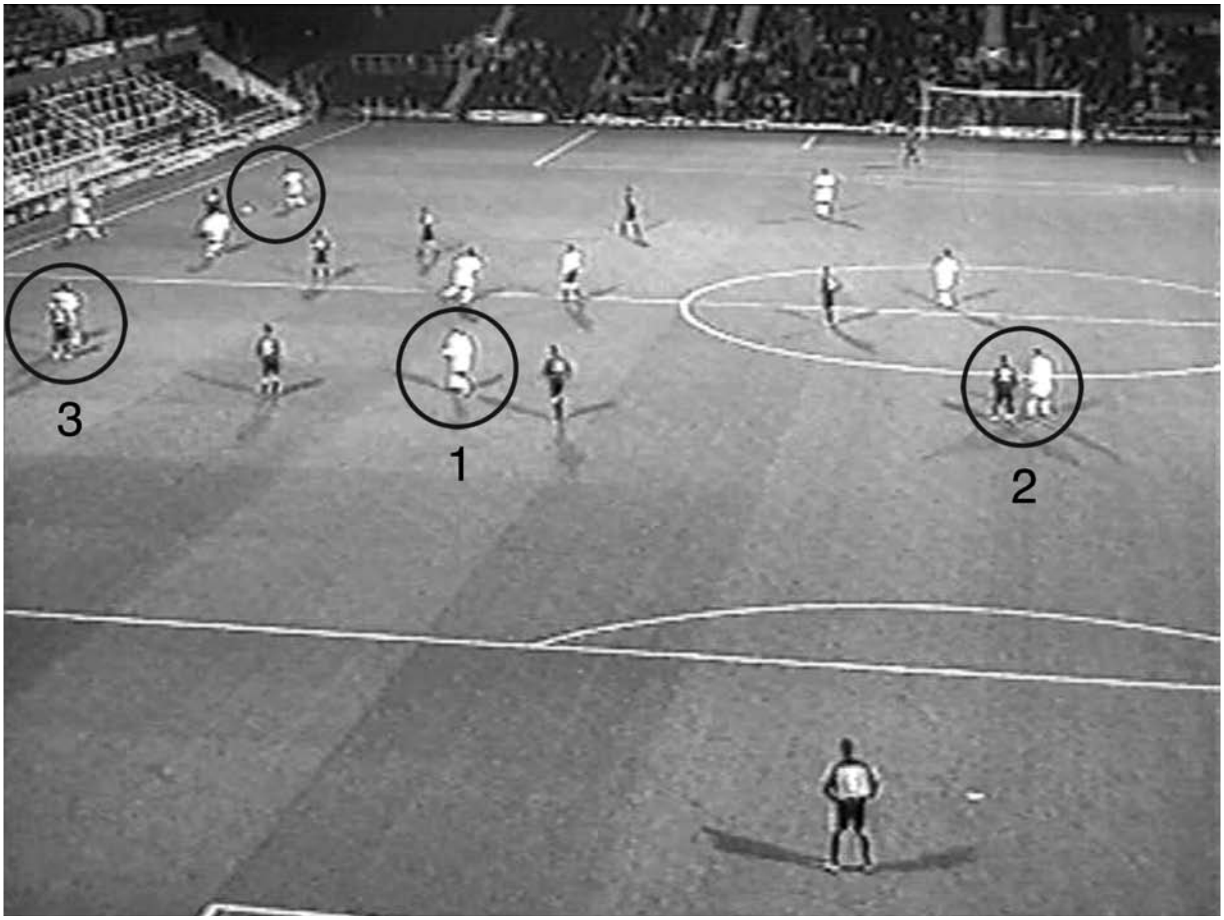

Figure 9.3 The final frame from a typical sequence of play presented in the situational probabilities paradigm. The circles highlight the potential pass options indicated by a participant, with the corresponding numbers illustrating their respective rankings. Adapted from "Underlying Mechanisms of Perceptual-Cognitive Expertise in Soccer," by P. Ward, A. M. Williams, and K. A. Ericsson, 2003, *Journal of Sport and Exercise Psychology, 25,* p. S136. Adapted with permission.

underpinning skilled performance, in this section we focus on these factors in greater detail.

Capturing Performance

The issue of how best to capture skilled performance has been discussed for some time (see Abernethy, Thomas, & Thomas, 1993; Ericsson & Smith, 1991) and remains an important topic (e.g., see Williams & Ericsson, 2005). One could argue that researchers have been too preoccupied with methodological issues at the expense of theoretical development (Williams et al., 1999), when, in reality, the greatest progress is likely to be made when the methods used to study the phenomena under investigation are specified by one's theoretical assumptions.

There are two ways of considering how best to capture performance. On the one hand, one can take a skills- or construct-oriented approach, in which a specific construct, skill, or skill set is measured, such as pattern recognition or cue usage. Researchers adopting this approach have created scenarios and paradigms that allow such skills or constructs to be directly measured (i.e., recognition paradigm, temporal occlusion paradigm), with the underlying assumption that these are integral to skilled performance (e.g., Abernethy & Russell, 1987; Allard & Starkes, 1980). Alternatively, one can take a performance or representative task-oriented viewpoint, recreating real-world scenarios in the laboratory that actually permit performers to do whatever it is they would actually do if presented with that situation during an actual game. A good example of this latter approach is the soccer free-kick task devised by Helsen and Starkes (1999), in which participants responded by performing as they would in the real world (i.e., by dribbling or passing the ball, or shooting at goal).

Most researchers have blurred the distinction between the skills- and performance-oriented views, or have adopted the viewpoint that performance is characterized by a series of skills. The assumption has been that by explicitly testing a battery of skills, one indirectly captures the essential characteristics of performance (e.g., P. Ward & Williams, 2003). From a practical perspective of conducting an experiment, the difference between approaches is often extremely subtle, but it is theoretically important. For instance, in a classical anticipation test (e.g., Williams, Ward, Knowles, & Smeeton, 2002) from the skills view, researchers have typically focused on anticipation skill (e.g., predicting the direction of the pass or shot) and have looked for scenarios in which experts would agree that anticipation was one of the primary components of task performance. From the performance view, however, when presented with multiple representative situations that truly capture performance in that domain, only a subset may require effective anticipation skill. Moreover, the importance of this variable is likely to be determined by the situation; hence, the relative contribution of this skill to performance on the representative task is likely to change from trial to trial and from moment to moment. The performance-oriented view is, therefore, not just a multidimensional approach to assessing skill (e.g., measuring multiple skills instead of one skill). Rather, this approach determines what individuals are specifically required to do in each situation to perform successfully, and focuses specifically on those situations where superior performance can reliably be identified and measured (cf. expert performance approach).

The skills view adopts a deductive approach to science, testing, for instance, the hypothesis that skilled players will be better anticipators than less skilled players. Although this approach is quite straightforward, one has to first assume that the construct or skill of interest adequately characterizes performance, or at least accounts for a significant proportion of the variance in real-world performance. Moreover, this approach often necessitates that researchers adopt certain theoretical assumptions about the nature of cognition (cf. recall paradigm; Simon & Chase, 1973). The performance view, on the other hand, adopts an inductive-deductive approach, first identifying representative situations in which superior performance can be captured, as well as the specific and context-dependent behaviors and actions required to perform successfully in those situations, then testing the hypotheses that skilled players will exhibit superior performance (reflected by more appropriate behaviors given the context). From this perspective, few a priori assumptions are required. This approach potentially offers new insights into the underlying characteristics of performance and the context-specificity of behavior and provides an objective basis for theory development.

One could argue that the skills approach is essentially equivalent to the latter half of the performance approach, having identified a priori through multivariate analyses that anticipation (or some other variable) is one of the most predictive variables of skill. However, one is likely to run into difficulty in falsifying this hypothesis when inclusion into the prior multivariate analyses is not based on some objective metric but on previous research that has adopted a skills viewpoint and/or on subjective, albeit, expert opinion. Few, if any, researchers have adopted a situation-specific performance view. This appears to be a ripe area for future research and a central issue to consider when deciding on an appropriate approach to capturing performance.

Typically, most researchers have attempted to capture performance by creating video or film simulations of the scenario in question (e.g., Abernethy, 1988; Jones & Miles, 1978; Williams et al., 1994). The advantages of film are that it enables sequences of action to be reproduced in a consistent manner from trial to trial, providing an objective method of evaluating performance. This is particularly important in sport, where sequences of events are rarely if ever repeated in an exact form (Ericsson, 2003). High-quality visual images may be easily captured and edited using digital video technology at a relatively low financial cost, and these images may be coupled with large-screen presentation formats and different methods of evaluating the appropriateness of participants' responses.

There have been a few attempts to develop potentially more representative field-based methods or to create virtual reality simulations of the performance context (see Howarth, Walsh, Abernethy, & Snyder, 1984; Starkes, Edwards, Dissanayake, & Dunn, 1995; Walls, Bertrand, Gale, & Saunders, 1998). Although it appears that film is likely to be more representative than slides (see Bourgeaud & Abernethy, 1987), it is not clear whether field-based methods or virtual reality simulations offer any advantages over film-based simulations. Although Abernethy and colleagues (1993) have argued that more representative methods increase sensitivity and therefore are more likely to discriminate performers who may be closer together on the skill continuum, this issue has rarely been examined empirically (for exceptions, see Farrow, Abernethy, & Jackson, 2005; Williams et al., 1999, pp. 112–113).

What Don't We Know?

The jury is still out as to whether there are additional benefits to be gained from developing field-based methods or immersive and interactive simulations of the performance context rather than relying on film. The development of field-based methods requires considerable creativity, and there are potential limitations both in relation to measurement accuracy and the reproducibility of stimuli. Virtual reality may offer advantages over film both in relation to access to three-dimensional images and the opportunity to interact with the environment and move in response to the action. However, in addition to the increased financial cost, virtual reality may have other disadvantages when compared to video with regard to image quality and the ability to effectively recreate the temporal characteristics of the action (see Dessing, Peper, & Beek, 2004). It would certainly be interesting to gather some empirical data to compare the veracity of each of these approaches across different sports using counterbalanced, repeated-measures designs. For example, what differences, both in relation to outcome and process, are observed when using film, virtual reality, or field-based methods to evaluate perceptual-cognitive skill in sport (for a recent review of the literature, see P. Ward, Williams, & Hancock, in press)?

It is likely that the medium of presenting stimuli to participants will interact with the expected mode of response to determine the validity of the method employed. Does it matter whether participants are required to respond verbally, using pen and paper, or via some gross, whole-body movement? It is almost certain to depend on the nature of the task. However, preliminary evidence suggests that requiring participants to move in response to the action, where an action-based response is typically required, is likely to elicit larger skill-based differences than paradigms that merely necessitate a verbal response (Williams et al., 1999). Although several researchers have lauded the virtues of employing a paradigm where participants are required to move around and interact with the environment, there have been few *well-controlled* empirical comparisons between different response modes.

It may well be that other factors are more important than the capability to move in response to presented stimuli. For instance, there is evidence to suggest that crucial factors such as emotional and physiological stress impact performance effectiveness and efficiency (Vickers, Williams, Rodrigues, Hillis, & Coyne, 1999; Williams & Elliot, 1999; Williams, Vickers, & Rodrigues, 2002). The ability to cope with stress is an important element of performance; consequently, a better understanding is needed of how perceptual and cognitive processes may be affected by such emotions in skilled and less skilled performers. Similarly, the typical approach to presenting simulations to test anticipation and decision making, whether using video, field-based methods, or virtual reality simulations, is to present experimental scenarios lasting a few seconds without additional contextual information that might drive or change prior expectations (e.g., names of players, positions of specific players, ability of players) or to specify the conditions or state of the game (e.g., winning/losing, extent of the current advantage/disadvantage, home/away, first/second half, normal/extra time). Sometimes, contextual factors are controlled so as to eliminate potential confounds. Such information is present in the competitive setting, and consequently, the addition of this information may significantly impact the underlying strategy employed to solve the task, particularly in experts.

Other methodological concerns, such as the absence of qualitative, idiographic, and longitudinal designs, the lack of consistency in defining participant groups, and the absence of appropriate control groups, are discussed elsewhere and not reiterated in detail in this chapter (see Abernethy et al., 1993; Williams et al., 1999). However, it is worth noting that there has been minimal progress in addressing many of these limitations in recent years, and the issues are as pertinent today as when first highlighted in the literature. The slow rate of progress may perhaps be indicative of the fact that although this area has grown markedly in recent years, the number of active researchers remains comparatively small—which is surprising, given the level of public interest in skilled sports performance and the potential implications for performance enhancement across domains.

Identifying the Underlying Mechanisms

The majority of researchers have relied on outcome measures of response accuracy and/or decision time to determine performance effectiveness. A smaller group of researchers have attempted to identify the important mechanisms underlying performance, even though this is a central component of the expert performance approach (Ericsson & Smith, 1991). Several process measures and task manipulations may be employed to help identify the mediating mechanisms, such as eye movement recording, verbal reports, and film-based occlusion techniques (for a detailed review, see Williams & Ericsson, 2005; Williams et al., 1999).

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Some of these process measures have been more frequently used than others. A reasonable number of researchers now routinely use eye movement registration techniques. Fewer rely on verbal reports, even fewer employ display manipulations such as film occlusion and point-light displays, and hardly any have used electrophysiological measures or biomechanical profiling using data reduction techniques such as principal component analysis. A difficulty is that each of these process measures suffers from various limitations (see Williams & Ericsson, 2005). Several researchers have recommended the need to employ more than one measure in an attempt to identify the underlying strategy, but few researchers have embraced the need to cross-validate findings or to determine which of many potential measures may be the most appropriate to use in any given context (for an exception, see Williams & Davids, 1998).

Although some researchers have employed process-based measures of perception and cognition, few have attempted to actually *trace* the process. Researchers adopting process-tracing methods in mainstream cognitive science have often used protocol analysis (Ericsson & Simon, 1980, 1993) to identify the intermediate sequence of steps (i.e., inputs and outputs—heeded or attended information—to otherwise inaccessible processes) through which individuals progress to reach their goal. Using this approach, alternative sequences of steps that an individual could plausibly undertake during performance are hypothesized a priori using a task analysis, and the (often incomplete) protocol data are then mapped to these alternatives to infer the process(es) used during performance (for more information on this approach to analyzing process-based measures such as verbal reports and eye movement data, see Ericsson & Simon, 1993; Newell & Simon, 1972). An alternative approach has been to use content analysis (Chi, 1997). In this approach, a frequency count of the types and variety of cognitions in which individuals engage is collated for a trial or across trials, and strategies are inferred from the types of cognitions employed. Given that content knowledge is the primary source of the data extracted, the latter approach may be useful if one were interested in knowledge elicitation and assumed that performance was primarily knowledge-driven. However, recent research suggests that explanations based on additional search-based processing, such as monitoring, and evaluation are perhaps more appropriate for skilled performance than explanations based on superior knowledge alone (Ericsson & Kintsch, 1995).

An issue of concern when using a particular form of content analysis, however, is that by aggregating data from a trial or multiple trials, researchers are often forced to generalize with respect to the types of strategies used by skilled individuals. Contemporary research suggests that cognition is contextually driven (see Kintsch, 1988, 1998; Zwaan & Radvansky, 1998; see also Ericsson & Kintsch, 1995), and the strategy used in one situation would not necessarily be used across all situations, even when they are similar or related. Moreover, recent research suggests that even within a trial, one cannot generalize with respect to the strategy that performers employ. Using a pseudo process-tracing approach, Savelsbergh, van der Kamp, Williams, and Ward (2002, 2005) demonstrated that, although skilled goalkeepers had previously been shown to rely on particular cues (e.g., hip rotation, nonkicking foot) when attempting to save a penalty kick in soccer, the goalkeepers used these cues only at certain moments in the penalty taker's approach run. More time was often spent fixating other cues during certain aspects of the approach, suggesting that cue importance changes over time and is clearly context-determined. This and other data suggest that an item analysis should first be performed (a) such that performance can be compared on a trial-by-trial basis, avoiding the theoretical assumption that one can generalize across trials (see P. Ward et al., 2003), and (b) to find the trials with the largest separation between skill groups, which are arguably more informative than those trials where no separation exists. In summary, to identify and understand the actual process(es) used by skilled anticipators and decision makers, there is a need for researchers to adopt a process-tracing methodology as opposed to merely using process measures or performing content analyses that are collapsed within and across trials.

It is possible that one or more process-based or process-tracing measures may produce slightly different findings. This may not necessarily threaten the validity of either measure; each measure may identify somewhat unique strategies, thereby enhancing understanding of the important differences between performers at various skill levels. One measure may be used to provide support for another, but it is equally likely that slightly different hypotheses may be posed for each measure, ensuring that any differences that emerge may be explained through reference to the prevailing theoretical framework. We consider some of these frameworks in the next section.

Theories and Models

Scientists working in the area of perceptual-cognitive expertise in sport have been criticized for not undertaking more theoretically driven research (e.g., see Abernethy et al., 1993; Williams et al., 1999). The majority of researchers have focused their efforts on developing realistic methods to capture expert performance and on providing detailed descriptions of the key differences between skilled and less skilled performers. Although description is often a precursor to theory building, the field is now at the stage where it must move beyond description and toward understanding and prediction. There are encouraging signs that reflect growing maturity within the field. In particular, there has been a much stronger focus of late on identifying the underlying mechanisms on which skilled performers' superiority over their less skilled counterparts may be based. However, there still remains a paucity of more theoretically driven research.

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A major difficulty perhaps is the absence of a unifying theory of expertise. The prototypical approach has been to embrace the metaphors of cognitive psychology and various information-processing models of human performance. A simple information-processing model illustrating the main components involved in anticipation and decision making is presented in Figure 9.4. The process of selective attention and the need to invoke a detailed role for knowledge structures stored in memory are deemed essential to help guide the search for, and effective processing of, task-specific information. Various theories have been proposed to explain experts' more refined and organized memory or their task-specific knowledge (e.g., Anderson, 1992; Ericsson & Kintsch, 1995; Gobet & Simon, 1996). For example, the long-term working memory theory proposed by Ericsson and coworkers (e.g., Ericsson, 1998; Ericsson & Delaney, 1999; Ericsson & Kintsch, 1995) suggests that experts bypass the limitations of short-term working memory by acquiring skills that promote rapid encoding of information in long-term memory and allow selective access to this information when required. After extended practice, experts index information in such a way that they can successfully anticipate future retrieval demands. The proposal is that retrieval cues kept in short-term working memory facilitate access to information stored in long-term memory. Skilled performers develop more flexible and detailed representations than less skilled athletes, allowing them to adapt rapidly to changes in situational demands.

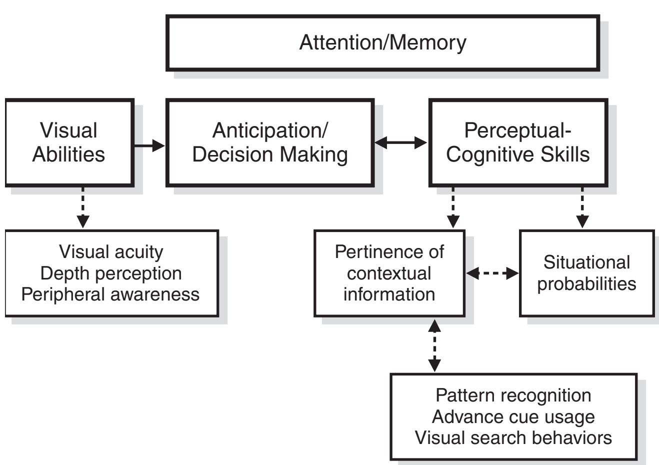

Figure 9.4 A simple information-processing based model of anticipation and decision-making skill in sport.

A particularly relevant aspect of the theory is their example of how one might go about constructing a retrieval structure on the fly that would allow such rapid adaptation to the changing nature of the situation. The construction-integration model provides a detailed explanation and computational mechanism for building a situation model and arriving at an appropriate response, albeit in text comprehension (see Kintsch, 1988). The model is supported by empirical evidence that has since been extended to explain dynamic and real-world tasks such as computer programming and piloting an airplane (e.g., Doane & Sohn, 2000). To date, there have been no efforts to take up the same mantle in sport to assess anticipation and decision making—a fact that is rather surprising given that an accurate situation model is likely to be the primary precursor to successful prediction of future consequences of action (see P. Ward, Williams, et al., in press). Although the long-term working memory theory has been used in a discursive manner to explain the nature of the knowledge structures guiding expert performance in sport, the original weak theory has not been sufficiently developed in the sporting domain such that clear hypotheses can be specified and tested. Until we extend this research beyond description, the theory will not provide a unifying framework for the study of expert performance.

An interesting notion is whether it is conceivable, or even desirable, to develop a unifying theory to account for expertise. In our laboratories, we have often debated the distinction between expertise as an entity in its own right or as the end product of a collection of skills. In sport, superior performers develop a range of skills, yet these skills do not always come together in a predetermined manner to create an expert level of performance. Nor do they have to! Not every elite performer possesses the same skills; this is often an advantage when molding a group of individuals into an effective team or unit. Although it is conceivable that every athlete requires a certain number of these skills, or at least a fundamental grasp of each skill, to be deemed an expert, it is likely that weaknesses in certain skills may be overridden by strengths in others. The eventual level of performance attained by any athlete may reflect the manner in which a range of skills is effectively integrated to achieve the goal in question. For example, in many team sports a player who lacks exceptional speed or agility may compensate by being good at reading the game or by developing exceptional technical skill when in possession of the ball. The key issue, therefore, is whether the development of each skill should be guided by its own unique theory, or whether there is sufficient similarity across skills such that a unified theory of expertise could be deemed viable.

A related question is whether coaches and others who mentor elite athletes attempt to develop skills or to enhance performance. In our experience, most coaches attempt to develop specific skills in the hope that any improvements lead to a positive change in performance. Put slightly differently, to improve performance coaches must develop the skills required to succeed. However, it is eminently probable that elite players develop strategies and skills over and above those in which they are directly instructed by engaging in deliberate practice activities and subsequently discovering new and better ways to perform. Unfortunately, this inevitability of expertise compounds the issue of measurement by necessitating that researchers answer the question "What constitutes expertise?" rather than "Do experts differ solely on certain skills?" To examine these issues, researchers should explore whether there are similarities in the causal mechanisms underlying the acquisition and performance of different skills. If one were to embrace the notion that expertise is merely a collection of skills, then there exists a range of relatively independent theories to explain the development of each unique skill. A brief glimpse at most academic texts focusing on topics such as perception, cognition, memory, attention, and learning reveals an abundance of different models and theories to explain superior performance of one skill or another. Do these theories share common principles? The challenge for a potentially unifying theory of expertise is whether it can subsume current theories of skill acquisition, provide an explanation for existing findings, and create a unifying framework that would permit adequate explanation and prediction of expert performance. This issue is likely to consume much thought and discussion over coming years.

In recent years, alternative theoretical explanations for expertise effects have been proposed from the perspectives of ecological psychology and dynamical systems theory. Beek and colleagues (e.g., Beek, Jacobs, Daffertshofer, & Huys, 2003; Huys, Daffertshofer, & Beek, 2004) have provided several excellent reviews to illustrate the potential value of these two theoretical frameworks for the study of expertise. In particular, the ecological notions of educating attention (i.e., the process of picking up specifying, higher-order invariants at the expense of nonspecifying information) and freezing and exploiting perceptual degrees of freedom (see Savelsbergh, van der Kamp, Oudejans, & Scott, 2004) may provide useful perspectives on the process of perceptual learning. Similarly, the dynamical notion of reducing dimensionality (i.e., the process of harnessing control over essential, and relinquishing nonessential, degrees of freedom for effective performance) may help answer interesting questions in relation to how skilled performers develop more effective coordination dynamics when compared with less skilled performers (Huys et al., 2004).

It should be noted that important epistemological and methodological differences exist between ecological/dynamical perspectives and the cognitive approach to perceptual-cognitive expertise. In the first instance, ecological/dynamical systems perspectives share a marked reluctance to resort to cognitive structures to explain human behavior, making reconciliation with more traditional models of perceptual-cognitive expertise difficult, to say the least. Although there have been several attempts to integrate cognition into more recent modeling in this area (for a review, see Davids, Williams, Bennett, & Court, 2001), this remains a significant philosophical barrier to overcome if a coherent and integrated framework for understanding expertise is to emerge.

A related hurdle to overcome is created by the contrasting methodological approaches employed by those working from each unique perspective. Those embracing the perspective of cognitive psychology have typically focused on the area of perceptual-cognitive expertise, with limited efforts to examine how decisions are translated into action, whereas those undertaking research from the perspectives of ecological or dynamical systems theory have examined issues related to perceptual-motor expertise, with limited efforts to identify how cognition may impact on the perceptual and motor subsystems. These underlying differences are readily apparent on reading a handful of publications in each area. In many ways, there is a clear need for multidisciplinary research to examine the complex interplay that exists among perception, cognition, and action in dynamic sport settings (Williams et al., 1999). The absence of truly cross-disciplinary research on expert performance in sport remains disappointing, particularly given the potential benefits that may be offered by exploring this issue from different theoretical and methodological perspectives. Concerted efforts are needed to map cognition, including key skills such as anticipation and decision making, onto the dynamics of perception and action via the use of a performance-oriented approach.

Practical Issues and Interventions

There have been concerted attempts of late to explore the practical value of existing research on perceptual-cognitive expertise in sport. Several researchers have attempted to develop interventions to enhance the acquisition of these skills. The typical approach has been to recreate the performance environment using film (e.g., return of serve in tennis) and then to provide instruction on the important cues underlying performance, coupled with practice and feedback (e.g., see Smeeton, Williams, Hodges, & Ward, 2005; Williams, Ward, & Chapman, 2003; Williams, Ward, et al., 2002). Although the literature base is not extensive, and several methodological shortcomings may be identified, results are encouraging and suggest that perceptual-cognitive skills can be enhanced using simulation training coupled with relevant instructional interventions. These experimentally based manipulations can provide useful information in the quest to elicit the adaptive learning mechanisms that account for effective performance on such tasks. A wealth of exciting research opportunities exists for those interested in enhancing perceptual-cognitive expertise using these types of approaches; these are discussed in detail elsewhere (e.g., see Abernethy, Parks, & Wann, 1998; P. Ward, Farrow, et al., in press; Williams & Ward, 2003; Williams, Ward, & Smeeton, 2004).

An alternative approach to identify useful practical interventions is to examine the practice history profiles of those individuals who can objectively demonstrate exceptional and superior perceptual-cognitive skills. Several researchers have employed the deliberate practice framework proposed by Ericsson, Krampe, and Tesch-Römer (1993) to determine whether skilled performers may be differentiated from their less skilled counterparts based on the nature and amount of practice hours accumulated since their initial involvement in the sport. Findings are consistent that skilled performers accumulate significantly more deliberate practice hours than less skilled performers (e.g., see Helsen, Starkes, & Hodges, 1998; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; P. Ward, Hodges, Williams, & Starkes, 2004). The proposal is that deliberate practice activities demand significant effort from the learner and are designed specifically to improve some aspect of performance.

What Don't We Know?

As indicated earlier, readers are directed elsewhere for a more detailed review of those questions that have yet to be answered in relation to the practical utility of perceptual-cognitive training interventions. Although progress in answering these questions has been encouraging of late, there remain more questions than answers, but we hope this area will attract new and innovative research over coming years. A difficulty with these interventions is that they are designed to improve a very specific perceptual-cognitive skill, usually advance cue utilization, within a fairly narrow or restricted context (e.g., tennis serve, penalty kick in soccer). The extent to which these observed improvements transfer to the highly variable and unpredictable situations characteristic of high-level sports performance may be limited. An important point of concern is that although researchers have recently attempted to examine whether improvements transfer to the field setting, the transfer tests used typically involve replicating the laboratory scenario in the field setting. It may well be that there is only limited transfer to the real competitive situation where successful performance results from a complex interplay among a multitude of different perceptual-cognitive skills.

Similarly, there have been some recent reviews of the deliberate practice literature, with ample suggestions for future research (see P. Ward, Hodges, et al., 2004). The proposal in this final section, therefore, is to focus more specifically on deliberate practice theory as it relates to the development of anticipation and decision-making skill. Thus far, few researchers have attempted to identify how deliberate practice activities contribute to the development of perceptual-cognitive expertise (for some exceptions, see Baker, Côté, & Abernethy, 2003a, 2003b; P. Ward, Hodges, et al., 2004), with the majority of researchers focusing almost exclusively on the proposed relationship between deliberate practice and expert performance.

P. Ward, Hodges, and colleagues (2004) reported that compared with less elite players, elite soccer players spend a much higher proportion of their time engaged in activities that necessitate good decision-making skills, although the specific nature of these proposed activities was not outlined. A breakdown of activities for a typical practice session is shown in Figure 9.5. Baker and colleagues (2003a, 2003b) attempted to identify whether there were differences in the practice history profiles of those who were deemed to be good and not so good at decision making in various sports. Although evidence was presented to indicate that those deemed to be good decision makers had participated in a broader range of sports prior to specializing in their specific sport, no efforts were made to determine whether differences in decision-making skill across groups

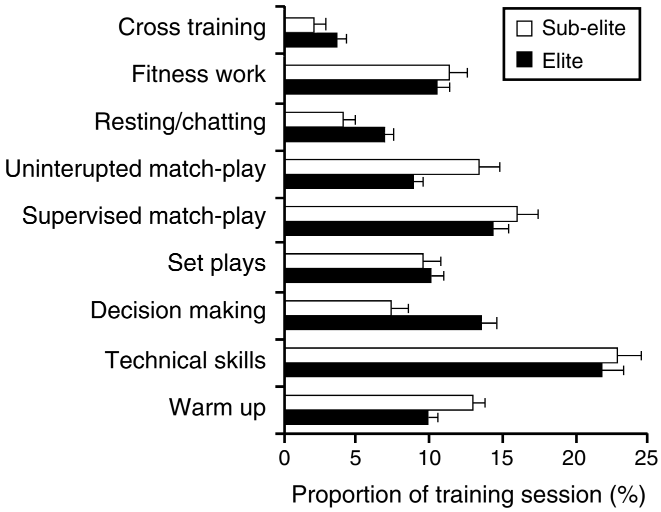

Figure 9.5 The proportion of time spent in various activities (along with standard error bars) during a typical practice session.

were directly related to specific practice activities. No attempt was made to classify participants based on their perceptual-cognitive expertise. The elite players were rated somewhat subjectively by a panel of coaches as good decision makers, rather than via any empirical means, whereas the control participants were not classified as good or not so good decision makers. Moreover, P. Ward and colleagues have recently reported contradictory evidence with respect to the issue of whether experts are characterized by greater sporting diversity during development. These contradictory findings leave open the question of whether individuals are better off spending time practicing their specialist sport or gaining different experiences from other sports during development.

A worthwhile comparison for researchers to undertake would be to examine whether a group of elite athletes who record high scores on various empirical measures of perceptual-cognitive skill can be discriminated from another group of elite athletes with poorer scores on such measures using the deliberate practice framework. One way to approach this issue is to undertake an initial analysis using large groups of elite participants and then to use a within-group criterion based on various measures of perceptual-cognitive expertise to identify those with high levels of perceptual-cognitive skill, assuming, of course, that these within-group differences actually reflect real-world performance differences. A logical progression would then be to identify a very small sample of athletes with truly exceptional levels of perceptual-cognitive skill for more detailed investigation using single case study designs and idiographic methods of enquiry. Such a multitiered approach would lead to progressively more detailed information on a few select participants, thereby providing a deeper and more meaningful analysis of the factors that impact the development of perceptual-cognitive expertise (Housner & French, 1994; Williams et al., 1999).

A criticism that has been directed at the deliberate practice approach is that there may be an overemphasis on merely adding up the accumulated practice hours, which has been termed "bean counting" (P. Ward, Hodges, et al., 2004, also see Sternberg, 1996). Clearly, the quality of practice activities, the nature of the instruction process, and the specific strategies employed by learners during practice are likely to be at least as important as the amount of accumulated practice hours in determining the rate of progress toward excellence. Greater effort is needed to identify the specific types of practice activities in which skilled performers engage and the specific relationship between these activities and the development of perceptual-cognitive expertise. At one level, a more fine-grained analysis of specific practice and instructional activities is required, using, for example, detailed behavioral coding of events within and across practice sessions (see Deakin & Colby, 2003). Practice sessions need to be dissected to determine how various activities and instructional interventions contribute to skill development. To this end, some measure of performance improvement over time is necessary. At another level, it would be helpful to identify the strategies that players classified as good perceivers or decision makers use during training and matches. A possibility is that the observed differences between groups of skilled players with good and below-average perceptual-cognitive skills may be more a product of the specific strategies employed during practice than mere exposure to the training stimuli per se. Those with exceptional perceptual-cognitive skills may approach the practice activity in a fundamentally different manner from those who are less exceptional in relation to these skills. Skilled individuals may display a much greater awareness of the underlying strategic and tactical aspects of performance, with these differences being apparent in the manner in which they process or recall information before, during, and after training and match play.

To identify those strategies that facilitate the development of perceptual-cognitive skill, researchers should endeavor, where possible, to use process-tracing measures before, during, and immediately after practice and matches. Although there has been some contention regarding the use of verbal reports, when correct procedures are adopted (see Ericsson & Simon, 1993), think-aloud and retrospective reports may provide valuable information on how those with high levels of perceptual-cognitive skill monitor, plan, act, and evaluate during performance. Perhaps more important, such reports may identify important differences between these individuals and those deemed to possess lower levels of perceptual-cognitive skill. Other process-tracing measures, such as eye movement recording and film occlusion techniques, may also be of value under more controlled laboratory conditions. Some empirical measure of performance improvement would also be helpful to attempt to determine causal relationships between specific practice activities or instructional interventions and improvements in anticipation and/or decision-making skill. The important point is that there is limited knowledge as to how perceptual-cognitive skills develop as a result of practice and instruction, and several exciting opportunities exist for those interested in this theoretical and applied issue.

CONCLUSION

The intention in this chapter was not to provide a comprehensive review of existing research findings, but to highlight some important questions and issues that have yet to be adequately addressed in relation to the area of anticipation and decision-making skill in sport. We have attempted to highlight several exciting opportunities for those interested in improving understanding in this area. In particular, we restricted discussion to projects associated with extending our knowledge of key perceptual-cognitive skills and their relationship with performance, the methods and measures that should be employed to capture these skills, the conceptual frameworks that may guide empirical research in this area, and the practical interventions that may be used to enhance performance. Our hope was to encourage new and innovative research in this area so as to extend current knowledge and understanding of those factors that contribute to anticipation and decision-making skill.

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CHAPTER 10

Degenerate Brains, Indeterminate Behavior, and Representative Tasks

Implications for Experimental Design in Sport Psychology Research

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Increasingly, experimental models used by many sport psychologists and movement scientists to gain theoretical insights into processes of decision making and action in human movement systems are being provided by a rich range of sports and cultural pastimes (e.g., Davids, Renshaw, & Glazier, 2005; Davids, Savelsbergh, Bennett, & van der Kamp, 2002). Traditionally, selection of movement models in motor behavior experiments has not favored dynamic, multijoint, functional actions prevalent in sports because of a reductionist idea that experimental rigor could be better maintained in laboratory studies of simple movements. The scientific philosophy of reductionism is based on a deterministic (completely predictable) view of the world, dating back to the Enlightenment period in European history (Glimcher, 2005). Scientific determinism arose in the mid-seventeenth century because of the desire to reduce uncertainty and enhance predictive capacity. Traditional experimental movement models in laboratory settings tend to involve fewer motor system degrees of freedom (e.g., muscles, joints, and limb segments) than sports movements, have a lower level of intentional constraint on behavior, and typically require a reduced amount of perceptual information to regulate action (Davids, Williams, Button, & Court, 2001; Newell, 1989). Research using movement models from sports to investigate actions has been sporadic (for rare exceptions, see Anderson & Sidaway, 1994; Beek & van Santvoord, 1992; Lee, Lishman, & Thompson, 1982; Tyldesley & Whiting, 1985; Zatsiorsky & Aktov, 1990). Of particular importance, these studies have used disparate theoretical frameworks, and there have been few attempts to theoretically rationalize why task constraints in sports and physical pastimes represent an important avenue for advancing understanding of functional movement behaviors (for exceptions, see Beek, 1989; Bootsma & van Wieringen, 1990; Newell, 1989).

In this chapter, we seek to redress this deficiency in the literature. We note that preference for more complex experimental models from sports and physical pastimes has accelerated rapidly in recent years. Consequently, detailed insights into the adaptive nature of movement behavior are now being provided by a large number of studies, ranging from apparently superficial and frivolous cultural activities such as playground swinging (Post, Peper, & Beek, 2003), hula-hooping (Balasubramaniam & Turvey, 2004), and pedalo paddle boating (Chen, Liu, Mayer-Kress, & Newell, 2005) to more traditional sporting tasks such as javelin and discus throwing (Schöllhorn, 2003), rowing (Daffertshofer, Huys, & Beek, 2004; Shuttleworth, 2004), and long jumping run-ups (Montagne, Cornus, Glize, Quaine, & Laurent, 2000).

HOW DEGENERATE BRAINS AND INDETERMINATE BEHAVIORS SUPPORT FUNCTIONAL BEHAVIORS IN DYNAMIC ENVIRONMENTS

In this chapter, we argue that the increasing popularity of movement models from sports is associated with the powerful influence of a functionalist philosophical perspective viewing decision making and the control of action as adaptive, emergent behaviors that self-organize under constraints. Recognizing the apparent indeterminate (not completely predictable) nature of solutions to many behavioral tasks has amplified the utility of relativist theoretical perspectives on brain and behavior (Glimcher, 2005). Virtually all previous decision-making studies in sport psychology have knowingly or unknowingly adopted a closed-systems analysis founded on classical utility theory and used to model economic systems. The application of such a model of rational action underpins traditional assumptions in sport psychology that decision making, perceptual judgments, and actions are dependent on knowledge structures stored in memory, from where *the* de facto appropriate program or schema can be recalled (for a review, see Starkes, Helsen, & Jack, 2001; Williams, Davids, & Williams, 1999). In such deterministic experimental paradigms, a major aim is the reduction of uncertainty for examining behavior in closed systems. From this philosophical standpoint, legitimate scientific enterprises include the empirical identification of *optimization mechanisms* of behavior (e.g., how experts make "correct decisions" and achieve reliable performances over trials; Staddon & Hinson, 1983).

However, theoretical approaches emerging in physics during the early decades of the twentieth century (e.g., quantum theory and the theory of special relativity) led to a change of thinking that was taken up later in the social, psychological, and neurosciences (Glimcher, 2005). As a result, indeterminacy has begun to emerge as a critical feature of many systems analyses of brain and behavior, leading to more open and dynamic, indeterminate models of decision making, perception, and action, incorporating the contextual constraints surrounding biological systems (e.g., Hastie, 2001; Schall, 2001, 2004). From this perspective it makes little sense to refer to optimization as a mechanism rather than as a functional outcome of indeterminate decision making and action (Staddon & Hinson, 1983). In this respect, optimization, as a functional outcome for each individual performer, emphasizes that expertise in specific domains, such as sports, is defined by attunement to relevant perceptual variables and the concomitant calibration of actions (Vicente, 2003; Vicente & Wang, 1998). Consequently, a focus has developed on models of *constrained optimization,* which emphasize functional descriptions of how individuals seek to optimally satisfy the unique interacting constraints on them in dynamic, complex environments (e.g., Araújo, Davids, Bennett, Button, & Chapman, 2004; Araújo, Davids, & Serpa, 2005; Davids, Araújo, Shuttleworth, & Button, 2003).

Models of constrained optimization are harmonious with concepts from nonlinear dynamics, such as emergence and self-organization under constraints, and capture the adaptability and compensatory variability of human actions required in dynamic contexts such as sport. Of particular importance, this modeling trend fits well with data from recent studies revealing the inherent degeneracy of biological movement systems (Edelman & Gally, 2001).

Why "Degeneracy" Is a Better Descriptor of Human Movement Systems Than "Redundancy"

In recent years, inspired by the insights of Nikolai Bernstein (1967), questions have arisen over the efficacy of descriptions of human movement systems as complex systems with many redundant degrees of freedom. For example, with tongue firmly in cheek, Latash (2000) pointed out that to make degrees of freedom truly redundant, surgical removal might be required. These criticisms may be a result of "redundancy" not being the most appropriate term to use in the context of describing biological systems. Tononi, Sporns, and Edelman (1999) argued that the term redundancy has specific usages in physics, engineering, and communications theory generally related to the duplication or repetition of components as a backup in case of system failure. Redundant systems provide similar outputs from the presence of identical components. However, Tononi et al. pointed out that biological systems are not structured in the same way as mechanical or electronic systems, as nature has a different solution for ensuring system robustness and adaptivity. In this respect, degeneracy is a more typical feature of biological systems than the ubiquitous redundancy.

Degeneracy refers to the capacity of structurally different components of complex biological movement systems to achieve different outcomes in varying contexts, and is exemplified by the networks existing at different levels of human movement systems, including molecular, genetic, and musculoskeletal. Degeneracy in complex biological systems provides the neurophysiological basis for the diversity of actions required to negotiate information-rich, dynamic environments from moment to moment as well as providing a huge evolutionary fitness advantage (Edelman & Gally, 2001). For example, several researchers using brain imaging techniques have revealed that the visual cortex in blind humans can be activated during tasks requiring attention to auditory and haptic information sources. These data have demonstrated how compensatory adjustment in degenerate nervous systems can result in the pick-up of novel information sources for planning and organizing movements (e.g., Kujala et al., 2005). Additionally it is now well established that motor equivalence, or the ability of different patterns of neuromuscular activity to achieve specific movement outcomes, can provide the degenerate human movement system with a distinct advantage through the contextual adjustment of actions to information-rich environments, typically needed in many sports. Degeneracy of human movement systems provides the capacity to trade off specificity and diversity of actions under changing task constraints, influencing the emergence of decision making and action (Edelman & Gally, 2001).

Why Movement Models from Sports Provide Representative Tasks for Studying Emergent Behaviors

What do the functionalist ideas of degeneracy and indeterminacy of brain and behavior imply for the study of decision making and action in sport? One important consequence of the influence of such relativist theorizing in science is that traditional distinctions between experimental rigor and field research are now being recognized as creating a false dichotomy. One relevant functionalist theoretical paradigm on movement behavior is dominated by the juxtaposition of ideas in ecological psychology (e.g., Brunswik, 1956; Gibson, 1979) and nonlinear dynamics (e.g., Jirsa & Kelso, 2004). It adheres to the metatheoretical commitment that knowledge of the world in biological systems is demonstrated by behavioral adaptations to functionally relevant invariant features of the environment (Heft, 2001; Reed, 1996). In sport psychology, this theoretical approach has been characterized as a "constraints-based framework" emphasizing the need to study behavior as an emergent property of the continuous interactions of a biological organism and its environment (Araújo et al., 2004; Davids et al., 2003; Handford, Davids, Bennett, & Button, 1997). Within this theoretical rationale, it is reasoned that experimental tasks need to provide adequate opportunities for emergence of adaptive behavior by ensuring that cognitive, perceptual, and movement processes function in a contextualized manner without being biased by the restriction of arbitrary and artificial tasks.

Sports and physical activities provide numerous relevant movement models because they readily lend themselves to the representative design of tasks to study adaptive behavior through the processes of perception, decision making, intentionality, and action. From this perspective it makes little sense to use the term *real-world* tasks, because all tasks—including artificial laboratory tasks—are performed in the real world (Hammond & Stewart, 2001). Indeed, it should be noted that not all dynamical systems and ecological psychology studies of coordination and control have chosen to investigate multijoint movement models from sports. In fact, some dynamical systems theorists have been criticized for implementing reductionist movement models that are somewhat isolated from everyday life, thus overemphasizing the rigor of experimental control over generalizability of findings (Schöllhorn, 2003). For example, it has been proposed that the experimental goal of seeking empirical support for abstract dynamical laws that characterize the movement system as comprising nonlinear coupled oscillators has led to the selection of "contrived laboratory tasks (finger, hand and arm wiggling), which sometimes involve rather unusual timing goals (polyrhythms)" (Walter, 1998, p. 327).

The theoretical insights of Egon Brunswik (1956) in ecological psychology provide a powerful theoretical rationale for evaluating the merits of these criticisms and the more general dichotomous trend of considering laboratory tasks as being diametrically opposed to field-based research designs for studying behavior. The issue of task constraints and their effect on performance has often been mistakenly presented as an issue of differences in ecological validity involving contrived, laboratory tasks versus natural tasks. Brunswik showed how this representation of scientific methodology was a false distinction, based on a misunderstanding of the concept of task "representativeness." For Brunswick, representativeness refers to the degree to which environmental conditions adopted in a research study reflect those present in the situations where the task is implemented (see later for a more detailed explanation). More generally, Brunswik's contribution to understanding of functional movement behavior has been highly significant. His work preempted both the emphasis on idiographic analyses of how individuals solve motor problems, relevant in indeterminate paradigms of brain and behavior, and the current shift to designing specialized experimental contexts that have a high level of representativeness of a biological organism's niche habitat. Clearly, these issues are still important today, with the generalization of findings outside of specific experimental contexts being recognized as a challenge in educational, social, developmental, and experimental psychology.

Although technological advances have undoubtedly impacted the selection of movement models for study, in this chapter we highlight how sports and physical pastimes provide relevant movement models for studying decision making and action because they provide unbounded opportunities to enhance the *representativeness* of experimental task design. They exemplify how processes of perception, decision making, and action (a) are examples of adaptive behavior, (b) are mutually enabling and "embodied" within the performer-environment system, (c) function in a task-specific manner, and (d) are dependent on nested, interacting constraints inherent to specific performance contexts. We have chosen to focus on research in the sports of basketball and cricket to exemplify the study of adaptive behavior in representative tasks involving dribbling, throwing, catching, batting, and locomotor pointing. We start by briefly discussing key concepts from the theoretical frameworks of nonlinear dynamics and ecological psychology for studying decision making and action, including the idea of task representativeness, which provides a cogent rationale for selection and adaptation of movement models from sports.

THE THEORETICAL IMPETUS OF NONLINEAR DYNAMICS AND ECOLOGICAL PSYCHOLOGY

Although there are some subtle differences, prominent ideas from nonlinear dynamics and ecological psychology demonstrate some theoretical consensus, for both theories seek to enhance our understanding of how actions are coordinated with respect to complex and dynamical environments (for detailed overviews, see Davids et al., 2001; Williams et al., 1999). Researchers in these areas have typically adopted a systems perspective. They have sought to characterize biological movement systems as complex, dynamical systems, revealing how the abundance of degrees of freedom is coordinated and controlled during goal-directed movements (see Bernstein, 1967). A functionalist perspective has revealed that patterns emerge between parts of dynamical movement systems through processes of self-organization ubiquitous to physical and biological systems in nature, as task solutions are assembled and implemented (see Davids et al., 2003). Dynamical movement systems are able to exploit surrounding constraints, particularly informational constraints, to allow functional, self-sustaining patterns of behavior to emerge in specific contexts. New behaviors emerge in a nonlinear manner as natural dynamical systems transit from one stable state of organization to another. The conditions surrounding these so-called phase transitions are of particular interest to researchers because they are relevant for understanding transitions between patterns of coordination in biological movement systems as actions are selected and implemented.

The type of order that emerges in movement systems is dependent on initial conditions (existing environmental conditions) and the ecological constraints that shape a system's behavior (Newell, 1986). Natural environments are dynamic, complex, and rich in indeterminacy, often requiring indeterminate responses from actors based on perception and anticipation of unfolding events. Ecological psychologists have addressed the problem of how perceptual information guides actions in natural environments, by emphasizing how biological movement systems are surrounded by banks of energy that can constrain decision making and action. To pick up this information, Gibson (e.g., 1979) attributed a significant role to specific *movements* of the performer and/or objects to be acted on. Movements cause changes to energy flows that provide specific information to organisms on the properties of a dynamic environment. Because flow patterns are specific to particular environmental properties, they can act as invariant information variables to be picked by individual performers to constrain their actions in specific contexts. It is clear that the specificity of ecological constraints provides the basis for the regulation of action, and it has become evident that the influence of task constraints can override the influence of other relevant constraints. For example, a number of studies of rhythmical finger movements have reported that neuroanatomical constraints of muscles involved in coordination have a strong influence on stability observed (for reviews, see Carson, 2004; Carson & Kelso, 2004). Finger flexions synchronous with an acoustic beat have been found to be more stable than extension movements syncopated with the beat. It has been proposed that evolutionary constraints on the neuroanatomical system have had a profound influence on differential stability of flexors compared to extensors (Carson, 2004). Flexor muscles originated phylogenetically as antigravity muscles and have evolved to produce relatively stronger forces than extensor musculature from similar numbers of motor units. However, when a small plastic mechanical stop was inserted into the typical experimental protocol to interrupt the oscillating finger movements, the effects of neuroanatomical constraints were overridden and neither flexion nor extension phases of the rhythmic oscillatory finger movements were found to be more stable (Kelso, Fink, Delaplain, & Carson, 2001). It was proposed that this simple modification to the protocols of rhythmical finger movement experimentation provided additional haptic information from the mechanical stop for participants; this exemplifies well how coordination patterns are soft-assembled and tuned to prevailing task conditions (Kugler & Turvey, 1987).

For sport psychologists, the major implication of these ideas is that perceptions, memories, intentions, plans, and actions may be conceived of as emergent, self-organizing, macroscopic patterns formed under a range of interacting ecological constraints (see Davids et al., 2001; Vicente & Wang, 1998). These arguments have led to proposals for an integrated constraints-based framework, effectively opening the window onto movement models from sports and exemplifying why they have gained such rapid popularity in recent years. In the following section, we explore in greater depth the implications of Brunswikian notions of representative task design for the constraints-based rationale for studying decision making and action.

TASK REPRESENTATIVENESS AND A CONSTRAINTS-BASED FRAMEWORK

Brunswikian (Brunswik, 1956; Hammond & Stewart, 2001) ecological psychology is predicated on key concepts of representative design (sometimes confused with Brunswik's concept of ecological validity; see Araújo et al., 2005, for clarifications) and intra-ecological correlation. Intra-ecological correlation refers to the close relationship between cues in the environment so that one or more may provide the same informational support to the actor (for an alternative explanation, see Savelsbergh & van der Kamp, 2000). Representativeness is a key feature that refers to the generalization of task constraints in a specific research context to constraints on behavior outside the experimental setting. Brunswik argued that psychological processes were essentially adaptive processes. Consequently, he noted that there needs to be congruence between the conditions of an experimental setting designed for the study of a particular feature of behavior and the environmental conditions within which that behavior is functionally implemented. To study how psychological processes help adapt behavior to dynamic environments, the basic principle of task representativeness is predicated on accurate sampling of environmental conditions for behavioral experiments. Brunswik's ideas suggest that, to be representative, ecological constraints of a to-be-studied behavior also need to interact, as they do in many contexts of performance. He labeled this feature of experimental design *ecological intercorrelation.* His ideas on sampling environmental conditions preempted the popularization of the current strategy of focusing on the interacting organismic, task, and environmental constraints on the participant in psychology experiments (e.g., Araújo et al., 2004, 2005). The more extensive the sampling of constraints, the more representative is experimental task design, according to Brunswikian ideas. The critical role of task constraints, as explained in our discussion of experiments showing how haptic information sources interacted with flexion/extension phases of finger movements, exemplifies the significance of the principle of ecological intercorrelation in task representativeness.

Brunswik's (1956) notions of representative task design make redundant the traditional dichotomization of empirical research as either laboratory or field-based. Understanding the interaction among key organismic, task, and environmental constraints for the emergence of movement behavior provides a comprehensive theoretical framework for designing natural, representative tasks, regardless of whether they are located in a laboratory or field setting.

So, what are the key principles of a constraints-based framework that can inform the design of representative tasks? How do these principles feature in sports tasks? Informed by the principles of a broad ecological psychology and nonlinear dynamics, a constraints-based framework demonstrates a metatheoretical commitment to understanding the organism and environment as the fundamental level of analysis, viewing it as a coherent, indeterminate ecological system (Davids et al., 2001). Such a functionalist analysis begins by understanding the ecological constraints on behavior and rejects any attempt to emphasize unilateral explanations of mind, body, and environment. The primacy of perception is complemented by a recognition that a useful functionalist theory of knowledge as adaptation to environments needs to explain the complex interactions among perception, intentions, and actions.

An important implication of these theoretical commitments for empirical work on processes of perception, decision making, and action is that representative task design to examine the function of adaptive behavior needs to consider the role of ecological constraints during active task exploration (i.e., at the level of the organism-environment relationship). Ecological psychology presupposes that an organism intends to be as empirically accurate as possible in its perception of information for action and its decisions about environmental objects and events. A broad ecological psychology begins by analyzing the ecological constraints on behavior before addressing the organism's adaptation over subsequent time scales (Vicente, 2003). The constraints-based framework provides a way of measuring the degree of adaptation between the organism's behavior and the structure of the environment. This is possible because the interaction of key task and environmental constraints provides a referent for evaluating the fitness (i.e., functionality) of behavior in individual performers. The empirical data reviewed in this chapter serve to demonstrate that very simple changes in task constraints can provide powerful insights into the adaptive coordinative structures that emerge as individuals find functional coordination solutions. They also show that sports abound with a variety of unique task constraints and that analysis of behavioral solutions after manipulating task constraints provides a particularly useful window on the role of specific intentions and perceptual information sources in constraining movements.

REPRESENTATIVENESS OF TASK CONSTRAINTS AND RESEARCH ON DECISION MAKING AND ACTION

To exemplify the theoretical arguments developed so far in this chapter, in this section we refer to two different approaches to studying dynamic interceptive actions. Sometimes quite subtle differences in methodologies can lead to significant adaptations in the behavior of participants, underlining the significance of considering sports tasks to enhance representativeness of experimental design. There are a number of key differences between traditional laboratory methodologies for studying processes of perception and movement, and the task constraints of natural interceptive movements such as catching, batting, or running toward a take-off board (Davids et al., 2002). The design of some traditional experimental contexts for studying perception has been characterized by "informational minimalism" because of a reductionist belief that holding a huge number of variables constant will allow investigators to produce laws of perception (see Harris & Jenkin, 1998).

For example, an inordinate emphasis on the use of simulated motion has led to the popularity of coincident timing tasks in which participants have to typically *predict* when a (suddenly occluded) object image will arrive at a designated target point. The task constraints of motion prediction paradigms emphasize the significance of *perceptual anticipation* processes in studying predictive visual timing during interception. In perceptual anticipation methodologies, participants are permitted to see only a part of the trajectory of the object image on the computer screen, for example, and are required to predict the arrival time of the object image at a designated target point. Those experimental constraints are assumed to "represent" part of the approach trajectory of an object image in short-term memory of participants to predict its time to arrival at a target location (e.g., see Bootsma & Oudejans, 1993; Todd, 1981). This traditional emphasis in designing studies to investigate processes of predictive visual timing fit well with theories of hierarchically organized perceptual and movement systems (see Poulton, 1957; Williams et al., 1999). From this perspective, the performer is highly dependent on accurate perception of spatiotemporal characteristics of projectile motion to program the movement of an effector toward a predicted future contact point.

However, it has been observed that the design of these tasks may not be representative of many natural interceptive actions where the emphasis is on *receptor anticipation* processes (Davids et al., 2001; Poulton, 1957). Under the natural constraints of interceptive tasks such as ball catching and cricket batting, participants are usually able to continuously regulate movements by viewing the ball until it arrives at the location of the hands or the bat, and do not need to perceptually construct the ball's flight path from earlier remembered information from ball flight. This view of task constraints in many interceptive actions fits well with the concept of information-movement coupling in ecological psychology, intrinsic to a strategy of prospective control of movement (Beek, Jacobs, Daffertshofer, & Huys, 2003). Prospection is based on a heterarchical view of the performer and an integrated relationship between movement and perceptual systems. It involves a close and continuous coupling of movement and perceptual systems based on the relationship between the instantaneous states of the performer and environment during task performance (e.g., see Montagne, 2005).

The different constraints of motion prediction and natural interceptive tasks might imply the existence of different control mechanisms for successful performance, highlighting the relevance of Brunswik's (1956) concept of task representativeness. For example, slower velocities are typically used in perceptual anticipation tasks (>1 s) and might permit the perceptual construction of the stimulus trajectory for prediction of future contact points. In most natural interceptive actions, however, movement execution times are usually much briefer (e.g., 300 ms for one-handed catching at 10 m/s; Alderson, Sully, & Sully, 1974), facilitating the use of strategies based on continuous regulation or information-movement coupling (Tresilian, 1995).

However, extant data on movement outcome variability suggest that performers find the task constraints of natural interceptive actions more functionally relevant than psychophysically based experiments. For example, in some studies involving computer simulations, participants usually underestimate time to arrival of a stimulus object at a designated location point on monitor screens. The amount of underestimation increases with increasing time to arrival (e.g., see data from Kaiser & Mowafy, 1993; McLeod & Ross, 1983; Schiff & Detwiler, 1979; Schiff & Oldak, 1990). Tresilian (1994) has calculated that the average underestimate of reported time to arrival in these tasks is around 60% of actual time to arrival at the point of execution of the button press, with the standard deviation of the estimates being 50%. These error margins and levels of outcome variability suggest that participants are not familiar with these task constraints and rarely experience them in real life. In contrast, data on timing from adults and infants suggest that such large levels of variability in estimated time to arrival are often not observed in performance of natural interceptive actions (see later section on spatiotemporal constraints of interceptive movements, documenting the results of several studies of interceptive actions in sport). Tresilian (1995, p. 237) highlighted the fact that "the variability (standard deviation of response times) of responses in CA [coincidence anticipation] tasks is some five or six times greater than that observed in IAs [interceptive actions] performed under the same stimulus conditions."

This observation can be interpreted in light of Bootsma's (1989) criticism of the "unprincipled" and arbitrary way in which processes of perception and movement have sometimes been separated in experimental designs. Bootsma examined the effects on performance of decoupling information and movement under three different types of task constraints. Participants in his study were presented with squash balls dropped through a plastic tube (length = 50 cm, diameter = 4.3 cm) from a height of 270 cm above a table surface. They attempted to intercept the ball in one of three different randomized conditions: (1) using their own arm and a bat, (2) pressing a button to release a 55 cm mechanical arm to hit the ball just before it landed on the tabletop, and (3) pressing a button when the ball was judged to be level with the tabletop surface (equivalent to motion prediction task constraints). These conditions were intended to provide a successive degradation in information-movement coupling, and percentage accuracy data on hitting performance under natural-arm task constraints (82.4%) and artificial-arm constraints (49.5%) were significantly different. Moreover, movement times were more variable for the natural-arm task constraints (14.6 ms) than the artificial-arm task constraints (5.0 ms). These findings are consistent with an ecological notion of information continuously regulating behavior under the natural task constraints of interceptive actions. With reference to Tresilian's (1995) observations discussed earlier, it is worth noting that variability in timing the initiation of striking movements was lower under natural-arm constraints ($SD = 16.3$ ms) compared to artificial arm task constraints ($SD = 34.0$ ms). When only perceptual judgments of interception points were required by participants (i.e., no physical movements were required), variability was significantly higher ($SD = 61.8$ ms) than under both arm conditions.

These findings imply that structuring experimental tasks to keep key sources of perceptual information and actions together seems to be an important principle for designing representative tasks to study natural interceptive actions. Interestingly, even after a 100-trial learning period (including 20 familiarization trials), although mean movement initiation time (MIT) in the motion prediction conditions was higher than in the natural-arm conditions, the observed differences were not statistically significant (Davids et al., 2001). In line with Bootsma's (1989) findings, statistically significant differences were obtained for the variability of MIT (operationalized as the SD around the mean) between the two conditions. Variability of MIT was greater in the motion prediction conditions compared to the natural-arm condition (see Table 10.1).

When the number of trials in the perceptual judgment (i.e., CA) task was quintupled, performance was still significantly better in the natural-arm striking condition, as evidenced by variability of movement initiation time. The task constraints of striking a ball set up the saliency of various sources of perceptual information involved in timing the movement (Davids et al., 2001). Under these specific task and informational constraints, the performer develops a coupling of movement to relevant sources of perceptual information. As evident from the data from the motion prediction task, the developed coupling cannot easily be transferred to different task constraints (Bootsma, 1989), highlighting the importance of task representativeness for studying adaptive movement behaviors.

Table 10.1 Interception and Movement

Subject Number	Motion Prediction Task (Mean MIT)	(SD)	Interceptive Action (Mean MIT)	(SD)
1	298	59	293	16
2	224	57	288	15
3	384	27	276	16
4	349	28	306	20
5	271	38	289	13
6	360	27	306	21

Note: MIT = Mean movement initiation time; SD = Variability of participants performing interceptive actions under the constraints of a motion prediction paradigm and a natural interception task. Each participant performed a total of 100 trials (including habituation trials) in each condition. Data are calculated in milliseconds.

Source: "Accuracy of Perceptual Processes Subserving Different Perception-Action Systems," by R. J. Bootsma, 1989, *Quarterly Journal of Experimental Psychology, 41A,* pp. 489–500. Reprinted with permission.

To summarize so far, these data indicate the extensive insights that might be available when studying movement models under the enriched ecological constraints of sport. Degenerate brains and indeterminate behavior support functioning in complex, dynamically changing environments. There is a need to examine processes of perception and action under dynamic task constraints to understand how people actively explore information to guide functional behaviors. Most important, individual *and* environmental constraints should be explicitly considered in studies of movement coordination and control. The constraints-based framework signals the need to carefully distinguish variability in *movement organization,* a healthy sign of adaptive behavior in indeterminate, biological movement systems, from variability in *movement output,* which is less functional (Davids et al., 2006). The latter is often caused by the use of task constraints that are unrepresentative, as data reported from studies of hitting actions have shown.

Sports and many apparently frivolous pastimes provide a plethora of tasks that lend themselves to representative design for studying ubiquitous actions such as interceptions. They exemplify how a process-oriented, time-continuous approach motivated by the study of adaptive behavior can be achieved in the analysis of complex movement models (Cordo & Gurfinkel, 2004; Schöllhorn, 2003). Sports and physical activities are replete with an extensive range of task constraints to experimentally manipulate, including clothing, equipment, rules, targets, boundaries, surfaces, and the presence of other individuals (Davids, Button, & Bennett, in press). Compelling arguments exist for empirical work to adequately reflect "enriched action environments" based on a broad range of task constraints (Cordo & Gurfinkel, 2004; Newell, 1991).

MOVEMENT MODELS IN BASKETBALL AND CRICKET: WINDOWS ON EMERGENT ACTIONS

In this section, we discuss how the sports of basketball and cricket provide a rich backdrop for the study of emergent functional solutions during performance.

The 1 × 1 Subphase of Basketball: A Dyadic System

Spontaneous movement variability can play an important role in allowing sport performers to create different movement solutions to fit various performance situations. In the dynamic context of basketball, one can get a good impression of how skilled players utilize a range of movement patterns to achieve individual and team goals. Araújo et al. (2004) recently examined the dynamics of motion interaction in a dyadic system formed by competing individuals in basketball dribbling. A start point for this analysis was consideration of two individuals in a dribbling dyad as a single system with dyadic synergy (Schmidt, Carello, & Turvey, 1990). In physical terms, these processes are expressed in the emergence of organized structures in phase-space describing the interpersonal interactions of the dribbling attacker and marking defender. Interpersonal coordination can be studied in the emergence and regulation of coordinated states through inherent perceptual processes, based on the dynamics between individuals in a dyadic system (Kugler & Turvey, 1987).

With the tools and concepts of nonlinear dynamics, the behavior of interacting players can be interpreted as an emergent process resulting from the spatiotemporal relations established during game situations. A dyadic synergy can show nonlinear properties, namely, entrainment and sustained periodic behavior, as specific modes of interpersonal coordination emerge from contextual, personal, and task constraints. In basketball, the interaction of a dribbler and a defender in a one-on-one situation can result in a relatively stable interactive dynamic structure, because the defender may counteract any movement toward the basket by an attacker. According to coaching knowledge, this stable balance between attackers and defenders characterizes the 1 × 1 situation in basketball (e.g., Bain, Hayes, & Quance, 1978). In this classic subphase of team sports, the attacker needs to destabilize or perturb the stable state of this momentary dyad. If this system is successfully destabilized, the attacker can dribble past the defender toward the basket. This destabilization corresponds to a symmetry-breaking process where the previous stable interpersonal state transits to a new dynamic state (Kugler & Turvey, 1987).

A dynamical systems analysis of this phase transition from one attractor pattern to another needs to begin with a measure of order in the stable interpersonal pattern formed by the position of the attacker and defender with respect to the ball and the basket. Analysis of coaching literature reveals that a candidate collective variable to describe order in an attacker-defender system is the distance between the basket and the median point of the distance between the attacker and defender during the 1 × 1 confrontation. The pedagogical literature also reveals that a specific control parameter can be the interpersonal distance between attacker and defender. We examined whether the distance from the attacker-defender dyad to the basket would become less stable until some critical value was reached, as interpersonal distance decreased. This investigation considered whether changes in interpersonal distance were associated with dribbling success by attackers. A specific issue of interest was whether the attacker-defender dyad became more frequently destabilized at critical values of interpersonal distance. Ten male players (regional level, 15 to 16 years old) participated in the experiment after recommendation by their coaches and providing informed consent. They were paired to form 5 dyads. Each dyad started at the free throw line, with the other members of both teams placed on the court based on the "attack system 1 : 2 : 2" (see Figure 10.1).

The horizontal plane trajectory (two-dimensional) of the center of mass of each player in the dyad was recorded by one digital camera. Body mass center was calculated with the 6 markers (2 ankles, 2 hips, and 2 shoulders). Task instructions were for the attacker to score and the defender to prevent a score, within the rules of basketball. The eight other players started to participate in the play 5 seconds after the beginning of the task (temporal task constraints), after having being placed in valid positions based on typical basketball match strategy (spatial task constraints). The action sequence started when the defender passed the ball to the attacker, after a signal from experimenters. In Figure 10.2a, it can be observed that, during the initial part of the dyadic entrainment, there is a stable state of the collective variable, followed by an abrupt change in the state of the system due to the attacker's success in destabilizing the dyad.

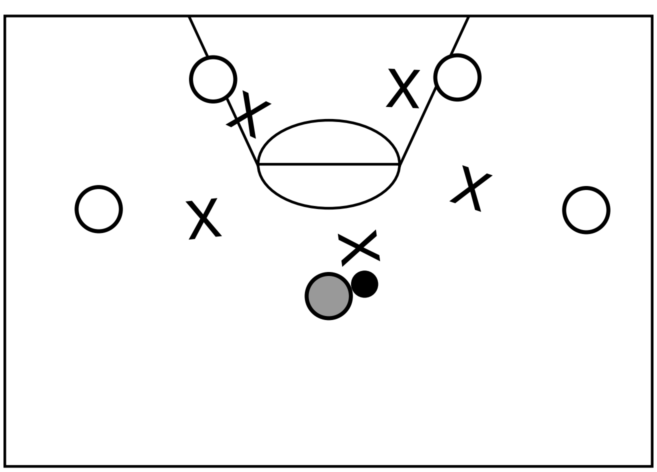

Figure 10.1 A schematic diagram illustrating the starting position of a typical basketball dyad (in gray), based on the "attack system 1 : 2 : 2." *Note:* X = Defenders; O = Attackers.

Interpersonal equilibrium, one stable state of the dyadic system, is kept during the whole situation (Figure 10.2c), where the defender has managed to constantly counterbalance the symmetry-breaking actions of the attacker. On the other hand, when the attacker is successful, there is almost no equilibrium. Figure 10.2b shows that the transition from a new state started immediately after the beginning of the interaction between the players in the dyad. Interestingly, the symmetry was broken exactly during the shortest values of the control parameter (i.e., interpersonal distance; right side of the figure). This is the transition phase from dyad equilibrium to a new system order (attacker's supremacy). In general, the attacker-defender system exhibited initial symmetry (clearly shown in Figures 10.2a and 10.2c), which was broken during transition to a new state at a certain value of the control parameter (which is clear in Figures 10.2a and 10.2b). These points can be further emphasized if we decompose our collective variable (distance between the medium point of the dyad to the basket), showing each player's distance to the basket. In Figure 10.3 we show the same situations as in Figure 10.2. There we can see more clearly how symmetry breaking occurs (Figures 10.3a and 10.3b) and how symmetry was maintained (Figure 10.3c). To create a diagnostic tool for coaches we can illustrate the behavior of both players in a phase space (right side of Figure 10.3).

The attacker-defender system exhibited initial symmetry, which was broken during transition to a new state at a certain value of the control parameter. In other words, the attacker was trying to dribble past the defender, but the defender was attempting to maintain the initial steady state. The attacker increased the variability of dribbling actions to create information on the emergence of a system transition (the decision when to drive with the ball). Suddenly (when the symmetry was broken), the decision emerged in the intending-perceiving-acting cycle. Considering the characteristics of the phase-space, the positions above its diagonal represent attacker supremacy and the positions of the system below the diagonal represent defender supremacy. In summary, the data suggest that it is possible to interpret the dynamics of player interactions in dribbling as emergent properties under constraints. As an aside, an interesting question concerns the relationship between the ability of the defender to maintain the symmetry of the system and his or her perceptual skills. An interesting question for future research concerns whether initial system stability is more easily maintained when the defender is able to perceive the specifying information provided in the attacker's dribbling actions. Alternatively, a

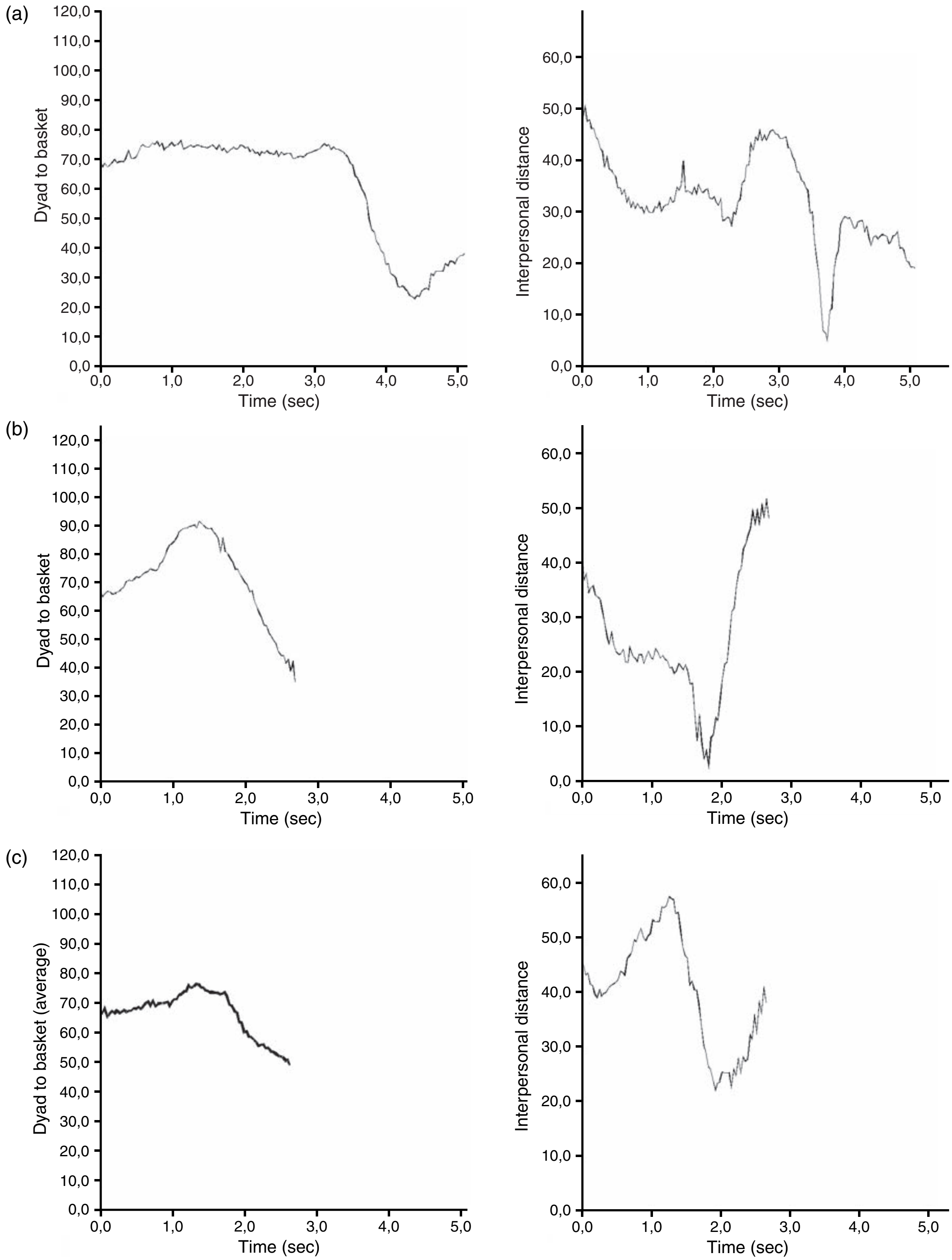

Figure 10.2 Three examples of collective variables (distance of dyad to basket) on the left column and control parameters (interpersonal distance) on the right column: 1st row = equilibrium situation with a slight attacker advantage; 2nd row = attacker's advantage; 3rd row = defender's advantage. Some of these data were initially presented in "Emergent Decision Making in Sport: A Constraints-Led Approach" (p. 77), by D. Araújo, K. Davids, J. Sainhas, and O. Fernandes, in *International Congress on "Movement, Attention and Perception,"* L. Toussaint & P. Boulinguez (Eds.), 2002, Poitiers, France: Université de Poitiers.

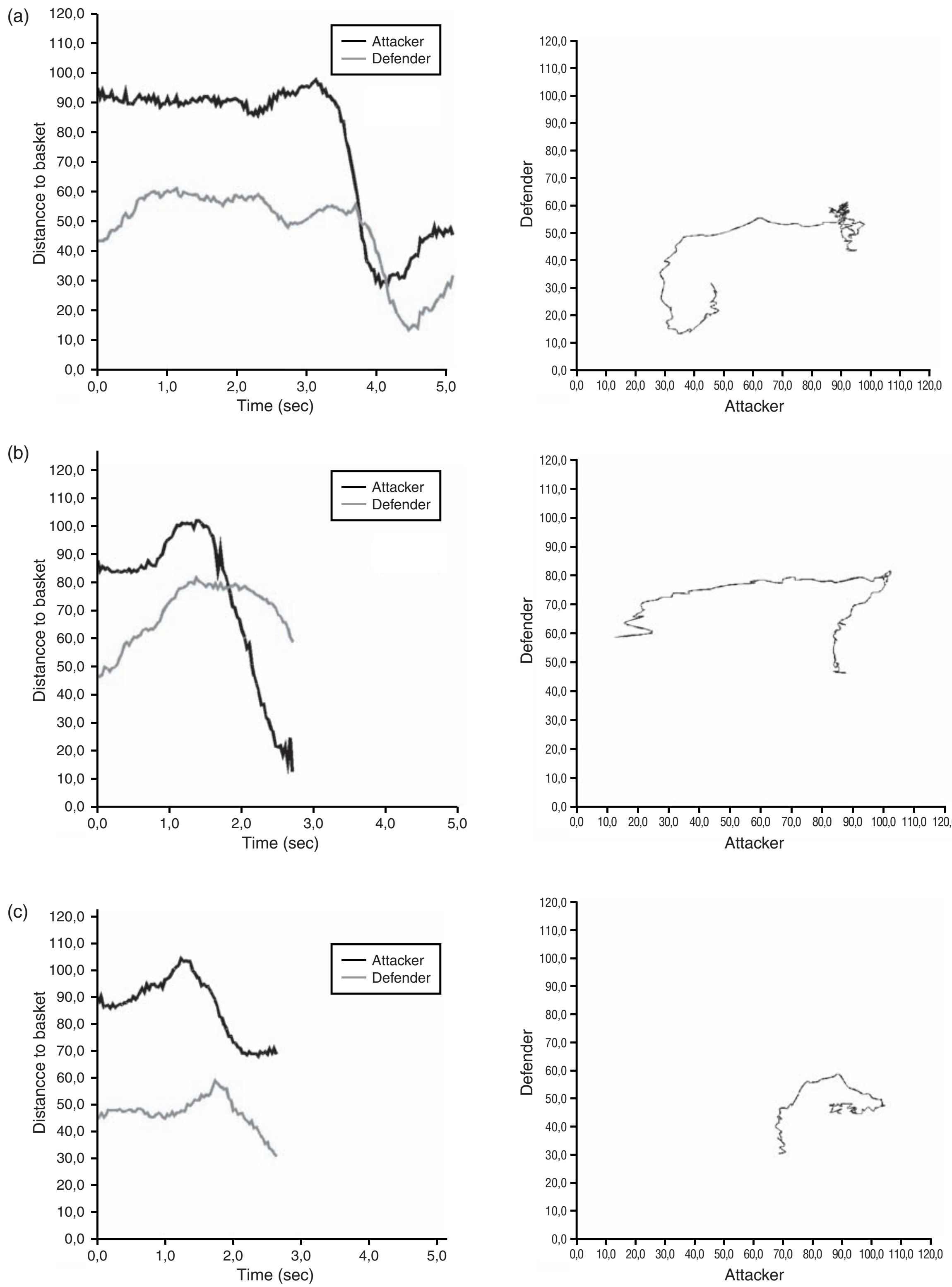

Figure 10.3 Same examples as previous figure. Decomposed collective variables (distance of dyad to basket) on the left column and phase space (interpersonal distance) on the right column: 1st row = equilibrium situation with a slight attacker advantage; 2nd row = attacker's advantage; 3rd row = defender's advantage. Some of these data were initially presented in "Emergent Decision Making in Sport: A Constraints-Led Approach" (p. 77), by D. Araújo, K. Davids, J. Sainhas, and O. Fernandes, in *International Congress on "Movement, Attention and Perception,"* L. Toussaint & P. Boulinguez (Eds.), 2002, Poitiers, France: Université de Poitiers.

phase transition may be more likely to result when unspecifying information is accessed.

Inter-Trial Variability in the Free-Throw Action

Using the sport of basketball, we have also revealed how the amount and structure of movement variability changes as an individual becomes increasingly skilled at a discrete task. The free-throw shot in basketball is a precision throwing task that is seemingly associated with a high degree of movement consistency among experienced performers. To test this observation, Button, McLeod, Sanders, and Coleman (2003) conducted a detailed individual analysis of the throwing kinematics of 6 female players performing 30 free-throw shots. The players comprised a range of expertise levels, from novice (Participant 1) to international (Participant 6). The data revealed an increasing amount of inter-trial consistency from the elbow and wrist joints as skill level improved (see Figure 10.4). One might associate such characteristics of the data with a stable attractor shell that enhances the reproducibility of the movement system under high levels of pressure and fatigue, which are important demands in competitive basketball. However, particularly at ball release, there was evidence of angular joint covariation to adapt to subtle changes in key release parameters of the ball. Regardless of expertise level, all players showed an increase in movement variability, indicating that this behavioral feature was a function of the task constraints rather than skill level. It could be that to satisfy the unique task constraints of the basketball free-throw, a bandwidth of trajectory variability is necessary that all the players tended to exploit. For example, the elbow position tended to be most variable during the middle phase of the throwing action, with a decrease toward ball release. It has previously been shown that increased variability is associated with rapid, accelerative phases of a movement, and projecting the ball in an arc toward the basket demands a forceful extension of the shooting arm.

Interestingly, Button et al. (2003) found that the coordination between the elbow and wrist joints became more variable toward the end of the action. Even Participant 6 showed a distinct peak in variability at approximately 90% of the movement duration. One explanation may be that as a result of changes in key release parameters, players need to maintain a functional level of joint-space adaptation toward the end of the action. For example, it has been observed that skilled throwers compensate the values of release speed and release angle against each other to achieve a consistent outcome. An implication of this work is that although sports performers may appear to use increasingly stereotypical movements with expertise, functional variability in trajectory space exemplifies adaptive behavior, which can be exploited on a trial-to-trial basis.

Cricket

Cricketers require skill in a variety of complex, multijoint, interceptive actions, including batting, bowling, and fielding. Interceptive actions involve controlled collisions during which perceptual information from the environment is picked up to guide the appropriate limb(s), or a striking implement, into the right place at the right time, while imparting an appropriate amount of force into a projectile. The task constraints of cricket are demanding; for example, batting requires the interception of a ball with a bat under severe time constraint (typically, the time from ball delivery to contact ranges from around 1 s to 0.6 s). Regan (1997) estimated that skilled cricketers, facing fast bowling speeds of 160 kph, need to be able to perceptually discriminate the spatial trajectories in depth of balls to a precision of 0.5 degrees. Response timing precision in cricket batting has estimated margins of failure of around ±2.5 ms at the point of movement execution. Fielding requires players to perform one- and two-handed catches of the ball, sometimes after running to an appropriate location in the field. Alderson et al. (1974) showed that errors could occur if skilled catchers varied the timing of hand closure around a ball during the grasp phase by around 16 ms.

Prospective Control of Interceptive Actions in Cricket

How does the central nervous system meet such severe spatiotemporal task constraints? Empirical support has recently increased for prospective control modeling in which various information sources are coupled to movements and used to continuously regulate even the most rapid interceptive actions (for overviews, see Beek, Dessing, Peper, & Bullock, 2003; Montagne, 2005). Modeling has revealed how properties of ball flight trajectories can be instantaneously perceived to continuously constrain the spatiotemporal movement patterning.

Beek, Dessing, et al. (2003) described how time to contact and place of contact have been identified as two relevant perceptual variables for prospective control of action in studies of catching and batting (see Figure 10.5). They showed how, according to prospective control models (e.g., Bootsma & Peper, 1992; Peper, Bootsma, Metre, & Bakker, 1994), catching a ball requires a performer to control the hand's acceleration based on an optically specified velocity differential (see equation 10.1). Information can

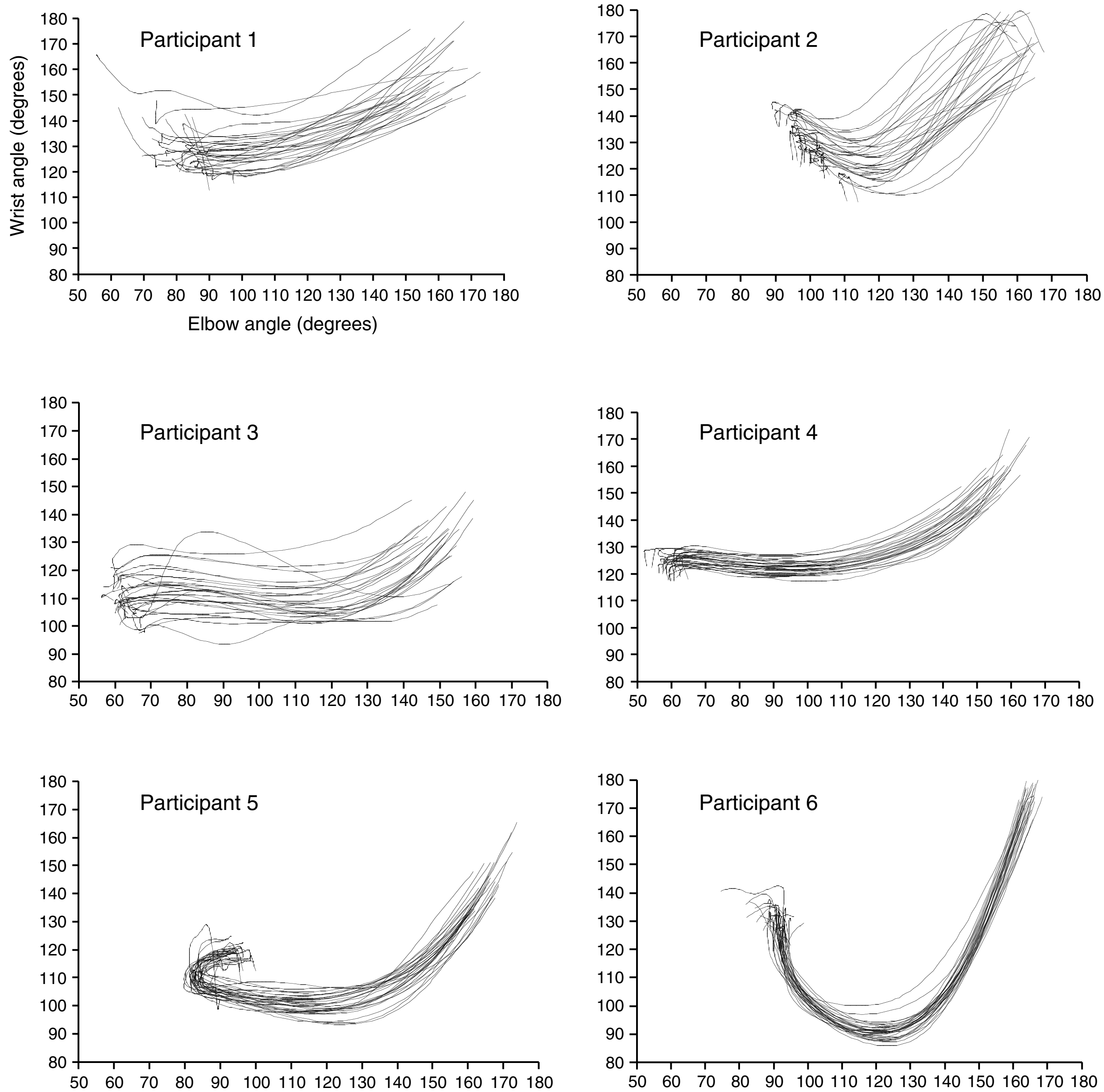

Figure 10.4 Elbow-wrist angle-angle plots for basketball players across a range of skill levels performing 30 free-throw shots. Participants 1 and 2 are novices, 3 and 4 are club, 5 and 6 are internationals. Data from "Examining Movement Variability in the Basketball Free-Throw Action at Different Skill Levels," by C. Button, M. McLeod, R. Sanders, and S. Coleman, 2003, *Research Quarterly for Exercise and Sport, 74,* pp. 257–269.

be continuously used to control the hand's acceleration so that the current hand velocity at a given instant (t) is increased or decreased for the hand to move at the required velocity needed to catch the ball. As shown in equation 10.2, the required velocity can be expressed as the ratio of the current lateral distance (i.e., distance between the hand and the ball's projection plane onto the hand-movement axis) to the first-order TC between the ball and the hand-movement axis. Factors on the right-hand side of equation 10.1 (i.e., the velocity differential) can be optically specified by monocular and binocular (lower order) variables.

$$\ddot{X}_h = \alpha \dot{X}_{h\,\mathrm{req}} - \beta \dot{X}_h \qquad (10.1)$$

with

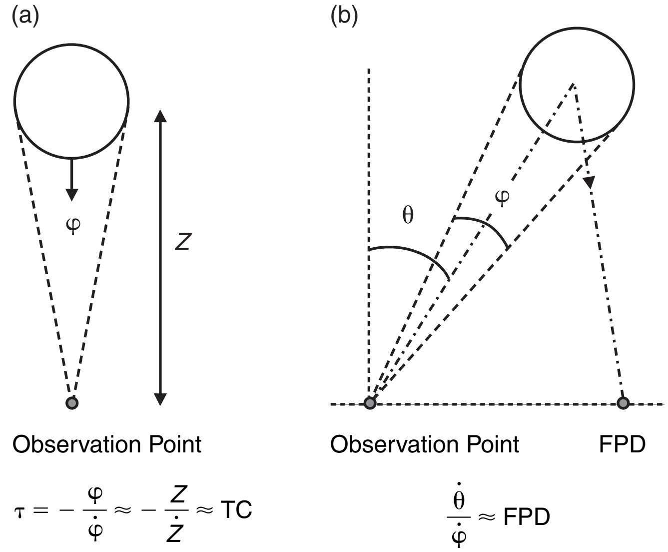

Figure 10.5 Schematic representations of (a) time to contact for an object approaching a stationary observer (local tau 1) and (b) final place of contact for a stationary observer.

$$\dot{X}_{h\,req} = \frac{X_h - X_b}{TC_1} \tag{10.2}$$

where X_h, $X_{h\,req}$ and X_h are the hand's current acceleration, current required velocity, and current velocity, respectively, and α and ß are constants, and where X_h, X_b and TC_1 are the hand's current position, the projection of the ball's current position on the hand-movement axis, and the first-order TC between the ball and the hand-movement axis, respectively.

In prospective control models, successful catching is dependent on achieving and maintaining required velocity by modulating the intercepting limb's acceleration on the basis of optical information from ball flight. Recent data support the use of this law of control. In one experiment, Montagne, Laurent, Durey, and Bootsma (1999) manipulated current lateral distances between the ball and hand to observe influence on hand acceleration. Individuals were required to catch a ball approaching the same point of interception from different initial starting points. Use of a prospective strategy would predict that when the hand was positioned at the point of interception, individuals would start by moving their hand to "fill in" the lateral distance (to the left for an outward angle, to the right for an inward angle) and then change direction to catch the ball (causing a movement reversal). Individuals demonstrated a significant number of movement reversals for the balls that approached on an inward or outward trajectory rather than a straight pathway (approximately 60% of all trials). Furthermore, they started moving their hand at the required velocity approximately 300 ms before catching the ball. Movement reversals are not superfluous and can be construed as evidence of performers creating constraining perceptual information (e.g., place of contact) to couple hand movements continuously with ball flight information. It remains a challenging task to identify the perceptual variables used to regulate action because humans are so adept at picking up and using many different types of information to prospectively control action (Savelsbergh & van der Kamp, 2000). Interestingly, many of the tasks used to investigate prospective control of interceptive actions have relied on experimental tasks in laboratory settings. An important feature of these studies is that they were designed to ensure that participants were able to use perceptual information to constrain action in an ongoing manner. It is clear from the research discussed in this section that experimental tasks for the study of processes of perception for action need to be carefully designed to allow human perceptual systems to function in an evolutionary-designed manner. The constraints of many sports tasks are suitable for this purpose.

Bimanual Coordination in Cricket

Batting is a two-handed task and cricket is replete with movement models to deepen understanding of bimanual coordination. Obhi (2004) noted that task constraints requiring two hands to perform continuous, rhythmical, cyclical, or oscillatory movements are overrepresented in the bimanual coordination literature, to the detriment of the study of discrete, object-oriented, goal-directed actions, as exemplified in slip fielding in cricket. Task constraints used to study two-handed actions can be broadly broken down into two main categories: (1) hands moving symmetrically and simultaneously and (2) hands moving asymmetrically and simultaneously (Swinnen, 2002). Slip fielding in cricket exemplifies the latter, in which both hands are brought together to move isodirectionally and intercept a ball moving rapidly off the edge of the bat at speeds in excess of 160 kph. It is an ideal movement model for studying bimanual coordination, although it has rarely been investigated. An exception to this trend was a study of two-handed catching behavior under similar task constraints to slip fielding in cricket reported by Tayler (2002). He found that during successful catching, skilled performers formed a coordinative structure in which the two hands adhered to a common timing structure that ensured synchronization of time of arrival at the perceived interception point, even from

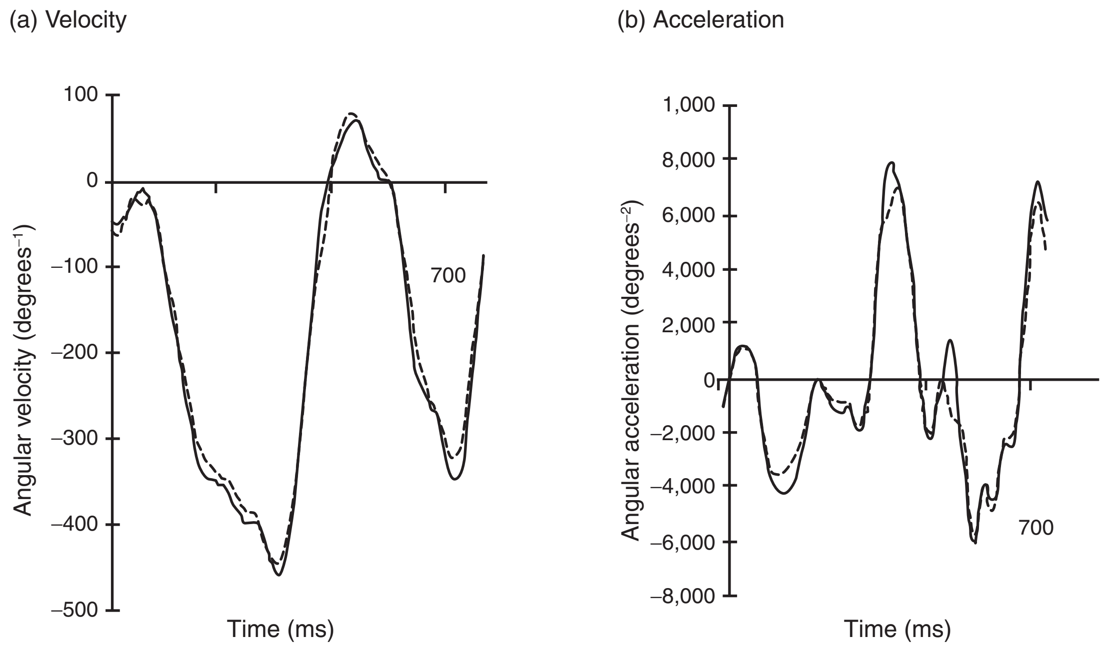

Figure 10.6 The (a) velocity and (b) acceleration trace for a single subject (subject 3) for one catch projected to the center of the chest area of the catcher. The dashed line represents the right arm and the solid line the left arm. Data from "Catching with Both Hands: An Evaluation of Neural Cross-Talk and Coordinative Structure Models of Bimanual Coordination," by M. A. Tayler and K. Davids, 1997, *Journal of Motor Behavior, 29,* pp. 254–262.

spatially variable initiation points. When one hand needed to travel farther than the other hand to the perceived interception point, it traveled faster to synchronize time of arrival. Movement initiation time data revealed that the limbs began to move at identical moments in time under three task constraints varying the distances that hands needed to travel. Despite the left and right limbs having to move farther under the three constraints, both limbs set off at the same time when performing the catch: MIT 208 (±18) ms, 204 (±22) ms, and 196 (±30) ms. Velocity and acceleration data also supported the idea that the two hands formed a coordinative structure to achieve the interception goal. The largest interlimb difference for time to peak velocity was 5 ms, with velocity traces of the two limbs showing a synchronous pattern throughout the entire movement; the largest interlimb difference in time to peak acceleration was 6 ms (see Figure 10.6). The slip-catching problem is solved by integrating the motor system degrees of freedom into a single unit of coordination that can be regulated by the central nervous system.

Bimanual Coordination Modes Emerge under Differing Practice Task Constraints

Two-handed tasks such as slip fielding and batting are often practiced with the use of ball projection machines, and research from cricket batting is beginning to raise important questions on their role in fine-tuning processes of perception and action. Because perception is specific to environmental properties uniquely constraining each performance situation, changing the ecological constraints of practice can deeply influence the movement behaviors that emerge (Beek, Jacobs, et al., 2003). An important role of practice is to educate learners to pick up constraining perceptual variables rather than nonconstraining (less relevant) variables in specific and relevant practice contexts (Jacobs & Michaels, 2002). However, practice environments have traditionally been adapted to manage the information load on learners by decomposition of the movement model into microtask components. This type of management strategy is prevalent in educational, training, and practice contexts and can be achieved in many different ways, for example, by use of ball projection machines to enable acquisition of specific batting skills in isolation from stressful performance contexts.

The problem with this approach in managing information loads during practice is that experienced performers use preball flight information to constrain coordination modes, as revealed by studies of cricket batting (Renshaw & Fairweather, 2000). Specificity of coordination was uncovered by analyses of the forward defensive stroke when batting against a real bowler and a bowling machine. The forward defensive stroke has been broken down into two phases: (1) the back lift and stance, and (2) the downswing to impact. To understand if the different task constraints of batting against a bowling machine or a bowler changes the timing and coordination of the forward defensive stroke, the temporal organization of the shot played by English premier league batsmen of high intermediate standard was examined from the moment of ball release (from the machine projection mouth or the bowler's hand) up to the point of ball-bat contact (velocity 26.76 ms^{-1} under both conditions). Data generally showed significant differences in coordination and timing under these different ecological constraints.

Against the bowling machine, batters coupled the backswing to the moment of ball release (0.02 ± 0.10 s), whereas against the bowler, the backswing started later (0.12 ± 0.04 s). Initiation of the front foot movement occurred after ball release by the bowling machine (0.16 ± 0.04 s) and earlier after ball release by the bowler. Initiation of the downswing commenced earlier against the machine than the bowler (0.32 ± 0.04 s compared with 0.41 ± 0.03 s). There was also a different ratio of backswing : downswing when batting against the machine (46% : 54%) compared to the bowler (56% : 44%). Peak bat height differed under the two constraints (bowling machine 1.56 ± 19.89 m; bowler 1.72 ± 10.36 m; see Figure 10.7). Mean length of front foot stride was shorter against the machine (0.55 ± 0.07 m) compared to the bowler (0.59 ± 0.06 m). Correlation between initiation of backswing and front foot movement was much higher against the bowler ($r = .88$) than the machine ($r = .65$).

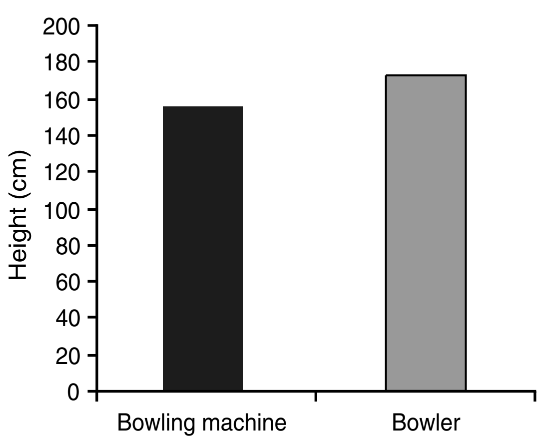

Figure 10.7 Peak height of the batsman's backswing in the bowler and bowling machine conditions.

In summary, results suggested that practice constraints involving projectile machines should be restricted to learners at the coordination stage, or when coordination needs to be restabilized after absence due to illness or injury. Although Bartlett (2003) has proposed that batting against a bowling machine is different, at least up until the release of the ball, from batting against a bowler, the data in this chapter show that batting against the task constraints of a bowling machine is also different *after* ball release.

Locomotor Pointing in the Cricket Bowling Run-Up

Cricket bowling requires the player to run toward a target area (the popping crease) to bowl a ball, placing the back foot before or across the front line of the popping crease to avoid bowling a no-ball. The bowling run-up is an example of locomotor pointing or running to place the foot on a target in space, a movement model that has been used quite extensively to study processes of perception and action in goal-directed gait. How are such actions controlled, and what information sources are used to regulate gait in the run-up phase? De Rugy, Taga, Montagne, Beukers, and Laurent (2002) proposed a prospective control model to explain visually driven adaptations of basic locomotion and locomotor pointing performance. It was argued that, if information on current and required behavior were optically available, then regulation of gait might be continuously based on the perception of the difference between them.

Some behavioral support for the prospective control model of locomotor pointing has been obtained with representative tasks in sports. For example, a study of the long jump run-up by Montagne et al. (2000) found that locomotor pointing was a direct function of the optical flow generated by the performer and that the onset of stride length adjustment was a function of the amount of adjustment required. Evidence has also shown that an important source of constraint in natural locomotor pointing tasks is provided by the nested actions at the end of an approach run. Certain locomotor pointing tasks in sports, such as horizontal jumps and gymnastics vaulting, require the generation of maximum velocity during the run-up to hit the take-off board, whereas others require a more controlled collision with a target area because of the need to complete additional complex actions nested on the end of the approach phase.

Two examples of complex, nested task constraints in locomotor pointing are the javelin throw and cricket bowling, both of which involve a run-up to a target area followed by reorientation of the body into a new projectile delivery position. Under these task constraints, a strategy of initiating visual regulation earlier is an advantage because adjustments can be spread evenly over more strides, causing less disruption to nested actions. Cricket bowling actions are composed of four phases; run-up, bound, delivery stride, and follow through. The run-up enables the bowler to transit into the bound phase while maintaining the velocity generated and positioning the body effectively for a successful “link” to the delivery stride. During the bound phase, the bowler aims to jump forward and high enough to enable him or her to land in the correct position for the delivery stride to release the ball with the desired velocity (i.e., angle and speed). The ideal final front foot placement in the delivery stride is one that cuts the front line, known as the popping crease, enabling the ball to be delivered as close as possible to the batter, reducing his or her potential response time.

An analysis of the run-ups of professional cricketers has revealed support for the continuous perception-action coupling locomotor control model proposed by de Rugy et al. (2002). A combination of interstep and intrastep analyses on the run-ups of cricket bowlers showed that, due to the specific constraints of cricket bowling, the majority of the bowlers made adjustments early in the run-up, before making late adjustments just prior to the bound stride (Renshaw & Davids, 2004; see Figure 10.8). This aspect of the modeling was emphasized by the high number of visually regulated run-ups reported in the study of bowlers compared to the analysis of long jumpers by Montagne et al. (2000). Almost all of the run-ups of the cricket bowlers were regulated at some stage (91 out of 92), and these regulations were spread over the whole length of the run-ups.

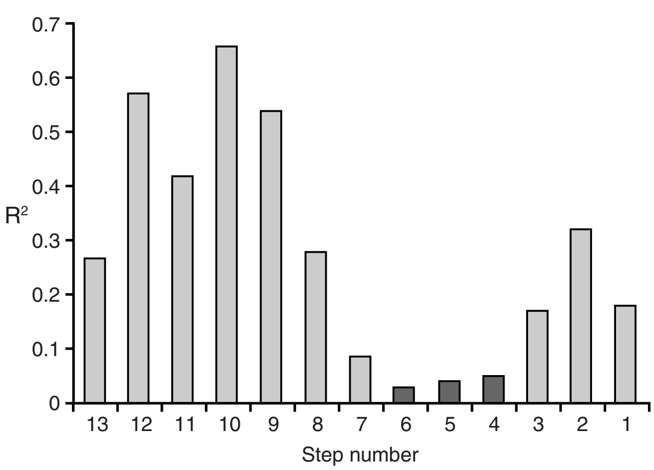

Figure 10.8 Relationships (R^2) between amount of step length adjustment and amount needed for each run-up step among professional cricketers.

An intertrial analysis was used by Montagne et al. (2000) to show that the amount of adjustment produced was a function of the point at which regulation was initiated. A linear relationship between stride number and amount of adjustment putatively showed that perception and action were closely coupled. In the study of cricket bowlers, few correlations were found between stride number and amount of adjustment. However, the inconsistent starting points of the bowlers, and initial high levels of variability, did not prevent them from achieving remarkably low levels of variability at the bound stride, consistent with findings in previous studies of long jumpers. To achieve such functional levels of footfall variability at the critical bound stride, the cricket bowlers were making adjustments based on need at a very early stage of the run-up, a finding in line with a key premise of de Rugy et al.’s model (2002): that regulation is continuous and based on perception of current and required behavior. Data showed that the task constraints of cricket bowling benefited from a greater amount of adaptive visual control during the run-up, compared to the velocity-generation constraint that dominates the athletic jumps. When the intertrial plots were followed with an intratrial analysis, significant relationships were observed between amount of adjustment produced and the amount of adjustment needed at steps throughout the run-up.

The data also demonstrated how nested task constraints shape the nature of control strategies implemented during locomotor pointing tasks. Bowlers were making significant adjustments at steps over 20 m from the popping crease. Speed-accuracy trade-offs required that, to successfully arrive at the bound stride with the feet correctly oriented and with functional run-up velocity, it was essential that bowlers made online adjustments at early stages of their run-ups, at all stages throughout the run-up, as and when they were needed. These findings support the model notion that locomotor pointing control is based on a stable attractor being open to instantaneous intentional or perceptual adaptations through the association of two model parameter values for threshold and gain.

CONCLUSION

The emergence of new theoretical approaches in the field of sport psychology and movement science is resulting in sports and physical pastimes being increasingly used to provide useful movement models for studying how indeterminacy and degeneracy is manifested in brain and behavior. A functionalist philosophy, based on a systemic perspective, emphasizes the constrained optimization that best characterizes how actions emerge from nonlinear movement systems. Such a philosophical perspective clarifies that behaviors or capacities can be studied only under conditions or constraints that facilitate their emergence. Based on Brunswik's (1956) insights, the clear implication for sport psychologists is that studying processes of decision making and action require tasks that are high in representativeness.

In this chapter, we outlined how representative task design is a key feature exemplified in many different movement models from sports and physical pastimes. We highlighted how research studies that use representative designs are better able to reflect the adaptive behaviors seen outside the laboratory context. We also demonstrated that the false distinction related to the issues of ecological validity in laboratory and field-based experiments is redundant due to the greater understanding of task representativeness informed by Brunswik's (1956) insights. We provided a detailed explanation of the metatheoretical concepts that underpin ecological psychology and nonlinear dynamics and the impetus that these approaches have had on research design in sport psychology and the movement sciences. For example, we highlighted the importance of the organism-environment interaction as a relevant scale of analysis for decision making and action. At this level of analysis, the examination of human behavior should occur with tasks that enable the interaction of the individual with appropriate task and environmental constraints.

The theoretical need for representative tasks is related to the increasing predilection for studying movement models from sports and physical activities. As exemplified in this chapter by a range of movement models from the sports of basketball and cricket, we have shown that many phenomena of interest to sport psychologists need to be understood in relation to the interacting constraints of structural and functional neuroanatomical design, specific task goals, and environmental contexts.

Specifically, we provided research examples that show how advances in theorizing from ecological psychology and dynamical systems theory combined in a constraints-led perspective has led to the utilization of complex multijoint task vehicles to provide greater understanding of movement behavior. A constraints-based framework for studying decision making and action provides the theoretical impetus for considering task representative design because it emphasizes:

- The need to adopt a systems perspective in viewing the human being as a degenerative system composed of many interacting subsystems
- The need to understand that a system viewed at another level of analysis is a subsystem of a larger system (e.g., the appropriate scale of analysis for the movement system is at the level of the performer-environment interaction)
- The need to understand the close link between a biological movement system and its environment (particularly the perceptual, movement, and cognitive subsystems and the surrounding energy sources)
- The role of energy arrays acting as perceptual information for constraining, that is, supporting, guiding, and regulating, movement coordination and control
- The study of functional, goal-directed movement activity, such as those performed in the context of sports

This emphasis on how individual constraints interact with task constraints is signaling a fresh perspective on the role of variability in facilitating adaptation to dynamic task environments. Analysis of behavior at the level of the performer-environment system is revealing action modes as examples of natural, emergent phenomena that can be functionally varied to suit the challenge of performing in dynamic contexts. A challenge for psychologists is to consider the benefits of a functionalist philosophy and the implications it has for the representativeness of experimental designs for studying decision making and action in sport.

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CHAPTER 11

Attentional Processes in Skill Learning and Expert Performance

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Attention and attentional processes pervade virtually all aspects of perception, cognition, and action—indeed, it is difficult to conceive of any aspect of human skill that is not, in some way, either dependent on or influenced by attention. Equally, it is difficult to conceive of any aspect of psychology that may be more central to the enhancement of skill learning and expert performance than attention (Rogers, Rousseau, & Fisk, 1999). However, despite its ubiquitous nature and its long history of philosophical and experimental scrutiny, attention remains a poorly defined and (mis)understood concept. In large part, this is because attention as a term is used to refer to a variety of different processes, many of which are only quite loosely related (Nougier, Stein, & Bonnel, 1991). Attention is not a unitary construct but a construct composed of a range of different, diverse, and contextually sensitive processes (Parasuraman & Davies, 1984).

In spite of its diversity, it is nevertheless possible to identify some common roles that attention plays in skill learning and expert performance (Posner & Boies, 1971). One critical role of attention is to preferentially select only particular information for detailed processing. This process of *selective attention* is one that permits relevant or essential information to gain access to the nervous system's limited processing resources while at the same time providing a means to effectively gate out irrelevant or potentially distracting or misleading sources of information, the processing of which may impede performance. Effective and efficient operation of selective attentional processes is essential for skilled performance in sports tasks where critical cues may be available only momentarily and sources of distraction abound. Selective attention is frequently examined experimentally using tasks in which focusing of attention ("concentration") to information from a specified modality, spatial location, or context is required in the face of competition from other items and sources of distraction. In natural tasks, the selective attention of experts is frequently examined using approaches such as cue occlusion and eye movement recording (e.g., see Abernethy, Wann, & Parks, 1998, for a review) and interpretation is heavily influenced by Gibsonian notions of the education of attention and attunement (e.g., see Beek, Jacobs, Daffertshofer, & Huys, 2003; Gibson, 1991).

A second role of attention relates to *alertness* and individual differences in the capacity to develop and maintain optimal sensitivity and readiness to respond to particular stimuli when they appear. Sustained attention, which refers to the capability of an individual to efficiently and effectively process incoming information over an extended period of time, is frequently measured using vigilance tasks and has been found to be influenced strongly by factors such as fatigue, anxiety, and motivation. In sports tasks optimal attention may need to be sustained for only a matter of seconds (in the case of a sprinter awaiting the starter's gun) or for a matter of hours (in the case of road cyclists or cricket fieldsmen awaiting their opportunity to make a definitive move or play). Regardless of the time frame, the quality of the attentional processes involved can have a direct impact on performance levels and outcomes.

A third major role attention plays in human performance relates to the management and allocation of *limited information-processing resources*. Understanding this role involves consideration of the attentional requirements of different tasks, individual- and expertise-related differences in the capacity to divide and switch attention between concurrent tasks, and, of particular importance, the capability, with practice, to "automatize" at least some task components such that they come to require little or no conscious attention to control. The progressive automatization of skills as they become better learned is an issue of potentially great importance to people involved with skill development in sport and other performance domains and, in itself, warrants more detailed examination.

Attention, in all its different roles, is crucial to human performance, and some of the evidence related to each role and some of the consequential implications for sports performance have been reviewed in detail in previous editions of the *Handbook* (Abernethy, 1993, 2001). A further comprehensive review of the evidence relating attention to sports performance is beyond the scope of the current chapter. Rather, in this chapter, we focus exclusively on attention as a limited processing resource and address in detail issues related to controlled and automatic aspects of skill learning and expert performance. Our treatment of this topic involves, inter alia, consideration of the implicit learning of movement skills, the neural pathways through which such learning might be achieved, and some directions for new approaches to the practice and learning of perceptual-motor skills grounded in the emerging evidence.

The chapter is organized into three major sections. In the first section we briefly review some of the key historical developments in attentional research to provide a background in which to position both established and newer theoretical perspectives on the construct of attention. The second, and largest, section of the chapter focuses on the role of automaticity in skill learning and expert performance. In this section, we introduce key distinctions between controlled and automatic modes of processing, implicit and explicit learning, and ventral and dorsal pathways that process visual information used in the perception and control of action, plus overview the major approaches that have been used for the measurement of attentional requirements. Evidence emerging from (cross-sectional) expert-novice comparisons of attentional requirements and from (longitudinal) learning studies of attention is reviewed and used to propose, and speculate on, some alternatives to existing forms of practice and instruction that may help accelerate the rate of skill learning and the acquisition of expertise beyond existing levels. The final section of the chapter provides a synthesis and some comments on future research directions and priorities.

A BRIEF HISTORY OF ATTENTIONAL RESEARCH

The study of attention has a distinguished history in psychology, with an interest in the concept being at least as old as the field of experimental psychology itself (see Boring, 1970, for a review). Some, now classical experimental examinations of divided attention (Binet, 1890; Bliss, 1892–1893; Welch, 1898) and of practice and skill learning (e.g., Bryan & Harter, 1899; Solomons & Stein, 1896) were undertaken in the late nineteenth century and early twentieth century. These complemented writings on attention from an introspective perspective undertaken around the same time by phenomenologists and psychophysicists such as Hamilton (1859), James (1890), and Titchener (1908). By 1928, there was sufficient literature on attention to support a review paper on the topic in the *Psychological Bulletin* (Dallenbach, 1928). Interest in attention waned, however, throughout the first half of the twentieth century, when behaviorism dominated thinking and theorizing in psychology but became reinvigorated post-WWII with the advent of information-processing theory (e.g., Wiener, 1948) and the rise of cognitive psychology.

A major stimulus for theory development in selective attention in particular came from the dichotic listening paradigm studies of Cherry (1953). In this paradigm, people were presented with separate messages to the left and right ears and were required to verbally repeat (or *shadow*) the message presented to one of the ears. The shadowing task was assumed to cause attention to be allocated preferentially to the message that was to be repeated, and the interest was in determining to what extent selective attention to only the shadowed message was complete. Measurement was made of how much and what features of the message presented to the other ear could be reported. The dichotic listening studies consistently indicated that people processed very little of the information from the unshadowed message, apparently being able to selectively process only that information that was relevant to the task at hand. Nevertheless, some particular physical characteristics of the unshadowed message (such as a change from a male to a female voice) were regularly detected, suggesting preferential (arguably automatic) processing of this kind of information.

Attempts to explain the selective listening data gave rise to a series of models of attention that all proposed bottlenecks at one or more stages of information processing (see Figure 11.1). Broadbent (1958) proposed a filter model of attention, with the processing bottleneck located early in the processing sequence and based on the physical properties of the different stimuli. Deutsch and Deutsch (1963) argued for much later selection, with all stimuli first given extensive feature processing. Treisman (1969) argued for an attenuation model of attention that proposed a series of tests (the first based on physical properties of the stimuli,

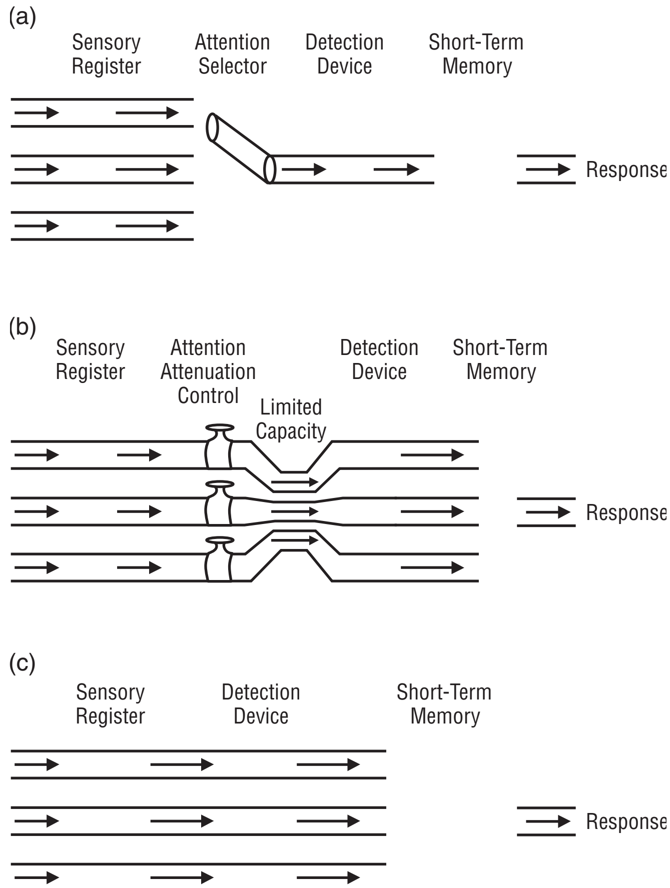

Figure 11.1 Comparative structure of (a) early filter models, (b) attenuation models, and (c) late selection models of selective attention. *Source:* "On the Degree of Attention and Capacity Limitations in Tactile Processing," by R. M. Shiffrin, J. C. Craig, and E. Cohen, 1973, *Perception and Psychophysics, 13,* p. 329. Copyright 1973 by the Psychonomics Society, Inc. Reprinted with permission.

the second based on collective stimulus patterns, and the third based on semantics), with irrelevant information being progressively attenuated at each of these levels of analysis. The attenuation model differed fundamentally from the filter models in that it proposed that (a) selection is based on elements additional to the simple physical properties of the incoming stimuli, and (b) the analyses guiding selection of stimuli for further processing occur in an essentially continuous rather than discrete fashion.

Inconsistent experimental data on the putative location of the information-processing bottleneck led Moray (1967) and Kahneman (1973) to suggest that cognitive (and attentional) processes were far more flexible than acknowledged by models that proposed structural bottlenecks and processing channels of limited capacity (e.g., see Welford's 1967 single-channel theory). Kahneman proposed that attention should be more appropriately viewed as a commodity that, while having finite overall limitations, can be flexibly allocated between concurrent tasks in a manner that the individual chooses and that best matches the situational requirements. Flexible allocation of a limited resource provides a reasonable explanation of why different bottlenecks emerge for different individuals and for different task combinations but was ultimately unable to explain the observations of inconsistent interference that appear when different secondary tasks are coupled with the same primary task. If attention really exists in the form of a large, undifferentiated general capacity, then different secondary tasks performed in conjunction with a common primary task should reveal consistent conclusions regarding the attention demand of the primary task; however, such does not appear to be the case (e.g., Wakelin, 1967).

The difficulties associated with viewing attention as a general-purpose, limited-capacity, central processor were clearly articulated by Navon and Gopher (1979) and Allport (1980a), and a major theoretical reformulation was set in place in the early 1980s. Attention is now most frequently conceived as a series of resource pools (Gopher & Sanders, 1984; Wickens, 1992) or multiprocessors (Allport, 1980b), each with their own unique capacities and resource-performance relationships. Within such a conceptualization, attentional capacity is seen not to be centralized but *distributed* throughout the nervous system. The major challenge presented by such a view of attention is therefore not to measure the limits of central processing capacity but to isolate the specific, special-purpose modular subsystems that collectively compose the attentional resource pool.

Over the past 2 decades development of theories of attention have also been progressively influenced by both computational modeling, driven by the rise of cognitive science and the increasing fusion of the methods of psychology with those of computer science, and by evidence arising from neurophysiological sources, especially neuroimaging. Computational models, including models of parallel distributed systems (or connectionist models; Rumelhart & McClelland, 1986), have proven useful in helping to further identify the source of bottlenecks for the control and production of movement (e.g., see Meyer & Kieras, 1997), and neurophysiological evidence from studies of brain imaging has helped to identify the role of different brain regions in different aspects of attentional processing (e.g., Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Fan & Posner, 2004; Posner, 2003). It is the convergent evidence from traditional experimental studies in conjunction with the evidence available from these newer techniques that has made possible new insights into how attention is allocated to different tasks and how attentional processes may become modified with skill learning and the acquisition of expertise.

AUTOMATIC PROCESSES IN SKILL LEARNING AND EXPERT PERFORMANCE

In this section, we examine the key concepts, investigative methods, findings, and theorizing pertaining to the issue of automatic and associated processing in skill learning and expert performance, drawing on evidence from an array of sources.

Controlled and Automatic Processing

Experience, observation, and conventional wisdom inform us that skill execution can sometimes require great effort and concentration, but at other times seems almost effortless. These observations essentially reflect the distinctions made, respectively, between controlled and automatic processing (Schneider & Shiffrin, 1977). Controlled processing reflects *conscious* efforts to appraise incoming information and select a suitable response. Under controlled processing, information is processed more or less serially; as a consequence, processing of this type tends to be slow, particularly when environmental cues and possible responses are numerous (Ackerman, 1988). Controlled processing is mediated by the actions of working memory, a modular cognitive construct that is thought to be at the heart of conscious attentional processes (Baddeley, 1999). In contrast, automatic processing takes place *unconsciously* and is associated with fluent movement production (Salmoni, 1989), apparent effortlessness, resistance to disruption (e.g., Abrams & Reber, 1988; Maxwell, Masters, & Eves, 2003), reduced physiological cost (Vereijken, van Emmerik, Whiting, & Newell, 1992), and less reliance on attentional resources (Curran & Keele, 1993; Schneider, Dumais, & Shiffrin, 1985), particularly those of working memory (Schmidt & Wrisberg, 2004).

Most, if not all, sport skills are performed with contributions from both controlled and automatic processes, rather than one process exclusively. As we shall see, the respective contributions depend both on skill level or stage of learning and on the nature and constraints of the task (see Anson, Elliot, & Davids, 2005; Bernstein, 1996). Assuming that controlled processing, but not automatic processing, relies heavily on the availability of a limited-capacity attentional resource (i.e., working memory), it follows that skilled performance depends on either efficient allocation of conscious attentional resources or automatization of certain subcomponents of the skill to free conscious resources. The applied benefit of understanding these processes is clear when considering the multiple attentional demands placed on athletes from many sports. Dribbling in basketball, for instance, requires the dribbler to maintain control of a moving ball while simultaneously running at speed, dissociating friend from foe, and evaluating possible attacking options.

Measuring Attentional Requirements

Assessment of the attentional demands of specific tasks requires the implementation of measures that fulfill several criteria. Specifically, measures must be sensitive to fluctuations in the availability of attentional resources, selective in terms of placing demands only on the structures of interest, unobtrusive in the sense of not interfering with the task of interest, diagnostic in the sense of being able to identify resources that are being taxed, and reliable (Sheriden & Stassen, 1979). The available behavioral, cognitive, and physiological measures of attentional demand vary in the extent to which they satisfy each of these, occasionally competing, criteria (Wickens, 1979).

Several techniques have been adopted in an attempt to measure the attentional demands involved in the performance of different tasks (Ogden, Levine, & Eisner, 1979; Wickens, 1992). These techniques predominantly measure controlled processing, from which automatic processing is inferred but not measured directly. The most common method of measuring attentional demand has been the dual-task paradigm. This paradigm involves performance of two tasks simultaneously, the primary task of interest and a secondary task that is hypothesized to selectively load conscious attentional resources. For example, a golfer may be asked to perform a putt (the primary task) and at the same time generate letters randomly from the alphabet (cf. Masters, 1992). The generation of random letters is mediated by working memory (Baddeley, 1966). Attentional capacity is limited; therefore, the ability of the golfer to perform both tasks simultaneously depends on their relative attentional demands. Should the putting action require conscious control, performance may deteriorate when competition for resources is provided by the secondary task; conversely, if putting is automatic, sufficient resources should be available to perform the secondary task without performance deterioration.

An enormous range of tasks are available both to measure human performance and select as potential secondary tasks. (For comprehensive reviews of human performance measures, see Gawron, 2000; Lysaght et al., 1989.) Random letter generation is an example of a continuous secondary task; other examples include monitoring audible tones, pursuit tracking, mental arithmetic, and shadowing speech. Continuous tasks have the advantage of placing demands on attentional resources throughout the execution of the primary task, and their difficulty can be systematically manipulated to provide an index of attentional load. However, continuous tasks are limited in their capacity to identify attentional fluctuations during specific phases of the primary task. For this reason, discrete secondary tasks have been adopted when the precise timing of attentional demands is of interest. Perhaps the most commonly utilized discrete dual task is probe reaction time (PRT), which involves measuring reaction time to a specific stimulus, usually an auditory tone (Lysaght et al., 1989). Quicker responses are thought to represent greater availability of attentional resources for allocation to the primary task (Abernethy, 1988).

The PRT paradigm has been used to identify attentional changes during learning (Wrisberg & Shea, 1978), differences between individuals (e.g., Wulf, McNevin, & Shea, 2001), and changing attentional demands throughout the duration of a movement (McLeod, 1980). Probes are ideally presented in such a way that their onset cannot be predicted. This can be accomplished by randomizing interstimulus intervals when the primary task is continuous (e.g., Wulf, McNevin, et al., 2001) or inserting catch trials (trials without probes) when the primary task is discrete (e.g., Salmoni, Sullivan, & Starkes, 1976). When attentional changes during the course of a single trial of the primary task are of interest, PRT can be plotted against time to provide an image of the primary task's attentional landscape (Posner & Keele, 1969). Attentional peaks and valleys (representing greater controlled and automatic processing, respectively) can be estimated by plotting PRT at stimulus onset (i.e., when the probe is presented) or when a response to the probe is completed, with the latter technique being commonly regarded as more conservative but nevertheless more accurate (Girouard, Laurencelle, & Proteau, 1984; McLeod, 1980).

Interactions between controlled and automatic processing are often difficult to interpret because they depend on the particular theoretical framework within which they are evaluated, and the degree of primary and secondary task integration cannot be easily predicted (Heuer & Wing, 1984). For these reasons, and those discussed previously, other measures of attentional capacity and load have been developed, although, to date, they have been little used in sport research. Subjective measures, such as the NASA Task Load Index (TLX; Hart & Staveland, 1987) and Pilot Objective/Subjective Workload Assessment Technique (Reid & Nygren, 1988), have been developed to assess attentional workload in ergonomic settings. The TLX assesses workload using self-report ratings of mental, physical, and temporal demand integrated with measures of performance, effort, and frustration. Subjective techniques have not been widely adopted by sport psychologists because there is doubt concerning concordance between the performer's verbal reports and the actual demand placed on processing resources, as well as problems with construct, concurrent, and predictive validity (Nygren, 1991).

Physiological indicators of attention have become increasingly popular because they have the advantage of being continuous and, in some cases, relatively unobtrusive. Pupil diameter, cardiac acceleration/deceleration, heart rate variability, and electroencephalographic (EEG) event-related potentials have been used with varying success to indirectly assess attentional resources (e.g., Janelle, Duley, & Coombes, 2004). Dilation of the pupils in response to the imposition of cognitively demanding tasks has been recorded (Beatty, 1982) but may have limited use in sport because dilations are also related to arousal increases and changes may not reflect the nature of the underlying resource conflict.

Although absolute heart rate (HR) does not appear to be a reliable indicator of attentional workload across a range of tasks (Wierwille & Connor, 1983), other cardiac indices may provide useful information. Jennings, Lawrence, and Kasper (1978) have argued that cardiac acceleration/deceleration (as assessed from relative changes in interbeat interval) may be systematically related to available processing capacity. Jennings et al. have demonstrated that although absolute HR is affected more by the overall response requirements of the task (a reaction time task, in their case), the relative acceleration/deceleration patterns in HR relate closely to PRT measures. Heart rate deceleration appears to accompany, and index, the presence of spare attentional capacity, whereas HR acceleration is more prevalent in conditions of processing overload. This approach is used occasionally in the sport context (e.g., Crews, 1989), although clearly this, like other potential cardiac measures of attention, can be of use only in those activities where the performer remains essentially stationary.

An increasingly popular measure of mental workload in the ergonomics literature is HR variability. Across a range of different methods of calculating variability, including spectral (e.g., Meshkati, 1988) and nonlinear (Sammer, 1998) analyses, HR variability appears to decrease with increasing attentional demands of tasks (Vicente, Thornton, & Moray, 1987), making it one of the more promising physiological indicators of attentional workload or effort. However, as with pupil diameter measures, HR variability appears to reflect more the total demand on all available processing resources than the specific competition between processing resources (Wickens & Derrick, 1981), and therefore may have limitations as a diagnostic device (Wickens, 1992). Heart rate variability has received little or no usage in assessing the attentional demands of different sport tasks, undoubtedly because the cardiac changes associated with any form of physical activity may confound and swamp the relatively small effects due to cognitive processing. However, the measure may be useful in sports in which the maintenance of body stability during preparation is important to performance. Nevertheless, all peripheral physiological measures of nervous system activity (such as HR variability and pupillometry) are necessarily limited in their utility in measuring attention to the extent that they are frequently (a) too slow or late, (b) too remote from the processes that are of primary interest, (c) too nonspecific, and (d) too closely influenced by activity and emotion (Näätänen, 1992).

Electroencephalography provides a measure of postsynaptic potentials in the cerebral cortex (Davidson, Jackson, & Larson, 2000; Janelle et al., 2004). The EEG signal contains frequency and amplitude components that may provide specific information about the underlying mental processes. Raw EEG signals are decomposed into sinusoidal waves of differing frequency (e.g., alpha, beta, and theta) using Fourier transformation (Smith, 1997), with each of these frequencies being associated with activities having different attentional requirement. Alpha activity is associated with low mental activity, whereas beta and theta activity increases with attentional demand (Janelle et al., 2004). Examining frequency characteristics provides a general measure of attentional workload, but the precise timing of attentional peaks cannot be identified. For this reason, event-related potentials (ERPs)—specific activation peaks relative to a specific event, such as movement initiation—are often examined to provide a temporal representation of attentional resource allocation.

The typical ERP is composed of exogenous and endogenous components representing generic and task-specific information processing, respectively. Endogenous components have been the focus of research concerning task-related attention, with a number of components appearing to reflect changes in attentional capacity and resource allocation (for a detailed discussion, see Hatfield & Hillman, 2001). Components are named according to the time of their appearance after an event and their polarity (positive or negative). One of the more important components in the context of attentional research appears to be the P300 component (Snyder, Hillyard, & Galambos, 1980). The P300 latency appears to be sensitive to the memory load imposed by the primary task (Kramer & Strayer, 1988), although reported correlations between P300 latency and reaction time vary considerably in their strength (Donchin, 1984; Donchin, Ritter, & McCallum, 1978). More important, the amplitude of the P300 appears to decrease as secondary task difficulty increases, suggesting that it is sensitive to attentional resource demands (e.g., Kramer, Wickens, & Donchin, 1983).

Although EEG measures have several limitations for the study of attention in sport, such as the requirement of minimal movement, poor concordance with other measures of attention, expense, and poor portability, they have nevertheless been successfully utilized in several sports, especially aiming sports such as rifle shooting (Hatfield, Landers, & Ray, 1984; Janelle et al., 2000; Rossi & Zani, 1991) and archery (Landers et al., 1994), baseball (Radlo, Janelle, Barba, & Frehlich, 2001), and self-paced skills such as golf putting (Crews & Landers, 1993). Integration of measurement techniques seems a logical strategy for assessing attentional workload at multiple levels (Abernethy, Summers, & Ford, 1998; Wilson & O'Donnell, 1988), consistent with the trend toward multilevel measurement and theorizing in other aspects of psychology and the behavioral sciences (e.g., Cacioppo & Berntson, 1992; McLeod & Driver, 1993).

Expertise and Attentional Resource Allocation

Cognitive approaches to skill acquisition are characterized by assorted variations of traditional stage theories of information processing of the type developed by Fitts and Posner (1967) and Anderson (1983, 1993, 1995). Such approaches are generally based on the distinction between processing of declarative and procedural knowledge; the application of declarative knowledge involves controlled processing, whereas procedural knowledge is processed automatically. In the sports context, declarative knowledge refers to verbalizable rules, techniques, or methods that are applied by controlled processes to achieve optimal performance. Procedural knowledge drives action and is typified by the idea of motor programs or schemas (e.g., Keele, 1968; Schmidt, 1975, 1982). According to stage theories, declarative rules are gradually transformed, through practice, into procedural knowledge that automatically guides performance without recourse to conscious attentional resources.

These theories predict that expert motor performance should place fewer demands on attentional resources than novice motor performance, and there is now ample evidence to suggest that this prediction is generally true. Leavitt (1979), for example, demonstrated that skating speed is considerably reduced when novice ice hockey players are required to complete concurrent secondary tasks (e.g., dribbling a puck), but is not reduced in experts. Beilock, Wierenga, and Carr (2002) reported that expert golfers were able to accurately perform an auditory word-search task without compromising putting performance, whereas novices were unable to maintain putting accuracy under such conditions. Beilock et al. also observed that the novices were more aware of their movements (assessed by self-report), suggesting more involvement of conscious control in the formative stages of learning.

The extent to which experts are robust to the effects of secondary task loading depends on the characteristics of the primary and secondary tasks, the overall availability of resources (capacity), and the degree to which the concurrent tasks can be integrated or structured (Heuer & Wing, 1984). Thus, interference from secondary tasks can be a result of capacity limitations (exceeding total available resources) or structural interference arising from concurrent demands on common processes (Kahneman, 1973). For example, working memory is conceived as a central executive supported by a phonological loop, visual-spatial sketchpad, and episodic buffer (Baddeley, 1986, 1996, 2000; Baddeley, Chincotta, & Adlam, 2001; Logie, 1995). The central executive governs and coordinates the functioning of the three slave systems. Capacity limitations are well researched in the motor domain (e.g., Maxwell, Masters, & Eves, 2000), but evidence for structural interference is limited. MacMahon and Masters (2002) provided some evidence of structural interference using a golf putting motor task and several secondary tasks that loaded differentially on the multiple components of working memory. Golf putting normally loads the central executive, episodic buffer, and visual-spatial sketchpad, but minimally loads the phonological loop. When participants were required to perform a phonological loop task (in this case, articulatory suppression, the repeated, continuous utterance of a single word), no interference of the primary task was observed; however, a secondary task requiring the central executive (random number generation) significantly reduced putting performance. MacMahon and Masters suggested that structural interference in the central executive was responsible for performance breakdown, although a capacity argument cannot be completely discounted.

The degree of interference from secondary tasks may also be affected by the particular focus of attention adopted by the performer. There is good evidence to suggest that adopting an external focus of attention (i.e., a focus on environmental information and the predicted outcome of a skilled action) promotes automatic control of body movement, whereas focusing internally or on skill execution promotes the use of controlled processing (e.g., McNevin, Shea, & Wulf, 2003; Poolton, Maxwell, Masters, & Raab, 2006; Shea & Wulf, 1999; Wulf, Höß, & Prinz, 1998; Wulf & Prinz, 2001). Gray (2004) showed that expert baseball batters were robust under secondary task loading that focused attention externally, but performed relatively poorly when the secondary task focused attention internally on skill execution. Novices, however, demonstrated the opposite pattern of results, exhibiting robust performance when focusing on skill execution.

Although experts have been consistently shown to employ automatic processing to a greater degree than novices, this does not imply that expert performance is completely automatic. Expert performance can be disrupted with a suitably taxing secondary load, and conscious control can act to inhibit automatic responses (Beek, 2000), possibly helping the performer adapt to novel situations (Schneider et al., 1985). The expert performer may also choose to impose conscious control over normally automatic actions when faced with certain demands (Masters, 2000; Masters & Maxwell, 2004). Masters, Polman, and Hammond (1993), for example, argue that performers may attempt to consciously control their actions when under pressure to perform optimally, despite the common recognition that "reinvesting" their attention in this manner may be an inappropriate strategy (Baumeister, 1984; Baumeister & Showers, 1986; Beilock & Gray, Chapter 19).

Attention and Learning: Implicit versus Explicit Motor Learning

The findings discussed thus far highlight the often complex interactions among task complexity, level of performance, strategic decisions, and cognitive architecture, each of which are further complicated by consideration of the sensory modality (visual, kinesthetic, or auditory), encoding strategy (verbal or spatial), stage of processing (perception, response selection, and responding), and response modality (manual or verbal) involved in execution of particular skills (Wickens, 1992). Recently, it has become apparent that the learning environment also has a profound impact on how skill execution is controlled. Based on the idea of progression from controlled to automatic processing over the course of learning, it would seem logical to restrict the amount of information that a novice must process so that attentional resources are not overloaded, and to direct the attention of learners to the intricacies of skill execution (e.g., Beilock et al., 2002; Gray, 2004); however, research to date does not comprehensively endorse this view.

An early study by Eysenck and Thompson (1966) that manipulated attentional resources during learning involved performance of a pursuit rotor task under varying degrees of distraction. Participants learned the pursuit rotor task under nondistracting conditions or under conditions of easy, medium, or difficult distraction. The distracting task required a foot pedal response to a high- or low-pitched tone. Difficulty of distraction was manipulated by varying the rate of tone presentation. Eysenck and Thompson discovered that performance deteriorated relative to the difficulty of the secondary task, but that learning, as measured by a retention test under nondistracted conditions, was surprisingly unaffected. They also found that performance of the distracter task during the rest interval between learning and retention did not affect consolidation processes. A similar study (McLeod, 1977) reported that level of difficulty of a secondary, mental arithmetic task did not differentially affect manual tracking performance, suggesting that the arithmetic and tracking tasks are supported by different, independent cognitive mechanisms.

In a related study, Pew (1974) had participants perform a pursuit-tracking task for 14 days, completing 24 trials per day. The task required participants to use a joystick to track a waveform presented on an oscilloscope. The waveform consisted of three sections of which the middle section was invariant and the first and last sections were randomly generated, and consequently variable, on each trial. Pew found that performance improved on the repeated section with practice; however, when questioned, participants were unaware of the presence of the repeating section. This effect has been replicated several times and appears to be independent of presentation order, variability of practice, and response modality (Hill & Raab, 2005; Magill & Hall, 1989; Magill, Schoenfelder-Zohdi, & Hall, 1990; Shea, Wulf, Whitacre, & Park, 2001; Wulf & Schmidt, 1997). Green and Flowers (1991) used a computerized catching task to identify differences in performance brought about by providing or withholding task instructions. Participants utilized a joystick to manipulate a cursor on a computer screen with which they attempted to catch a descending single-pixel ball. A "glitch" in the descent of the ball predicted a 75% probability of a fade (or sharp break) to the right in the final 300 ms of the ball's descent. Interestingly, participants who were not informed of this relationship performed the task in a qualitatively different manner to and more accurately than those who were informed of the relationship. Green and Flowers proposed that the uninformed participants had learned the glitch-fade relationship implicitly.

Implicit learning has been conceptualized by Reber (1989, p. 220) as the "process by which knowledge about the rule governed complexities of the stimulus environment is acquired independently of conscious attempts to do so." In other words, learning takes place automatically with minimal input from controlled processing. Explicit learning, on the other hand, relies heavily on controlled processing. The implication from the studies of Pew (1974) and others is that manual skills can be learned automatically, without input from controlled processing. This observation and the concept of implicit learning clearly present a serious problem for the wholesale application of stage theories of learning to the motor domain.

It is possible that the implicit learning effect found in tracking studies may be due to the primary (tracking) task being relatively simple, and therefore perhaps not requiring extensive contributions from controlled processing (Glover, 2004), although this seems increasingly unlikely. A growing body of literature now provides evidence of implicit motor learning of tasks that are more complex than pursuit tracking. In an early study, Masters (1992) required learners to perform a random letter generation (Baddeley, 1966), while concurrently performing the more complex task of golf putting. The random letter generation task was hypothesized to fully occupy controlled processes (i.e., those processes involving working memory) such that any contemporaneous learning of the primary task would be a function of implicit, automatic processes. The putting performance of the implicit group improved over trials, demonstrating that learning had indeed occurred. Furthermore, the participants failed to accrue explicit, declarative knowledge of the putting skill, providing initial evidence that the skill had been acquired implicitly. Masters, and later Hardy, Mullen, and Jones (1996), also demonstrated that the performance of the implicit learners improved under evaluation-induced psychological stress, whereas the performance of the explicit learners degraded, mirroring characteristics known to be true of implicit learning in the cognitive domain (e.g., Reber, 1993).

Promotion of implicit processing during the learning of complex motor skills has since been investigated using a variety of techniques, including error reduction, heuristic instruction, and feedback manipulations (e.g., Liao & Masters, 2001; Masters, Maxwell, & Eves, 2001; Maxwell et al., 2000, 2003; Maxwell, Masters, Kerr, & Weedon, 2001). Collectively, the findings from such studies suggest that learning need not progress from predominantly controlled processing to chiefly automatic processing, as stage theories suggest, but that learning involves a complex interplay of contributions from both. Several authors (e.g., Gentile, 1998; Masters & Maxwell, 2004; Sun, Slusarz, & Terry, 2005; Willingham & Goedert-Eschmann, 1999) have proposed adapted theories of skill acquisition, based on the concepts of implicit and explicit learning, to accommodate this principle. In the motor domain, Masters and Maxwell have argued that procedural knowledge can be acquired and applied automatically, independent of working memory resources (Maxwell et al., 2003), whereas the accrual and controlled application of declarative knowledge requires the availability of working memory. The acquisition of both types of knowledge may involve dedicated neural architectures and can occur in parallel, with the potential for either to dominate movement control.

The Ventral-Dorsal Processing Pathway Distinction

The notion of implicit and explicit modes of skill learning has much in common with emerging neuropsychological perspectives on human visuomotor control. Neuroanatomically, the human visual system contains two broad pathways emanating from the primary visual cortex: a ventral pathway that projects to the inferotemporal cortex and a dorsal pathway that projects to the posterior parietal cortex (Ungerleider & Mishkin, 1982). Although not without its critics (e.g., Glover, 2004), a widely accepted interpretation of the functional distinction between these two pathways is that the ventral pathway subserves the pick-up of information for the perception of objects, events, and places, whereas the dorsal pathway provides information for the control of action (Milner & Goodale, 1995).

The two visual functions have been differentiated on the basis of the spatial and temporal scale at which they operate. Identification and recognition of objects demands enduring information that is independent of an observer's momentary viewpoint. Hence, the ventral pathway chiefly relies on *allocentric* (or world-centered) information that specifies the location, motion, and size of an object in relation to other objects. To the extent that the visual perception of objects is exploited for communication (i.e., telling or being told about the environment), ventral pathway activity is associated with explicit awareness. By contrast, the control of action requires metrically precise information about the location, motion, orientation, and size of objects relative to the actor. The dorsal pathway's primary dedication, therefore, is to the detection of *egocentric* (or body-centered) sources of information. Further, because movement control requires information to be available almost immediately (information that is more than a fraction of a second old is of little use), the dorsal pathway's operations are necessarily fast, although the information it detects may be quickly lost.* On this basis, Milner and Goodale (1995) argued that, by and large, the control of action is automatic and implicit; people need not be consciously aware of how they move.

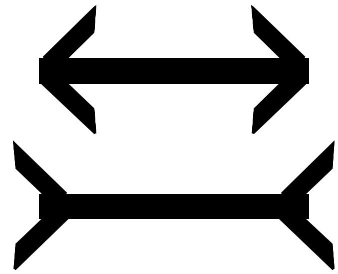

Figure 11.2 The Müller-Lyer illusion. Even though one sees the shaft of the bottom configuration to be larger than the one in the top figuration, the maximal hand apertures when grasping the shaft do not differ, or only marginally so.

An important part of the behavioral evidence underpinning the differences between the ventral and dorsal pathways has come from investigations of illusory effects on visual perception and the control of action in healthy participants (Milner & Goodale, 1995). For example, in the Müller-Lyer illusion (Figure 11.2) the perceived shaft length depends on the direction of the tails. Grip scaling when picking up the shaft, however, remains (almost) unaffected by the illusion (Otto-de Haart, Carey, & Milne, 1999). This dissociation between visual perception and action control is usually attributed to the differential reliance of the two streams on allocentric and egocentric sources of information. Because the dorsal pathway is dedicated to detecting egocentric information, the illusion does not bias grasping. Additionally, as the dorsal pathway operates within a short temporal frame, it is assumed that under circumstances where action cannot be performed under direct visual control, such as when moving without vision of the target or when pantomiming movements, the ventral pathway must participate in the control of action (Milner & Goodale, 1995). This is exactly what is found. Imposing a delay between viewing the shaft and initiating the grasping action results in bias of the grip aperture consistent with the perceptual effects of the Müller-Lyer illusion (Heath, Rival, & Neely, 2006). Engagement of the

* Related dichotomies exist. For example, Lewis and Miall (2003) distinguished between separate neural systems for time measurement: an automatic system that is linked to movement for subsecond durations and a cognitively controlled system that draws heavily on working memory and attention processes for the measurement of suprasecond intervals.

ventral pathway in movement control thus leads to an increased reliance on allocentric information.

Particularly important in the context of the current discussion of attentional processes, the ventral/dorsal dichotomy seems to have many features in common with the explicit and implicit (motor) learning distinction outlined in the previous section. In particular, both distinctions are associated with different degrees of conscious awareness and involvement of (working) memory. This has led some (e.g., van der Kamp, Savelsbergh, & Oudejans, 2003) to hypothesize that implicit learning may chiefly involve engagement of the dorsal visual pathway, whereas explicit learning may also engage the ventral visual pathway, especially early in skill learning. There is some experimental evidence to support this contention. Rossetti (1998), for example, reported evidence that concurrent explicit verbalization induced involvement of the ventral pathway. In his study, participants were presented with an array of visual stimuli, one of which (the target stimulus) changed color. In one condition, participants were required to point to the target stimulus the moment the array disappeared from screen, and at the same time speak aloud the number corresponding to the target location. Pointing errors in this verbalization condition were aligned with the surrounding stimulus array, indicating that the participants used allocentric information that specified target location relative to the other stimuli. By contrast, nonverbalization and task-irrelevant verbalization conditions resulted in egocentric pointing errors (i.e., errors that were aligned with the movement direction). Verbalization during action execution thus appeared to have encouraged ventral pathway involvement in normally dorsal movement control.

Unlike an implicit learner, a novice who consciously invokes explicit knowledge (perhaps based on instructions from a coach) would be expected to demonstrate a relatively strong reliance on the ventral pathway. The dedicated dorsal pathway would be fully responsible for control only after the action had become highly automatized (see Milner & Goodale, 1995). In such a scenario, learning would be characterized not only by a declining awareness of the movement during execution, but also by a concurrent change in guidance from allocentric to egocentric information (van der Kamp et al., 2003; Willingham, 1998). For example, actions may become progressively less susceptible to visual illusions. In this respect, it is noticeable that the highly automatized actions of grasping and reaching appear much less sensitive to illusions than hopping, which is arguably a less commonly performed action (Glover & Dixon, 2004). In these terms, implicit skill learning would be typified as a direct tuning of the dorsal pathway (Willingham, 1998), thereby reducing intervention by the ventral pathway (van der Kamp et al., 2003). It follows that if the goal is to enhance the learning of visuomotor control, approaches involving implicit rather than explicit learning may be beneficial because such approaches are more likely to invoke the essential dorsal pathways and minimize ventral pathway interference.

Alternative Approaches to Learning Perceptual-Motor Skills

Other approaches to the study of implicit motor learning over the past decade also raise the possibility that the rapidity of motor learning can be enhanced by the way attention is influenced during learning. In particular, it would appear that there may be merit in trying to develop learning conditions that are more implicit, and hence, by definition, less explicit, conscious, and dependent on verbal (and verbalizable) information, than those that are currently in vogue. This interest in implicit approaches to skill learning has been stimulated largely by the research suggesting that skills learned implicitly are more robust under stress (Hardy et al., 1996; Masters, 1992).

Errorless Learning

A major challenge to using implicit learning methods to facilitate skill acquisition is that the majority of implicit motor learning paradigms developed thus far, though promoting a form of learning that is more resistant to performance deterioration under stress, nevertheless produce learning at a much slower rate than occurs with conventional (explicit) learning. Masters (1992), for example, found that although benefits of robustness under psychological stress accompanied a golf putting skill learned implicitly via a concurrent secondary task paradigm, learning was up to 25% slower than a discovery learning, or an explicitly instructed treatment condition. Maxwell et al. (2000) showed that this remains the case over as many as 3,000 trials (see also MacMahon & Masters, 2002; Maxwell et al., 2001, 2003).

An important challenge is therefore to discover or develop alternative implicit motor learning approaches that may have a less disruptive effect on rate of learning. One possibility lies with the notion of errorless learning (Maxwell et al., 2001). Prather (1971) observed that errorless learners tend to learn in a more attentionally passive manner than typical trial-and-error learners and, in so doing, make relatively limited demands on working memory, as do implicit processes (Berry & Dienes, 1993). Most learners of movement skills typically adopt a problem-solving approach to movement issues (Glencross, 1992), paying considerable conscious attention to primarily visual sources of information regarding the success of their movements (Posner, Nissen, & Klein, 1976). On the basis of feedback showing discrepancies between movement intention and outcome, learners typically develop and test in a quite deliberate way alternative movement strategies (Anderson, 1987; Salmoni, 1989). Working memory is deployed to identify and correct the movement errors in a form of hypothesis testing (Baddeley & Wilson, 1994; Berry & Broadbent, 1984, 1988).

This process of hypothesis testing (Allen & Reber, 1980; Hayes & Broadbent, 1988; Ohlsson, 1996) involves the production of verbal proposals, which are tested as trial movements (e.g., "What will happen if I keep my weight over my left knee and tilt my right ear toward my right foot?"). If performance improves, the knowledge is stored as explicit, declarative "rules" for future reference, but if performance fails to improve (or worsens), the knowledge tends to be discarded or ignored. The potential difficulty with this approach is that it is both an attentionally demanding and a time-consuming way to learn. As Singer (1977, p. 494) points out, if there is "concern for economy in training time," a reduction in the commission of errors (especially early in learning) will prevent the tortuous business of "unlearning" them. Reduction of errors by provision of guidance during learning has been shown to result in performance superior to trial-and-error learning (e.g., Holding, 1970; Hunkin, Squires, Parkin, & Tidy, 1998; Prather, 1971; Wulf, Shea, & Whitacre, 1998), although often this superiority has not carried over into delayed retention or transfer tests of learning (Singer, 1977).

Maxwell et al. (2001) argued that errors in performance cause learners to test hypotheses about their movements. This results in a highly explicit, declarative mode of learning in which working memory is heavily involved. By constraining the learning environment in such a way that learners made few mistakes, Maxwell et al. were able to limit the role of working memory in the learning of a golf putting task, so deflating the accrual of declarative knowledge (explicit learning) and inflating procedural knowledge accumulation (implicit learning). This was reflected in superior performance for the errorless learners throughout the different stages of practice compared to errorful learners. The notion of implicit learning being encouraged through approaches that reduce the errors in learning is a powerful one, and one that can also be meaningfully applied to reinterpretation of some existing data on the attentional demands of movement.*

Discovery Learning

Researchers interested in the development of expert perceptual skills for sport have begun examining techniques both to create implicit learning conditions (e.g., Farrow & Abernethy, 2002; Raab, 2003) and to examine (guided) discovery learning (Smeeton, Williams, Hodges, & Ward, 2005; Williams, Ward, Knowles, & Smeeton, 2002). For example, Smeeton et al. compared the robustness of explicit, discovery, and guided discovery learning techniques in the anticipation of young intermediate tennis players. They found that the decision times of performers in the explicit group slowed significantly more than either the discovery or guided discovery group in the anxiety condition. They also became less accurate, suggesting that the results were not due to speed-accuracy trade-off. Furthermore, the increase in decision time in the explicit players was positively related to the number of rules accumulated during the learning period. Comparing the change in response accuracy under pressure for each group together with the number of self-reported rules further implicated explicit knowledge in this process. The discovery learning group generated the fewest rules (2.0) and had the smallest decrement in response accuracy (–9%), offset by faster decision times (–99 ms). The guided discovery group generated more rules (4.9) and had a larger decrement in accuracy (–12%), again offset by slightly faster decision times (–71 ms). The explicit group generated the most rules (9.5) and suffered the largest decrease in response accuracy (–17%), accompanied by an increase in decision time (+334 ms).

Research examining the benefits of implicit or less directed perceptual training interventions is in its infancy, and support remains equivocal (Jackson, 2003; Jackson & Farrow, 2005; Poulter, Jackson, Wann, & Berry, 2005). Jackson and Farrow highlighted conceptual, methodological, and practical issues for researchers in this area, noting the different views regarding how to conceptualize implicit learning research that have been expressed in other

*Interestingly, Leavitt's (1979) efforts to manipulate attention demands during ice hockey showed that performance when using an oversized puck was similar if the player was skating only or skating and concurrently dribbling the puck. Leavitt assumed that increasing the size of the puck decreased demands on attention, permitting better performance; however, a parallel explanation is that increased puck size reduced errors in performance, which directed attention away from hypothesis-testing behavior and permitted learning to proceed in a more implicit way.

domains. This is particularly relevant to training interventions that encompass different elements that may draw on both explicit and implicit processes. For example, perceptual training interventions have varied in frequency and duration (from a single 45-minute session to 16 20-minute sessions), mode of presentation (normal speed versus slow motion), the degree of explicit information given (from "tips" to formal biomechanical-based instruction), and the opportunity to practice using this information. It is possible that some of these factors influence the degree to which explicit and implicit processes are invoked during learning. It is clear that the extent to which implicit and explicit processes are active during both perceptual and motor learning will be dependent, at least to some degree, on the specific constraints of the task to be learned. In discovery learning, for example, emerging movement solutions may be predominantly implicit in nature if the underlying task-relevant information is not easily extracted, but more explicit if the information is easily extracted.

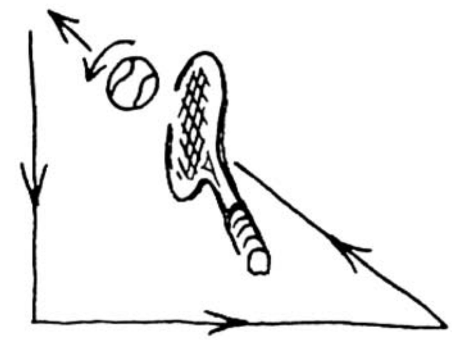

Figure 11.3 A right-angle triangle analogy used to help teach the top-spin forehand stroke in table tennis. The learner is asked to imagine a right-angle triangle and to swing his or her racket along its hypotenuse when striking the ball. *Source:* "Theoretical Aspects of Implicit Learning in Sport," by R. S. W. Masters, 2000, *International Journal of Sport Psychology, 31,* p. 539. Reprinted with permission.

Analogy Learning

Hodges and Franks (2002, p. 805) have called for the development of learning paradigms "that help the learner to constrain the degrees of freedom involved in the movement and focus on more general aspects of the response." One promising approach, which has been shown to facilitate the acquisition of a fundamentally accurate motor representation, is analogy learning (Liao & Masters, 2001; Masters, 2000; Masters & Liao, 2003; Sawada, Mori, & Ishii, 2002).

Information presented in an analogy is not rule-based, but reflects an implicit, higher-order relationship among the rules of the concept. The learner can apply the concept described by the analogy, despite an inability to explicate the rules underlying the concept (Donnelly & McDaniel, 1993). This phenomenon is a defining characteristic of implicit learning (Berry & Broadbent, 1984; Hayes & Broadbent, 1988) and was shown by Liao and Masters (2001) to be present when a top-spin table-tennis forehand was taught using a right-angled triangle analogy (see Figure 11.3). Unlike previous implicit learning paradigms, however, learning was no poorer than in an explicitly instructed treatment condition.

Masters and Liao (2003) argued that analogy learning reduces the amount of information explicitly attended to during motor learning by repackaging task relevant rules, cues, and knowledge into a single, heuristic algorithm (Todd & Gigerenzer, 2000), or biomechanical metaphor (Masters, 2000). By "chunking" discrete task relevant bits of information into an integrated and meaningful memory representation, the attention demands on working memory may be reduced. The concept of chunking, or knowledge compilation, in its various theoretical manifestations (e.g., Chase & Simon, 1973; Ericsson & Kintsch, 1995; Gobet & Simon, 1998; Miller, 1956), is a fundamental building block of memory and underlies practice effects in skill acquisition. Chunking, according to Rosenbloom and Newell (1987), occurs in a hierarchical, bottom-up manner, with smaller patterns of movement learned first, but subsumed by increasingly larger, more complex patterns. As motor competence develops, higher-level chunks are generated that represent the numerous bits of information required to successfully perform the skill. Working memory then needs only to process those higher-level chunks instead of dealing with information bit by bit. Masters and Liao provided preliminary evidence for this conceptualization by showing that the right-angled triangle analogy chunked only information (movement instructions) subsumed under the analogy (i.e., relevant bits of information), because chunking occurs only when the discrete bits of information are relevant to the learning process. They showed that a movement learned using only rules relevant to the analogy remained robust under secondary task loading (implying that working memory was processing only higher-level chunks). The same movement learned using rules irrelevant to the analogy did not remain robust.

From a theoretical point of view, it is possible to speculate that the technique of analogy learning should result in more rapid learning because it allows the coach to present more information than normal to the learner in a format that the learner can attend to with relative ease. The work of Liao and Masters (2001) and Masters and Liao (2003) is based on only limited numbers of learning trials, providing little evidence regarding the long-term implications of analogy learning for rapidity of learning. An extended period of learning, far in excess of any comparable learning studies documented in the literature, would be interesting to consider.

External Focus of Attention

The work of Wulf and her colleagues provides an additional avenue of investigation into the role of attention in skill acquisition that is reminiscent of the implicit-explicit distinction. Wulf has argued that focusing attention on the effects of body movements (external focus), rather than on the movements themselves (internal focus), is more efficacious for the acquisition of new movement skills (for a review, see Wulf & Prinz, 2001). This conceptualization evolved from Prinz's (1990, 1997) common coding principle, which postulates that for actions to be effective, afferent and efferent information must exhibit a high degree of compatibility; therefore, movements need to be planned in terms of their desired outcome, or in other words, their effect.

The advantageous nature of an external focus was first reported by Wulf, Höß, and Prinz (1998) using a ski-simulator task. They found that directing performers' attention externally to the effect their movement had on the apparatus produced superior performance throughout learning and in delayed retention compared to instructions to focus on the outer foot (internal focus) and to no attentional instructions (discovery learning control group). This basic finding has since been replicated several times and has also been generalized to more complex motor skills, such as golf chipping (Wulf, Lauterbach, & Toole, 1999), tennis (Wulf, McNevin, Fuchs, Ritter, & Toole, 2000), and volleyball and soccer (Wulf, McConnel, Gärtner, & Schwarz, 2002). Generally, external focus instructions enhance complex skill performance in novices when measured during both learning and delayed retention tests (Wulf, McNevin, et al., 2001). However, doubts have been raised over whether learners can maintain an external focus of attention throughout the duration of learning (Maxwell & Masters, 2002; Poolton et al., 2006).

McNevin et al. (2003, p. 22) postulated that advantages associated with external focus of attention arise as a consequence of the "utilization of more natural control mechanisms." This postulate led to the formation of the constrained action hypothesis, which states that "conscious attempts to control movements interfere with automatic motor control processes, whereas focusing on the movement effects allows the motor system to self-organize more naturally, unconstrained by conscious control" (Wulf, Shea, & Park, 2001, p. 342). The theory implies that external focus instructions promote the automatic processing of information subsuming motor control, whereas focusing on the movements themselves elevates this information to the level of conscious control, presumably by involving working memory (Baddeley, 1986; Baddeley & Hitch, 1974). This theory demonstrates a high degree of compatibility with implicit learning and ventral-dorsal distinctions.

CONCLUSION

Attention is one of the broadest and most researched topics in all of psychology. In this chapter, we have examined the role of attention as a limited resource in one specific context, that of skill learning and expert performance as it applies in the sport domain. It is apparent from a treatment of only this portion of the topic of attention that, although much effort has already been expended in attempts to conceptualize attentional processes, understand their function, and utilize this knowledge to guide the development of enhanced approaches to skill learning, our existing knowledge is nevertheless still at a quite rudimentary level. The development of suitable, robust models and theories of attention still remains controversial. Measurement approaches, though improved, still remain largely unidimensional and fragmented, and key issues such as the nature of implicit, automatic, and unattended processes, their interaction with explicit, controlled, attention-demanding processes, and their relative contributions to skill learning and expert performance are only beginning to receive the kind of detailed theorizing and experimental scrutiny that they warrant.

The rapid improvements in both the capability and accessibility of brain imaging techniques offer great promise as a means of extending existing knowledge about attention and helping sensibly integrate psychological theories of attention with neurobiological ones. Applications of these techniques to examining sport-specific attentional issues are currently rare but will hopefully become more commonplace over the decade. Relatedly, for knowledge about attention and automaticity to have a practical impact on skilled performance in sport, it is clear that, among other things, a research approach that increasingly uses natural sports activities rather than contrived laboratory tasks is highly desirable. Only with such an orientation is it likely that approaches to skill learning in sport can progress from practices based on tradition, folklore, and intuition to practices that are, more appropriately, evidence-based. The future challenge, in part, is for researchers of attentional processes in sport to make the study of attention *in* sport sufficiently relevant to attract the attention *of* sport.

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CHAPTER 12

A Social-Cognitive Perspective on Team Functioning in Sport

DAVID W. ECCLES and GERSHON TENENBAUM

The year is 2003. England and tournament hosts Australia are 17–17 in the final 25s of the Rugby Union World Cup Final. In a breathtaking finale, Matt Dawson spins the ball out of the England's line-out to Jonny Wilkinson. Under great pressure, Wilkinson drops the ball to his feet and performs a perfect drop goal to clinch the game and seal England's name in the history books as the first Northern Hemisphere side to win the World Cup.

After the game, Wilkinson was asked to reflect on his team's preparation with relation to the drop-goal. His response was, "We had a clear routine of how we'd get a drop-goal. It just went absolutely like clockwork. That's why you win these big games" (British Broadcasting Corporation, n.d.). Watching the game, we were left to ponder how extant concepts in sport psychology could account adequately for how teams achieve such routines. The research literature on teams, being predominantly social in perspective, and on cognition in sports, being predominantly individualistic in orientation, seems weak at offering insights into how team members achieve coordination. An understanding of this topic seems to require a consideration of both social and cognitive aspects of the way teams function and, in particular, of the interaction of these aspects.

Consequently, this chapter is concerned with how a social-cognitive perspective on teams might enhance the current understanding of team functioning in sport. The concepts discussed in the chapter are drawn predominantly from the research literature concerned with teams in industrial and organizational (I/O) psychology and on social cognition in general psychology. The chapter includes proposals for concepts relevant to insights into team coordination, but also considers more general implications of a social-cognitive perspective on team functioning in sport. In particular, consideration is given to how social processes might affect individual cognition, and how the social organization of a team might affect its collective cognitive properties.

The chapter begins with a discussion of how team functioning in sport has been considered predominantly from a social perspective, and how researchers interested in cognitive aspects of sports performance have been concerned predominantly with the individual, with little attention being paid to interactions between an individual's cognition and the team's social properties and processes. This section concludes with a discussion of the weaknesses of current approaches to studying the functioning of sports teams. In the second section, it is proposed that an understanding of such functioning might benefit from a consideration of interactions between social and cognitive aspects of teams. Following this, there is a discussion of three key concepts that have been proposed in the I/O research literature relating to such interactions. These include the cognitive affects of social processes, team cognition, and team coordination. The implications of these concepts for research on sports teams are also discussed. The third section comprises an extended discussion of the concept of team coordination because it is believed to offer the most potential for advancing the current understanding of team functioning in sport. This section also includes suggestions for developing methods for studying coordination in sports teams. It ends with the proposal of various best practice guidelines, based on the concepts described, for applied practitioners working with teams. The chapter concludes with a summary and recommendations for future research in this area.

CURRENT RESEARCH ON THE FUNCTIONING OF TEAMS IN SPORT

In this section, we first discuss how team performance in sport has been considered predominantly from a social perspective. Following this, we discuss how researchers interested in cognitive aspects of sports performance have been concerned predominantly with the individual performer. Finally, we attempt to articulate some weaknesses of these approaches in accounting for team functioning in sport.

The Predominance of a Social Perspective on Team Functioning in Sport

A recognized limitation of sport psychology is that research has been focused predominantly on individuals compared to groups of individuals, such as teams, even when the individuals being studied are members of a team (Woodman & Hardy, 2001). However, research into the psychology of teams in sport has been almost entirely social in nature (e.g., Carron & Hausenblas, 1998). This is apparent in most introductory texts on sport psychology that include sections on team functioning. For example, the text by Weinberg and Gould (2003) includes four chapters related to the topic of group processes, which are titled "Group and Team Dynamics," "Cohesion," "Leadership," and "Communication." The chapter on group and team dynamics covers concepts such as group development, group norms, team climate, and social loafing within groups. With regard to creating an effective team climate, the authors describe how the extant research has provided some support for how social support, team members' perceptions of their team's distinctiveness, and the extent to which coaches treat players fairly affect team climate. Thus, these concepts are predominantly social in nature, and this approach is reflected throughout the extant research literature on team functioning in sport.

Current Considerations of Cognitive Aspects of Sports Performance

In the past decade, much research has been devoted to the cognitive bases of skill acquisition and expert performance in sport (Starkes & Ericsson, 2003; Williams & Hodges, 2004). Research has shown that sport expertise is attained primarily through complex, domain-specific cognitive and physiological adaptations to the target domain. These adaptations are driven by practice in, and experience of, that domain, which often begins at a young age and is usually maintained at a high daily level for more than a decade. These adaptations include changes in the amount and organization of domain-specific knowledge and in memory for and access to that knowledge. These adaptations afford development of perceptual and cognitive skills that support an efficient search for and recognition and encoding of task-relevant information and an efficient integration of that information with a network of relevant, organized, and interrelated knowledge previously acquired in long-term memory. Consequently, experts are able to obtain rapid access to a variety of response strategies and options during performance. In addition, these skills support the monitoring, evaluation, and prediction of changes in the domain environment, allowing the expert to adapt flexibly and in anticipation of such changes. They also support the planning, monitoring, and evaluation of response strategies and selections, allowing the expert to better prepare for, execute, and evaluate the efficacy of responses. However, in the extant research on cognitive aspects of sports performance, little attention has been paid to interactions between an individual's cognition and the social processes and settings associated with the team environment.

A Common Weakness of the Two Approaches in Accounting for Team Functioning in Sport

A key weakness of the two approaches is that neither considers the other. Team functioning in sport has been considered predominantly from a social perspective, and research on cognitive aspects of sports performance has been focused predominantly on the individual. Consequently, we argue that the following questions are difficult to answer based on extant concepts in the discipline of sport psychology:

- How is individual cognition affected by many of the social processes on which the extant research on teams in sport has been focused? For example, does being assigned a particular role on a team affect a performer's processing of game-relevant information?
- How are decisions made in teams? How do the individuals on the team bring the knowledge bases unique to each individual to bear on the process of making a decision? Does the organization of and the communication within the team affect this process?
- How do the tasks that teams undertake actually get done? To elaborate, what information needs to be known by an individual for that individual to be able to function as part of a coordinated team?

Researchers have made similar criticisms of the discipline of cognitive psychology. Levine, Resnick, and Higgins (1993, p. 586) posited that cognitive psychology "has traditionally been a psychology of the individual," and "little attention has been paid to . . . cognitive functioning in interaction with others." As these researchers have argued, the human is a social animal, exhibiting a willingness to interact rarely paralleled in other species. Try to identify the number of different types of groups, teams, and larger organizations (e.g., family, work, and social) within which you are a member—it is usually harder to identify activities undertaken solely as an individual. Similarly, and following Hutchins (1991), try to identify an object that is not the product of human collaboration. Even when an individual is not engaged in an individual activity, researchers have argued that the individual's cognition is still affected by the social network and cultural context within which the individual operates (D'Andrade, 1981; Resnick, Levine, & Teasley, 1996). Thus, the human rarely thinks in a "social vacuum" and yet is often treated as such (Levine et al., 1993, p. 586).

To summarize, there have been important advances in our understanding of social aspects of team performance. Furthermore, important insights into skilled performance in sports have been provided by research on the perceptual-cognitive skills of individuals operating on sports teams (Starkes & Ericsson, 2003; Williams & Hodges, 2004). However, there has been little consideration of an approach that has, as a central feature, a consideration of how these aspects interact. However, we assert that team functioning in sport will be better understood by adopting a perspective from which these aspects are considered to interact. Accordingly, the next section comprises an overview of key concepts associated with a social-cognitive perspective on team functioning and suggestions for ways in which these concepts might relate to functioning in sports teams.

SOCIAL-COGNITIVE CONCEPTUALIZATIONS OF TEAMS

We present here three key concepts from the research literature in I/O psychology and on social cognition in general psychology that concern interactions between social and cognitive aspects of team functioning. These concepts have received no attention in sport psychology, but we believe that a consideration of the concepts by sport psychologists might provide new insights into team functioning in sports. The first concept is that social processes operating within a team can affect the cognition of an individual team member. The second is that the cognitive properties of a team cannot be defined simply as the sum of the properties of the individual members of that team. Social properties of the team, such as the way the team is organized, and social processes within the team, such as the nature of intrateam communication, affect the cognitive properties of the team. The third concept is that the ability of the team to achieve an organizational structure and to coordinate its operations is enhanced when the team is able to first achieve, and subsequently maintain, a specific social-cognitive state, termed a shared knowledge state.

Cognitive Affects of Social Processes

Levine et al. (1993) provided a review of research on the influence of social factors associated with groups and teams on individual cognition (see also Kerr & Tindale, 2004). These authors proposed a taxonomy of such factors, which included various categories, a selection of which is discussed next. Examples of a research study are also described briefly for each category, and suggestions are made for how each factor category might relate to sport team functioning.

Mere Presence of Others

A line of research that provides evidence for how the mere presence of others can affect an individual's cognition is concerned with group composition. For example, Lord and Saenz (1985) studied how individual cognition is affected by the presence of underrepresented "tokens" interacting within groups. Participants, who were students, were led to believe that they and three other students would be engaged in discussion with the experimenter. The participants were also told that the three other students would each be located in a separate room, and that all four people (the participant and the three students) would be able to see and hear each other on television monitors as they interacted with the experimenter. The three students were either all of the participant's own gender or, to create a token condition, all of the opposite gender. However, unknown to the participants, the three students were not interacting live with the experimenter but were previously videotaped confederates. In addition, an observer watched, but was not involved in, the "group interaction."

Following the interaction, participants and observers undertook a recognition-memory test relating to the opinions voiced during the interaction. Tokens remembered fewer opinions that they and the three other students had expressed than did nontokens. However, the observers remembered more of what was said by tokens than by nontokens. One explanation for this effect was that tokens, aware that they attract more attention than other members of the group (as shown by the observer data), devote more attentional resources to self-presentation, and thus less to the task, than the other group members. Thus, the study by Lord and Saenz (1985) provides evidence that individual cognition can be affected in a group setting by the nature of the members that constitute the remainder of the group. This concept might be applicable in sport team environments. Might minority members of teams attend to and recall less team-related information than their counterparts? For example, in football, the implications of a team member not attending well during a play-planning session during practice, or failing to recall plays during a game, could negatively affect how that team member executes the play and thus negatively affect the overall performance of the team.

Social Roles, Positions, and Identities within a Social Group

Individual cognitions also appear to be influenced by expectations associated with the role that the individual has been allocated. Anderson and Pichert (1978) asked participants to assume the role of a burglar or a potential house buyer while reading text about what two boys did at one of the boys' homes. Participants were then asked to write down as much as they could remember of the story content. Following this, they assumed the role opposite the role first assumed and rewrote the story. The results revealed that by assuming the new role, information relevant to the new role, and that was previously unrecalled, was now recallable.

In a similar study, Zukier and Pepitone (1984) contrasted the effects of asking participants, who were college students, to adopt either a "scientific" or a "clinical" orientation when making judgments about whether a person worked as an engineer or a lawyer based on a thumbnail description of that person. Participants were told that the thumbnails were drawn at random from a sample comprising a thumbnail for each of 30 engineers and 70 lawyers. The scientific orientation condition was created by asking participants to make judgments as a scientist analyzing data. The clinical orientation condition was created by asking participants to "try to understand the individual's personality, professional inclinations and interests" when making the judgment (p. 353). Two descriptions of individuals were then provided to the participants: One was intended to be the target description, which evoked the stereotype of an engineer, and the other to be a neutral description, which was intended to convey no information relevant to the question of whether the target was a lawyer or an engineer. Participants were then asked to assign to the description the probability that it belonged to one of the 30 engineers, on a scale of 0 to 100. The findings indicated that those in the scientific orientation condition were more scientific in their judgments, in that they judged the likelihood of the target's being an engineer as closer to the known proportion of lawyers to engineers in the sample (i.e., 30 to 70), than those in the clinical condition.

Thus, role allocation appears to affect cognition. This affect might also occur in team environments in sport. For example, might the role a player is allocated in sport affect his or her processing of game-relevant information?

An Individual's Mental Representations of Others

An individual's cognition can also be affected by his or her mental representations of others, such that cognition is affected even when those others are not physically present. For example, Baldwin, Carrel, and Lopez (1990) asked students to evaluate their own research ideas after first exposing them to images of either the disapproving face of their advisor or the approving face of another person. To avoid the students being consciously aware of the images, the images were presented for only 2 ms during a previously completed bogus reaction-time task. The results indicated that self-ratings were lower after the presentation of the disapproving image. Thus, processing information about significant others, even subliminally, can affect the cognitive processes underlying decision making. This phenomenon might also occur in team environments in sport. For example, how might thinking about the presence of a significant other, such as a stern coach, affect a player's process of self-evaluation during the game?

Social Interaction and Cognitive Change

Research on social interaction has provided evidence that an individual's thinking is actually formed during social interaction. For example, intragroup conflict has been shown to affect individual cognition. Nemeth and Kwan (1987) asked participants to identify words with capital letters embedded in letter strings, such as identifying "DOG" in the string "tDOGto." Participants were members of a group of four but were tested individually so that they were not aware of each others' responses. After initial trials, they were informed that either a majority or a minority of the other group members had used an unusual strategy to identify words, such as reading the letters backward. When the participants where then asked to identify as many words as possible from the letter strings, those informed about the minority strategy made use of a larger variety of identification strategies (e.g., reading the letters forward and backward) than those informed about the majority position. The conclusion was that minority views in a group can promote group members to engage in divergent thinking, and majority views in convergent thinking. Thus, individual cognition can be formed during social interaction. Might such interaction affect the cognitive processes that mediate performance in sport settings?

Summary

The research on social cognition has demonstrated that various social processes can affect individual cognition. By adopting a social-cognitive perspective, sports psychologists may be able to gain insights into how the cognitive processes of individual members of sports teams can be affected by the social processes inherent in the team and on which the extant research on teams in sport has been focused. To date, there have been few studies that have considered the interaction between social and cognitive aspects of teams in sport.

Team Cognition

Rather more radically, researchers have recently proposed that the team can be considered to be a cognitive system (Hinsz, Tindale, & Vollrath, 1997; Hutchins, 1991, 1995). To elaborate, each team member has certain cognitive properties. These properties include the knowledge held by the team member and the capacities of each team member for information processing (i.e., for perceiving, attending to, memorizing, and recalling information). The assertion of some social-cognitive theorists is that when multiple individuals work together as a team, a cognitive system, which is comprised of individual cognitive units (i.e., brains), is established. The *system* can then be considered to have cognitive properties. However, these properties are not just the result of the sum of multiple cognitive units comprised therein. Social factors such as the organizational structure of the team and the nature of the communication within the team, which is in part influenced by the team's organization, also affect the cognitive properties of the system.

For example, Roberts (1964; see also Hutchins, 1991) described how a cultural group could constitute a memory system that is more robust and has a larger capacity than any single member of that group. Roberts, a cultural anthropologist, studied four Native American tribes to identify, for each tribe, how information was retrieved when needed from the collective memories of the entire tribe. The tribes were preindustrial and nonliterate, and so the storage of information via artifacts (e.g., books) was not possible. Thus, information important to decision making was located only in the memories of the tribal members. Roberts concluded that some tribes were more efficient than others in storing, retrieving, and utilizing such information for decision making, and that the determinants of a tribe's efficiency were organizational and communicational in nature. These included tribe size, the distribution of information among tribal members, and the patterns and time course of the interactions among members.

Hutchins (1991) used connectionist models of group cognition to explore how organizational factors affected confirmation biases during group decision making. Confirmation bias is defined as the tendency to stick with prior interpretations of a situation and discount disconfirming evidence for the interpretation. The motivation to create the models arose from a real ship accident. The accident occurred after members of the ship's crew appeared to have reinforced beliefs among themselves that a nearby ship was sailing away from the crew's ship. By contrast, the nearby ship was actually being sailed toward the crew's ship. Even while holding constant the cognitive properties of the individuals that composed the two teams, the models showed that teams can display different cognitive properties depending on the nature of the communication within the team. They also showed that, in some circumstances, confirmation bias can be exacerbated at the team level compared to the individual level.

Another related area of research concerns how the distribution of information among group members affects group decision making. For example, Stasser and Titus (1985) showed that two members of the group must hold the same piece of information for it to be discussed by the group. If the information is available to only one member of the team, it tends to be treated as mere opinion and is less likely to be discussed, but there are more opportunities to provide social validation of the value of the information when more members hold the information. This process appears accentuated under time pressure, such that shared information receives attention early during discussion, but unshared information is mentioned relatively late in the discussion. These problems arising from time pressure may play a role in information-processing biases in teams.

The research on this topic has provided evidence that the cognitive properties of a team are affected by the social properties of the team. By adopting this perspective, sports psychologists may be able to gain insights into how decisions in sports teams are made, and how the organization of the team and the way team members communicate within such an organization affect this process. Researchers in sport psychology have been calling for the adoption of organizational, social, political, and cultural perspectives to gain broader insights into the psychological phenomena associated with sports performance (Woodman & Hardy, 2001).

The third concept pertaining to interactions between cognitive and social aspects of team performance is concerned with team coordination. We believe that team coordination is most relevant to an understanding of team functioning in sport; consequently, we devote the entire next section to this topic.

TEAM COORDINATION

The following builds on the proposal by Eccles and Tenenbaum (2004) of a conceptual framework for studying coordination in sports teams. We begin with an overview of the extant research on coordination in sports teams, and then discuss key concepts related to team coordination based on research in I/O psychology. We focus on the intracommunication required for coordination, and how coordination, and the communication required for coordination, is achieved in expert teams. Following this, suggestions are made for developing methods of studying coordination in sports teams. This section concludes with the proposal of various best practice guidelines for practitioners working with teams.

Existing Research on Coordination in Sport

Coordination in teams involves integrating the operations of the team in a timely way to form a composition of operations that achieves satisfactory performance. Considerations of team coordination in sport have been limited to simple descriptions of the construct and its relation to team productivity. For example, Carron and Hausenblas (1998) discussed Steiner's (1972) conceptual framework of group productivity in regard to sport. Steiner proposed that the potential for group productivity increases with group size, owing to the extra resources provided by the extra group members. However, the increase in group productivity decreases with each additional member, until productivity reaches a plateau so that any increase in membership has no additive effect on productivity. An unpublished but classic study by Ringlemann (cited in Kravitz & Martin, 1986) was used by Carron and Hausenblas (1998, pp. 32–38) as an example of Steiner's predictions. Ringlemann studied team tug-of-war performance wherein the addition of team members increased team productivity but decreased individual efficiency. Steiner proposed two reasons for the efficiency reduction. First, group size increases cause a reduction in personal accountability, which in turn causes a reduction in individual motivation and an increase in social loafing. Second, group size increases make difficult the coordination of group operations. The social orientation of sport team research is marked by the fact that only the constructs of motivation loss and social loafing have received subsequent research attention (e.g., Carron & Hausenblas, 1998, chap. 2). No consideration has been given to how a team actually achieves coordination (cf. Carron & Hausenblas, 1998, pp. 32–38).

Key Concepts Related to Team Coordination

When humans work together to achieve some task, they are cooperating; in sport, their collectivity is usually labeled a *team.* However, though necessary, cooperation is not sufficient for satisfactory team performance. The operations performed by each team member must be coordinated; that is, the operations must be integrated in a timely way to form a composition of operations that achieves satisfactory performance. Failing to coordinate team operations can result in performance that is worse than that which is possible in a team with fewer members (Kidd, 1961; Naylor & Briggs, 1965). For example, a single rower would easily outperform a team of two rowers if the team could not achieve the coordination of oar strokes required to steer and power the boat. Steiner (1972) argued that the actual productivity of a team is the result of its potential productivity, which includes the sum of the potential productivity of each of the members of the team minus its faulty processes, such as social loafing and poor coordination. He called the loss of productivity resulting from faulty processes *process loss,* and the loss of productivity resulting from poor coordination specifically has become known as a *coordination decrement* (Fiore, Salas, Cuevas, & Bowers, 2003). Clearly, the full potential of the human resources available within a team are wasted when process losses occur.

Several studies have provided evidence of process loss. An early example was provided by Comrey (1953) using a pegboard assembly task. In an individual condition, two men sat across from one another at a table. Each man undertook his own pegboard assembly task. Both men were given the same amount of time to complete the task. Immediately following this, and with the men still seated in their original positions, a team condition was created by positioning a board between the two men and asking that they complete overlapping operations as if working on a production line, so that the requirement to coordinate their activities was introduced. Similar to the finding of the tug-of-war study discussed earlier, the key finding of these studies was that, although the absolute performance of a team was superior to that of an individual, it was always less than the sum of the team members' individual performances.

Evidence of process loss was also provided by Kidd (1961). In this study, team performance was examined on a simulated air traffic control task. The size of the team was manipulated so that one-, two-, or three-person teams undertook simulated control tasks. Performance measures included the percentage of delay per aircraft, mean fuel consumption per aircraft, number of missed approaches, errors in keeping aircraft spaced correctly in the air, and errors in keeping aircraft spaced correctly on the runway. Even when workload per team member was held constant, performance actually decreased as team size increased. Naylor and Briggs (1965) found a similar result in a study that involved ground-based control of military airplanes as they intercepted enemy aircraft. Three-person teams received initial training on a board-based version of the task and were then asked to undertake a similar task on an electronic simulator. Various organizational aspects of the team were manipulated to observe their effects on performance during training and transfer. In one condition, a supervisor oversaw two subordinates who operated independently, in that they were each asked to monitor only half of the enemy aircraft. In a comparison condition, a supervisor oversaw two subordinates who were asked to monitor all the enemy aircraft as a team. Performance measures included amount of fuel consumed per session and number of successful interceptions per session. A key finding was that performance in the individual condition, which comprised the sum of each individual team members' performance, was superior to performance in the team condition.

Evidence of process loss in teams has also been provided in the sports domain. To investigate the effects of team size on team cohesion and performance, Widmeyer, Brawley, and Carron (1990) assigned college students to basketball teams of 3, 6, or 9 players that played 3-on-3 games in a basketball league on a weekly basis for a 10-week period. Teams of 6 outperformed teams of 3 and 9. It was asserted that the performance of the teams of 3 was negatively affected by fatigue, whereas the teams of other sizes were able to avoid this problem because they had enough players to rotate players in and out of play. The explanation of relative inferiority of performance by the teams of 9 was less clear, but Widmeyer et al. provided evidence that poor motivation as the explanation was unlikely. Instead, these authors argued that poor coordination was the most likely explanation, although coordination was not measured.

Knowledge Requirements for Achieving Coordination

In the studies just described, the process losses identified were often attributed to the need for team members in the team condition to coordinate their operations. In the studies by Kidd (1961) and Naylor and Briggs (1965), it was reported that the work required to achieve coordination impinged on the work associated with the task per se. By comparison, participants in the individual conditions were not required to coordinate their operations, and thus could focus exclusively on the task. In this regard, I/O psychologists have used the term *taskwork* to describe elements of a team member's task that are independent of fellow members' operations, and thus do not introduce the need for coordination. *Teamwork* is the term used to describe elements that are interdependent with fellow members' operations, and thus do introduce the need for coordination (McIntyre & Salas, 1995). Subsequently, the knowledge required to undertake taskwork has become known as *taskwork knowledge,* and that required to undertake teamwork as *teamwork knowledge.*

Consider this distinction in relation to football. A quarterback must acquire taskwork knowledge to be able to aim a pass so that it lands accurately in a given target location and time a pass so that it arrives punctually at a given target time. However, the ability of the quarterback to execute the pass accurately and punctually also relies on the acquisition of teamwork knowledge pertaining to the operations of the quarterback's receivers, because these operations dictate the target location and timing of the pass. Similarly, a team member who transfers between teams is able to rely on previously acquired taskwork knowledge in the new team to undertake taskwork elements of the task because these elements are unrelated to fellow team members, and thus are relatively constant across teams. However, the team member's previously acquired teamwork knowledge is of limited use in the new team because the teamwork elements of the task have changed. Furthermore, although the individual performer needs only taskwork knowledge to undertake his or her task, he or she must gain teamwork knowledge to work as part of a team, owing to the introduction of the requirement for coordination in team settings. An example is an individual rower who transfers to a four-person rowing team.

Teamwork knowledge can be further delineated as pertaining to (a) operations that are to be undertaken by the overall team, and more specifically, by those team members with which a given member must interact, over and above taskwork; and (b) how and when the given member's operations are to be integrated with those operations (Entin & Serfaty, 1999). Furthermore, both taskwork *and* teamwork require cognitive resources to undertake. Therefore, knowledge requirements, in the form of teamwork knowledge, and cognitive demands, imposed by teamwork processes, are imposed on team members that are not imposed on individual performers (Hutchins, 1991).

Team coordination is also facilitated if a subset of each team member's taskwork and teamwork knowledge is at least similar to a subset of this knowledge held by other team members, such that some taskwork and teamwork knowledge is *shared* by all team members (Cannon-Bowers, Salas, & Converse, 1993). The term *shared* in this instance means "held in common" (Dictionary.com, n.d.). To elaborate, considering just teamwork knowledge, a two-person team that includes you and me will achieve coordination more easily if the following state is obtained: Your knowledge of what you and I are going to do and when you and I are going to do it is similar to my knowledge of what you and I are going to do and when you and I are going to do it. If this state is met, coordination will be facilitated.

A key benefit of achieving a shared knowledge state is that each team member can generate accurate expectations about the behavior of the team and its constituent members, such that coordination can be achieved (Cannon-Bowers et al., 1993). These expectations afford each team member the ability to accurately anticipate the operations of the team so that the *appropriate team member* selects and undertakes *appropriate operations* at *appropriate times* in response to a given task. Consider a team that does not have a shared knowledge state. The members in the team possess knowledge about the operations that are to be undertaken by the overall team, and more specifically, by those team members with which a given member must interact, and about how and when the given member's operations are to be integrated with those operations. However, this knowledge differs among members. Consequently, although team members are as able to generate expectations about the team's operations as if the team had achieved a shared knowledge state, the expectations among the members are likely to be different. Thus, when the operations are undertaken, it is less likely that coordination will be achieved.

An interesting example of this occurs in the sport of mountaineering. A principal cause of mountaineering search-and-rescue operations is a situation in which a mountaineering team splits up during an expedition and arranges to meet again at some later time, but fails to achieve a shared knowledge state with regard to the meeting time and place. Consequently, the teams often fail to coordinate their operations and thus to meet. The subteams that result from the split often appear to possess knowledge about the meeting arrangements, but that knowledge is not shared among the members. In the words of the rescue services of the Alpine Club of Canada (n.d.), "A high number of searches result simply from parties splitting up while not coming to reasonable understandings about who is going to do what."

This concept is also manifested in the everyday language of individuals operating in teams in phrases such as "reading from the same page." A similar phrase, "playing from the same playbook," originates in football. A playbook is developed by football coaches and comprises plans of the movements of each player for discrete game plays. Players are required to study their team's playbook to gain knowledge of the team's operations for each play. Because the playbook is a stable source of information about planned operations, each player can study the playbook independently, but the knowledge each obtains should be the same as that obtained by other team members, which affords the team a shared knowledge state.

However, various researchers have asserted that not all knowledge possessed by a team member needs to be shared by other members (Entin & Serfaty, 1999). For example, although a quarterback possesses some knowledge of receiving, this knowledge is only a subset of a receiver's knowledge of receiving. Moreover, a trade-off exists in teams between specialization and generalization. Thus, all team members will share *general team knowledge* pertaining to overall team strategies, but team members who interact more regularly than others will additionally share more *specific knowledge* about each others' operations (Cannon-Bowers et al., 1993; Entin & Serfaty, 1999). For example, a rugby union forward player will share general team knowledge with the back players—such as knowing that the team strategy is to attack down the right wing—but will share more detailed knowledge with colocated forward players about each others' operations, owing to their more frequent interaction.

Factors Affecting the Requirement to Coordinate

Coordination requirements appear to be affected by the characteristics of both the team and the task that is being undertaken (Steiner, 1972; Widmeyer et al., 1990). One such characteristic is the size of the team. The relationship between team size and coordination is exponential if every team member's operations must be coordinated with every other member's operations. If the coordination of operations between two team members is considered a coordination link (Carron & Hausenblas, 1998), the number of coordination links for a given group size is determined by the following formula:

$$\text{Coordination links} = \frac{N(N-1)}{2} \qquad (12.1)$$

where N equals the number of team members. If two people crew a sailboat, there is only one coordination link between team members, but if eight people crew the same sailboat, providing four times the resources, there is the potential for 28 coordination links. Thus, as team size increases, there is the potential for an exponential increase in the cognitive resources required to undertake teamwork.

Some tasks involve minimal coordination because the task requires that team members engage mostly in taskwork (i.e., work independently); others involve substantial coordination because members must also engage in teamwork (i.e., work interdependently), exemplified by the concept of a coordination link (Saavedra, Earley, & Van Dyne, 1993). Sports involving a high level of teamwork, such as basketball and soccer, have been described as *interactive* and those involving a low level of teamwork, such as archery and golf, *coactive* (Cratty, 1983). Football and relay swimming contain both interactive and coactive task elements. There is a negative relationship between the coordination requirements of a sport and the contribution of individual performance to overall team performance. Jones (1974, cited in Cratty, 1983) found that the correlation between these variables was .94 in baseball but .60 in basketball. The difference was attributed to the high level of teamwork that characterizes basketball compared to baseball.

Tasks can also vary over their time course in terms of coordination requirements. Some periods of a task can require teamwork, such as during a relay race baton handover, and others just taskwork, such as relay race running. Tasks can also vary over their time course in terms of taskwork. Periods of high taskwork demand can cause a concurrent increase in teamwork, as team operations must be coordinated to ensure a successful response to the increase in taskwork (Bowers, Morgan, Salas, & Prince, 1993). The combined increases in taskwork and teamwork often lead to rapid escalations in cognitive demands (Patterson, Watts-Perotti, & Woods, 1999; Woods & Patterson, 2000).

Patterson et al. (1999) used observational methods to study the relationship between workload demands on and the coordination of the operations of NASA's ground-based space shuttle mission control crew. In one shuttle launch studied, an unexpected event occurred, which was a sudden drop in hydraulic fluid pressure in the shuttle. The sudden and unexpected increase in taskwork needed to resolve the problem required operations to be coordinated between the shuttle crew and multiple members of the physically distributed ground crew. Although no objective measures of coordination or performance were taken, Patterson et al. asserted that the team was suddenly presented with not only a high taskwork demand, but also a high teamwork demand. However, Patterson et al. described how the crew made use of voice loop technology to help coordinate their operations; this was a real-time auditory channel that enabled the distributed crew members to listen selectively and speak selectively to other members. It is the communication required for coordination that is the focus of the next section.

Communication for Coordination

Similar to considerations of coordination in sports teams, communication in sport teams have been considered primarily from a social perspective. Researchers have been concerned predominantly with the impact of social constructs on communication, or vice versa. For example, Carron and Hausenblas (1998) reviewed evidence of how intrateam communication is effective to the extent that the team is homogeneous in terms of characteristics such as age and educational attainments. Communication has also been studied in terms of its effect on team cohesion and conflict, and in terms of social pressure and conformity (Carron & Hausenblas, 1998). Consistent with this orientation, recommendations for improving team communication have included creating opportunities for team member socializing and promoting member discussions. Although not explicitly stated, the treatment of communication in the chapter on this topic by Weinberg and Gould (2003) relates to the impact of communication on team cohesion. The social orientation is further reflected in the only current measure of communication in sport, presented by Sullivan and Feltz (2003), which pertains predominantly to aspects of team cohesion. No consideration has been given to the role communication plays in achieving team coordination (cf. Carron & Hausenblas, 1998), and so the remainder of this section is concerned with this topic.

Communication is a key method by which teams achieve shared knowledge. Consequently, communication quality and quantity affect the ability of team members to acquire a shared knowledge state (MacMillan, Entin, & Serfaty, 2004). Communication can be conceptualized in cognitive terms as a process of information transfer characterized by stages (Adler & Rodman, 2002): First, the cognitions of the intended sender must be encoded as a message and sent via some channel; second, the message must be received by the intended recipient; third, the message must be decoded by the intended recipient and interpreted correctly. Communication can be disrupted at any stage: The message might be encoded incorrectly; the intended recipient might not receive a sent message owing to disruptions such as noise; and the receiver might lack sufficient knowledge of the sender's code or fail to interpret the message correctly. Thus, the process of communication takes time, requires cognitive resources, and is subject to disruption (Casali & Wierwille, 1983; Entin & Serfaty, 1999; MacMillan et al., 2004). Therefore, communication becomes problematic during performance owing to concurrent taskwork demands.

In Kidd's (1961) study of teams undertaking an air traffic control simulation task, the team leader in a three-person team spent 30% of his time communicating in order to coordinate team operations. This was one explanation for the lack of performance gain that occurred when the human resources brought to bear on this task were increased from one to three persons; as Naylor and Briggs (1965, p. 228) stated, "Interaction (verbal communications between operators) does not exist for a single operator working alone." Also, MacMillan et al.'s (2004) studies of military command and control settings revealed that teams reported more workload under high coordination conditions, which was attributed partly to the need for increased communication.

There are different types of communication, each of which has benefits in terms of achieving coordination and costs in terms of time and cognitive resources. Communication can be intentional or unintentional and verbal or nonverbal. Intentional communication occurs when a sender intentionally sends a message to one or more recipients. Intentional verbal communication is a flexible method of communication because humans share a vast code, in the form of natural language, with which to encode and decode cognitions. Intentional nonverbal communication can be used where verbal communication is not possible or desirable, such as when two team members are located distally so that hearing a verbal message is problematic. However, in inexperienced teams, messages transferred via intentional nonverbal communication have a less specific code, which can confuse team members. Both types of communication can also be used to encrypt messages so that only the intended recipient can interpret the message: The football quarterback communicates intended play configurations to the offensive line using a verbal code unknown to the opposing team; baseball coaches communicate intended pitches to the catcher using a nonverbal code unknown to the opposing team. However, encrypted messages generally have a smaller code than natural language, placing constraints on the flexibility of communication. The flexibility of intentional verbal communication might be of benefit to coordination, but it is a costly type of communication in terms of time and cognitive resources because of the need to encode cognitions and interpret messages. These resources might not be available owing to the demands imposed by concurrent taskwork. Studies of aircrew communication (e.g., Orasanu, 1993) have revealed that experienced teams avoid such communication during periods of high demand owing to its costs.

Unintentional communication occurs when an individual unintentionally sends messages to recipients. Unintentional verbal and nonverbal communication can provide important information to a team member about the operations of other team members (Wittenbaum, Vaughan, & Stasser, 1998). Unintentional verbal communication is rare, but unintentional nonverbal communication is always available to the extent that team operations are sensible. For example, team members (message recipients) can gain information by seeing or hearing the operations being undertaken by other members (message senders). A sensed operation might provide members with information about task status changes or serve as cues for members to perform operations that must be integrated with the sensed operation (Hutchins, 1995). On a sailboat, foredeck crew might be unable to hear commands spoken at the stern owing to noise from the sea. However, if they observe the tiller operator shifting into a position conducive to swinging the tiller from one side of the boat to the other, they can anticipate a tack or jibe maneuver and begin to undertake the foredeck operations required for such a maneuver.

Unlike intentional communication types, unintentional nonverbal communication has cognitive costs to the sender because it is incidental to their operations and is convenient for the receiver because it is often available. However, unlike intentional communication, the ability to interpret observed operations relies on the team's having achieved a shared knowledge state with regard to team operations (MacMillan et al., 2004).

Recently, researchers have compared the communication used by humans to achieve coordination to that used by animals to achieve the same end (e.g., Eccles & Groth, 2004; P. Feltovich, personal communication, August 27, 2003). Animals exhibit displays that, like those of humans, allow or disallow other animals to collaborate and allow the prediction of future operations (Smith, 1977). For example, animals have ways to display a readiness of opportunity to interact, which include various forms of chirping or bowing. By contrast, various forms of sticking out the tongue and vocalizations at unusual frequencies indicate an absence of opportunity to interact. Species that depend on coordinated locomotion, such as geese (which fly as a group), use locomotion displays to indicate that the animal is about to move; these include head tossing in geese and dances in honeybees (Smith, 1977).

Temporal Aspects of Achieving Team Coordination

A team can achieve a shared knowledge state prior to, during, and after performance, known as *pre-, in-,* and *post-process coordination,* respectively (Fiore et al., 2003). Preprocess coordination comprises preparatory behaviors that enable a team to achieve a shared knowledge state prior to performance. Such behaviors include deciding on goals, planning, and allocating role responsibilities (Weldon & Weingart, 1993; Wittenbaum et al., 1998). Preparatory behaviors often rely on intrateam communication, which is primarily in the form of intentional verbal communication (MacMillan et al., 2004) and is exemplified by a coach's talk to the team on team plans and strategies for an upcoming game.

Stout, Cannon-Bowers, Salas, and Milanovich (1999) studied teams of two undertaking surveillance missions in a helicopter simulator. The task was designed so that teamwork was required (i.e., operations were interdependent). In particular, the task necessitated that appropriate task information was communicated to appropriate team members at appropriate times. After receiving practice, the participants were provided with the mission requirements and a session for planning how to undertake the mission. Observers rated the planning quality of the teams on nine planning dimensions, which included clarifying roles and preparing information. Members in teams that were rated as having engaged in higher quality planning processes performed better, where performance was measured as the number of errors (e.g., errors in helicopter navigation) committed during the task. They were also better able to anticipate other members' information requirements during performance and communicated that information in advance of its being requested. It is likely that planning enabled team members to develop shared knowledge relating to other members' information requirements, which in turn afforded better anticipation of these requirements during performance.

Planning is a key component of preprocess coordination and involves deciding on, and subsequently specifying, the intended courses of team operations. Plans can specify operations at different levels of organization based on the level of plan abstraction, ranging from specific to general (cf. Hayes-Roth & Hayes-Roth, 1979). Plans at the general end of this continuum specify macrolevel rather than microlevel operations, such as overall team plans and strategies. Thus, general plans are useful in the coordination of sports that are continuous and in which the environment is dynamic, open, and difficult to predict. This is because general plans help achieve a relative degree of operational structure by specifying operations, in terms of their nature and timing, only at a macrolevel while allowing flexibility and adaptation in the nature and timing of operations at a microlevel. An example of such a sport is soccer, and an example of a general plan is to attack down the wings in the first half of the game. This plan specifies the nature of the operations, in that the team should attack down the wings, and the timing of these operations, in that the attacks should be made in the first half of the game; however, it does not specify in any detail the series of operations involved in attacking down the wings or when these attacks should be made in the second half. Thus, the team can be flexible and adaptive in the nature and timing of these attacks, which is necessary given that elements of the task of soccer are often difficult to predict (such as when a player unexpectedly makes a poor pass that travels to the feet of an opposing player) and that the team must be able to attack opportunistically as a consequence.

Plans at the specific end of this continuum specify microlevel operations, in that they include specifying in more detail the nature and timing of team members' operations. Thus, specific plans are useful in the coordination of team sports characterized by discrete sequences of operations because they achieve a high degree of operational structure at a microlevel. Football is an excellent example of a sport in which members' operations are preplanned in relative detail, as discussed earlier in the chapter. However, although football might be further toward the specific end of a general-to-specific planning continuum, this does not mean that team operations in football are fully specified, simply that they are more specified than, say, soccer. There remains in football flexibility, even in a specified receiver route. A receiver and quarterback memorize a planned route. The receiver will run this route and at its culmination prepare to receive the quarterback's pass. However, with regard to the spatial element of this plan, the plan allows that the route will culminate anywhere within an area of the field that is a subset of the area of the overall field, but this is rarely a definitively specified point. Thus, flexibility is still afforded by the plan and is necessary owing to a variety of reasons, such as the need for the receiver to evade defenders. For the same reasons, and with regard to the temporal element of this plan, the plan allows that the route will culminate within a period or window of time, but this is rarely a definitively specified point in time.

In many sports, in-process coordination is problematic compared to pre- or postprocess coordination because the time and cognitive resources required for coordination, and the communication required for coordination, are scarce owing to concurrent taskwork demands. These constraints mean that any planning undertaken during performance to coordinate responses to task status changes tends to result in plans that are limited in terms of complexity, and thus limited in terms of the plan's effects on performance over space and time. Consequently, planning is limited in effect to the coordination of a subset of the team, task, or performance duration (Patterson & Woods, 2001).

Teams also utilize knowledge of situational probabilities to achieve in-process coordination, especially when a reliance on plans is less appropriate, such as in many situations in dynamic sports. Team members combine sensed information about the current task status with previously acquired taskwork and teamwork knowledge to attach a hierarchy of probabilities to the likelihood of upcoming changes in the task status and upcoming responses by their fellow team members to the current and possible future task status (Ward & Williams, 2003). Consequently, team members are able to coordinate their own operations with the overall team operations.

Postprocess coordination comprises postperformance evaluative behaviors that facilitate the acquisition of shared knowledge by team members pertaining to coordination successes and failures (Smith-Jentsch, Zeisig, Acton, & McPherson, 1998). Team members often view films of previous performances to identify together "coordination breakdowns" (Smith-Jentsch, Zeisig, et al., 1998, p. 272). Such feedback is often used to inform remediation activities. Thus, postprocess coordination can inform preprocess coordination.

Blickensderfer, Cannon-Bowers, and Salas (1997) tested the effectiveness of training teams to evaluate their performance, identify errors, and plan to correct these errors in future performances. Three-person teams monitored a radar screen displaying allied and unidentified craft. The team had all the pieces of information required to complete the task, but each member possessed only a subset of the information, and thus interdependency was created within the team in the form of the requirement to share information. Teams completed a pretest on the task before being assigned to a self-correction training or control condition, the former of which involved a videotaped discussion on the role of self-correction, and directions for reviewing the task and planning future operations. Subsequently, self-correction practice sessions were undertaken involving a task requiring team coordination, such as preparing documents to be mailed. Teams then undertook several posttest sessions of the task and were allowed to engage in self-correction between the sessions. Teams completed a questionnaire developed to assess shared knowledge, which related to expectations about team roles, strategy, and communication patterns. Using a Likert-type scale ranging from "unlikely" to "very likely," each participant was asked to estimate the likelihood of the selection by the team of each of a range of possible responses to a given stimulus, such as "Your team will first examine the fastest moving contacts" versus "Your team will first examine contacts closest to the circle of fear." The results were interpreted as providing evidence that self-correction training had led to increased self-correction behaviors and subsequently had a higher degree of shared knowledge relating to expectations of team operations. However, there were no significant differences in performance between conditions.

In a similar study, Rasker, Post, and Schraagen (2000) examined the role of intrateam evaluation on team performance. Two-person teams undertook a computer-based firefighting task requiring coordination between team members. Teams were required to strategically allocate resources to contain several fires occurring in a city. One member was allocated the task of observing the display to track the status of the fires, and the other the task of allocating firefighting resources. Rasker et al. compared the performance of teams that were allowed to evaluate and self-correct their performance between trials to those that were not. Performance was superior for teams that were able to evaluate their performance. Thus, Rasker et al. concluded that teams that were given the opportunity to evaluate their performance were able to determine strategies that enabled members to better coordinate their operations in future trials.

Coordination and Communication in Expert Teams

Team properties and processes change as the team acquires expertise (Kraiger & Wenzel, 1997; McIntyre & Salas, 1995). Principally, team members' taskwork and teamwork knowledge becomes more refined and better shared with other team members. Through experience and practice, team members gain knowledge of the habits, preferences, and idiosyncrasies of their fellow members with regard to the operations they are likely to perform for a given task status change, which leads to a refined and shared knowledge of situational probabilities. Through experience and practice, team members also gain a refined and shared knowledge of an extensive repertoire of team plans and set routines across a range of specificity and contingent on a range of task statuses (Gersick & Hackman, 1990; MacMillan et al., 2004; Stout et al., 1999). In addition, members of expert teams can use this knowledge to interpret accurately and efficiently unintentional nonverbal communication from teammates and thus obtain information about task status changes and known and likely responses to those changes by team members.

Members of expert teams also develop memory adaptations that provide memory support for the creation and maintenance of elaborate problem representations that keep active taskwork knowledge pertaining to the current and possible future status of the task and teamwork knowledge pertaining to possible responses by fellow team members to the task status (cf. Ericsson & Kintsch, 1995; McPherson, 1999). These memory adaptations also support monitoring, evaluation, and planning processes that enable the expert to respond flexibly to changes in the task status. Ultimately, these changes enable expert teams to achieve in-process coordination implicitly (Entin & Serfaty, 1999). Implicit coordination, in contrast to explicit coordination, occurs when members are not required to describe or explain explicitly intended team operations to any other team member for a given task status change. Thus, teams rapidly and flexibly respond to such changes with a minimal coordination decrement (Cannon-Bowers, Salas, Blickensderfer, & Bowers, 1998; Entin & Serfaty, 1999; Gersick & Hackman, 1990). This is of particular benefit during periods of the task characterized by high workload (Wittenbaum et al., 1998) because the cognitive resources required for coordination during these periods are reduced and, in turn, made available for taskwork (Gersick & Hackman, 1990).

Even when expert teams must undertake explicit in-process coordination, and thus make greater use of intentional communication, the costs associated with this form of communication are reduced (McIntyre & Salas, 1995). Members of expert teams develop a shared knowledge of a highly specific code to achieve intentional verbal communication and intentional nonverbal communication, which is reflected by succinct, domain-specific, and standardized messages (Kanki, Folk, & Irwin, 1991; Kanki, Lozito, & Foushee, 1989; Smith-Jentsch, Johnston, & Payne, 1998). This reduces communication costs in various ways, such as by increasing the quality and quantity of information transferred in a given communication and increasing the accuracy and reliability of message interpretation.

Bastien and Hostager (1988) provided an interesting example of efficient, explicit in-process coordination in their study of music bands. These authors reported that what appeared to be spontaneous jamming was actually concurrently (i.e., in-process) coordinated through band members' communication in the form of intentional verbal and nonverbal codes that "have become a tradition in the profession" (p. 588). These codes could be interpreted correctly by other band members owing to the band's having achieved a shared knowledge of these codes. Examples of the nonverbal codes are turning to an individual, making eye contact at particular points in the performance, and changing the volume of one's playing. These codes allowed the musicians to communicate so that in-process coordination could be achieved but remained relatively undetectable to the viewing audience.

In a more traditional I/O setting, Kanki et al. (1991), through the use of aircraft simulators, studied the communication patterns of 18 aircrews with different error rates during landings. Errors were identified and tabulated by raters who inspected videotaped performances of the simulated flights. Crew communications were coded into categories, such as commands, questions, observations, replies, and acknowledgments. The frequencies of utterance dyads, defined as an initiating utterance followed by a response utterance, were then computed. One variable of interest in the study was communications variation, described as the degree to which a given crew varied from the overall expected frequencies generated from an analysis of all crews' communications. The communication variations of low-error crews were very low compared to high-error crews, suggesting that a standard and specific communication code had been adopted in low-error crews. Kanki et al. proposed that, by adopting such a code, the within-crew communications were less open to interpretation and thus had become more efficient, which aided coordination.

Lausic, Eccles, Jeong, Johnson, and Tenenbaum (2005) recently undertook a study of communication between winning and losing tennis doubles teams. College-level teams were videotaped while playing. Verbal communications were coded as uncertainty statements, action statements, acknowledgments, factual statements, non-task-related statements, or emotional statements. Sequential analysis methods were used to compute the transitional probabilities within all dyadic combinations of statement types and whether these probabilities departed from expected frequencies. The number of points played by winning and losing teams was equal, creating equal opportunity for the two teams to communicate. However, the results revealed that winning teams communicated twice as much as the losing teams but did not differ from losing teams in terms of the number of utterance dyad types in which they engaged. However, the winning teams made very frequent use of only a few dyads, which predominantly involved an action statement. An example of such a dyad is an initiating utterance, "What are you doing on this point?" which was coded as an uncertainty statement, and a response, "Let's play 'I' formation, go-out-wide," which was coded as an action statement. Note that the action statement appears to be the team members' attempt to achieve prior to the upcoming point a shared knowledge state relating to a planned sequence of coordinated operations. By comparison, the losing teams used all the dyads with a similar frequency, and thus used fewer dyads involving an action-related statement, which was interpreted as being less beneficial for coordination.

Methods and Measures Relating to the Study of Team Coordination and Communication

A key challenge when presenting any new conceptual framework is to develop objective, valid, and reliable measures to begin to test hypotheses afforded by the framework. There are currently no measures of coordination and only one measure of communication in sport. However, much research effort has been devoted to studying teams in the I/O psychology domain, and various methods and measures have been developed for the study of coordination. The relative merits of these methods are discussed in the next section. Following this, several specific methods are described in more detail.

Many studies of coordination in teams operating in I/O domains have been undertaken in the field. One reason is that the individuals operating in these domains have been unwilling or unable to be detached from the field to engage in controlled laboratory studies (e.g., military personnel are often too busy). However, many I/O domains, such as command and control, involve large human and machine systems that comprise multiple, interacting, and dynamic elements. Consequently, researchers in I/O psychology have argued that ecological validity is too heavily compromised when aspects of these environments are studied in the laboratory (Hutchins, 1995). Thus, many studies of team coordination in I/O domains have involved methods associated with anthropological and sociological field studies, such as observations, augmented by note taking and video recording and interviewing. This is the case in the studies of teams involved in space shuttle mission control (e.g., Patterson & Woods, 2001), naval ship operations (e.g., Hutchins, 1995), and simulations of expeditions on the planet Mars (e.g., Clancey, 2001). Furthermore, researchers studying cognition in these types of domains have proposed the terms *cognitive anthropology* (e.g., Hutchins, 1995), and *cognitive ethnography* (e.g., Ball & Ormerod, 2000) to describe their approaches.

The advantages of these approaches include providing a rich and detailed insight into the functioning of teams as they operate in the real world, yet they are not without their critics. Researchers more familiar with experimental approaches to scientific inquiry often criticize such methods as inherently subjective and remain skeptical of their scientific value. Furthermore, even when more controlled studies of team functioning have been undertaken in I/O domains, progress in developing objective measures of team processes or performance has not been substantial. Measures are often in the form of subjective ratings of a given variable (e.g., communication quality) undertaken by socially recognized subject-matter experts (see Ward et al., in press). However, given the nature of the teams and the environments in which they operate in these domains (i.e., comprising multiple, interacting, and dynamic elements), there has been limited progress in developing objective measures. The challenge facing sport psychologists is to develop methods and measures of coordination given the potential for the tradeoff between internal and ecological validity introduced by sport team environments. A brief description of a selection of these measures follows to provide insight into the variety of measures of team coordination and communication that have been used in I/O psychology. Note that the only goal of this section is to introduce these methods, and so, to achieve brevity, the results of some of the studies discussed are not provided.

Template-based analysis has been used to analyze coordination in tasks wherein operations are performed in discrete sequences (Xiao & The LOTAS Group, 2001). This involves creating a template of the nature and timing of a team's operations and of the team members who perform those operations for a prototypical task. For example, in football, there are a variety of discrete and sequenced plays learned by the team that could be (and usually are) specified in a template form. The actual performance of team operations is compared to the template. Expert observers, such as coaches, undertake the comparison process. Performance scores are allocated for each team member and correspond to each appropriate operation undertaken at the appropriate time. For example, a football receiver who runs an incorrect route would be allocated a poor score. Consequently, team members who undermine coordination can be identified and their actions corrected. Template-based analysis might be adapted for dynamic tasks by selecting segments of the task that can be treated as discrete, such as a tack or jibe in sailing.

Hutchins (1995) described a qualitative method of representing coordinated team operations called an *activity score.* The score is a graph on which is plotted the temporal pattern of operations for a given task and the team members involved in performing those operations. Depicting the operations on the score makes clear the relation of time, team member involvement, and operations that constitute coordinated behavior. In terms of its application, the graph could be used for comparisons between teams of different skill levels, as a graphic version of a template for template analysis, and as a diagnostic and evaluation tool for identifying coordination breakdowns. Advances in video and audio recording and analysis methods (e.g., *Observer,* 2003, and RATE software) have made measuring a variety of coordination variables for one team performance faster and less labor-intensive.

Achieving shared knowledge affords team members an accurate anticipation of other team members' operations. MacMillan et al. (2004) proposed that an indirect method of assessing the extent to which knowledge has been shared is to assess the team's anticipation ratio (AR), which is the ratio of members' frequency of requests for information to the frequency of transfers of information via intentional verbal communication. Shared knowledge is indicated by a team member offering information in advance of the recipient's request. Thus, if N_t represents the number of communications transferring information to members, and N_r represents the number of communications requesting information, then

$$\mathrm{AR} = \frac{N_t}{N_r} \tag{12.2}$$

MacMillan et al. argued that shared knowledge is indicated by a ratio less than 1 : 1. The anticipation ratio has been shown to predict team performance in military settings (Entin & Serfaty, 1999; Serfaty, Entin, & Johnson, 1998). This methodology might be suited to sports teams characterized by the need for and feasibility of verbal communication of task-relevant information, such as mountaineering teams.

Kraiger and colleagues (Kraiger, Ford, & Salas, 1993; Kraiger & Wenzel, 1997) proposed a knowledge-based method of assessing shared knowledge. Tasks are described to the team, for which a correct sequence of operations is known for each team member. Members are then asked what operations another member would be expected to perform at a given point in the sequence. Alternatively, members watch together a video of a recently played game. At selected segments of the game, subsequent segments are occluded, and members are asked what operations another member would be expected to perform during this segment. Shared knowledge (SK) would be indicated by the agreement rate between members. Thus, if in one "occluded situation" the total number of members' anticipated solutions was $N_{as,}$ and of shared solutions was $N_{ss,}$ then

$$\mathrm{SK}_i = \frac{N_{ss}}{N_{as}} \tag{12.3}$$

and across many anticipated situations

$$\mathrm{SK} = \frac{\sum \mathrm{SK}_i}{k} \tag{12.4}$$

where k is the number of situations given.

Kraiger and colleagues (1993) also proposed a similar method in which members are presented with written sequences of other members' operations and asked to articulate reasons why those operations were necessary. Furthermore, these authors suggested using a card-sorting task to measure shared knowledge. A task is described to the team, and members are provided individually with cards denoting various task elements. Team members are then asked to sort the cards into categories of similar concepts and then label the concepts and any similarity between them. Concepts that overlap with other members' concepts should indicate shared knowledge. This method could also be used to discriminate between teams with different experience levels (cf. Chi, Feltovich, & Glaser, 1981).

With regard to measures of communication, Bowers, Jentsch, Salas, and Braun (1998) explored how the *type* of intentional verbal communication differed between high- and low-performing aircraft crew members operating in a simulator. Crews undertook low-level reconnaissance missions involving the identification of buildings, and performance was measured as the number of buildings identified. The task required crew members to coordinate their operations. The communication between the crew members was video recorded and assigned by observers to preselected categories. These included uncertainty statements, such as direct and indirect questions; acknowledgments, such as yes and no; responses, which differed from acknowledgments only in that they conveyed more than one bit of information; planning statements; factual statements, which include verbalized, readily observable realities of the environment; and non-task-related statements. Analyses of single-statement and statement-response data were made and compared across teams.

Serfaty et al. (1998) explored the relationship between intrateam intentional verbal communication *quality* and team coordination by devising a communication quality scale. This comprised seven points ranging from poor to good communication, on which observers rate the communication of performing teams on dimensions such as the ability to pass information, clarify information, and use proper terminology. Smith-Jentsch, Johnston, et al. (1998) devised a similar scale with dimensions such as inaudible and incomplete communication and excess chatter. Xiao and The LOTAS Group (2001) explored the relationship between intrateam intentional verbal communication *direction* and team coordination by employing flow pattern analysis, by which the frequency of the direction of intentional verbal communication between team members was tabulated for a given task. A schematic diagram of intrateam flow is often created to better identify flow differences between members.

Implications of Coordination Concepts for Sport Psychology Practitioners and Coaches

Based on team research in I/O psychology, various recommendations for enhancing team coordination are offered next. These have received only limited testing in real-world sporting contexts, so some trialing is recommended to test their efficacy.

Use Pre- as Well as Postmortems

In sports postmortems, coaches and team members discuss video footage of prior games to identify causes of coordination breakdowns and generate solutions to remediate these problems. Military researchers have been testing the use of premortems to critique military plans. Where, when, and why might coordination break down? How might the breakdowns be rectified at the time? Attempts to perform premortems with sports teams might provoke members into thinking about possible errors and contingent recovery strategies.

Use Check-Backs to Evaluate Comprehension

During pregame planning, there might be a benefit in developing methods to check whether each team member understands the plans and his or her role in them. Coaches might normally allow players to come forward with queries about plans while they are being developed or explained; developing a routine of checking back with each team member that he or she fully understands the plans is likely to reduce miscomprehensions and also increase members' accountability. In this regard, military teams use check-backs that vary in terms of thoroughness, and their use will depend on time constraints and the implications for performance of comprehension failures. These include structured opportunities for team members to say "I don't understand" when plans are described to the team. Reducing team members' confusion about team plans is likely to enhance coordination.

Train Situational Probabilities

Recent studies (see Ward & Williams, 2003; Williams, Ward, Herron, & Smeeton, 2004) have provided evidence that having team members study videos and match statistics from previous games can enhance their knowledge about situational probabilities. From these sources, the team together identifies players' typical responses in a given situation. Another method is to describe to a team a sequence of actions for which a correct sequence is known for each team member. Team members are then asked what actions another player would be likely to perform at a given point in the sequence. Alternatively, members watch a video of a recently played game. At selected segments of the game, subsequent segments are occluded, and members are asked what actions another member would be expected to perform during this segment. Remediation activities can be targeted at players' weaknesses in knowledge.

Use Cross-Training

I/O psychologists have advocated cross-training in the development of shared teamwork knowledge. This involves team members spending time in another member's role or position so that they gain a better appreciation of how to coordinate their own actions with other members' actions.

Develop a Shared Language

This language should be short and not easily confused with other messages and should convey specific information so that everyone understands exactly what message is being transferred. The language can be both verbal (shouts) and nonverbal (gestures) and can also be encrypted. Message senders can better signal which team member is the intended recipient by having the team develop succinct nicknames. These can also be encrypted so that the opposing team does not know who is being sent messages.

CONCLUSION

In this chapter, we have argued that an understanding of team functioning in sport will be enhanced if the topic is studied from a social-cognitive perspective. Traditionally, team functioning in sport has been considered predominantly from a social perspective, and research on cognitive aspects of sports performance has been concerned predominantly with the individual. Consequently, little attention has been paid to interactions between an individual's cognition and the social processes and settings of teams. Specifically, we have proposed that the adoption of a social-cognitive perspective on team functioning will allow greater insight into (a) the cognitive affects of social processes inherent to teams and on which the extant research on teams in sport has been focused; (b) how the social properties and process inherent to teams affect team cognition, such as that underlying team decision making; and (c) how a team achieves coordination.

There are limitations to the research in I/O psychology and on social cognition. The concepts proposed in these domains have tended to be theoretically well developed but lacking in extensive empirical support. This claim is made even by those from within the domain (Rentsch & Davenport, in press). Furthermore, although it would be difficult to argue against the claim that it is self-evident that coordination is an important component of team performance, there have been few attempts in the I/O domain to measure coordination and successfully relate it to performance outcome measures. In addition, some authors (e.g., Eccles & Ward, in press) have taken issue with the use of various terms for concepts in the I/O psychology literature, labeling them confusing or nebulous (e.g., preprocess coordination, premortem). However, the goal of this chapter has been to introduce to sport psychologists a range of concepts from research on teams in I/O psychology and on social cognition, and thus it would have been inappropriate to describe these concepts without using the terms given to them by researchers in these domains.

A key challenge for future research in this area is to develop valid and reliable methods and measures that will facilitate investigations of the interactions between social and cognitive aspects of team functioning in sport. A social-cognitive perspective on team functioning, which has not been considered previously in sport psychology, provides a substantial extension of what is known today about teams in sport.

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PART IV

Interventions and Performance Enhancement

CHAPTER 13

Mental Skills Training in Sport

ROBIN S. VEALEY

Sport psychology has evolved from a fledgling academic discipline narrowly focused on motor behavior research in laboratory settings to a broad, interdisciplinary profession in which psychological services are provided to a range of physical activity participants. The focus of this chapter is on mental skills training with athletes, coaches, and teams, with the objective of assisting sport participants in the development of mental skills to achieve performance success and personal well-being. A comprehensive review of the literature pertaining to mental skills training in sport is undertaken to address the following questions: What has the field of sport psychology learned from almost 3 decades of mental skills training with athletes? How has mental training evolved, and have the objectives of mental training in sport been achieved? What future directions should the field consider to enhance the significance and impact of mental skills training in sport?

The chapter is divided into five sections. First, the historical development of mental training in sport is described. Second, a model of mental skills for athletes and coaches is offered, and third, a framework for understanding mental skills training in sport is presented. Fourth, the uses and effectiveness of mental skills training in sport are reviewed, and finally, suggestions for the future of mental training in sport are provided. The theme of the chapter is that mental skills training has evolved from the decontextualized application of specific techniques to enhance performance (e.g., imagery, self-talk) into a comprehensive intervention process whereby various philosophies, models, strategies, techniques, and consultant styles are utilized in specific social-cultural contexts to help athletes and coaches achieve significant personal development as well as performance success.

HISTORICAL DEVELOPMENT OF MENTAL SKILLS TRAINING IN SPORT

Published literature indicates that the Soviet Union was the first country to systematically engage in mental skills training with athletes and coaches in the 1950s (Ryba, Stambulova, & Wrisberg, 2005; J. M. Williams & Straub, 2006). Avksenty Puni was a key leader in Soviet sport psychology, and his 1963 article "Psychological Preparation of Athletes for Competition" and other writings (cited in Ryba et al., 2005) formalized perhaps the earliest mental training model, which included self-regulation of arousal, confidence, attentional focusing, distraction control, and goal setting. The Soviet emphasis on mental training with athletes was systematically applied to other Eastern Bloc countries, including East Germany and Romania, during the 1970s and 1980s (Salmela, 1984; J. M. Williams & Straub, 2006).

Although the systematic practice and study of mental training in sport in North America did not emerge until the 1980s, several pioneers began work in mental training prior to this time. Coleman Griffith was hired by the Chicago Cubs professional baseball team in 1938 to improve the performance of the team. The mental training techniques used by Griffith included practice management strategies for enhanced learning and automation of skills, communication skills for coaches, team dynamics and leadership development, goal setting, confidence building, competitive simulation, a test battery for measuring players' basic physical and "visual" skills, and a recommendation that psychological testing and observation be included in scouting (Green, 2003). Another American mental training pioneer from this historical era was Dorothy Hazeltine Yates, who engaged in mental skills training with boxers and aviators, primarily focusing on a "relaxation set-method" and mental preparation (Kornspan & MacCracken, 2001; Yates, 1943). Like Griffith, Yates (1943) also engaged in controlled experimental investigations of the effectiveness of her mental training interventions, with positive results.

David Tracy was hired as a mental training consultant with the St. Louis Browns professional baseball team in 1950, and his work with the players included relaxation, thought management through self-talk and thought stopping, and hypnosis (Kornspan & MacCracken, 2002). Bruce Ogilvie, a clinical psychologist, began consulting work with athletes in the 1960s (Ogilvie & Tutko, 1966), and another clinical psychologist, Richard Suinn, published one of the first intervention studies that assessed the effectiveness of mental training with athletes. Suinn's (1972) intervention using relaxation, imagery, and behavioral rehearsal improved race performance in a group of elite skiers and led to subsequent mental training work with the U.S. Ski Team (Suinn, 1977).

Mental skills training became a major focus for research and practice in North American sport psychology in the 1980s. Several events are indicative of this professionalization, in which sport psychology moved from an academic research discipline to an interdisciplinary professional field offering services to consumers. These events include the establishment of guidelines and a registry for the provision of sport psychology services by the U.S. Olympic Committee in 1983, the first systematic provision of sport psychology services to the U.S. Olympic Team in 1984 (Suinn, 1985), the hiring of a full-time sport psychologist by the USOC and the formation of the Association for the Advancement of Applied Sport Psychology (AAASP) in 1985, the formation of a division of Exercise and Sport Psychology within the American Psychological Association in 1987, the establishment of two new applied journals (the *Sport Psychologist* in 1987 and the *Journal of Applied Sport Psychology* in 1989), the development of a certification program for sport psychology consultants by AAASP in 1991, and the publication of numerous books devoted to mental training interventions (e.g., Harris & Harris, 1984; Nideffer, 1981; Orlick, 1980, 1986, 1990). Massive debate occurred during this time period regarding *who* could offer *what types* of psychological services to consumers (Brown, 1982; Clarke, 1984; Danish & Hale, 1981, 1982; Gardner, 1991; Harrison & Feltz, 1979; Heyman, 1982, 1984; Nideffer, DuFresne, Nesvig, & Selder, 1980; Nideffer, Feltz, & Salmela, 1982; Silva, 1989; "U.S. Olympic Committee," 1983) and whether there was adequate scientific evidence to justify mental training interventions in sport ("ABC Nightline News Telecast," 1988; Dishman, 1983; R. E. Smith, 1989).

Today, sport psychology is widely acclaimed as an interdisciplinary field in which professionals across the globe use training from both the sport sciences and psychology to engage in mental skills training that is guided by established training standards and professional competencies (Morris, Alfermann, Lintunen, & Hall, 2003; Tenenbaum, Lidor, Papaioannou, & Samulski, 2003), ethical guidelines for service delivery (Petitpas, Brewer, Rivera, & Van Raalte, 1994), and a rapidly accumulating body of knowledge on which appropriate and effective mental training interventions are developed and implemented (e.g., Andersen, 2000, 2005; L. Hardy, Jones, & Gould, 1996; Lidor & Henschen, 2003; Meyers, Whelan, & Murphy, 1996; Morris, Spittle, & Watt, 2005; S. Murphy, 2005; Vealey, 2005).

MENTAL SKILLS FOR ATHLETES AND COACHES

What knowledge have we gained in the past 25 years about mental skills that are important for athletes and coaches? The objective of mental training is to assist sport participants in the development of mental skills to achieve performance success and personal well-being. Thus, it seems important to identify key mental skills that are related to performance success and personal well-being to guide the development of mental training interventions. A model of mental skills for athletes and coaches is shown in Figure 13.1. An extension of a previous model (Vealey, 1988), it serves to emphasize that multiple types of mental skills are important for success and well-being in athletes and coaches, including foundation, performance, personal development, and team skills.

Foundation Skills

Foundation skills are intrapersonal resources that are the basic foundation mental skills necessary to achieve success in sport. *Achievement drive* is the urgent, compelling desire to apply effort and persistence to overcome obstacles to accomplish something of worth or importance. Achievement drive also leads to committed behavioral management

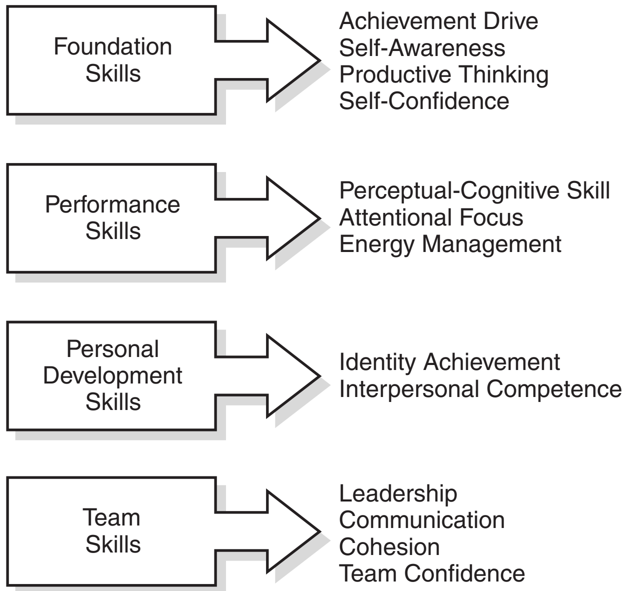

Figure 13.1 Mental skills for athletes and coaches.

to organize and manage daily living in the pursuit of important goals. An overwhelming amount of research has shown that highly successful elite athletes possess strong achievement drives that fuel their daily commitment to pursuing and achieving important goals (Bull, Shambrook, James, & Brooks, 2005; DeFrancesco & Burke, 1997; Durand-Bush & Salmela, 2002; Gould, Dieffenbach, & Moffett, 2002; Greenleaf, Gould, & Dieffenbach, 2001; Jones, Hanton, & Connaughton, 2002; Orlick & Partington, 1988). This skill involves meticulous planning, time management and prioritization, hard and smart training, a willingness to sacrifice and delay gratification, taking personal responsibility for training, designing and following behavioral strategies such as routines, and the ability to set and achieve goals (Durand-Bush & Salmela, 2002; Gould, Dieffenbach, et al., 2002; Gould, Eklund, & Jackson, 1992a, 1992b; Gould, Eklund, & Jackson, 1993; Gould, Finch, & Jackson, 1993; Greenleaf et al., 2001; Holt & Dunn, 2004). Expert athlete performance results from many hours of specific and focused training at a high level (Baker, Côté, & Abernethy, 2003; Durand-Bush & Salmela, 2002), and success in coaching requires a passion to coach, commitment to learning, perseverance in the face of obstacles, and strong planning and organizational skills (Vallée & Bloom, 2005; Vealey, 2005).

Self-awareness is the ability to engage in introspection and retrospection to understand one's thoughts, feelings, and behaviors. The ability to engage in honest self-appraisal to enhance self-awareness has been identified as an important mental skill by elite athletes (Bull et al., 2005; Calmels, d'Arripe-Longueville, Fournier, & Soulard, 2003) and sport psychology consultants (Ravizza, 2006). Self-monitoring and self-evaluation are critical precursors to effective self-regulation and success in sport (Chen & Singer, 1992; Kirschenbaum & Wittrock, 1984).

Productive thinking is the ability to manage thoughts to effectively prepare for and respond to life events in a way that facilitates personal success and well-being. Research has substantiated that successful athletes think more productively than less successful athletes. Successful athletes focus more on task-relevant thoughts and are less likely to be distracted (Eklund, 1994, 1996; Gould et al., 1992a, 1992b; Gould, Eklund, et al., 1993; Gould, Dieffenbach, et al., 2002; Greenleaf et al., 2001; Jones et al., 2002; Orlick & Partington, 1988). A unique study by McPherson (2000) examined the thinking of collegiate tennis players by recording their thoughts during and after each point in a tennis match based on the questions "What were you thinking during that point?" and "What are you thinking now?" The elite athletes' thoughts were task-oriented, involved planning strategies, focused on problem solving, and focused confidently on enabling feelings and beliefs about their competence and ability to succeed. The novice athletes' thoughts included more expressions of frustration and emotion and were indicative of low confidence and having negative expectations and a consistent desire to quit.

Successful elite athletes have also been shown to be optimistic, hopeful, and adaptively perfectionistic in setting high personal standards, but not being overly concerned with making mistakes (Gould, Dieffenbach, et al., 2002). Research with professional baseball, professional basketball, and collegiate swimming teams found that optimistic teams performed better than pessimistic teams (Seligman, 1998). Rational thinking and perspective have been shown to be important mental skills for the mental resilience needed to cope with the uncontrollable obstacles and setbacks inherent in competitive sport (Bull et al., 2005; Gould, Eklund, et al., 1993; Gould, Finch, et al., 1993; Greenleaf et al., 2001; Jones et al., 2002; Thelwell, Weston, & Greenlees, 2005). Finally, expert athletes have demonstrated adaptive attributional patterns to explain their performance successes and failures (Cleary & Zimmerman, 2001; Kitsantas & Zimmerman, 2002), which serves to enhance their motivation. Expert coaches demonstrate several forms of productive thinking, including mental rehearsal of competition plans, maintaining a positive focus, and knowing how to occupy their thoughts in productive ways prior to competition (Bloom, Durand-Bush, & Salmela, 1997).

Self-confidence is the belief that one has the internal resources, particularly abilities, to achieve success. International-level elite athletes identified resilient and robust self-confidence, or the unshakable belief in one's ability to achieve, as the most critical mental skill defining mental toughness (Bull et al., 2005; Jones et al., 2002; Thelwell et al., 2005). Self-confidence consistently appears as a key skill possessed by successful elite athletes (DeFrancesco & Burke, 1997; Durand-Bush & Salmela, 2002; Gould, Dieffenbach, et al., 2002; Gould, Greenleaf, Chung, & Guinan, 2002; Kitsantas & Zimmerman, 2002), and fluctuations in confidence account for differences in best and worst performances (Eklund, 1994, 1996; Gould et al., 1992a, 1992b; Greenleaf et al., 2001). Elite field hockey players identified the development and maintenance of self-confidence as one of their biggest needs in terms of mental training (Grove & Hanrahan, 1988).

Performance Skills

Performance skills are mental abilities critical to the execution of skills during sport performance. *Perceptual-cognitive* skill refers to the cognitive knowledge structure that enables optimal strategic processing of task-relevant information. Although perceptual-cognitive expertise is discussed extensively in Chapter 11, it is included in this chapter as a critical performance skill that must be included in the mental skills model shown in Figure 13.1. Highly skilled athletes demonstrate expertise in tactical/strategic knowledge and perceptual and decision-making skill in sport, including superior recall and recognition of patterns of play, faster detection and recognition, more efficient and appropriate visual search behaviors, and better anticipation of likely events in their specific sports (McPherson & Kernodle, 2002; Tenenbaum, 2002; Tenenbaum & Bar-Eli, 1993; A. M. Williams & Ward, 2003). Also, the ability to generate and use vivid and controllable mental images of performance responses is associated with better sport performance (K. A. Martin, Moritz, & Hall, 1999).

Attentional focus is the ability to selectively direct and sustain a focus of attention required for the successful execution of a specific activity. The ability to direct and sustain a nondistractible focus of attention is widely observed in and cited by athletes as a mental skill critical to performance (DeFrancesco & Burke, 1997; Durand-Bush & Salmela, 2002; Gould, Dieffenbach, et al., 2002; Gould, Eklund, & Jackson, 1993; Greenleaf et al., 2001; Jones et al., 2002; Kitsantas & Zimmerman, 2002; Orlick & Partington, 1988; Thelwell et al., 2005). Athletes' attentional focusing skills have differentiated between peak and failing performance (Eklund, 1994, 1996; Gould et al., 1992a, 1992b; Privette & Bundrick, 1997) and effective and ineffective coping (Nichols, Holt, & Polman, 2005) and have been identified by coaches as the most important mental skill needed in sport (Gould, Medbery, Damarjian, & Lauer, 1999).

Energy management is the ability to effectively manage various feeling states (e.g., arousal, anxiety, anger, excitement, fear) to achieve personally optimal physical and mental energy levels for performance. The structure of competitive sport and the highly valued rewards inherent in sport elicit a range of intense emotions or feeling states that must be effectively managed to create the optimal energy level for performance. The ability to cope with and manage negative feeling states, such as anxiety and pressure, is a key mental skill possessed by elite athletes (Bull et al., 2005; Gould, Dieffenbach, et al., 2002; Gould, Eklund, et al., 1993; Jones et al., 2002; Thelwell et al., 2005). Athletes have identified "normal nervousness" and optimal emotional arousal as associated with high-level performances and inappropriate or negative emotional states as associated with low levels of performance (Eklund, 1994, 1996; Gould et al., 1992a, 1992b). A key component of mental toughness as identified by elite athletes is the ability to push back the boundaries of physical and emotional pain to maintain effective performance under distress (Jones et al., 2002). Successful expert coaches have the ability to remain composed and manage their energy levels during and after competition to remain effective (Bloom et al., 1997; Vallée & Bloom, 2005). Elite coaches have also identified emotional control and management of nervousness and tension as the biggest mental training need for their athletes (Grove & Hanrahan, 1988).

Personal Development Skills

Personal development skills are mental skills that represent significant maturational markers of personal development and that allow for high-level psychological functioning through clarity of self-concept, feelings of well-being, and a sense of relatedness to others. Life skills (Danish & Nellen, 1997; Danish, Petitpas, & Hale, 1992) that are athlete-centered (P. S. Miller & Kerr, 2002) and child-centered (Weiss, 1991), life engagement (Newburg, Kimiecik, Durand-Buch, & Doell, 2002), philosophical counseling (Corlett, 1996), and sociocultural (Brustad & Ritter-Taylor, 1997; Ryba & Wright, 2005) approaches to mental training interventions all focus on personal development skills as outcomes of interest. Successful coaches have identified both performance enhancement and personal development as important objectives for coaches (Vallée & Bloom, 2005).

Two personal development skills seem to be important for mental training in sport (see Figure 13.1). *Identity achievement* is the establishment of a clear sense of identity, or "who I am," that allows the individual to experience psychological well-being and feelings of self-worth, usually after exploration and introspection about life experiences (Marcia, 1994). This skill requires long-term development but seems important for athletes because it involves resistance to conformity and subcultural pressure based on the controlling nature of elite sport (Coakley, 1992; G. M. Murphy, Petitpas, & Brewer, 1996; Sparkes, 1998). *Interpersonal competence* is the ability to interact effectively with others by demonstrating effective communication skills. Interpersonal competence was identified as an important mental skill for elite athletes in terms of providing and using social support (Holt & Dunn, 2004).

Team Skills

The final category of mental skills shown in Figure 13.1 is team skills. Team skills are collective qualities of the team that are instrumental to an effective team environment and overall team success. *Team confidence* is the belief that the team has the collective resources, or team abilities, to achieve team success. Team confidence is a better predictor of team success than the aggregate of individual levels of confidence for all team members (Feltz & Lirgg, 1998; Gould, Greenleaf, et al., 2002). *Cohesion* is the team's ability to stick together and remain united in the pursuit of its goals, which is an important predictor of team performance (Carron, Colman, Wheeler, & Stevens, 2002; Greenleaf et al., 2001). *Communication* is the process of interpersonal interaction within the team that facilitates team success and athletes' well-being. *Leadership* is the ability of individuals (coaches and athletes) to influence others on the team to think and act in ways that facilitate team success and the quality of the team's social psychological environment. Successful Olympic teams have been shown to possess coaches who instilled confidence and trust in their athletes and who coped well with crisis situations, whereas unsuccessful Olympic teams had coaches who failed to develop trust and effective communication and who were inconsistent in their behaviors in pressure situations (Gould, Guinan, Greenleaf, Medbery, & Peterson, 1999).

The mental skills model shown in Figure 13.1 is not meant to definitively identify and categorize mental skills needed in sport. The point of the model is to clarify the objectives for mental training programs by emphasizing that mental skill foundations, personal development abilities, and team skills, along with performance skills, are key mental training targets for sport psychology consultants. As discussed in the next section, the mental training process includes many different approaches that consultants may adopt as they target specific mental skills or sets of skills for enhancement.

A FRAMEWORK FOR UNDERSTANDING MENTAL SKILLS TRAINING IN SPORT

A framework for understanding mental skills training in sport is shown in Figure 13.2. The targets for mental training are foundation, performance, personal development, and team skills. The process of mental training includes the philosophy, model, strategies, and techniques that define the consultant's approach to enhancing mental skills. This process is mediated by the interpersonal and technical effectiveness of the consultant.

The two arrows on each side of the framework represent the influence of physical training and the social-cultural influences of sport and society on the mental

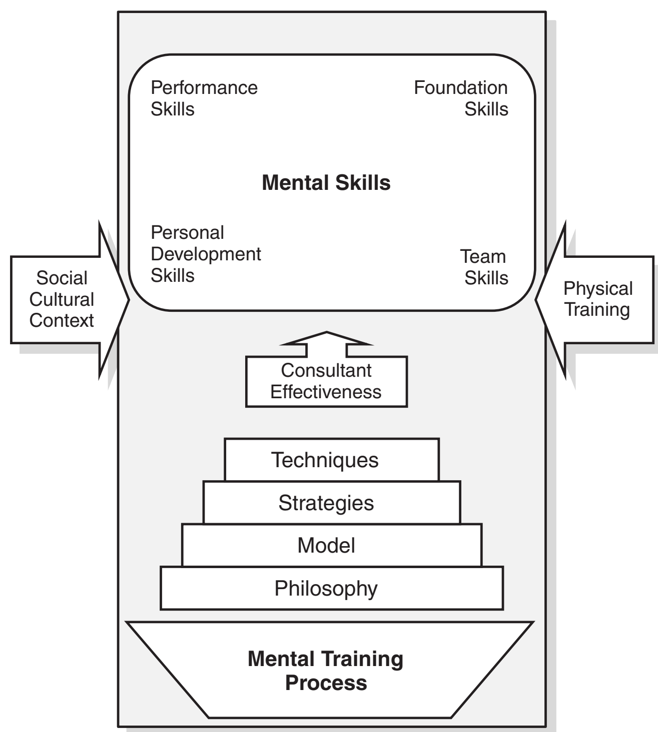

Figure 13.2 A framework for understanding mental skills training in sport.

training process. Mental skills in athletes are obviously developed and enhanced through high-quality physical training regimens designed by innovative master coaches (e.g., Dorrance & Averbuch, 2002; Gould, Hodge, Peterson, & Giannini, 1989; Krzyzewski, 2000). However, many coaches need guidance and training to learn specific ways that they can integrate mental training into their physical training sessions with athletes (Gould, Damarjian, & Medbery, 1999), and the mental training literature should begin to address this important need (e.g., Vealey, 2005). In addition, mental training consultants must understand the specific physical training requirements for the athletes with whom they are working, and they must be able to readily and creatively integrate mental and physical training into one integrative process. Sinclair and Sinclair (1994) provide an excellent "mental management" model that embeds mental skills training in the process of learning physical skills, using the premise that mental skills are more easily taught, learned, and remembered if they are developed along with physical skills.

A critical point that needs much more attention by the field of sport psychology and mental training consultants is that the process of mental skills development and training occurs within a social-cultural context. This includes the unique subcultures of various types of sport, as well as the broader cultural factors that influence athletes' mental skills and their participation in mental skills training. For example, the insular and "macho" subculture of sport creates a climate whereby mental training is stigmatized and distrusted (S. B. Martin, 2005; S. B. Martin, Lavallee, Kellmann, & Page, 2004) and also perpetuates dysfunctional self-perceptions and behaviors such as negative body image, hazing, substance abuse, homophobia, hyperconformity, identity foreclosure, burnout, and violence (e.g., Brustad & Ritter-Taylor, 1997). Many issues faced by mental training consultants are rooted in problematic aspects of the social-cultural structure of society and sport, and mental training consultants must broaden their perspective to help athletes achieve significant personal development by understanding how the culture in which they live and perform directly influences their thoughts, feelings, and behaviors. (This is discussed at the end of the chapter as an important future direction for mental skills training.)

The Mental Training Process

The mental training process shown at the bottom of Figure 13.2 is a complex, multilayer, integrative approach to developing mental skills in athletes. Indeed, mental skill training has matured from early interventions that focused on the random application of mental training techniques, such as imagery and goal setting, to programmatic intervention models that utilize specific mental training strategies and techniques within a coherent guiding intervention model.

Philosophy

The mental training process begins with the consultant's *philosophy,* or his or her set of ideas and beliefs about the nature of mental skills and mental training, usually including program objectives and the respective roles of the consultant, athlete, and coach in the process. Poczwardowski, Sherman, and Ravizza (2004) have conceptualized a hierarchical structure of professional philosophy for sport psychology service delivery, which is very similar to the hierarchical layers of the mental training process shown in Figure 13.2. Multiple examples of mental training consultant philosophies, and resulting mental training models, strategies, and techniques, were published in three special issues of the *Sport Psychologist* on delivering services to Olympic athletes (December 1989 issue), professional athletes (December 1990 issue), and special populations (December 1991 issue).

The main philosophical differences in mental skills training in sport have been educational versus clinical approaches, program-centered versus athlete-centered approaches, and performance enhancement versus personal development approaches. The educational approach is based on the philosophy that athletes possess the mental skills needed for success in sport, but that they often need assistance in optimizing these skills, systematically training them to hold up under increasing competitive pressure, and developing additional skills required to successfully navigate the competitive demands of sport (e.g., Danish, Petitpas, & Hale, 1995; Orlick, 2000; Ravizza & Hanson, 1994; Vealey, 2005). The clinical approach focuses on psychopathology or dysfunctional personality processes and behaviors, with the objective of providing remedial therapeutic assistance to athletes (Gardner & Moore, 2006; Marchant & Gibbs, 2004; Ward, Sandstedt, Cox, & Beck, 2005). Consultants embracing the clinical philosophy of remedial therapeutic assistance require training and licensure as psychologists.

Program-centered approaches to mental skills training use a preplanned sequence of intervention activities designed by the professional consultant; athlete-centered approaches take a more interactive, needs-based approach to interventions. L. Hardy and Parfitt (1994) evaluated their participation in two philosophically different mental training programs. The first program used a program-centered prescriptive approach in which consultants served as the experts to formally assess athletes' mental skills and needs using inventories, interviews, and observation, and then provided written reports and tutorials to athletes and coaches, prescribing the mental training activities for athletes based on their individual profiles. The second program scrapped the "consultant as expert" formal prescriptive approach of assessment and reports and focused on the needs of athletes and coaches from their perspective. A key philosophical tenet of this athlete-centered approach was that the consultants, athletes, and coaches were all equal in terms of knowledge and expertise. Consultants focused on being available to meeting athletes' and coaches' needs when requested and responded to the valuable insights and experiences that athletes and coaches brought to the consulting relationship using a collaborative, problem-solving intervention philosophy.

L. Hardy and Parfitt (1994) admitted that the athlete-centered program was more difficult for them as consultants in that they had to serve in unforeseen and multiple roles, yet their effectiveness as consultants was evaluated more positively by athletes in the athlete-centered program. However, this is not to say that one philosophy is better than another, as intervention philosophies should be carefully developed with regard to program objectives, the social-cultural context, and consultant skills and training. Program-centered philosophical approaches that delineate pragmatic intervention models and user-friendly strategies should not be denigrated, because these canned programs provide specific and innovative ways that athletes and coaches can incorporate mental training into their lives without the direct involvement of a sport psychology consultant (e.g., Moore & Stevenson, 1994; Singer, 1988; Vealey, 2005).

The third philosophical issue in mental skills training is whether the objective of interventions should target performance enhancement or personal development in athletes. Clearly, these two objectives are not mutually exclusive and are often noted as important companion objectives of mental skills training (e.g., P. S. Miller & Kerr, 2002; Vealey, 1988, 2005; J. M. Williams, 2006). Research examining the effectiveness of mental skills training is slowly moving beyond performance as the only outcome of interest to examine intervention effects on other important outcomes such as successful life transition (Lavallee, 2005), the quality of sport experiences (Lindsay, Maynard, & Thomas, 2005; Newburg et al., 2002), life skills (Danish & Nellen, 1997), and sociomoral growth of children (S. C. Miller, Bredemeier, & Shields, 1997).

Model

The second layer in the mental training process, emanating from philosophy, is one's *model* of intervention, or the overarching thematic framework from which specific mental training strategies and techniques are developed and utilized. The mental skills training literature abounds with the description of many models of intervention. These include systems models for team, organizational, and family interventions (Hellstedt, 1995; Zimmerman, Protinsky, & Zimmerman, 1994), self-regulatory or cognitive-behavioral models (Boutcher & Rotella, 1987; Hanin, 2000; Kirschenbaum & Wittrock, 1984; Moore & Stevenson, 1994; Singer, 1988), behavioral management models (G. L. Martin & Toogood, 1997; S. B. Martin, Thompson, & McKnight, 1998; Tkachuk, Leslie-Toogood, & Martin, 2003), educational mental skills models (Orlick, 2000; Vealey, 1988, 2005), developmental models (Danish & Hale, 1981; Danish & Nellen, 1997; Danish et al., 1992; M. Greenspan & Andersen, 1995; Weiss, 1995), sport-specific mental skills models (Ravizza & Hanson, 1994; R. E. Smith & Johnson, 1990; Thomas & Over, 1994), clinical intervention models (Gardner & Moore, 2004), and perceptual training models (A. M. Williams & Ward, 2003).

The models identified in the preceding paragraph are categorized based on theoretical emphases in psychology to help readers appreciate the broad scope of mental training models in the literature. However, perhaps the most important function of mental training models is their ability to creatively present a big picture of mental skills training to athletes and coaches to enhance their understanding of and interest in mental training. Models can be represented by motivational acronyms such as GOAL (Going for the Goal) and SUPER (Sports United to Promote Education and Recreation; Danish & Nellen, 1997), pictorial models such as the Wheel of Excellence (Orlick, 2000) and Inner Edge (Vealey, 2005), or popular descriptions such as the Mental Toughness Plan (Bull, Albinson, & Shambrook, 1996).

Strategies

The third layer of the mental training process is the strategies that logically emanate from one's intervention philosophy and model. These are the organizational plans of action that operationalize how the intervention specifically works, typically using sequential steps, multiple phases, or the practical packaging of mental training techniques into a coherent, integrative program. Example strategies in the mental skills training literature include the Five-Step Strategy (Singer, 1988), the four-phase psychological skill program for close-skill performance enhancement (Boutcher & Rotella, 1987), P^3 Thinking and goal mapping (Vealey, 2005), centering (Nideffer & Sagal, 2006), competition focus plans (Orlick, 1986), the five-step approach to mental training using biofeedback (Blumenstein, Bar-Eli, & Tenenbaum, 2002), and visuomotor behavioral rehearsal (Suinn, 1993). Assessment strategies are an important part of this layer of the mental training process, as consultants decide how and when to assess the mental skill training needs of athletes (Vealey & Garner-Holman, 1998). The overall assessment strategy then leads to the use of specific assessment techniques, such as observation, interviews, questionnaires, and psychophysiological measures. Although the majority of AAASP-certified consultants use some type of written survey in mental training with athletes (O'Connor, 2004), these instruments are used sparingly, and interviews and observations are used most frequently to assess athletes (Vealey & Garner-Holman, 1998).

Techniques

The final layer of the mental training process is the techniques, or specific procedures or methods used in a mental training strategy. These methods are the familiar tools known to all mental training consultants, including imagery, relaxation, goal setting, self-talk, biofeedback training, performance profiling, and behavior management techniques. The traditional four mental training techniques of imagery, goal setting, thought management, and physical relaxation/arousal regulation have been most widely used by consultants (Gould, Murphy, Tammen, & May, 1991; Sullivan & Nashman, 1998; Vealey, 1988), although other techniques, such as performance profiling (Jones, 1993), have emerged, and variations on the traditional four techniques have proliferated (Sullivan & Nashman, 1998). These specific techniques have been the focus of most of the intervention research in sport psychology, yet they represent only the final layer in the mental training process. Although it is important to test the effectiveness of specific mental training techniques, the field has matured to the point where future research and professional practice initiatives are needed to study how to most effectively utilize specific techniques within particular strategies and models and as targeted toward specific mental skill development.

Summary of the Mental Training Process

In summary, the mental training process is made up of layers that unfold as part of a comprehensive mental training approach. Mental skills training starts with the philosophical foundations embraced and valued by the consultant, and then unfolds into the conceptualization of an intervention model with appropriate and useful strategies and techniques. There are many ways to conceptualize the multilayer mental training process (e.g., Poczwardowski et al., 2004), but what is important is that it involves a comprehensive process as opposed to starting at the bottom and simply applying mental training techniques without an overall framework to guide the intervention. Examples of layers of the mental training process from four approaches are presented in Table 13.1, with each program moving from a broad philosophy and model to strategies that incorporate many different types of specific mental training techniques in unique ways.

Consultant Effectiveness

Athletes and coaches often use mental training strategies and techniques on their own without the use of a mental training consultant. However, when mental training is coordinated by consultants, the interpersonal and technical skills of the consultants are critical in the effectiveness of the mental training process (as shown in Figure 13.2). Research has shown that athletes and coaches rate interpersonal skills, particularly listening skills, being able to relate to athletes and coaches, and being open, flexible, and trustworthy, as consultant characteristics critical for success (Dunn & Holt, 2003; Gould et al., 1991; Orlick & Partington, 1987; Partington & Orlick, 1987). A study of the verbal interactions between an eminent mental training consultant and athletes found that the consultant spent over 60% of the time listening and facilitating the interactions so that athletes would spend the majority of the time expressing themselves (Lloyd & Trudel, 1999).

Technical competence displayed by effective mental training consultants includes the ability to relevantly apply concepts to create concrete, useful strategies for athletes and coaches, the ability to adapt mental training strategies and techniques to fit specific personalities and situations, understanding competitive demands and timing of services in relation to competition preparation, and serving as facilitators to enhance communication and help resolve conflict within teams (Orlick & Partington, 1987; Partington &

Table 13.1 Examples of the Mental Skills Training Process

Authors	Philosophy	Model	Strategies	Techniques
Vealey, 2005	Help athletes attain optimal development, experiences, and performance; coaches serve as educational mental trainers.	Getting the Inner Edge, foundations to mental training toolbox to big three mental skills.	P^3 Thinking Goal Mapping Energy Management Special Recipes sample programs.	Self-monitoring, thought-stopping self-talk, imagery, physical relaxation, goal setting, behavior management.
Martin, Thompson, and McKnight, 1998	Goal is to teach athletes to teach/manage themselves; focus is on education and mental health (not illness).	Integrative psychoeducational approach; combines reality therapy and behavioral counseling.	Problem-focused process: 1. Identify problem category. 2. Identify problem type. 3. Determine problem cause. 4. Select problem solution.	Goal setting, goal attainment scaling, self-management plans, self-talk.
Danish & Nellen, 1997; Danish, Petitpas, and Hale, 1992	Optimization, not remediation; teacher/skill trainer, not therapist; problems as imbalances that precede personal growth; developmental-educational focus.	Live development intervention; life skills, GOAL (Going for the Goal), SUPER (Sports United to Promote Education and Recreation).	Ten 1-hour skill-based workshops, peer teaching and modeling, STAR (stop and chill out, think of choices, anticipate consequences of choices, respond effectively).	Goal setting, skits for mastery modeling, imagery, self-talk, physical relaxation, behavior management.
Singer, 1988	Direct instruction of mental strategies can enhance learning and performance by activating appropriate cognitive processes.	Information-processing metastrategy for self-paced sport skills.	Five-step strategy: 1. Readying. 2. Imaging. 3. Focusing. 4. Executing. 5. Evaluating.	Self-talk, imagery, focus plans, centering, physical relaxation.

Orlick, 1987; Tod & Andersen, 2005). Overall, effective mental training requires interpersonally and technically skilled consultants who are able to personally and professionally fit mental training programs to meet the special needs of athletes, coaches, teams, and organizations.

EFFECTIVENESS AND USE OF MENTAL SKILLS TRAINING IN SPORT

How effective is mental training in sport? Comprehensive reviews of the mental training literature have supported the effectiveness of mental training in enhancing the performance of athletes (M. J. Greenspan & Feltz, 1989; Meyers et al., 1996; Vealey, 1994). These reviews examined published research reports using either group or single-subject research designs. In these early reviews, the needs for appropriate controls, manipulation checks, maintenance data, and specific descriptions of interventions were identified, and it is apparent that the experimental mental training research conducted today is more sophisticated as a result of these previous review articles.

Another question related to mental skills training is how much athletes and coaches use mental training strategies and techniques. Research indicates that successful elite athletes (Durand-Bush & Salmela, 2002; Gould, Eklund, et al., 1993; Gould, Finch, et al., 1993) and coaches (Bloom et al., 1997) use mental training techniques and strategies to help them achieve success in sport. However, Heishman and Bunker (1989) found that although 81% of elite athletes from various countries rated mental preparation as very important, only 44% made frequent use of mental preparation strategies and techniques. In addition, athletes tend to use mental training techniques more in competition than in practice (Frey, Laguna, & Ravizza, 2003). Overall, this research indicates that athletes believe in the efficacy of mental training, but most fail to use it systematically as part of their physical training regimen.

Several personal characteristics have been shown to influence the use of mental training by athletes. Obviously, self-motivation is a big factor in predicting adherence to mental training (Bull, 1991), and type of motivation influences use of mental training as well. Harwood, Cumming, and Fletcher (2004) found that high task/moderate ego-oriented athletes (in terms of achievement goal orientations) used more imagery, goal setting, and positive self-talk as compared to low task/high ego- and moderate task/low ego-oriented athletes. This research indicates that athletes who define success as mastering skills and improving incorporate mental training as part of their skill development more than athletes who focus more on comparison with others. Mental training is also used to a greater degree by international-caliber athletes as compared to national-caliber athletes (Calmels et al., 2003). International-caliber athletes used a wider range and more elaborate and complex mental strategies and techniques than national-caliber athletes. But interestingly, the national-caliber athletes who engaged in mental skills training with consultants developed and used strategies as complex as the international-caliber athletes. Research has substantiated that mental training programs increase the importance that athletes place on using mental training techniques and strategies, as well as their intentions to use these techniques and strategies (Brewer & Shillinglaw, 1992; Gould, Petlichkoff, Hodge, & Simons, 1990; Grove, Norton, Van Raalte, & Brewer, 1999).

Effectiveness and Use of Imagery in Mental Training

Imagery, or the mental creation or re-creation of sensory experiences in the mind, is the most popular mental training technique used by athletes as well as the most widely studied technique in the mental training literature (Morris et al., 2005). Of 235 Canadian athletes who participated in the 1984 Olympic Games, 99% reported using imagery (Orlick & Partington, 1988). These athletes estimated that during training they engaged in systematic imagery at least once a day, 4 days per week, for about 12 minutes each time. At the Olympic site, some reported engaging in imagery for 2 to 3 hours in preparation for their events. Coaches have indicated that they use imagery more than any other mental training technique and felt that imagery was the most useful technique that they used with their athletes (Bloom et al., 1997; Hall & Rodgers, 1989). Overall, more successful elite athletes use imagery more extensively and more systematically and have better imagery skill than less successful athletes (Calmels et al., 2003; Cumming & Hall, 2002; Hall, Rodgers, & Barr, 1990; Salmon, Hall, & Haslam, 1994). All athletes have the potential to increase their imagery abilities through systematic practice (Evans, Jones, & Mullen, 2004; Orlick & Partington, 1988; Rodgers, Hall, & Buckolz, 1991), with increases in imagery ability enhancing the effectiveness of imagery training (Isaac, 1992).

Athletes use imagery for many different reasons, including skill learning and practice, strategy development and rehearsal, competition preparation, including familiarization with venues and mental warm-ups, mental skill development and refinement, and coping with various sport stressors or obstacles, such as injuries, heavy training, and distractions (Morris et al., 2005; White & Hardy, 1998). An important consideration in using imagery is the imagery perspective (internal or external) adopted by athletes, although research has shown that performance may be enhanced using either perspective. Research on this topic indicates that the type of task athletes are engaging in should dictate the imagery perspective that will best facilitate the effectiveness of imagery on enhancing performance (e.g., L. Hardy & Callow, 1999).

Imagery training is effective in enhancing athletes' performance on sport skills (Feltz & Landers, 1983; K. A. Martin et al., 1999; Morris et al., 2005). Often termed "mental practice," this involves practicing imagery over a period of time in an intermittent learning style similar to a distributed physical practice schedule. Research has also shown that preparatory imagery, or using imagery immediately before performance, can improve performance on strength tasks, muscular endurance tasks, and golf putting (Vealey & Greenleaf, 2006). Imagery has been shown to be effective in enhancing self-confidence (Callow, Hardy, & Hall, 2001; Evans et al., 2004; Garza & Feltz, 1998; Hale & Whitehouse, 1998; McKenzie & Howe, 1997; Short et al., 2002), motivation (K. A. Martin & Hall, 1995), attentional control (Calmels, Berthoumieux, & d'Arripe-Longueville, 2004), and visual search abilities (Jordet, 2005) of athletes during competition. Specific types of imagery were effective in changing athletes' perceptions of anxiety from harmful and negative to facilitative and challenging (Evans et al., 2004; Hale & Whitehouse, 1998; Page, Sime, & Nordell, 1999).

Explanations for how imagery facilitates the performance and self-perceptions of athletes include cognitive, psychological state, and neurophysiological explanations (Morris et al., 2005). Cognitive explanations focus on information processing and how information is acquired, stored, retrieved, and used in the brain. Bioinformational theory has been a popular cognitive theoretical explanation for how imagery enhances sport performance, due to its intuitive appeal and pragmatic implications for using imagery to create "mental blueprints for perfect responses" (Vealey, 2005). Athlete performance has been improved to a greater degree through imagery that emphasizes productive responses, as opposed to imagery that focuses just on stimulus characteristics of the situation (D. Smith & Collins, 2004; D. Smith, Holmes, Whitemore, Collins, &

Devenport, 2001). Also, response-oriented imagery has created more "priming" responses in the brain, as measured by electroencephalographic activity when compared to stimulus-oriented imagery (D. Smith & Collins, 2004).

Psychological state explanations focus on the motivational function of imagery, in helping athletes feel more confident, optimally aroused, and clearly focused for competition. Neurophysiological explanations focus on the premise of functional equivalence, meaning that imagery and actual movement recruit common structures and processes in the brain, with the only difference being that during imagery the performance skill is not executed (Finke, 1980; Holmes & Collins, 2001; Jeannerod, 1994). In an imagery training program designed to improve golf putting, performance was enhanced more by mental practice using audiotapes and videotapes than by mental practice using written scripts that were read by the golfers (D. Smith & Holmes, 2004). The interpretation of this finding was that imagery training using the audio- and videotapes engaged more functionally equivalent neural processes in relation to the actual execution of putting as compared to written scripts.

Imagery is a technique that is incorporated into many different mental training strategies and models. These include the applied model of imagery use in sport (K. A. Martin et al., 1999; Paivio, 1985), the PETTLEP model (Holmes & Collins, 2001), the three-level model of sport imagery (S. M. Murphy & Martin, 2002), and the sport imagery ability model (Watt, Morris, & Andersen, 2004). Specific mental training strategies incorporating imagery include visuomotor behavior rehearsal (Suinn, 1984), the Five-Step Strategy (Singer, 1988), and the AIM strategy (Korn, 1994). Because the technique of imagery has been shown to effectively enhance performance, research efforts should begin to examine how effective imagery is for athletes as packaged in different ways using specific strategies or models of intervention.

Effectiveness and Use of Goal Setting in Mental Training

Another technique popularly used in mental training interventions is goal setting. Research with elite, collegiate, and adolescent athletes has confirmed that almost all athletes set goals, but most of them rate goals as only moderately effective in enhancing their performance (Burton, Weinberg, Yukelson, & Weigand, 1998; Weinberg, Burke, & Jackson, 1997; Weinberg, Burton, Yukelson, & Weigand, 1993, 2000). This finding emphasizes the important point that goals by *themselves* do nothing to enhance athletes' performance. A goal is simply a target, or a specific standard or accomplishment that one strives to attain. Goals must be incorporated into a systematic mental training program that enables athletes to plan, set, focus on, evaluate, and manage their behavior and thoughts in relation to their goals (Burton, 1989; Burton, Naylor, & Holliday, 2001; Gould, 2006; Vealey, 2005). When used systematically, goal setting works because it focuses attention on specific task demands, increases effort and intensity, encourages persistence when adversity is encountered, and promotes the development of strategies and problem solving to move toward goal achievement (Locke & Latham, 1990).

When compared to no goals or do-your-best goals, specific goal setting enhances athletes' performance (Burton & Naylor, 2002; Kyllo & Landers, 1995). Besides examining the overall effectiveness of goal setting, research has also examined what types of goals are most effective in what types of situations. The important distinction between outcome, performance, and process goals indicates that mental skills are enhanced when athletes focus on the right goals at the right time (Kingston & Hardy, 1997). Because outcome goals are uncontrollable, yet attractive and exciting, they are useful in enhancing motivation for the exhausting physical and mental preparation needed to achieve typical outcomes goals, such as winning championships or medals. Performance goals are more flexible and controllable for athletes, which allows them to continually raise and lower goal difficulty levels to remain challenged and successful in their pursuit of exciting outcome goals. Process goals are used in immediate situations to enable athletes to focus on specific task demands in productive ways, such as occupying their minds with key verbal cues that lock in optimal performance images and plans. This distinction in goal focus should be an important part of any intervention that uses goal setting as a mental training technique. Other attributes of effective goal setting are the use of specific, difficult, and measurable goals, an emphasis on desired behavioral outcomes as opposed to a focus on problem statements, the use of short- and long-term goals, and a congruency between individual and team goals (Burton et al., 2001).

The technique of goal setting has been incorporated into several intervention models for sport. Burton and colleagues (2001) devised a seven-phase model from which goal setting may be implemented with athletes. These steps include setting goals, identifying obstacles, securing a commitment, developing an action plan, gaining feedback on goal attainment, evaluating goal attainment, and reinforcing goal attainment. Vealey (2005) has proposed a four-phase model of goal mapping, defined as a systematic approach to acting and thinking in purposeful ways to achieve specific accomplishments and personal fulfillment. Personal and team goal maps are developed that include milestone, challenge, and focus goals, as well as goal achievement strategies and a progress log. Gould (2006) offers a three-phase goal-setting system for coaches, including planning, meeting, and follow-up/evaluation phases. Goal setting is a primary technique used with the life development intervention model and Going for the Goal strategy (Danish & Nellen, 1997), which includes such phases as setting goals, making your goal reachable, making a goal ladder, roadblocks to reaching goals, overcoming roadblocks, and rebounds and rewards. Again, as shown in Figure 13.2, research should begin to examine the effectiveness of comprehensive mental training programs that incorporate various mental training techniques, as opposed to simply studying the effectiveness of one isolated technique on athletes' performance. For example, a life development intervention was shown to be effective in enhancing the career transition adjustment for recently retired professional soccer players (Lavallee, 2005).

Effectiveness and Use of Self-Talk in Mental Training

A third mental training technique studied in sport psychology is self-talk, or the verbal dialogue in which athletes interpret their feelings and perceptions, evaluate themselves, and give themselves instructions or reinforcement (Hackfort & Schwenkmezger, 1993). Eighty percent of U.S. Olympic wresters used thought management strategies such as positive thinking, coping thoughts, blocking distractions, and perspective taking (Gould, Eklund, et al., 1993), and rational thinking and self-talk were two common coping strategies used by U.S. national champion figure skaters (Gould, Finch, et al., 1993). Highly skilled athletes use self-talk in a more planned and consistent manner than less skilled athletes, who tend to think reactively (J. Hardy, Hall, & Hardy, 2004; McPherson, 2000).

Researchers have found that planned self-talk enhances skill acquisition and performance in sport (J. Hardy, Gammage, & Hall, 2001; Johnson, Hrycaiko, Johnson, & Halas, 2004; Landin & Hebert, 1999; A. Miller & Donohue, 2003; Ming & Martin, 1996; Perkos, Theodorakis, & Chroni, 2002; Rushall, Hall, Roux, Sasseville, & Rushall, 1988; Wrisberg & Anshel, 1997). Research indicates that different types of self-talk (e.g., instructional versus motivational) may be effective in enhancing different types of sport performance (e.g., precision versus power tasks); thus, future research should pursue the specificity or matching of type of self-talk with type of task (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004).

Planned, productive self-talk is also effective for using strategy, psyching up for emotion and effort, relaxation and calming down, attentional focusing, maintaining confidence, and self-evaluation/self-reinforcement (e.g., J. Hardy et al., 2001; Landin & Hebert, 1999; Mallett & Hanrahan, 1997; Zinsser, Bunker, & Williams, 2006). Several other mental training techniques are associated with self-talk, including thought stopping, thought replacement, countering, reframing, and cognitive restructuring (e.g., Zinsser et al., 2006). Many of these techniques are used in multimodal mental training interventions or in specific mental training strategies such as P^3 Thinking (Vealey, 2005), rational-emotive education (Elko & Ostrow, 1991), and energy management (Hanton & Jones, 1999).

Effectiveness and Use of Physical Relaxation Techniques in Mental Training

Because the stressors inherent in sport often create physical tension in athletes, physical relaxation techniques may be useful to help athletes manage their physical energy levels to allow them to perform their best. Research concurs that successful elite athletes regularly use relaxation techniques to manage their physical energy (Durand-Bush & Salmela, 2002; Gould, Eklund, et al., 1993; Gould, Finch, et al., 1993). Most mental training programs incorporate relaxation as one of several techniques within a multimodal approach; thus, it is difficult to ascertain the specific effectiveness of physical relaxation as a mental training technique.

Research has been directed to test the "matching hypothesis" from multidimensional anxiety theory that suggests that effective anxiety management requires a match between the type of intervention strategy/technique used and the type of anxiety experienced by the athletes (cognitive or somatic). Physical relaxation strategies specifically targeted for athletes experiencing somatic anxiety were more effective than cognitive relaxation strategies in reducing this type of anxiety (Maynard & Cotton, 1993; Maynard, Hemmings, & Warwick-Evans, 1995; Maynard, MacDonald, & Warwick-Evans, 1997), although the physical relaxation intervention did not enhance the athletes' performance. Annesi (1998) developed a specific precompetitive anxiety regulation intervention for elite tennis players based on the individual zones of optimal functioning model. Physical and cognitive energy management strategies were used to help athletes remain within their individual optimal zones, which served to enhance their performance. The technique of flotation REST (restricted environmental stimulation technique) has been shown to be effective in reducing muscle tension and perceived exertion and enhancing performance on fine motor tasks (Norlander, Bergman, & Archer, 1999; Suedfeld, Collier, & Hartnett, 1993). Flotation REST involves athletes immersing themselves in a water tank filled with saltwater of an extremely high salt concentration, with the objective of inducing a deep state of relaxation by reducing external stimuli and preserving warmth.

Effectiveness of Multimodal Mental Skills Training

A plethora of research studies have examined the effects of multimodal mental training interventions on athletes' performance and mental skills. Multimodal interventions combine several mental training techniques into an integrated strategy that targets specific psychobehavioral outcomes of interest, such as performance improvement or mental skill enhancement. Multimodal interventions have enhanced athletes' attentional focus (Kerr & Leith, 1993), self-confidence (Prapavessis, Grove, McNair, & Cable, 1992; Savoy, 1997), motivation (Beauchamp, Halliwell, Fournier, & Koestner, 1996; Holm, Beckwith, Ehde, & Tinius, 1996), energy management (Crocker, Alderman, & Smith, 1988; Hanton & Jones, 1999; Holm et al., 1996; Kerr & Goss, 1996; Kerr & Leith, 1993; Kirschenbaum, Owens, & O'Connor, 1998; Mamassis & Doganis, 2004; Prapavessis et al., 1992; Savoy, 1993, 1997; Thomas & Fogarty, 1997), anger management (Brunelle, Janelle, & Tennant, 1999), productive thinking (Crocker et al., 1988; Kirschenbaum et al., 1998), and performance (Bakker & Kayser, 1994; Beauchamp et al., 1996; Daw & Burton, 1994; Groslambert, Candau, Grappe, Dugue, & Rouillon, 2003; Hanton & Jones, 1999; Kendall, Hrycaiko, Martin, & Kendall, 1990; Kerr & Leith, 1993; Kirschenbaum et al., 1998; G. L. Martin & Toogood, 1997; Patrick & Hrycaiko, 1998; Prapavessis et al., 1992; Savoy, 1993, 1997; Thelwell & Greenlees, 2003; Thomas & Fogarty, 1997; Wrisberg & Anshel, 1989; Zhang, Ma, Orlick, & Zitzelsberger, 1992).

Hypnosis, as a multimodal intervention strategy incorporating imagery, relaxation, and self-talk triggers, has been shown to be effective in enhancing basketball shooting performance (Pates, Cummings, & Maynard, 2002; Pates, Maynard, & Westbury, 2001) and golf putting (Pates, Oliver, & Maynard, 2001). Another multimodal intervention strategy is the use of biofeedback with other mental training techniques such as physical relaxation and imagery. These strategies have been shown to enhance athletes' abilities to manage their physiological energy as well as to enhance performance (Blumenstein, Bar-Eli, & Tenenbaum, 1995; Landers et al., 1991; Petruzzello, Landers, & Salazar, 1991).

SUGGESTIONS FOR THE FUTURE OF MENTAL SKILLS TRAINING IN SPORT

Despite significant advances and a growing knowledge base, mental skills training in sport must continue to evolve in socially significant ways. As discussed, mental training in sport must begin to address issues that arise with athletes and coaches due to their inclusion in a specific social-cultural context. Coakley (1992) has criticized mental training in sport as "psychodoping," or the use of mental training strategies and techniques that "dope" athletes into blindly accepting the social-structural conditions that negatively affect them. Coakley offers evidence for the overriding influence of the oppressive and controlling sport structure as a key causal factor in burnout in adolescent athletes. Interventions using a cultural praxis approach (Ryba & Wright, 2005) would help athletes understand their identities in problematic subcultures that spawn negative self-perceptions and unhealthy behaviors.

Brustad and Ritter-Taylor (1997) stated that the social-cultural context serves as the backdrop against which all thoughts, feelings, and behaviors of athletes and coaches take on meaning. They provide excellent suggestions that could enhance the social relevance of mental training by focusing on the underserved mental skills in athletes, such as identity development and achievement and self-awareness related to membership in specific subcultures, and team skills such as leadership processes and enhanced team functioning. As stated by mental training consultant Gloria Balague (1999, p. 89), "Regardless of the techniques (e.g., relaxation, imagery) I may be using in [mental training] work with athletes, understanding the larger issues of their identities and value systems and what sport and competition mean to them in their lives plays a central role in determining the quality and effectiveness of services that I deliver." Balague provides a provocative discussion about understanding the context within which athletes exist and the need to help athletes achieve balance within the problematic "imbalanced" world of elite sport. Philosophical counseling (Raabe, 2001), a fairly new approach that focuses on helping individuals come to a better philosophical understanding of themselves in relation to their personal context, seems to be a fruitful approach for mental training consultants to consider when working with athletes in mental skills training in sport.

Although performance success will always be a primary outcome of interest for mental training interventions in sport, an expanded mental skills model was presented in this chapter (see Figure 13.1) to call attention to the need to focus on foundation, personal development, and team skills. The life skills model for mental training has been adopted to focus on the development of personal development skills in sport participants (Lavallee, 2005; Papacharisis, Goudas, Danish, & Theodorakis, 2005; Petitpas, Van Raalte, Cornelius, & Presbrey, 2004), and additional programs are emerging that focus on psychosocial development in young athletes (Petitpas, Cornelius, Van Raalte, & Jones, 2005). By broadening the focus of mental training to enhance important foundation and personal development skills, the social relevance and credibility of sport psychology will also be enhanced. Mental skills training will not simply be a sophist-oriented (Corlett, 1996), decontextualized intervention in sport, as defined by the professionalized performance by a small minority of elite athletes. Rather, mental skills training represents a broad spectrum of programs and interventions specifically targeted toward certain populations in certain contexts (e.g., college athletes, children entering organized sport programs, older adults involved in sport, at-risk youth athletes) that integrates mental and physical skill development for performance success and personal well-being.

Although cohesion is a popular research topic and team building is a popular intervention topic, the development of specific team skills has received very little attention in the mental training literature, with most of the focus on team building but without specific outcomes (e.g., team confidence, leadership, communication, cohesion) that could be targeted beyond the abstract notion of building a team. Two team intervention programs to enhance cohesion did not produce clear results (Cogan & Petrie, 1995; Prapavessis, Carron, & Spink, 1996), and additional research is needed on team interventions. A communication skills training program for interactive teams was evaluated positively by athletes (Sullivan, 1993), and other team interventions, such as using performance profiling (Dale & Wrisberg, 1996) and teaching assertiveness skills (Connelly & Rotella, 1991), have been reported. A special issue of the *Journal of Applied Sport Psychology* (March 1997) provided several examples of team building, yet research is needed to examine the effects of mental training interventions on specifically targeted team skills. Eccles and Tenenbaum (2004) provide a comprehensive conceptual framework for team communication and coordination that could serve as a model for team interventions.

Another suggested direction for mental skills training is the development of models, approaches, and/or programs that address transitions, or key events representing significant change, for athletes and coaches. These may include mental skills models for entry into new sport structures (e.g., high school, college, professional sport), departure from sport such as retirement, role changes, and participation interruptions (e.g., injury, ineligibility, transfer; Danish, Owens, Green, & Brunelle, 1997), and life crisis events (Buchko, 2005; Vernacchia, Reardon, & Templin, 1997). Finally, technology should continue to be developed and utilized to enhance the delivery of mental skills training to athletes and coaches. Current approaches include Internet Web-based interventions (Farres & Stodel, 2003; Zizzi & Perna, 2002) and innovative uses of video technology (Ives, Straub, & Shelley, 2002; Omodei, McClennan, & Whitford, 1998). Technological advancements seem particularly important for the future of perceptual training of athletes, where the transfer of positive training effects from laboratory settings to the field has been problematic (Jordet, 2005; Singer et al., 1994; A. M. Williams & Grant, 1999; A. M. Williams, Ward, & Chapman, 2003).

CONCLUSION

Mental training in sport has significantly evolved in the past 30 years as the knowledge base has expanded with a plethora of books describing the practice of mental training as well as journal articles focusing on mental skills, mental training interventions, and professional practice issues. Overall, mental training has been found to be effective in enhancing the performance success and mental skills in athletes. The external validity of intervention research has been enhanced by focusing on behavior in competitive contexts, using athlete-centered approaches in which mental training is individualized based on the needs and abilities of athletes and utilizing idiographic designs to assess intervention effects with individual athletes. Multiple models and programs are available in the literature to help athletes, coaches, and consultants integrate mental and physical training in specific sport environments in creative and user-friendly ways. Professional development resources are available for mental training consultants to enhance their interpersonal and technical skills and to increase their awareness of and commitment to ethical practice.

A mental skills model and a mental skills training framework were presented in this chapter to provide an organizational structure within which the literature on mental skills training in sport was reviewed. Of course, additional models and frameworks may be developed, but the intent has been to stimulate critical thinking about this important service delivery component of sport psychology. The evolution of mental skills training in the past 30 years is impressive, as the knowledge base has grown and mental training practice has become more sophisticated. However, greater sophistication means greater complexity; thus, the challenge remains for sport psychology professionals to continue to creatively grow mental skills training in productive and socially relevant new directions.

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CHAPTER 14

Sport Psychology: A Clinician's Perspective

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Sport psychology consultants vary in their educational backgrounds and theoretical persuasions. They may be educated in sport science, in counseling and clinical psychology, or, more rarely, in medicine. Theoretical perspectives range from those based largely on educational models to those rooted in the principles of behavior change. The diversity among sport psychology practitioners can be regarded as a strength in that it provides numerous frameworks and methods by which one can assist those who come for help. On the other hand, this same diversity can become a source of confusion and misunderstanding to those served as well as to students and practitioners seeking to enhance their competence.

In this chapter, we give our perspectives on the field based on our backgrounds in clinical and counseling psychology. However, with the goal of maintaining diversity as a strength in the field, we also seek to provide the reader with a basis with which to integrate information from various theoretical underpinnings. To this end, information has been incorporated in the chapter spanning a variety of research traditions, including the sport sciences, psychology, and medicine. For purposes of the chapter, we use *sport psychology consultant* (or simply *consultant*) when referring to professionals, regardless of training, who provide services in sport contexts. To designate those receiving services, we use *athlete* or *client.*

The chapter begins with an invitation to reflect on the importance of developing a practice philosophy. This section is followed by discussion of the need and merits of a clinical perspective when providing sport psychology services. Topics include information about psychopathology, incidence of psychopathology in the general population and among sport participants, and prevention and treatment of psychopathology. The next section covers general assessment and screening for psychopathology, networking of referral sources, and methods for handling emotionally or cognitively based emergencies. Penultimately, we propose a conceptual paradigm or framework from which to view the sport psychology consultant's work. The final section of the chapter is devoted to a discussion of professional issues that is intended to foster an appreciation of the overlap and relatedness among sport psychology consultants regardless of their educational or theoretical backgrounds.

A PRACTICE PHILOSOPHY

We believe that successful professional practice of any type depends on practitioner awareness and understanding of the theoretical roots underlying daily decisions and actions. The work involved in acquiring a personal theoretical and practical orientation must predate situations where effective decisions and actions are necessary. One does not have the luxury to ponder various theories on crisis intervention when a client is obviously overwhelmed, in tears, and sitting in front of you asking for your help. Likewise, it is not advisable to reflect on the latest theoretical debates on performance enhancement when giving a presentation to athletes interested in how they can get better at their specific sport. The philosophical foundations are best considered and discussed with teachers and mentors during formal education and with colleagues during one's professional career. The result is a philosophy underlying interventions that evolves and is intertwined with the practitioner's development as a person and a professional.

Poczwardowski, Sherman, and Ravizza (2004) offered a conceptual framework useful for professional philosophy

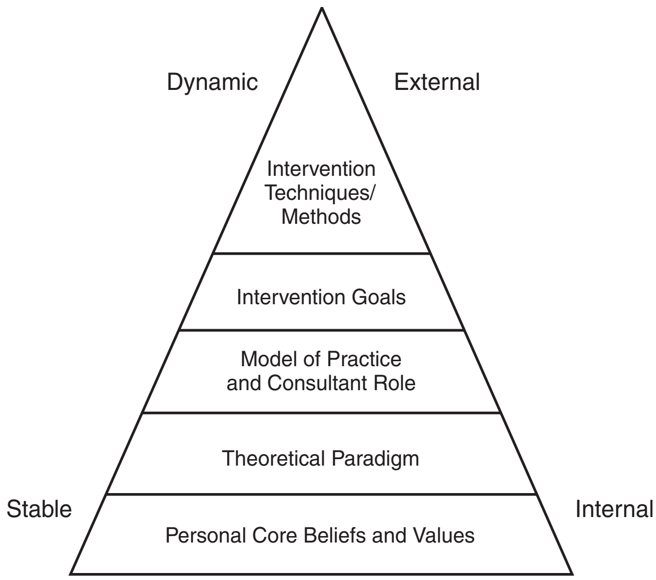

Figure 14.1 Hierarchical structure of professional philosophy. *Source:* "Professional Philosophy in the Sport Psychology Service Delivery: Building on Theory and Practice," by A. Poczwardowski, C. P. Sherman, and K. Ravizza, 2004, *Sport Psychologist, 18,* p. 450. Copyright 2004 by Human Kinetics Publishers. Reprinted with permission.

development. They present a systematic means for organizing the topic (see Figure 14.1). Their conceptualization is hierarchical in nature, with the most stable and internal component (i.e., personal core beliefs and values) providing the base for progressively more dynamic and external components moving toward the apex. The components are interdependent; however, greater influence is exerted by more fundamental levels. Although this conceptualization is in its infancy, it has potential to positively shape examination of this important topic and implications for the advancement of education, training, and practice in sport psychology. We encourage readers to reflect on their own professional philosophies related to sport psychology in the process of entertaining our thoughts about clinical issues.

THE NEED FOR A CLINICIAN'S PERSPECTIVE

Professional clinical practice can include circumstances that unexpectedly challenge the skills of the practitioner. Sport psychology is no exception. Consider the following scenarios:

- Upon arriving at the office, you receive a phone call from a despondent collegiate athlete with whom you have worked in the past. She is obviously distraught and recounts recent problems in her relationships with teammates, poor competition performances, and problems with her grades as primary concerns. She becomes tearful while talking and states, "I don't know how long I can keep going with all these terrible things happening."
- You receive a phone call from a parent who is concerned that her daughter is losing too much weight and putting too much pressure on herself in pursuing her goal to become an accomplished diver. She goes on to explain that her daughter has had a "lifelong struggle" to keep her weight under control but that she now looks "too thin."
- You sit down to a leisurely breakfast on a Sunday morning, open the local paper, turn to the sports page, and read about a collegiate football player at the university where you are on the faculty and where you provide consultation to the athletic department. The athlete was arrested the night before at a local bar for his involvement in a fight. The article goes on to explain that he has had similar problems previously and may be suspended from the team indefinitely. Upon arriving at the office the next morning, you notice two messages from your primary contact with the football team asking you to call immediately.
- You are meeting with a self-referred tennis player who has joined a professional tour after an exceptional college career. Despite all of his previous competitive success, he indicates that he is struggling with his transition to the professional ranks. He describes episodes prior to matches where he is tense, irritable, shaking, and unable to calm himself. He also indicates that he has had restless sleep for the past several weeks, ruminating about his difficulties in adjusting to the professional tour.

These scenarios could certainly be a part of the daily routine of a sport psychology consultant. The circumstances described in each scenario may be suggestive of some type of mental disorder, but this determination is dependent on further evaluation by an appropriate professional. A perusal of the mass media also suggests that athletes are not immune to mental disorders (Lapchick, 2003; Olson, 2003). Although sport psychology consultants vary in their comfort level in handling these types of difficult situations, it is imperative that all consultants be educated to deal with them either by way of direct treatment or appropriate referral.

A Working Definition of Psychopathology

A thorough discussion of psychopathology is obviously beyond the scope of this chapter. However, in this section we provide a working definition for psychopathology and related concepts. The *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV-TR;* American Psychiatric Association, 2000) is a rich source of information on criteria for diagnoses and differentiation among diagnoses but is limited in providing a clear indication of the distinction between abnormal and normal states of functioning (Ingram & Price, 2001). To address this limitation, Ingram and Price have offered a working definition of psychopathology that relies on practical criteria. Specifically, they broadly define psychopathology by reference to "impairment in the individual's established, or expected, roles at a given developmental period, . . . typically accompanied by reports of emotional distress" (p. 6). We believe that this is a useful definition that allows the consultant, in most situations, to draw relatively unambiguous distinctions between abnormal and normal functioning.

Other important concepts related to psychopathology discussed by Ingram and Price (2001) are *vulnerability, stress,* and *diathesis.* With respect to vulnerability, the core themes in the extant literature meriting consideration include the views that (a) vulnerability is a stable trait, whereas the actual disorder is a state that can emerge and recede episodically; (b) vulnerability is endogenous, or residing within the individual; and (c) vulnerability processes are causally related to symptoms but difficult to assess because they are latent (i.e., they are present in individuals with few or no obvious signs).

The second important concept, stress, is viewed as "the life events (major or minor) that disrupt the mechanisms maintaining the stability of an individual's physiology, emotion, and cognition" (Ingram & Price, 2001, p. 11). In the case of psychopathology, these life events are interpreted by the person as undesirable or aversive, represent a strain on adaptive capability, and interfere with physiological and psychological homeostasis. Therefore, stress is viewed as a critical variable in many models of psychopathology.

Diathesis, the third important concept discussed by Ingram and Price (2001), is conceptually related to vulnerability and refers to a predisposition to illness. Examples of biological diatheses include genetic endowment, oxygen deprivation at birth, and poor nutrition. Psychological diatheses can include chronic feelings of hopelessness and intense fear of becoming fat. Genetic, experiential, or sociocultural factors may contribute to psychological diatheses (Davison, Neale, & Kring, 2003, p. 59). Many models of psychopathology are viewed as diathesis-stress models. Psychopathology is regarded as an interactive effect of the diathesis and situational cir-

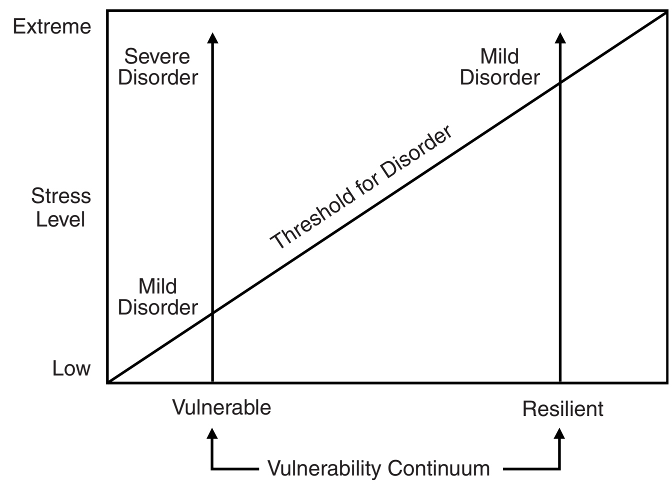

Figure 14.2 The diathesis-stress continuum. When vulnerability is at its highest level, less stress is required to activate a disorder. Adapted from *Vulnerability to Psychopathology: Risk across the Lifespan* (p. 15), by R. E. Ingram and J. M. Price, 2001, New York: Guilford Press. Copyright 2001 by the Guilford Press. Adapted with permission.

cumstances or personal events perceived by the individual as stressful. Figure 14.2 depicts the role of vulnerability and stress in understanding psychopathology where vulnerability and resilience represent opposite ends of the vulnerability continuum. Resilience, therefore, suggests resistance to disorder but not immunity.

Epidemiology of Psychopathology

Mental disorders occur frequently in the United States and internationally. Recent outcomes from the U.S. National Comorbidity Survey (Kessler et al., 2005) indicated that approximately 50% of Americans will experience a mental health problem meeting the criteria for a *DSM-IV* disorder at some point in their lives. Data from the massive Global Burden of Disease Project conducted by the World Health Organization and others indicated that mental illness (including suicide) accounted for 15% of the burden of disease in established market economies (National Institute of Mental Health, n.d.).

Although epidemiological data indicate significant prevalence of mental disorders and related morbidity, there also is evidence of considerable unmet treatment needs. It has been found that the rate of help seeking by individuals with a mental disorder is low (Bourdon, Rae, Locke, Narrow, & Regier, 1992) and that there often are significant time lags between when a disorder is fully manifested and entry into treatment (Wang, Berglund, et al., 2005). Unfortunately, no treatment and poor treatment are frequent (Bijl et al., 2003; Wang, Berglund, & Kessler, 2000; Wang, Lane, et al., 2005), particularly for vulnerable groups such as the poorly educated and the underinsured.

Susceptibility to psychopathology among athletes parallels that of the general population (Calhoun, Ogilvie, Hendrickson, & Fritz, 1998; Heyman, 1986; Piersall & Hirshberg, 1955). Although a lack of empirical studies is noted (Glick & Horsfall, 2001), a recent review by Brewer and Petrie (2002) documented case studies and anecdotal reports of a variety of mental disorders in sport participants, including bipolar disorder, major depression, obsessive-compulsive disorder, and panic disorder. Nationwide surveys of clinical and counseling psychologists (Petrie & Diehl, 1995; Petrie, Diehl, & Watkins, 1995) indicate that areas of psychopathology frequently addressed in individual therapy were reported to be anxiety/stress, depressive disorders, eating disorders, and substance-related disorders. Furthermore, it has been suggested (Hays, 1999, chap. 17) that some characteristics of the sport environment, particularly at the elite level (Pipe, 2001), may place athletes at additional risk for these and other adverse health consequences. Demanding training regimens and associated performance pressures as well as the abuse of trusted relationships by coaches or others in the sport environment may be factors contributing to maladjustment. Overtraining Syndrome, characterized by a chronic decrement in sport performance along with maladaptive responses to sport- and non-sport-related stress, is one risk associated with the sport environment (Meehan, Bull, Wood, & James, 2004).

Although athletes are susceptible to a wide variety of mental disorders (see review by Brewer & Petrie, 2002), the extant sport-related literature focuses primarily on substance abuse and dependence (including anabolic steroids) and eating disorders. General information on these disorders is contained in the *DSM-IV-TR.* These topics are covered in detail in other chapters in this volume; however, because these disorders may have serious adverse health consequences, are often present with other mental disorders (comorbidity), and typically require specialized clinical treatment, we review some epidemiological information here.

Substance use in sport has a long history, is not uncommon currently, and has been reviewed extensively in an edited book by Bahrke and Yesalis (2002b). A comprehensive survey (Green, Uryasz, Petr, & Bray, 2001) of college student athletes encompassing National Collegiate Athletic Association Divisions I through III indicates that substance use is an issue to be reckoned with in this population. These investigators found that 81%, 28%, and 23% of student athletes reported use of alcohol, marijuana, and smokeless tobacco, respectively, in the past year. Although anabolic steroid use was reported at a low rate (1%) relative to other substances, 38% of steroid users reported obtaining the drug from either a team physician or another physician (Green et al., 2001, p. 55), despite professional, ethical, and legal proscriptions to providing these drugs without a legitimate medical indication. Naylor, Gardner, and Zaichkowsky (2001) in a study with adolescent athletes in Massachusetts found that 69%, 38%, and 8% of student athletes reported use of alcohol, marijuana, and smokeless tobacco, respectively, in the past year. These use rates were not significantly different from rates among students not participating in sport. However, 38% of athletes reported having violated rules designed to discourage drug use, and 13% reported having been caught doing so without penalty. These authors suggest that coaches and administrators need to assess the efficacy of drug prevention programs and their efforts to enforce rules and regulations.

Regardless of the motivation for substance use (e.g., performance enhancement, enjoyment, relaxation), it does not come without associated risks, including potential deleterious health consequences. Indeed, in a recent review of literature on alcohol use in sport, Stainback and Cohen (2002, p. 242) cited "evidence that athletes participate in more high-risk behaviors generally, including drinking-related risk behaviors, than their age peers." It has been found that intercollegiate athletes consumed significantly more alcohol per week, binge drank more frequently, and experienced more negative consequences from their substance use than college students not participating in intercollegiate sports. Male team leaders were a subgroup found to be at exceptional risk relative to other team members (Leichliter, Meilman, Presley, & Cashin, 1998). Furthermore, intercollegiate athletes appear to engage in a constellation of high-risk behaviors more frequently than their college peers. For instance, Nattiv, Puffer, and Green (1997) found athletes reported less likelihood of always using seat belts, greater quantity and frequency of alcohol use, less contraceptive use, and more involvement in physical fighting, among other high-risk behaviors. Male athletes reported greater risk taking than female athletes, and athletes in contact sports reported greater risk taking than those in noncontact sports. Athletes with one risk-taking behavior tended to report multiple risk-taking behaviors.

Research with adolescents has found that male competitive athletes are significantly more likely to initiate alcohol use than males not involved in competitive sport (Aaron et al., 1995). Adolescent athletes participating in multiple school or other organized sports have been found to drink more frequently and be more inclined toward binge drinking (defined as five or more drinks in a row during the past 30 days) than their peers with low physical activity (defined as participating in physical activity in one or two of the past 7 days) and peers who were sedentary (defined as participating in no physical activity in the past 7 days; Rainey, McKeown, Sargent, & Valois, 1996). Adolescents reporting binge drinking also have been found to be more likely to report drinking with peers, in large groups of underage persons, and away from home—situations that constitute additional risk (Mayer, Forster, Murray, & Wagenaar, 1998).

More recent findings substantiate reasons for concern about substance use in sport. In a large, nationally representative sample of American college students, Nelson and Wechsler (2003) found that significantly more sports fans drank alcohol, engaged in binge drinking (defined as drinking five or more drinks in a row for men and four or more drinks in a row for women), had a heavy drinking style (including less abstaining from alcohol, more episodes of being drunk, and more endorsement of the importance of drinking "to get drunk"), and reported alcohol-related problems than students who were not sports fans. Furthermore, the percentage of sports fans at a school was related to binge drinking rates and to secondhand effects (e.g., being assaulted, having property vandalized, having sleep or study disrupted), suggesting that the subculture surrounding sport is at the very least tolerant of binge drinking and possibly supportive of it.

College athletes have been found to have significantly higher problem gambling rates than their peers not participating in sport, and problem gambling has been associated with self-reported heavy drinking, negative consequences of alcohol use, regular tobacco and marijuana use, binge eating, and greater use of weight-control efforts in a college population (Engwall, Hunter, & Steinberg, 2004). College athletes reporting higher rates of alcohol abuse relative to their athlete peers reported more emotional symptoms, such as depression, suggesting a possible causal link between psychopathology and alcohol abuse in this population (B. E. Miller, Miller, Verhegge, Linville, & Pumariega, 2002). Finally, Stainback and Taylor (2005) briefly reviewed literature indicating that alcohol consumption is related to increased risk for a variety of health consequences, including traffic accidents, drowning, occupational injuries, and violence (either as perpetrator or victim). In particular, young men age 20 to 29 (a population in which athletes are well represented) were found to be at greatest risk for alcohol-related violence.

Anabolic steroid use has received considerable recent attention in the lay media (G. Smith, 2005). Its inappropriate use represents health risks to the individual as well as ethical and legal concerns for sport generally, and hence, the use of this class of drug is briefly reviewed here. Synthetic derivatives of testosterone have been colloquially termed "steroids." These drugs have legitimate medical uses for treatment of a variety of conditions. It is their illicit use by athletes and others for putative performance-enhancing or appearance-enhancing effects (e.g., strength and weight gain, enhanced recovery from intense workouts) that is reason for concern. Although anabolic steroids have received much research attention relative to most other performance-enhancing drugs and their effectiveness in increasing performance is well-accepted by the majority of the sport community, the extent of their effectiveness and the factors influencing these effects are not well understood (Bahrke & Yesalis, 2002a, p. 35). What is understood is that their use ranges widely and appears to have increased significantly over the past 3 decades, attributable in part to increasing use by adolescents, recreational athletes, and those not participating in sport. Indeed, as noted by Bahrke and Yesalis, "The use of anabolic steroids has cascaded down from the Olympic, professional, and college levels to the high schools and junior high schools, and there are significantly more adolescents using anabolic steroids than elite athletes" (p. 41).

While the long-term health effects of anabolic steroid use are unknown, physiological effects on the liver, serum lipids, and reproductive system are most substantiated. Definitive causal conclusions are elusive; however, it is important to understand that the deleterious psychological and behavioral effects associated with steroid use noted in the literature encompass major mood syndromes, including mania, hypomania, and depression (Pope & Katz, 1988, 1994), and psychotic symptoms (Pope & Katz, 1988). Forty-six percent of the subjects in the latter study had a positive history for substance abuse or dependence, including alcohol, cannabis, and cocaine. There is also at least one report (Brower, Blow, Beresford, & Fuelling, 1989) documenting a case description suggesting the presence of steroid dependence. In more recent research with female athletes age 18 to 65, Gruber and Pope (2000) found steroid users reporting hypomanic and depressive symptoms associated with steroid use; however, these symptoms did not meet *DSM-IV* criteria for a hypomanic or major depressive episode. Interestingly, several unusual syndromes were reported by users and nonusers among these athletes, including rigid dietary practices, nontraditional gender roles, and chronic dissatisfaction and preoccupation with physique ("muscle dysmorphia"; Gruber & Pope, 2000, p. 24). Recent research with males (Cafri et al., 2005) found that in attempting to achieve a muscular ideal, they may also resort to inappropriate dieting and steroid and other drug use. Male steroid users also have been found to be less confident about their body appearance and to display higher rates of illicit substance use, abuse, and dependence than nonusers (with use of other illicit substances typically preceding steroid use; Kanayama, Pope, Cohane, & Hudson, 2003).

Eating disorders are characterized in the *DSM-IV-TR* by severe disturbances in eating behavior. Two diagnostic categories are described: Anorexia Nervosa and Bulimia Nervosa. The reader is referred to more recent reviews (Polivy, Herman, & Boivin, 2005; Tamburrino & McGinnis, 2002) for additional, general information on these disorders.

Eating disorders among athletes have received research attention for well over a decade. In 1992, Brownell, Rodin, and Wilmore edited a book devoted to integrating, evaluating, and synthesizing information on eating and weight problems among athletes. More recently, studies have supported the notion that athletes, particularly female athletes, are a subpopulation with enhanced risk for eating disorders. In a study with a large sample of collegiate athletes, Johnson, Powers, and Dick (1999) found that approximately 13% of the sample self-reported clinically significant problems related to disturbed eating behaviors and attitudes, with females being predominantly affected. Sundgot-Borgen and Torstveit (2004) found a similar percentage of elite Norwegian athletes (13.5%) with subclinical and clinical signs of eating disorders, which was significantly higher than the percentage (4.6%) found in age-matched controls. In addition to self-report questionnaire measures, this study also included a detailed standardized clinical interview of all at-risk individuals and a representative sample of athletes and controls not classified as at risk for eating disorders. These investigators also found higher percentages of eating disordered symptoms among female (20%) than male (8%) athletes and among those competing in leanness-dependent (e.g., gymnastics) and weight-dependent (e.g., wrestling) sports than in other sports. Other studies (DeBate, Wethington, & Sargent, 2002; Hausenblas & McNally, 2004; Sanford-Martens et al., 2005) have consistently found a greater percentage of female than male athletes with behaviors symptomatic of eating disorders. Support has been inconsistent for athletes demonstrating higher rates of eating disorders than nonathletes (Sanford-Martens et al., 2005) and differences in eating disorder rates based on sport group (Hausenblas & McNally, 2004; Sanford-Martens et al., 2005). However, Sherwood, Neumark-Sztainer, Story, Beuhring, and Resnick (2002) found that among adolescent girls participating in weight-related sports, there were higher rates of substance abuse, physical and sexual abuse history, depressive symptoms, and suicide attempts in girls who demonstrated eating disorder symptoms than in those who did not.

Prevention of Psychopathology and Early Intervention

Sport is a pervasive and well-established institution in the United States and throughout the world. It occupies a significant portion of time for many individuals and is a potent factor in socialization. It has been estimated that only 3.7% of the U.S. population does not engage in any athletic event (as fan or participant) more than once a month. Approximately two-thirds of adolescents ages 14 to 17 are participants in sport (Miller Brewing Company, 1983). The majority of youth participate in non-school-based programs, and there has been a recent significant increase in youth sports league participation (Edmondson, 2000, p. 233).

Given the growing activity level in sport, we can assume more opportunity for positive influence on the current and future health and well-being of young people. Adolescent sport participation has been associated with self-reports of positive health behaviors, such as consumption of fruits and vegetables (Pate, Trost, Levin, & Dowda, 2000), and with a lower rate of some negative health behaviors, such as sexual risk activity and substance use (Kulig, Brener, McManus, 2003). Positive effects of regular physical activity on mental health have been documented among adults (Goodwin, 2003; Woodward, 2005).

We believe, along with others (Eppright, Sanfacon, Beck, & Bradley, 1997; Stryer, Tofler, & Lapchick, 1998), that attention must be directed toward examining how sport participation results in positive health outcomes among youth. As suggested by Danish and Nellen (1997, p. 112), "The future of our country is much more dependent on helping our youth reach their goals than it is on helping elite athletes win gold.” Indeed, sport psychology is considered by Danish, Fazio, Nellen, and Owens (2002, p. 269) “to be the use of sport to enhance competence and promote development throughout the life span.” Given this broad mission statement, sport psychologists are as relevant for life development as they are for athletic development. At the heart of this approach is the belief that sport is a vehicle for enhancing competence. By participating in sport, the individual learns valuable lessons transferable to other life situations. These lessons take the form of attitudes and behaviors called *life skills* that enable individuals to succeed in their living environments, including families, schools, workplaces, neighborhoods, and communities. The development and application of these life skills is seen as the lasting value of sport, rather than an end in itself. Descriptions of programs founded on this and similar philosophies are frequent in the recent literature (Curry & Maniar, 2003; Danish, 2002; Danish et al., 2002; Danish, Forneris, Hodge, & Heke, 2004; Danish & Nellen, 1997; Danish, Petipas, & Hale, 1993; Lavallee, 2005; Petitpas, Cornelius, Van Raalte, & Jones, 2005; Petitpas, Van Raalte, Cornelius, & Presbrey, 2004; C. Sherman, 2000, 2001; R. E. Smith, 1999; Unestahl, 1990).

Programs oriented toward developing life skills are a primary prevention for potential new cases of psychopathology. Secondary prevention aimed at early signs of psychopathology and use of appropriate measures for change is equally important, as well as tertiary prevention intended to arrest more advanced stages of psychopathology and decrease associated negative consequences through appropriate treatment and rehabilitation. Primary and secondary prevention are reasonable objectives for the sport psychology consultant, whereas tertiary prevention is best provided by other appropriately trained professionals (e.g., clinical psychologists, psychiatrists, social workers, mental health counselors).

Advocates of secondary prevention assume that conditions exist that predate diagnosable mental disorders and that these conditions are identifiable, thus setting the stage for potential intervention. Recent research supports this supposition. For example, persistent anhedonia and feelings of worthlessness in childhood and adolescence are prognostic of the development of depressive conditions (Wilcox & Anthony, 2004). The occurrence of problem behaviors during adolescence (e.g., smoking, alcohol use, and drug use) is associated with a high and generalized risk for developing adult psychopathology (McGue & Iacono, 2005). Other research has found reliable predictors of problematic drinking among college students (O’Connor & Colder, 2005) and of development of subsequent marijuana dependence among adolescents (Fergusson, Horwood, Lynskey, & Madden, 2003).

Unmet treatment needs and low rates of help seeking have been noted among collegiate athletes, both historically (Pierce, 1969) and currently (P. S. Howland, personal communication, May 27, 2005; S. N. Moore, personal communication, May 27, 2005). It also has been suggested that there is a tendency among athletes to deny emotional problems and stigmatize help seeking-behavior (Schwenk, 2000). Martin (2005) similarly suggested that some athlete groups (e.g., male athletes, younger athletes, and athletes socialized in sports involving physical contact) may have a stigma toward seeking sport psychology consultation.

Taken together, these findings underscore the need for secondary prevention in sport. There is growing awareness of this need as well as emerging efforts to meet it. Petrie (1993) described a disordered-eating continuum among female collegiate gymnasts: Higher levels were associated with a desire to weigh less, lower body satisfaction and self-esteem, and greater endorsement of cultural values related to women’s attractiveness. Similarly, Wright, Grogan, and Hunter (2001) found that steroid users were more positive than nonusers about steroid benefits and minimized negative side effects of the drugs. These characteristics may serve as early warning signs for secondary prevention efforts. Vinci (1998) described eating disorder prevention efforts at the University of Washington in the Husky Sport Nutrition Program, a component of an overarching program that provides life skills assistance to student athletes. Iven (1998) noted the importance of preparticipation physical examinations for team physicians in establishing a sound relationship with athletes while emphasizing a thorough history, including an assessment of risk factors, family history, and personal tendencies toward substance abuse. The importance of an ongoing relationship between physician and athlete to promote early recognition and intervention with developing substance abuse problems is also highly relevant. See Stainback (1997, chap. 5) for a review of sport-related alcohol abuse and dependence prevention.

Treatment of Psychopathology

The intent here is to provide general informational sources regarding treatment, to briefly discuss referral for treatment (more is covered in the ensuing section), and to refer the reader to the regrettably infrequent descriptions of treatment in the sport context. The World Wide Web provides comprehensive resources enabling the public and professionals to obtain information on scientifically supported treatment modalities. For example, the National Guideline Clearinghouse is a comprehensive resource for evidenced-based clinical practice guidelines for physical and mental disorders (U.S. Department of Health and Human Services, n.d.). Similar resources specifically for mental disorders are provided by the American Psychological Association (APA), Division 12, Society of Clinical Psychology (n.d.), and the American Psychiatric Association (n.d.).

When considering a referral of an athlete to a mental health treatment professional, it is important to know the scope, nature, and philosophy of the professional's practice. In examining 1987 data on the distribution of patients among psychiatrists, psychologists, general medical physicians, and other health professionals, Olfson and Pincus (1996) found that psychiatrists provided significantly more visits than psychologists for schizophrenia, bipolar disorder, substance abuse, and depression, but significantly fewer visits for anxiety disorders and symptoms such as "nervousness." General medical physicians provided the most visits for adjustment disorders and substance abuse, and other professionals provided the most visits for childhood mental disorders and mental retardation. As these data are almost 20 years old and substantial changes have occurred in the delivery of and reimbursement for mental health treatment services in the intervening years, it is difficult to determine if these practice patterns exist today. However, in a recent review of the efficacy of psychological treatments, Barlow (2004, p. 873) noted that multiple surveys, across a variety of specific disorders, indicated that when given a choice, the public preferred psychological to pharmacological interventions.

Attention in the literature given to treatment of psychopathology in sport is scant; however, there are some helpful exceptions. For example, Stainback (1997) and Stainback and Taylor (2005) provided case descriptions and discussion of related issues for treatment of alcohol abuse and dependence in sport. Similarly, R. T. Sherman and Thompson (2001) discussed the unique challenges posed in the management and treatment of eating disorders among athletes. Petrie and Sherman (2000) provided a case description exemplifying the kinds of issues often encountered in working with an athlete who has an eating disorder. Articles also have been devoted to treatment of personality and mood disorders (Andersen, Denson, Brewer, & Van Raalte, 1994; Marchant & Gibbs, 2004) and head injury (Erlanger, Kutner, Barth, & Barnes, 1999; Kontos, Collins, & Russo, 2004) in athletes.

ASSESSMENT AND REFERRAL

Work with athletes often begins with a focus on performance enhancement (Van Raalte & Andersen, 2002, p. 325). An athlete also may present with issues outside of athletics, or the focus may shift from performance to personal issues as the consulting relationship progresses. Leffingwell, Weichman, Smith, Smoll, and Christensen (2001, p. 533) noted that the reasons athletes approached them for services varied as follows:

> Problems strictly related to performance enhancement compose 43% of the presenting problems. An equal number (42%) involve more personal issues, including depression, anxiety, anger management problems, substance abuse, eating disorders, and deficient life skills. Finally, 15% are initially represented by the athlete as a performance enhancement issue but later are disclosed to be personal issues that may underlie the performance problem.

As a sport psychology consultant, how does one screen effectively for the presence of mental disorders or personal issues that may impact not only performance but also an athlete's life generally? The answer to this question can be shaped by your training and background (Taylor & Schneider, 1992) but also, as noted earlier, by your professional philosophy (Poczwardowski et al., 2004).

A comprehensive, accurate assessment is a critical part of consultation. Many formal sport psychology models include assessment as part of the model (see Danish, Petitpas, & Hale, 1995; Gardner, 1995; Hellstedt, 1995; Perna, Neyer, Murphy, Oglivie, & Murphy, 1995; Whelan, Meyers, & Donovan, 1995). Assessment is used for setting up goals and strategies in preparation for intervention (Taylor & Schneider, 1992) and for evaluating the effectiveness of interventions already conducted.

One method for assessing the presence of psychopathology is a preconsultation questionnaire. Use of these questionnaires allows the athlete to communicate to the consultant a variety of concerns that can be explored further in a face-to-face meeting (B. C. Kelley, personal communication, June 14, 2005). Peterson, McCann, and Smith (1997) provide an example of such a questionnaire. A second method for assessing the presence of psychopathology is the clinical interview. Several of these have been developed for use in assessing specific psychopathologies (for examples of these, see Taylor & Schneider, 1992). Taylor and Schneider developed an intake interview format that combines sport and clinical psychology and includes questions regarding issues such as sleeping and eating habits, substance use, anxiety, and depression.

A combination of the preconsultation and clinical interview formats would be ideal in helping the consultant identify possible psychopathology. However, as Andersen (2000, p. 4) pointed out, "Probing about clinical issues may alienate some athletes." Therefore, the consultant's judgment must come into play when determining the appropriate time to introduce these issues. As rapport and trust are established between athlete and consultant, the athlete will ideally feel free to speak frankly about any troubling issues, regardless of their apparent relationship to sport. The consultant also must be alert for subtle factors that could signal the need to extend the focus beyond performance enhancement. These factors may include the length of time a problem has existed and its impact on the athlete's life, unusual emotional reactions or mood changes, and how effective more traditional performance enhancement interventions are in solving the presenting problems (Andersen, 2001). In our experience, an additional consideration is the new clinician's inclination either to overdiagnose, which often reflects inexperience and lack of confidence, or to underdiagnose as a form of denial and false self-assurance. Both serve the client poorly and can have significant negative implications.

Networking Referral Sources

The sport psychology consultant is similar to the primary health care professional in that both are likely to discover issues during their interactions with clients or patients that require referral to an alternative source for appropriate assessment and treatment. It is important for the sport psychology consultant to develop a readily available referral network of professionals who are sensitive to athletes' needs (Andersen, 2001; Van Raalte & Andersen, 2002). Consider the following: Imagine that you have completed your initial assessment and are negotiating a consultation plan with an athlete. Depending on the assessed issues, you have to decide if you are competent to provide the necessary services. Van Raalte and Andersen suggested that "competence is an issue of knowledge and skills" (p. 330). Therefore, when considering your next step, two questions should come to mind: Do I have the knowledge to provide the necessary intervention? and Do I have the skills to provide the necessary intervention? The answers to these questions can be straightforward or complex, depending on the situation.

If the answer to both questions is an unqualified no, then a referral to an appropriate professional is obviously indicated. For example, when the presenting problem is a physical illness, a referral to a primary care physician is warranted. A referral is not likely needed when the answer to both questions is an unqualified yes. An example might be a situation in which the athlete is initiating a consultation to help with establishing a precompetition routine, and you have both the requisite knowledge and skills to assist. However, in many instances, the decision may not be quite so clear-cut. An athlete with an eating disorder may require involvement of multiple professionals in addition to the sport psychology consultant. These might include a clinical psychologist, nutritionist, and sports medicine physician as well as other professionals. Andersen (2001) described concerns that should prompt the consideration of a referral, including identity and relationship issues, sexual orientation and homophobia, alcohol and substance abuse, and anger and aggression control. Questions pertaining to technical aspects of sport performance should also prompt the sport psychology consultant to refer (Brewer & Petrie, 2002).

There are other important issues surrounding a decision of whether to refer. First, consider areas you want to improve on. You may possess requisite knowledge and skills in a particular area but desire to become more proficient. Certainly, introspection is one way to assess this question, but seeking supervision, both as a way of determining your relative strengths and weaknesses as a consultant and for acquiring additional skills, is a recommended method (Van Raalte & Andersen, 2002). Supervision in general or by an expert in the relevant area may provide useful information and possibly allow you to continue working with an athlete rather than refer while expanding on your expertise. Second, consider the extent of your relationship with the athlete. Have you established trust and rapport? If so, referring the athlete when issues arise peripheral to your areas of expertise may not be the optimal or timely choice (Andersen, 2001); on the other hand, for any referral to be effective, rapport is vital. Andersen proposes another option, which is to invite a qualified professional to a session with the athlete (provided necessary confidentiality issues have been attended to) as a way of keeping the "therapeutic process going" (p. 404). This strategy may meet several needs. It may allow you to (a) learn more about the issue in question, (b) facilitate a successful referral, (c) maintain a working relationship with the athlete in the event of a referral, and (d) provide continuity of care between you and the referral source.

The development of a referral network is an active process (Hankes, 2005). You are assembling a team of professionals who are experienced in working with athletes and who are licensed or otherwise credentialed to do so. You might include some professionals who are specifically credentialed to work in sport and some professionals who are interested in becoming more experienced in the area. Van Raalte and Andersen (2002, p. 331) make the following suggestions for developing a referral network: (a) Identify appropriate local professionals, including athletic trainers, coaches, exercise physiologists, nutritionists, physical therapists, primary care physicians, psychiatrists, and psychologists; (b) attempt to get to know these professionals; and (c) evaluate the network on an ongoing basis and make adjustments as appropriate. They also discuss "dos and don'ts" of establishing a referral network, and the reader is directed to their excellent summary for further information.

Handling Psychiatric Emergencies

Roy and Fauman (2000, p. 2040) define a psychiatric emergency as "any unusual behavior, mood, or thought, which if not rapidly attended to may result in harm to a patient or others." In essence, if an athlete with whom you are working is exhibiting behavior dramatically different from normal (either in your experience with the person, in the person's experience, or in the experience of those close to the person), you should consider the possibility that the athlete is experiencing a psychiatric emergency (e.g., suicidal or homicidal behaviors, gestures, or attempts; overwhelming anxiety or depression; confusion; paranoia; hallucinations; or agitated behavior). One does not have to look very far in the popular media to find athletes' accounts of struggling with issues such as these (see, e.g., "Olympian Holmes considered suicide," 2005). With the exceptions of suicidal or homicidal circumstances, the observation of any of these symptoms should result in the calm recommendation that the athlete be evaluated at a local psychiatric facility or medical center. It is wise to recommend that the athlete allow a trusted friend or family member to provide the transportation. If no friend or family member is available, then emergency professionals should be contacted.

In the event the athlete has disclosed suicidal thoughts, preliminary assessment is critically important. Barney and Andersen (2000, p. 147) do so with questions using the acronym PAL: "Does the person have a plan (P) for committing suicide? If a plan is present, how available (A) are the components of the plan? Finally, if carried out, how lethal (L) might the plan be?" Similar approaches have been recommended by Hirschfield (1998) and Lyon, Chase, and Farrell (2002). Though seemingly simple, this can require complex clinical judgments that can challenge even seasoned professionals. If the athlete has a plan (e.g., "I am going to get drunk and take an overdose of my pain medication") that is available (e.g., she is currently recovering from surgery and has been prescribed pain medication), that has a high chance of lethality (e.g., sufficient quantities of pain medication and alcohol can certainly be lethal), and cannot reliably and safely be transported to the emergency department, then emergency professionals should be contacted. If the answers to the questions are less definitive, the consultant will need to use professional judgment regarding how to proceed in the circumstances and with knowledge of local resources. The safety of the athlete and society as a whole is always the paramount concern. Other issues for evaluation include, but are not limited to, substance use (decreases inhibition and may potentiate the effects of medications, enhancing their lethality), previous attempts (current risk increases with the number of previous attempts), recent losses (increases current risk), the presence of depression (increases current risk), and the availability of a support network (supportive family and friends may decrease the current risk; Scully, 2001). Therapeutic choices include calling emergency professionals, setting up a "no-harm" contract (for additional information, see Zuckerman, 1997), or making a referral for more intensive care.

Assessment is also critical if the athlete reports homicidal thoughts. Homicidal ideation can be assessed in a fashion similar to that of assessing suicidal ideation (i.e., using the PAL format). The difference between the two types of assessments is the addition of the need to determine if a specific victim of the intended violence is identified by the athlete. Many states have "duty to warn" laws in place based on or derived from the landmark case *Tarasoff v. Board of Regents of the University of California* (1976). In this case, the California Supreme Court "ruled that a physician or a psychotherapist who has reason to believe that a patient may injure or kill someone must notify the potential victim, the victim's relatives or friends, or the authorities" (Kaplan, Sadock, & Grebb, 1994, p. 1174). Not all states have "duty to warn" laws. Depending on your judgment as to the seriousness and specificity of the homicidal threat, you may choose to warn the person being threatened even if "duty to warn" laws are not present. You should be aware that if "duty to warn" laws are not present, you may risk being reported to your licensing/certifying body for failure to maintain the confidentiality of the client. Examine the laws that govern your practice to determine the presence or absence of "duty to warn" laws in your jurisdiction. Other issues for evaluation include, but are not limited to, a history of violence (a positive history is the most reliable predictor of future violence) and substance use (decreases inhibition, which may make carrying out the violent threat more likely; Scully, 2001). Therapeutic choices include calling emergency professionals, notifying the intended victim if identified, or making a referral for more intensive care. Sport psychology consultants who work with children and adolescents must also be aware of the signs and symptoms and of the laws regarding the reporting of child exploitation and abuse in their jurisdiction.

PARADIGM FOR CHANGE

In a recent review of psychotherapies, Prochaska and Norcross (2003) noted the fragmentation that characterizes the field and the resulting confusion for students, practitioners, and patients prompted by an escalating number of choices of therapies (400 and growing, by recent estimates; p. 2). In an effort to reduce this fragmentation and to promote theoretical integration, these authors analyzed 16 major systems of psychotherapy, highlighting the many similarities across systems. They proposed an integrative, comprehensive model, the transtheoretical model (TTM) as "an intellectual framework for thinking and working across systems" (p. 3). This framework includes an explication of stages, processes, and levels of change. Within the TTM, it is proposed that therapeutic integration is the "differential application of the processes of change at specific stages of change according to the identified problem level" (p. 530). These authors indicated that research has been supportive of the core constructs of the TTM and suggested that the model "holds considerable promise for describing, predicting, and explaining changes in a broad range of disorders" (p. 536). Although the TTM has its origins and primary supporting data based largely in research on addictions (DiClemente, 2003; DiClemente, Schlundt, & Gemmell, 2004), the model also has been applied to preventive health behaviors, such as exercise (Adams & White, 2003; Biddle & Nigg, 2000; Landry & Solmon, 2002; Prochaska & Marcus, 1994) and dental hygiene practices (Astroth, Cross-Poline, Stach, Tilliss, & Annan, 2002), and to sport psychology consultation (Leffingwell, Rider, & Williams, 2001).

The TTM has enjoyed significant popularity among practitioners and researchers; however, its utility in understanding and promoting behavior change has been questioned. For instance, conceptual and empirical limitations have been noted, including problems with stage definition, measurement, and discreteness, among others (Sutton, 2001; Wilson & Schlam, 2004). Despite these criticisms, the model endures and continues to receive considerable attention. A specific value of the model is its focus on commonalities across therapy approaches that constitute a core of psychotherapy.

One factor discussed by Prochaska and Norcross (2003, p. 8) is the development of a strong therapeutic alliance between client and therapist. We believe this alliance is of paramount importance to the success of any helping relationship, be it in psychotherapy, sport psychology consultation, or other context. The guidelines for motivational interviewing described by W. R. Miller and Rollnick (1991, 2002) provide an excellent method to establish a therapeutic alliance that is successful in assisting the client to make desired changes. The basic tenets follow: (a) change occurs naturally and in the context of formal interventions; (b) interpersonal interactions strongly affect the likelihood that change will occur and even brief interactions can initiate change; (c) much of change occurring within treatment occurs in the first few sessions; (d) the clinician is a significant determinant of treatment outcome; (e) an empathic counseling style appears to encourage change and in its absence change may be deterred; (f) both client and counselor expectations for change in the client have powerful effects; and (g) what people say regarding change is important. Statements reflecting motivation for and commitment to change predict later behavior change. Conversely, arguments against change yield less change. Interpersonal or counseling style can significantly influence both types of statements (W. R. Miller & Rollnick, 2002, pp. 9–10).

Motivational interviewing is defined as "a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence" (W. R. Miller & Rollnick, 2002, p. 25). As such, it is a clinical method or style of counseling characterized by a collaborative relationship between counselor and client. In the spirit of this collaborative role, the counselor seeks to find and evoke or elicit intrinsic motivation for change in the client, all the while acknowledging and respecting the autonomy of the individual in accepting the responsibility for change (pp. 33–35). Four guiding principles that underlie motivational interviewing methods are described: (1) Express empathy through acceptance, skillful reflective listening, and respect; (2) develop discrepancy. Change is motivated by a perceived discrepancy on the client's part between current behavior and a valued goal. When motivational interviewing is done well, it is the client, not the counselor, who presents arguments for change; (3) roll with resistance. The counselor avoids arguing for change, invites but does not impose new perspectives, and views resistance as a signal to respond differently. The client is a primary resource for finding solutions; and (4) support self-efficacy. The client's belief in the possibility of change is an important motivator, and the client, not the counselor, is responsible for choosing and implementing change. The counselor's personal belief and expectations about the client's capability to change can exert a powerful effect on outcome, serving as a self-fulfilling prophesy (pp. 37–41).

In a recent meta-analysis of controlled clinical trials of adaptations of motivational interviewing (AMIs), Burke, Arkowitz, and Menchola (2003, p. 856) concluded that "AMIs were equivalent to other active treatments and superior to no-treatment or placebo controls for problems involving alcohol, drugs, and diet and exercise." Their results indicated statistical and clinical significance for the efficacy of these AMIs. The authors noted mean effect sizes comparable to those found in a compilation of meta-analyses of psychological, educational, and behavioral interventions (approximately 0.50; Lipsey & Wilson, 1993). Although AMI effect sizes are less than those reported in data from meta-analyses of psychotherapy (effect sizes ranging from 0.75 to 0.85, Wampold, 2001, as cited in Burke et al., 2003), the authors noted that AMI studies averaged under 100 minutes of treatment (two sessions), whereas most psychotherapy studies included at least eight sessions (400+ minutes) of treatment. Adaptations of motivational interviewin treatments for alcohol and drug addiction also produced client improvement rates (51%) at least equal to rates found in empirically supported treatments for depression and panic disorder. Similarly to the comparisons on effect sizes, AMI treatments demonstrated these improvement rates in an average of two sessions, compared with eight sessions of psychotherapeutic treatment (Howard, Kopta, Krause, & Orlinsky, 1986).

Results of the Burke et al. (2003) meta-analysis support the efficacy of AMIs for the problems noted earlier. Further, given the conceptual and procedural overlap between motivational interviewing and cognitive behavioral therapy (Wilson & Schlam, 2004), it is reasonable to expect that the former may be effective for applications in other areas. There is evidence that such is the case (Arkowitz & Mann, 2002). Motivational interviewing and related approaches may also have specific applications in sport. Earlier in the chapter we noted evidence of low rates of help seeking by athletes. Although reasons for this are unclear, motivational interviewing is a reasonable approach for a sport psychology consultant to take with an athlete who might benefit from counseling but is reluctant to pursue it. Stainback (1997, pp. 137–140) and Stainback and Taylor (2005) offer case examples describing the potential utility of a motivational interviewing style with athletes experiencing problems related to their alcohol use. In the latter case, the authors interject commentaries during the dialogue between counselor and athlete designed to illuminate the thoughts and intentions of the counselor during the session. Although largely connected to other theoretical backgrounds, the solution-focused approach to sport psychology as described by Hoigaard and Johansen (2004) bears a resemblance to motivational interviewing. Both approaches entail relatively brief interventions, focus on the collaborative nature of the counselor-client relationship, and emphasize that solutions ultimately are within the client. These and similar approaches appear well suited to the premiums placed on time efficiency in the sport environment and to the focus of athletes and coaches on performance improvement.

PROFESSIONAL ISSUES

At the beginning of the chapter, we discussed our belief that developing a coherent professional philosophy is an integral part of the provision of sport psychology services. We offered Poczwardowski et al.'s (2004) hierarchical model for conceptualizing this philosophy. One aspect that the model focuses on is "the consultant's beliefs and values concerning his or her potential role in, and the theoretical and practical means of, influencing . . . clients toward mutually set intervention goals" (p. 449). In essence, developing a professional philosophy defines the roles taken on by a sport psychology consultant and how these roles are approached.

Current sport psychology consultation can be truly multifaceted, as evidenced by the various roles taken and methods used by consultants as well as the numerous settings in which they provide services. McCann (2005, p. 283) aptly summarized by stating that "applied sport psychology is not easy to pigeonhole." He identified several roles taken, including team consultant and clinician and individual consultant. Interventions range from teaching athletes to use mental skills for performance enhancement, such as goal setting, relaxation, imagery, confidence building, and attention control (Williams, 2001), to applying knowledge and methods that have been traditionally the purview of psychology and related fields, such as organizational development, psychotherapy, hypnosis (Hays & Smith, 2002), and neuropsychological assessment (McCann, 2005). Finally, settings can vary tremendously, ranging from an office to considerably less traditional settings such as a locker room or a basketball court.

Sport psychology consultants come from diverse educational backgrounds, having been trained largely in sport science, counseling and clinical psychology, or medicine. In an effort to bring some cohesion to the field, the Association for the Advancement of Applied Sport Psychology (AAASP) established criteria for certification of consultants in sport psychology in the early 1990s. Zizzi, Zaichkowsky, and Perna (2002) reported that the benefits of this action are the establishment of standards of accountability and professionalism in the field, recognition and credibility for those certified, guidelines for the preparation of the professional, and an increase in the public awareness of sport and exercise psychology. The current criteria for certified consultant status require a minimum of one course in professional ethics and standards, one course in psychopathology and its assessment, and graduate coursework in counseling skills. In addition, the requirements include a minimum of three courses in sport psychology, one course in biomechanical and/or physiological bases of sport, and one course in the historical, philosophical, social, or motor behavior bases of sport (pp. 464–465). Thus, expectations are set that certified sport psychology consultants will have some common core of educational background.

This expectation is important when one considers the alternative. For example, Sanchez, Godin, and De Zanet (2005, p. 81) surveyed French-speaking sport psychology service providers in Belgium (a country without sport psychology certification) as a case study and found that "degree-holding psychologists and people without any credentials coexist." These authors called for cooperative efforts between sport governing bodies and political authorities in Europe to develop the professional practice of sport psychology.

Given the variety of roles, methods, and settings that characterize the practice of sport psychology, a professional with a "hybrid" (Cogan, 1998; Hays, 1995) background in both psychology and sport science would appear most advantageously prepared. Support for such an approach comes from several sources. In his interview with Nicki Moore, PhD, about her responsibilities at the University of Oklahoma as assistant director of athletic academic affairs for psychological services, Hankes (2005) highlighted the need for a variety of skills when working in a collegiate athletic department. Eyal (2001, p. 170) noted that to be successful, the consultant must be stylistically flexible in working within the rules of the world of sports. Leffingwell, Wiechman, et al. (2001) described a clinical doctoral training program that provided services to the school's athletic department, including consultation with coaches, team interventions, performance enhancement with individual athletes, mental health and leadership consultation, and program evaluation. In return, participating graduate students received applied training, financial support, and research opportunities. Career summaries of the graduate students who participated in these training opportunities indicated their contribution to sport psychology research and practice.

Ethical Issues

Whelan, Meyers, and Elkins (2002) noted that the development of an ethics code is one way for a profession to regulate itself. It is also a way of protecting the public from misuse of the knowledge unique to the profession. Both the International Society of Sport Psychology (n.d.) and AAASP have developed codes of ethics for sport psychology. The latter is based in great part on the 1992 version of the American Psychological Association's Code of Ethics (AAASP, 1998, as cited in Sachs, Burke, & Schrader, 2001). In reporting the results of a Web-based survey of AAASP members' ethical beliefs and behaviors, Etzel, Watson, and Zizzi (2004, p. 248) indicated that consultants certified by AAASP were more likely than noncertified consultants "to have practiced without supervision or peer consultation, to have been sexually attracted to clients and to have allowed out-of-town clients to reside in their home while services were being provided." The authors conceded that, though these behaviors are not necessarily unethical, they are potentially risky and could lead to ethical problems. The authors theorized that the certified consultants included in the study may have felt they had the experience to judge each particular situation instead of rigidly adhering to the ethical standards, or may not be as familiar with the current ethical principles as they could be. The results may also reflect that the certified consultants were more honest, self-aware, and sensitive to boundary concerns. Nonetheless, each applicant for certified consultant status indicates acknowledgment of the need to adhere to the AAASP Ethics Code by signing the application.

The divergent backgrounds of sport psychology consultants pose challenges to ethical code adherence. Those professionals trained in areas outside of psychology may not view the practice situations in which they find themselves as particularly ethically complex. Also, they may view the work they do as not within the purview of psychology and thus not subject to the ethical constraints of psychology. Conversely, those from psychology backgrounds are probably not familiar with the nuances of sport psychology practice and lack experience in applying their ethical standards outside of a traditional psychology practice. With the development of an AAASP Ethics Code comes the need for professional dialogue to explore its ramifications. Moore (2003, p. 602) noted, "Ethical limitations and considerations . . . have been discussed in the sport psychology literature . . . , yet these potential ethical concerns have not been fully assessed and discussed as they pertain to the Ethics Code developed by the APA (2002)." Whelan et al. (2002, p. 520) noted that sport psychology consultants often encounter ethical situations that are both difficult and controversial in the field. Several of these areas of concern have been identified in the sport psychology literature and are discussed next. These include the potential negative health effects of competitive athletics, confidentiality, use of informed consent, balancing multiple roles, and maintaining professional boundaries.

The mental health benefits of exercise are well-documented in the general population (for reviews of this topic, see Hays, 1995; Woodward, 2005); however, some (Lavallee, 2005; Pipe, 2001) have pointed out the potential personal costs of the pursuit of performance excellence, particularly at the elite level of sport. One area receiving recent attention in the literature is overtraining, which can present with symptoms similar to clinical depression and can have a serious negative impact on an athlete's career (e.g., Meehan et al., 2004; Schwenk, 2000). As Pipe (2001, p. S193) stated:

> It is essential that all involved in the development and training of athletes understand the degree to which sport participation may pose problems to an athlete's physical, emotional and social well-being. Involvement in sport may lead to injury and illness as well as a variety of behavioural and psychological issues.

It is incumbent upon all sport service providers to remember that the health and well-being of the athlete is their paramount goal. However, it is equally important to recognize that concerns for the well-being of the athlete may conflict with the wishes of the athlete and other interested parties (e.g., coaches, organizational agents, family members).

Confidentiality is a critical part of the practitioner-client relationship. If an athlete independently initiates a consulting relationship and pays for it, most practitioners understand that the athlete determines who has access to confidential information, with exceptions being dictated by state or federal law for those licensed to practice. However, if the practitioner is approached and paid by a third party, perhaps a coach or a representative of a team, who then determines access to information? An additional issue involves the conducting of assessments. How and to whom are results presented? Another issue may occur while traveling with a team. For example, the sport psychology consultant is approached by an athlete with preperformance anxiety issues and there is no office in which to meet. How do you keep the ensuing discussion confidential?

Informed consent includes "all information necessary for a client to make an educated, informed decision about the likely benefits and risks of the specific intervention to be used and the development of a professional working relationship with the therapist/consultant" (Moore, 2003, p. 603). For clarity, it is preferable that the client receives this information in writing, be given ample opportunity to ask questions, and be asked to sign the document indicating understanding and acceptance. Harris (2002) recommends that informed consent include the nature of the practice, treatment plan and options, the purpose of meetings and sessions, fees, billing practices, insurance reimbursement, practitioner availability, treatment record policy, confidentiality and its limitations, and the treatment of minors, including the minor's rights to informed consent. The Codes of Ethics of both AAASP and APA require the use of appropriate informed consent. However, given the small amount of formal discussion in the sport psychology literature regarding this issue, Moore concluded that there may be sport psychology consultants practicing without conducting preconsultation informed consent. If true, this practice can lead to both ethical and legal problems.

Multiple roles when working with an organization (such as a team or school) are often unavoidable (Gardner, 2001; McCann, 2000; Moore, 2003) and can become problematic, especially when the roles conflict (Canter, Bennett, Jones, & Nagy, 1994, as cited in Moore, 2003). Examples of potential role conflicts include being the team psychologist while also being asked to give input to management regarding player termination, providing services to two athletes who are currently competing for the same position, and acting in the apparent best interests of the individual athlete when these interests potentially conflict with the team's success.

Many ethical concerns can be avoided by maintaining professional boundaries. A boundary in this case is defined by Gutheil and Simon (2002, p. 585) "as the 'edge' of appropriate or professional behavior, transgression of which involves the therapist stepping out of the clinical role." The interested reader is referred to work by Gutheil and his colleagues (Gutheil, 2005; Gutheil & Simon, 2002; Norris, Gutheil, & Strasburger, 2003) for additional discussion regarding the issue of professional boundaries. It is important for the sport psychology consultant to be alert to feelings of overidentification (Andersen, Van Raalte, & Brewer, 2001), to conflicting roles, and to the presence of multiple relationships as clues to the possible blurring of professional boundaries. Andersen et al. noted these warning signs:

> (a) feeling more vibrant in the athlete's presence, (b) prolonged emotional reactions to the athlete's wins and losses, (c) pleasurably anticipating athlete sessions more than usual, (d) finding excuses for more athlete contact, and (e) breaching confidentiality with colleagues (e.g., name dropping one's client to a colleague). (p. 17)

Establishing clear expectations for the consultation before beginning is a reasonable initial strategy to prevent boundaries from being crossed (Andersen et al., 2001; Gardner, 2001; Moore, 2003). Mutual expectations can be spelled out with written and verbal informed consent. Consulting relationships with peers are also effective ways to receive counsel on managing professional boundaries and resolving difficult ethical issues. The consultant may also find it appropriate to engage in supervision regardless of how long he or she has been consulting, especially when learning new skills or facing new professional situations.

Moore (2003) recommended that sport psychology consultants have a thorough understanding of the Ethics Codes of both APA and AAASP so as to practice more ethically, morally, and competently. We would like to add that thinking about the ethical issues unique to sport psychology consultation and the possible options for their successful resolution before being confronted with them will also assist the professional in managing difficult ethical situations. These suggestions emphasize the importance of risk management in the practice of sport psychology consultation. Risk management incorporates spending time anticipating problems prior to their occurrence and acting to prevent their occurrence as much as possible. The reader is referred to the general psychology literature (e.g., Doverspike, 1999) or to available workshops (e.g., Harris, 2002, 2003) for more information regarding risk management.

Consultant Self-Awareness

One way that a sport psychology consultant can think about the concerns just discussed and stay informed of ethical issues is by being ethically self-aware (Moore, 2003). For this purpose, Moore included the "Ethical Self-Awareness Checklist for Sport Psychologists" in her article (pp. 608–610). This checklist is comprised of a series of questions that can be answered by yes, no, or N/A, such as "Am I thoroughly aware of APA's Code of Ethics and how it pertains to my work?" and "Do I have professional liability insurance?" More important, it includes a section of questions to use when faced with an ethical dilemma, such as "Have I consulted with a colleague or another professional in the field?" and "If applicable, have I contacted a lawyer regarding this issue?"

An alternative or complement to Moore's (2003) approach is to develop a reflective practice, as advocated by Anderson, Knowles, and Gilbourne (2004). They defined reflective practice as "adopting an approach to practice that requires practitioners to be open and questioning. The process also stresses the importance of making space and time to retrospectively examine practice in detail" (p. 192). The authors offered several uses for reflective practice: focusing on the technical aspects of practice, exploring personal meaning in a situation, questioning the consultant's own values in a situation, and looking at issues outside of the consultant that impact the practice of sport psychology (p. 192). They reviewed many ways of becoming a reflective practitioner; these included journaling, supervision, and the use of structured questions practitioners may ask themselves that encourage consideration of "the consequences of their actions and whether alternative action may have been more appropriate" (p. 194).

Van Raalte and Andersen (2002) suggested that self-assessment may have limited utility for the improvement of consultant self-awareness. They argued instead that supervision is the best way to understand one's limitations as a consultant. It is also a good way to clarify the integrity of boundaries, to maintain adherence to ethical standards, and to generally improve the supervisee's comfort in the consulting role. Sport psychology consultants who have established practices may not require supervision; however, they may benefit from peer consultation. Although Van Raalte and Andersen argue that self-assessment is inferior to supervision or consultation for enhancing self-awareness, the use of strategies such as those presented by Anderson et al. (2004) and Moore (2003) are excellent starting points for either supervision or consultation.

CONCLUSION

We have endeavored to present a clinician's perspective on the practice of sport psychology. The field is characterized by diversity in consultant educational background and theoretical roots, highlighting the importance of philosophical clarity to personal and professional development. We endorse the model described by Poczwardowski et al. (2004) as a guide for philosophy development.

The need and merits of a clinical perspective when providing sport psychology services were emphasized. Sport psychology practice scenarios involving athletes with potential mental disorders, a working definition of psychopathology, and a model depicting relationships among vulnerability, stress, and mental disorder were offered. Diathesis-stress models suggest that as stress increases, so does the incidence and severity of mental disorders. These models have particular heuristic value for the sport psychology consultant because stress is an unavoidable component of the sport environment. We recommend that sport psychology consultants familiarize themselves with these models and related literature to better understand the incidence and nature of mental disorders in sport.

Incidents of mental disorders in the general population and in sport are frequent and result in significant disability relative to most other health problems. Particular attention in the sport literature has been paid to substance abuse and eating disorders; however, these disorders demonstrate significant comorbidity with other mental disorders. Low rates of help seeking and high incidence of insufficient treatment place great importance on effective prevention and treatment efforts. Primary, secondary, and tertiary efforts are needed, with sport psychology consultants potentially playing a major role in the first two and typically referring the last for appropriate treatment elsewhere.

Accurate and timely assessment is critical to determine how to proceed with interventions and whether or not a referral is indicated. Establishing a readily available referral network of professionals is critical, as are basic competencies in handling psychiatric emergencies. These skills are important components of the foundation of effective practice. Therefore, sufficient time and energy should be spent in their development.

The TTM and motivational interviewing provide useful conceptualizations for sport psychology consulting. The former is an integrative structure from which to view change in a variety of behaviors, and the latter is a clinical method for enhancing client intrinsic motivation. We recommend both as potential sources of valuable information relevant to sport psychology practice development.

Current sport psychology consultation is multifaceted, requiring the consultant to take on a variety of roles in numerous settings using a variety of methods. The diversity of practitioners and practice activities poses challenges to ethical code development and adherence. Several areas of concern have been cited in the literature and reviewed here. Anticipating consultation problems ahead of time can help the sport psychology consultant better manage them when they occur. Developing self-awareness as well as actively seeking supervision or peer consultation when appropriate are suggested as reasonable alternatives to establish and maintain an ethical practice.

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CHAPTER 15

Action-Theory Approach to Applied Sport Psychology

THOMAS SCHACK and DIETER HACKFORT

A typical track and field sports event reveals a great deal of diversity. While a pole-vaulter is getting ready for the next vault, the starting pistol goes off and a group of track athletes break explosively into a 100 m sprint. A coach is helping an athlete to prepare herself mentally for a decisive high jump, while another group of athletes is relaxing on a mat at the edge of the stadium. During this time, spectators watch and applaud when appropriate.

Such a diversity of behaviors also suggests diversity in task-related and situation-related components. For example, the behavior of the 100 m sprinters seems to rely on simple reaction time after the pistol shot. The behavior of the spectators seems to rely on the performance of the athletes. The relaxing group of athletes is engaged in regulating physiological or psychological processes, and the coach is busy in consultation and provision of instructions to the athletes.

However, the events observed in the stadium rely, among other things, on the experiences, specific viewpoints, and conceptual framework of the sport psychologist. The action-theory approach formulates a fundamental concept of actions in sport and thereby provides a consistent and plausible basis for explaining the diversity of phenomena in sport practice. The theoretical foundation and empirical evidence of the fundamental aspects of actions in sport should promote and support the practical work of sport psychologists.

NEED FOR A COMPREHENSIVE THEORY

There are several reasons for formulating an action-theory approach:

• *Previous basic concepts of human behavior are either not formulated explicitly or are inadequate.* Numerous authors have criticized the theoretical and terminological "fragmentation" of psychology (see Nitsch, 2004). A variety of theoretical approaches often tackle only single and isolated functions and components of human action, such as emotions, motivations, or cognitions, without relating them to broader goals, plans, or action processes. This state of affairs was criticized by Vygotsky (1927) and later by Holzkamp (1972) and Rubinstein (1984). A further notable criticism was expressed by Prinz (1997, 1998). He outlined how psychology often follows a line of thought established by Descartes (1664) that views human behavior only in terms of reactions. Many psychologists interpret experiments purely as stimulus-reaction constellations; other professionals in sport view the 100 m start, for example, only in terms of the athlete's reaction to the pistol shot. Analyzing the construction and control of actions offers a number of advantages over the stimulus-reaction sequence. A functional approach to actions can also integrate, for example, the individual goals and anticipations that are so crucially important not only in psychological experiments but also in the practice of sport.

• *Applied psychology has an inadequate theoretical foundation.* The pure-research-oriented psychological disciplines (such as general psychology and developmental psychology) rely on different theoretical perspectives. One outcome of this has been a lack of any binding or fundamental theoretical approach in the applied disciplines (industrial psychology, clinical psychology, sport psychology, etc.). As a consequence, most sport psychologists cultivate their own theoretical basis for their practical work. Frequently, they are not aware of this theoretical basis, refraining from communication and thus avoiding any possibility of change. However, we believe that a good theory is of enormous value in practical work and that it is highly advantageous for sports psychologists working in the field to have a functional understanding of sport actions at their disposal.

ESSENTIAL ASSUMPTIONS FOR AN ACTION-THEORY APPROACH

The action-theory approach has a number of different historical roots. These include Miller, Galanter, and Pribram's (1960) book *Plans and the Structure of Behavior* that broke away from behaviorist concepts and formulated preliminary ideas on the functional construction of action. Further roots are to be found in German (Ach, 1905; Lewin, 1926) and Russian psychology (Luria, 1978; Rubinstein, 1964; Vygotsky, 1978). In the applied disciplines, the action-theory approach has been formulated most elaborately for industrial psychology (e.g., Hacker, 1998) and sport psychology (Hackfort, 1986, 2000; Hackfort & Munzert, 2005; Hackfort, Munzert, & Seiler, 2000; Nitsch, 1975, 1985, 2004; Schack, 1997, 2000).* We focus on applied sport psychology, and we start by enumerating the essential assumptions underlying an action-theory approach in this field:

- *Sport action is an intentional event.* This means that the various sequences or elements of a behavior that can be observed externally are carried out to attain a specific action goal. Hence, sport activities are always performed relative to a goal and are directed toward this goal. This gives all psychological processes and structures (emotions, representations, etc.) an action-regulating function.

A fundamental action situation in sport consists of the following components: person, task, and environment (Nitsch, 1982, 1985, 2000, 2004; Nitsch & Hackfort, 1981; see also, Newell, 1986). With these components, every sport situation can be accounted for in more detail. Sport performance depends on the current physical and mental condition of the athlete (person), on the situational demand or the type of sport (task), and on the conditions under which the task must be carried out (environment). This may vary strongly between, for example, training and competition (environment). From this perspective, actions are organized intentionally in line with a person's subjective interpretation of a given person-task-environment constellation (action situation). However, this does not mean that actions are completely conscious.

The assumption of intentionality has some important implications. First, it implies some kind of internal representation of the person-environment-task constellation. Second, it requires the formulation of a functional understanding of how intentions (ideas) find their path from the center to the periphery (in the action regulation system, the brain/cognitive processes are regarded as the center and the muscles/body movements as the periphery). In the action-theory perspective, self-instructions forge an important link between intentions and external behavior.

- *Sport actions are embedded within various systems.* A systems-oriented perspective is useful for sport psychologists working in the field when they must analyze problems or structures that they are confronting. A potential structuring of the relevant systems for an action is given in Figure 15.1.

Athletes are embedded within social systems. These may be friends or family, as well as the social situation in a competition. However, human beings also have to be viewed as a physical system, particularly when they are engaged in movement actions. Movement effects are always

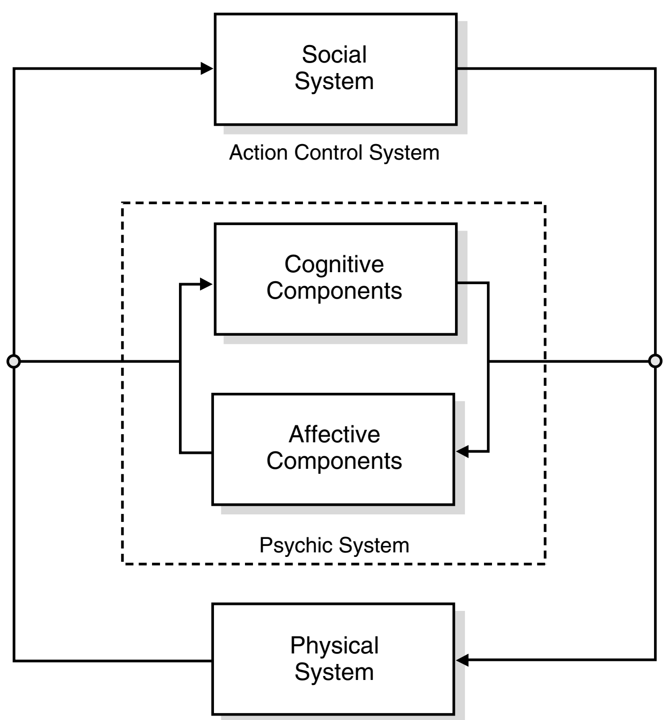


Figure 15.1 Action control from a system-theory perspective.

*There have also been interesting developments in the field of movement science, particularly motor control. For example, Jeannerod (1997, 2004) has formulated a neuropsychological concept of action planning. Other authors have formulated an ideomotor theory of action control (Hoffmann, Stoecker, & Kunde, 2004; Prinz, 1997), and there are now some studies addressing "the construction of action" on an experimental basis (see the two special issues by Schack & Tenenbaum, 2004a, 2004b).

physical effects as well, such as vaulting over a bar or long jumping. Major parts of the competitive conditions of a sport are defined within this physical system (e.g., wind, lighting conditions, water temperature). Moreover, the psychological system of the athlete should be taken into account. This includes, for example, cognitive or affective components. All these systems are dynamic. Hence, they initially possess a function and are composed of various elements. Another crucial aspect is that they possess a history. These systems have an environment and, as a result, greater or smaller degrees of freedom. The action-control system may be located, for example, between the social and the psychological system. It depends very strongly on the physical system and also tries to achieve an effect within this system. However, in principle, it is possible to exert only a minimal influence on the physical system. These system characteristics are important for the sport psychologist in the field who aims at modifying the athlete's action or behavior. For example, it is better to avoid considering the athlete's performance or social problems in isolation and to analyze these systematically.

The systems that influence an athlete's individual performance are tied very strongly to his or her action goals. This is illustrated in Figure 15.2, showing that the athlete should primarily be conceived as a biopsychosocial unit. As a result, physiological processes (such as regeneration or the healing of injuries) also depend very strongly on psychological and social framing conditions. For the psychological system, in turn, the biological and social framing conditions are crucial. Nonetheless, the psychological system is capable of altering these framing conditions through its own action, giving this system some degree of freedom. The task of the sport psychologist in the field is to help the athlete to exploit these degrees of freedom and attain optimal performance. This may mean, for example, learning how to handle the social demands of a competition (spectators, mass media, etc.). However, this also indicates that physiological variables (tiredness, stress, etc.) do not impact directly (in a deterministic way) on an athlete's performance but are mediated by the psychological system.

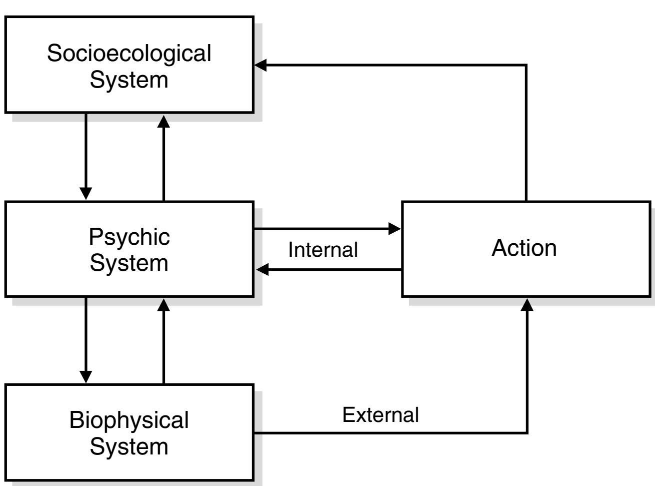


Figure 15.2 Interrelation of systems with respect to actions.

- *Every sport action can be broken down into its structure and process.* The structure of an action is discussed later in the chapter as the construction of action. We shall look at the process of the action here. Sport actions can be broken down into various phases (Nitsch, 2004). In the first phase, the action *anticipation* phase, the outcome of the action and its concrete course are anticipated. In the second phase, the *realization* phase, the planned action is implemented and its performance is adapted to fit given conditions. In the *interpretation* phase, the outcome of the action is compared with the action goal and expectations. This is where the course of the action and its effectiveness are interpreted.

Taking such an approach to the action process has benefits for psychological sport training. It becomes possible to relate training procedures to the single steps of the process. Whereas psyching up and psyching down techniques are typical for tuning, attention control training is essential to improve the processing of movement actions in the realization phase. Goal setting is a typical strategy to improve anticipation (planning and calculation), and attribution strategies or techniques to modify attributions are characteristic for psychological interventions to improve the interpretation of actions and to encourage motivation and volition.

A FUNCTIONAL PERSPECTIVE ON ACTION ORGANIZATION

The task-person-environment constellation presented in Figure 15.3 is fundamental for the understanding of the construction of actions. Furthermore, an analysis of the conditional framework of actions is essential for the development of applied perspectives (Figure 15.2). We first analyze the system of actions in more depth. According to the action-theory approach, we integrate the latest results of research gained in the fields of psychology and sport science to derive an applied perspective.

To attain such a perspective and take a first step toward improving knowledge and methods, we reflect on the functional organization of actions. Different approaches con-

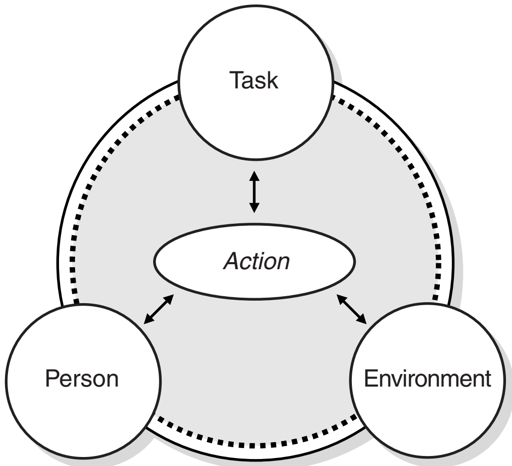


Figure15.3 Action situation as a person-environment-task constellation.

tribute to an action-theory perspective. Current findings from neurophysiology, biocybernetics, and psychology emphasize the relevance of cognitive-perceptual effects for the organization and control of actions (Schack & Tenenbaum, 2004a, 2004b). These new approaches have much in common with an action-theory perspective. They emphasize the goal-directedness of actions and the crucial role of mental representations for action control. Hence, they are characterized by the common idea that voluntary movements might basically be planned, performed, and stored in memory through representations of anticipated effects. New and interesting perspectives have emerged on how such perceptual-cognitive structures develop in action control. These include the ideomotor approach (see Knuf, Aschersleben, & Prinz, 2001; Koch, Keller, & Prinz, 2004), the theory of event coding (see Hommel, Müsseler, Aschersleben, & Prinz, 2001), and the anticipative behavioral control approach (see Hoffmann, 1993; Hoffmann, Stoecker, & Kunde, 2004). Various experiments have shown that sensory information and effect representations play a major role in the mental control of movements. For example, Kunde (2003, 2004) has demonstrated that presenting optical or acoustic response-affording targets can speed up motor responses. Through their shared basic idea that voluntary movements may be planned, performed, and stored in memory by representations of anticipated effects, these theories differ from theories that conceive of motor programs as a prestructured set of muscle-oriented commands and assume that movements are initiated without regard to sensory information (see Schmidt & Lee, 1999). However, they also differ specifically from the dynamic system approach (Kelso, 1995). For example, Mechsner, Kerzel, Knoblich, and Prinz (2001) have shown that the spontaneous tendency toward symmetry that sets in with bimanual finger movements is not due to the coactivation of homologous muscles (see Kelso, 1984), but to a spatiotemporal symmetry tendency based on perceptual information. The authors view this result as support for the assumption that human movements are organized on the basis of sensory effect representations.

When integrating such topical results into an action-theory approach to applied sport psychology, it is necessary to consider the functional components of action. We next define the building blocks and levels of the organization of action more closely.

In his now classic work *O postrojenii dvizenij* (On the construction of movement), Bernstein (1947) presented the most comprehensive compilation of descriptive and experimental data on the functional mediation of the building blocks of the action system available at that time. His detailed model of the interplay among, for example, movement goals, motor representations, and perceptual feedback is composed of several interdependent levels in a hierarchy headed by an object-related action organization level. He even claimed that there should be a superordinate cognitive level of symbolic or conceptual organization for complex movements, but he did not work out this idea in detail.

From an evolutionary perspective, conscious mental functions can be assumed to emerge from more elementary functions. As the discussion on the evolution of the human action system (e.g., Bernstein, 1996; Schack, 2004b; Vygotsky, 1978) has shown, symbols (as specific cognitive tools) convey higher, mentally controlled functions. Hence, whereas elementary functions (e.g., reflexes) are influenced directly by stimulus constellations, mental control functions are guided intentionally; they are regulated by the self. For example, it is not possible for a mentally controlled action to emerge from the grasp reflex in humans. In fact, this reflex has to be inhibited actively before verbal or other cognitive means can be applied and a goal-directed action can be formed. Should children fail at this point to develop any inhibitory activity, they cannot manipulate objects at all. All they will do is grasp. The same applies on an ontogenetically more advanced level to associations (between stimuli and action schemes) that were found appropriate at one time in the past but have now become (automated and) purposeless. This points to the *vertical dimension (hierarchical organization) of cognitive control.* As the organization of the organism-environment interaction becomes increasingly effective, various levels of functional organization also seem to have been formed.

Since Bernstein's (1947) approach to the construction of action, there have been several formulations of the idea that movement control is constructed hierarchically. One set of studies has focused on a hierarchy of different levels of representation (see, e.g., Keele, 1986; Perrig & Hofer, 1989; Saltzman, 1979). Other studies, in contrast, have focused more strongly on hierarchic execution regulation (e.g., Greene, 1972; Hacker, 1998; Keele, Cohen, & Ivry, 1990; Rosenbaum, Hindorff, & Munro, 1987). The present model bases the functional construction of actions (Schack, 2002, 2004a) on a reciprocal assignment of performance-oriented regulation levels and representational levels (see Table 15.1). These levels differ according to their central tasks on the regulation and representation levels, and are each assumed to be functionally autonomous.

The function of the mental control level (Level IV) has already been sketched for voluntary movement regulation and the coding or anticipated outcome of movement. The level of mental representations (Level III) predominantly forms a cognitive benchmark for Level IV. It is organized conceptually, and is responsible for translating the anticipated action outcome into an appropriate movement program that will lead to the desired outcome. Because an action is "no chain of details, but a structure subdivided into details" (Bernstein, 1988, p. 27, translated), action organization has to possess a working model of this structure. The abilities to use such targets and representations have been acquired stepwise during evolution (Schack, 2004b), and the current level of human development can draw on hierarchically organized representations of either states in the environment, objects, or goal-directed movements.

So-called basic action concepts (BACs) have been identified as major representation units for complex movements (Schack, 2002) that link together their functional and sensory features. The functional features are derived from movement goals linking BACs to Level IV. However, BACs also integrate sensory features of submovements through, for example, chunking. This links them to Level II, as they also refer to the perceptual effects of the movement. Finally, the connection between BACs and sensory effect representations permits the intentional manipulation of the cognitive framing conditions of sensorimotor coordination. These mental representations (BACs) are the subject of the next section and the experimental analyses reported subsequently. Although BACs contain a kind of knowledge that relates directly to performance, the model also reveals clearly that they are functionally embedded in further levels and components of action organization.

This makes it necessary to sketch the functioning of the lower levels (I and II). The level of sensorimotor control (I) is linked directly to the environment. In contrast to the level of mental control (IV), which, as just explained, is induced intentionally, this level is induced perceptually. It is built on functional units composed of perceptual effect representations, afferent feedback, and effectors. The essential invariant (set value) of such functional units is the representation of the movement effect within the framework of the action. The system is broadly autonomous, and automatisms will emerge when this level possesses sufficient correction mechanisms to ensure the stable attainment of the intended effect.

The need for a level of sensorimotor representation (Level II) is obvious in this context. It can be assumed that this is where, among others, the modality-specific information representing the effect of the particular movement is stored. The relevant modalities change as a function of the level of expertise in the learning process and as a function of the concrete task. Kinesthetic representations are also found on this level. It is clear that eye-to-hand coordination has emerged during the course of evolution. In prior stages of evolution, kinesthetic feedback was predominantly responsible for controlling the extremities. However, grasping movements have now become associated with kinesthetic, tactile, optical, and, in part, auditory feedback (e.g., when cracking a nut). This requires a representation of perceptual patterns of exteroceptive and proprioceptive effects that result from the structure of the particular movement and refer back to the goal of the action.

Table 15.1 Levels of Action Organization

Code	Level	Main Function	Subfunction	Means
IV	Mental control	Regulation	Volitional initiation control strategies	Symbols, strategies
III	Mental representation	Representation	Effect-oriented adjustment	Basic action concepts
II	Sensorimotor representation	Representation	Spatial-temporal adjustment	Perceptual effect representations
I	Sensorimotor control	Regulation	Automatization	Functional systems, basic reflexes

Empirical findings on these two lower levels come from studies on the physiology of movement. Anochin (1967, 1978) has identified an *action acceptor* as an important functional component in these goal-directed movements. It translates the intended action outcome into a sensory (perceptive) model of the action effects, thus providing criteria to guide the system's comparison and control processes. The outcome of this process is knowing how, for example, a product feels at the end of the work process, what it looks like, and how to use it. This component simultaneously draws on the criteria that have been generated to evaluate the action steps performed. Its existence is also confirmed by neuropsychological research. Patients who are unable to draw on their action acceptor (e.g., due to frontal lobe brain damage) are still able to formulate an intention and even control the enactment of this task by third persons (recognizing any errors they make). However, they no longer possess control over their own actions or are able to evaluate errors in their own action performance (see Luria, 1992; Luria, Pribram, & Chomskaja, 1964).

What is interesting for complex movements in sport is that routines, such as preperformance routines in golf (Whitmarsh & Schack, 2004), emerge particularly in the interaction between the two lower levels. From a certain stage of learning onward, these levels are broadly autonomous. However, during the learning process, they become embedded within the action, thus entering into a functional interaction with Levels III and IV (Schack, 2002). Increasing automatization is accompanied by increasingly adequate correction mechanisms between Levels I and II, and so-called tacit knowledge (see, e.g., Sternberg, 1995) emerges. The routines that develop here are direct components of high-level performance. According to the present model, the emergence and stabilization of such routines is supported not only by sensorimotor representations but also by mental representations. This means that tacit knowledge also builds on knowledge structures that are localized on the level of mental representations. This is what makes it possible to also assess this knowledge base of performance experimentally.

THE CONNECTION BETWEEN ACTION THEORY AND APPLIED FIELDS

When a sport psychologist transfers theoretical knowledge to applied work, it is necessary to think about the interaction of theory, technology, and practice. For the actions performed by sport psychologists or therapists (their technology), theory represents a framework that usually relates to a practical problem. Such ideas can be found in Barlow, Hayes, and Nelson's (1984) science-practitioner model and in the self-management therapy approach proposed by Kanfer, Reinecker, and Schmelzer (1991). The crucial aspect is that a theory is primarily used in connection with practical problems and that its value is then derived from evaluating its practical impact. However, practical steps (training, intervention techniques) have to be attached to theory. In this respect, nothing would be more practical than a good theory.

When taking an action-theory approach, the theoretical concept of the construction of action (see Figure 15.4) is fundamental for both the development of suitable diagnosis procedures and the selection of appropriate training methods. It becomes possible to define relevant systems of action more precisely. Problems, which may, for instance, be located in the areas of emotion regulation or motivation, result from deficits in mental control. They are allocated to the level of mental control. Psychological training procedures, which intervene at this level, aim to improve basic regulation. This applies particularly for psychological training procedures targeting attention control, optimization of self-talk, stress and anxiety control, and so forth (see Figure 15.5). In contrast, the structure of a movement—and therefore its optimal technical execution—is largely determined by the level of mental representations. Consequently, training procedures designed to optimize process regulation ought to be allocated on the level of mental representations.

In applied work, it is exceptionally important to bear in mind that such different systems play a part in an athlete's performance. A frequently observed practical problem is that athletes are able to perform a certain movement optimally in

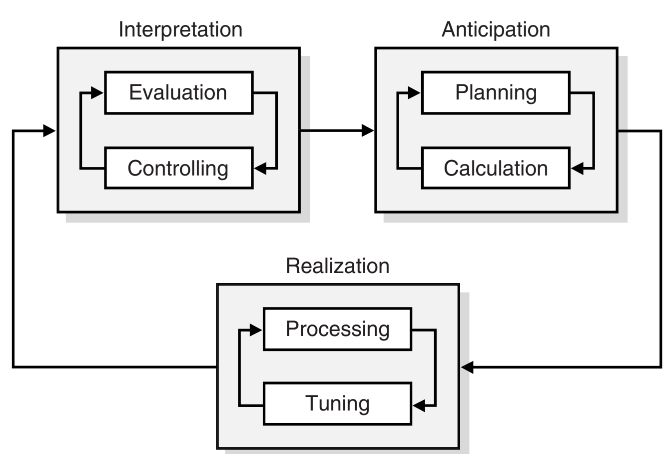


Figure 15.4 Process components of an action.

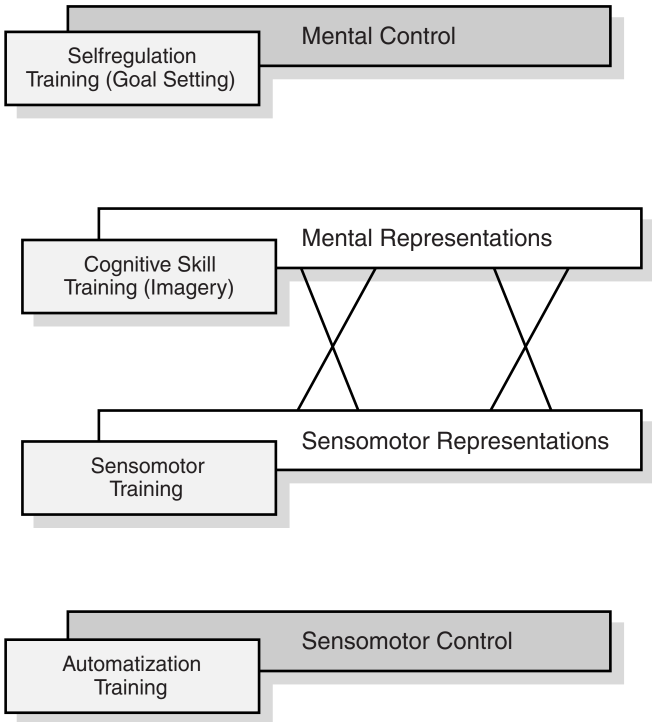


Figure 15.5 Levels of action regulation and psychological training methods.

practice but fail to do so in competitive settings. In such a case, the problem is likely to be rooted in deficits of mental control. The movement structure is accessible under less stressful circumstances (practice) and appears to be optimally represented in the athlete's memory. We have developed specific methods for a reliable diagnosis of how a movement is represented, which enables athletes to control the goal-directedness of psychological training. A method for measuring mental representation of movements is illustrated in the following section.

ACTION-ORIENTED METHODS IN APPLIED SPORT PSYCHOLOGY

According to action theory, actions take place in a person-task-environment relation. Thus, the relevant knowledge is quite specific. An athlete's mental representations relate to the action or movement-related problems he or she has to solve within the framework of voluntary acts. As a consequence, if sport psychologists wish to work from evidence-based methods, they must know the structure of the respective movement. This approach has been documented in several contributions (Schack, 2002, 2004a, 2004b; Schack & Mechsner, in press). To introduce our method for measuring mental representation, we have chosen a special action, the tennis serve, because it seems well suited to an investigation of potential conceptual representational structures in different levels of expertise. In the tennis serve, many degrees of freedom in the musculoskeletal system have to be controlled, and performance quality is influenced considerably by training and expertise. On the other hand, it is a finite, recognizable, and thereby flexible action pattern whose overall structure is well defined by biomechanical demands (Schack & Mechsner, in press).

We start by characterizing the task-adequate functional organization of the tennis serve and formulating a plausible and workable set of basic action concepts in collaboration with nonplayers, athletes of different levels, and coaches. A tennis serve consists of three distinct phases; each fulfills distinct functional and biomechanical demands. In a preactivation phase, body and ball are brought into position, and tension energy is provided to prepare for the strike. The following BACs are identified: (a) ball throw, (b) forward movement of the pelvis, (c) bending the knees, and (d) bending the elbow. In the following strike phase, energy is conveyed to the ball. Here, the following BACs are identified: (e) frontal upper body rotation, (f) racket acceleration, (g) whole-body stretch motion, and (h) hitting point. In the final swing phase, the balance is maintained and the racket movement is decelerated after the strike. The following BACs are identified: (i) wrist flap, (j) forward bending of the body, and (k) racket follow-through.

Because the usual rating and sorting methods do not permit a psychometric analysis of the representational structure, we developed a special method for measuring mental representation structures (Lander & Lange, 1996; Schack & Schack, 2005). It has now been modified for the analysis of action representation (structural dimensional analysis-motoric, or SDA-M; Schack, 2002). SDA-M consists of four steps. First, a special hierarchical split procedure involving a multiple sorting task provides a distance scaling between the BACs of a suitably predetermined set. Second, a hierarchical cluster analysis is used to transform the set of BACs into a hierarchical structure. Third, a factor analysis is applied to reveal the dimensions in this structured set of BACs. Fourth, the cluster solutions are tested for invariance within and between groups.

We provide an example. We examined three groups of tennis players: The expert group consisted of 11 males (mean age: 24 ± 3.7 years) who were players in upper German leagues and ranked between places 15 and 500 in the German men's rankings. The low-level group consisted of 11 males (mean age: 26 ± 4.8 years) who were players in lower German leagues (district leagues) and not listed in the German men's rankings. A nonplayer group consisted of 11 males (mean age: 24 ± 6.7 years) who had virtually no experience with the game (maximum: 5 hours) and had never taken any tennis lessons.

We submitted the BACs specified earlier to a hierarchical cluster analysis, with the distances based on subjective distance judgments of all combinations of pairs of BACs. In preparation, participants were familiarized with the BACs by looking at pictures with a verbal BAC name as a printed heading. These pictures were positioned in front of each participant throughout the experiment. To determine subjective distances between the BACs, the participants performed the following split procedure as the first step in the SDA-M: On a computer screen, one selected BAC was presented constantly as an anchoring unit in red writing. The rest of the BACs were presented in yellow writing as a randomly ordered list. The participant judged whether each of these additional yellow-colored BACs was "functional related" (associated) to the red anchor BAC "while performing the movement" or not. This produced two subsets that were submitted to the same procedure repeatedly until the referee decided to do no further splits. As every BAC was used as an anchoring unit, this procedure resulted in 11 decision trees per participant. In the second step of the SDA-M, the individual partitioning was determined with a hierarchical cluster analysis. In the third step, the dimensioning of the cluster solutions was performed using a factor analysis applied to a specific cluster-oriented rotation process. This resulted in a factor matrix classified by clusters. Finally, in the fourth step of the SDA-M, a within- and between-group comparison was used to test for significant differences between cluster solutions using an invariance measure. Alpha was set at 5% in all significance tests.

Figure 15.6 presents dendrograms for the subjective distances of BACs based on the hierarchical cluster analysis of the means of experts and nonplayers. Experts (Figure 15.6a) showed a cognitive structure close to the functional structure of the tennis serve. The three functional phases (i.e., preactivation, strike, and final swing) could be identified as distinct tree-like structured clusters in the dendrograms. Experts seemed to group the BACs in their memory according to generic terms that conformed to the solution of special movement problems. An invariance analysis (step 4 of SDA-M) confirmed this interpretation. There was no significant difference between the cognitive BAC framework in experts and the biomechanical demand structure of the movement ($\lambda = .70$; $\lambda_{crit} = .68$). Results were rather different in nonplayers (Figure 15.6b): BAC clusterings did not reflect the functionally and biomechanically necessary phases so well. Basic action concepts were less clearly grouped, with no close neighborhoods, and the partial clusters usually failed to attain significance. The difference between the cognitive BAC framework and the functionally demanded structure of the action even attained significance in nonplayers ($\lambda = .31$; $\lambda_{crit} = .68$).

The individual clusterings of BACs (data not shown here) were rather similar in experts, with an invariance analysis revealing no significant differences. Significantly distinct subclusters could also be seen in individual low-level players, but these were not as functionally well structured. Although the functionally and biomechanically

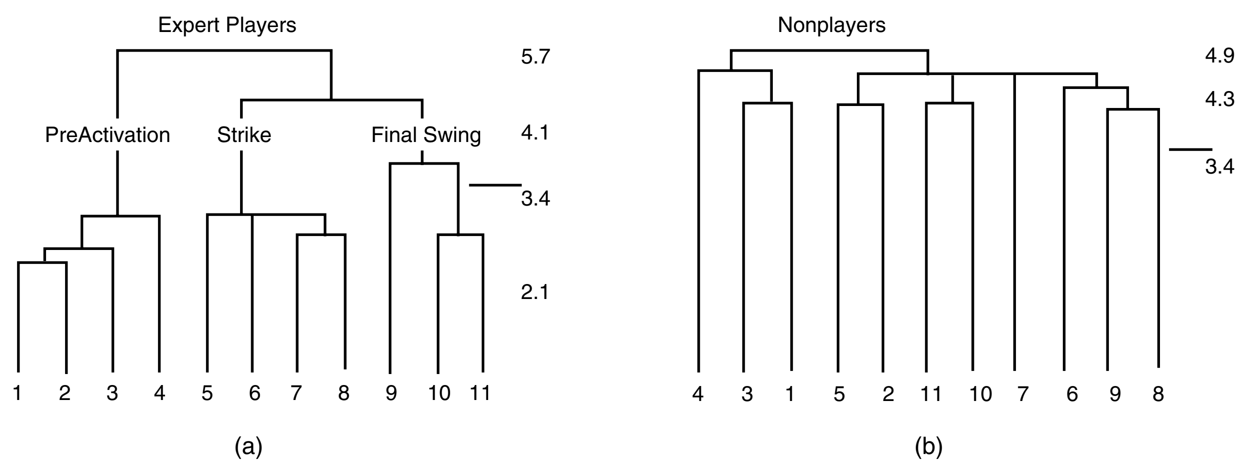


Figure 15.6 Dendrograms for two chosen expertise groups (experts and nonplayers) based on the hierarchical cluster analysis of basic action concepts (BACs) in the tennis serve. The horizontally aligned numbers denote the BACs (for the code, see text); the vertical numbers are the Euclidean distances. For every group, it holds $n = 11$; $p = .05$; $d_{crit} = 3.46$.

required phases could be discerned regularly, they were not matched so well and consistently. There were rather arbitrary associations based on surface or unfathomable criteria that often varied from person to person. As a result, interindividual differences were significant. In nonplayers, significantly distinct subclusters were generally rare and arbitrary. The structure of the clustering trees varied greatly between persons and revealed no clear grouping principles. Such experimental measurement of structures in long-term memory constitutes an essential condition for applied work. Coaches have to decide whether the athlete's memory structure corresponds to the actual movement structure. Such measurement enables them to identify problems on precisely defined levels of action. Ultimately, such information will make a substantial contribution to a coach's understanding of how to communicate with his or her athletes and how to instruct them specifically. As our further illustrations show, measuring movement representation is also a vital precondition for technical preparation, imagery training, and consulting.

APPLIED FIELDS OF SPORT PSYCHOLOGY: PSYCHOLOGICAL COMPONENTS OF TECHNICAL PREPARATION

The SDA-M method is highly applicable in the area of technical preparation (see Schack & Bar-Eli, in press). Professional windsurfing provides a good example here. Until 1986, the possibility of performing an "end over" (see Figure 15.7) was only speculated on. Nobody knew for certain how the impulse for forward rotation might be generated out of an ongoing forward motion. In 1985, Cantagalli became the first to perform a forward rotation (which he titled "Cheese Roll") in an international competition. This led to a boom of experimentation with highly complex movement actions. Mark Angulo turned this sideways rotation into the spectacular front loop (end over) with the characteristic rotation over the mast top (see Figure 15.7).

The front loop represents a mixture of a rotation around the horizontal axis and a rotation around the longitudinal axis. This movement is a technical challenge for both excellent hobby windsurfers and competitive professionals, because even many highly skilled windsurfers are unable to perform jumps involving forward rotations. Their performance requires mastery of the following subproblems of the movement task:

- The need to execute a sufficiently high jump from the water surface (optimally 5 to 8 m, yet at least as high as the mast; energizing problem).
- Introduction of the rotation at the peak of the jump. The impulse starts at the sail's pressure point, which, after takeoff from the water surface, is located above the center of the complete system. This makes it necessary to

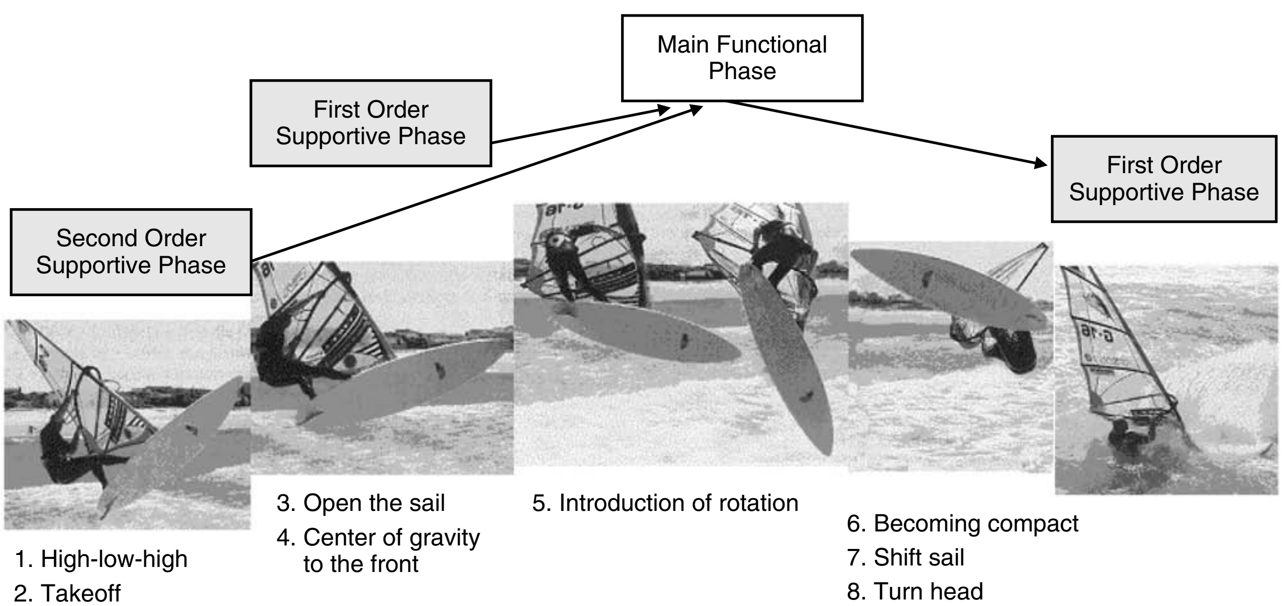


Figure 15.7 Movement phases of the front loop in windsurfing. The task-related BACs are allocated to the respective phases. In the takeoff phase, the front loop can hardly be distinguished from a regular jump. The surfer waits until the angular point of the slope angle, and then abruptly pushes the sail's pressure point forward down. Robby Nash, a surf legend, called this time lag before the introduction of the front loop the "moment of shock for the spectator." *Source:* "Loopernein," by W. Smidt, 1995, *Surf* (11/12), 61–63. Reprinted with permission.

overcome an enormous mass moment of inertia (impulse-introduction problem).

- Stabilization of the windsurfing-board system during the forward rotation (stabilization problem).
- Solution of numerous orientation problems resulting from the rotation during the whole movement. For example, a permanent orientation regarding the situation in space is necessary for initiation, stabilization, and completion of the rotational movement. The water, the sail system, and the horizon represent benchmarks in this context (orientation problem).

Basic action concepts were ascertained for the functional phases, making substantial contributions to the solution of the movement tasks and the connected movement problems. To permit an allocation to the biomechanically (functionally) determined movement phases, these BACs are already entered in Figure 15.7. The concepts relevant for the movement were gathered in a process involving several stages. First, a group of expert ($n = 8$) and novice ($n = 7$) athletes gave spontaneous descriptions of the movement (front loop in windsurfing). Subsequently, they were interviewed individually regarding the BACs from their point of view. This revealed that BACs were not just labeled verbally, but could also be demonstrated as a specific movement pattern. Following an active execution of the movement, the former results were complemented or corrected through video-based self-confrontation. Later, these findings were also controlled with allocation experiments (Schack, 2002).

The acquired BACs for the frontal loop are:

1. High-low-high
2. Takeoff
3. Opening the sail
4. Moving center of gravity to the front
5. Introduction of rotation
6. Becoming compact
7. Shifting the sail
8. Turning the head

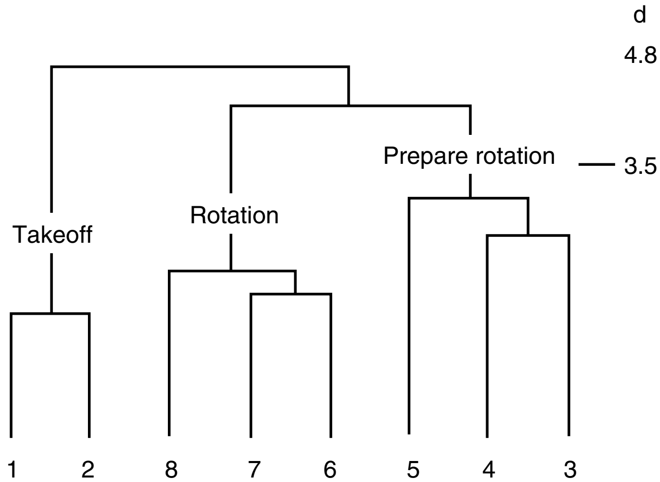
A total of 40 experts and novices participated in a special study to develop new forms of technical preparation. The 20 experts (all male) had a mean age of 28.8 years and had been engaged in windsurfing for an average of 15.8 years (performing front loops for an average of 9.4 years). This group consisted of American, French, and German athletes who were counted among the world elite in windsurfing at that time. A number of them ranked among the pioneers of windsurfing and had been involved in the movement from its beginning. They all participated in international competitions (World Cup, Grand Prix, etc.) as professional windsurfers. They could perform the front loop reliably and variably in a competitive setting (some as a double frontal loop) and trained for about 30 weeks annually. Expert status was defined as the ability to perform front loops on a competitive level for at least 7 years.

The 20 novices (18 males, 2 females; mean age: 22 years; engaged in windsurfing for 8.2 years on average; front loop on average for 1.6 years) were mostly German and American athletes. They trained for approximately 23 weeks annually and participated in national and international competitions. However, they had no rankings worthy of mention and were unable to perform the front loop under competitive conditions. Overall, their (potential) scope for development was comparable to the expert group. Hence, these were persons with the capability to reach an expert level who had not got there yet. The main aspect for the present study was that the novices mastered the technical execution of the front loop far less reliably and regularly than the experts. Experts stated that mastery depends highly on experience in windsurfing and repeated practice under various conditions. The minimum condition for acceptance in the novice group was to have performed the front loop at least twice (according to their own reports).

The results of this study are illustrated in Figures 15.8 through 15.10. For this illustration, α is constantly set at 5%; this equals a d_{crit} value of 3.51.

Figure 15.8 displays the group structure of the experts based on cluster analysis in the form of a dendrogram and reports the factor matrix arranged according to clusters. There were three clusters. The structures of mental movement representation in the expert group showed a remarkable affinity to the biomechanical functional structure of the movement. As Figure 15.8 shows, the functional structure of the movement could be divided into several phases. *Takeoff* could be classified as a second-order supportive phase, *preparation of rotation* as a first-order supportive phase, and *rotation* as the main phase. The superordinate concepts acquired on the basis of clusters (takeoff, preparation of rotation, rotation) are spatially distinct and organized in a temporal sequence. We assume that they serve as a means to solve specific subproblems (energizing, introduction of impulse, rotation).

Figure 15.9 illustrates the cluster solution for the novice group. These cluster solutions reveal a weak structural link between elements. The BACs were located slightly above the critical distance ($d_{crit} = 3.51$). Therefore, no structure could be proven for the whole group.

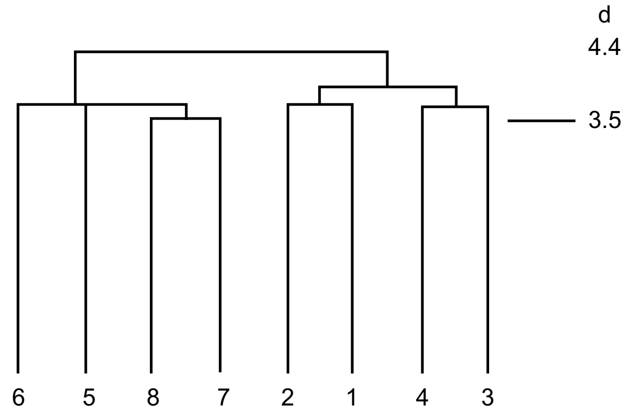


1. High-low-high; 2. Takeoff; 3. Open the sail;
4. Center of gravity to the front; 5. Introduction of rotation;
6. Becoming compact; 7. Shift sail; 8. Turn head

Figure 15.8 Results of the hierarchical cluster analysis of BACs for the front loop in the expert group. The lower the value of an interconnection between the study units (see the Euclidian distance scale on the right), the lower the distance of the concepts ($n = 20$; $\alpha = 5\%$; $d_{crit} = 3.51$).

Obviously, the technique-related representational structures were too weak at this point. The claims regarding movement representations in individual cases are particularly interesting for technical preparation.

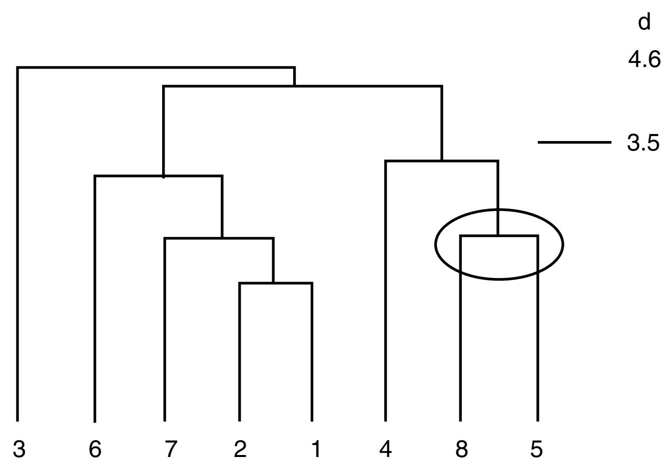
The dendrogram of the novice revealed a significant difference in the clusters compared with that of the expert group. Whereas the expert cluster solution followed a functionally based phase structure of the movement, no comparable structure could be found in the novice. Here, elements were arranged differently, and neither a phase-related clustering nor a temporal-sequential structure could be seen. Furthermore, inexpedient mental structures were apparent. Subject 4 (see Figure 15.10) combined elements from different movement phases. This resulted in a cluster consisting of elements 5 (rotation) and 8 (head turn). Although both elements of the cluster represent rotary motions, they have nothing in common regarding functional aspects. Whereas element 5 plays an important part in the introduction of the rotation, element 8 completes it. Obviously, surface features, not functional features, were consulted when classifying the elements. The unification of these elements on the representational level is often linked to typical movement errors on this level of motor learning (rough coordination). In this context, novices often forget the head turn needed to complete the movement, and this usually leads to dangerous falls.



1. High-low-high; 2. Takeoff; 3. Open the sail;
4. Center of gravity to the front; 5. Introduction of rotation;
6. Becoming compact; 7. Shift sail; 8. Turn head

Figure 15.9 Results of the hierarchical cluster analysis of BACs for the front loop in the novice group ($n = 20$; $\alpha = 5\%$; $d_{crit} = 3.51$).

In this study, we were able to confirm the relation between cognitive representation and performance for a special movement technique. The cognitive structure of persons with high ability is more differentiated, and more strongly function-oriented, than that of beginners. Experts obviously are better able to apply their knowledge in prac-



1. High-low-high; 2. Takeoff; 3. Open the sail;
4. Center of gravity to the front; 5. Introduction of rotation;
6. Becoming compact; 7. Shift sail; 8. Turn head

Figure 15.10 An individual novice's (Subject 4) solution in the learning stage of rough coordination as an outcome of hierarchical cluster analysis. The circular mark denotes a link between two elements that is obviously based on surface features ($\alpha = 5\%$; $d_{crit} = 3.51$).

tice when aiming for optimal execution of the movement. Furthermore, we find statements on cognitive structures that are directly relevant for training processes. These statements can help a coach to decide which cognitive context athletes can understand and work on. This statement is particularly relevant for movements that have to be carried out under extreme time pressure and presumably make use of their nondeclarative knowledge.

Consequences for technical preparation can be derived from such analyses of the representational structures and biomechanical structures of a movement. It becomes possible to ascertain the phase of the movement in which representational problems are located. Then technical preparation can train precisely this motion sequence. A specific teaching method has been developed for this purpose (Garzke, 2001; Schack & Garzke, 2002).

The first step is to imitate the whole movement. Initially, the judo somersault is perfectly suitable for training the frontal direction of rotation and motion. Practicing this movement trains and stabilizes the structure of the front loop. Further focal points in this exercise are the acquisition of coordination and rhythm during rotation. Training here focuses on those movement components that were found to be poorly structured in representations. The persons whose representational structure is illustrated in Figure 15.9 have to focus their training particularly on the rotation phase. It is crucial for athletes to experience what the optimum movement structure feels like. They can experience that turning the head is not immediately connected with the rotational impulse. The person with difficulties in executing this (see Figure 15.10) learned to integrate the intermediate steps, *becoming compact* and *shifting the sail,* into the movement.

The next main step is to execute the judo somersault with the rigging. This is a way to further improve the movement structure. Incorporating the rigging brings the practiced movement closer to the targeted movement on the water. Again, this method is designed to work on the tactile movement effects. The athlete should achieve a further improvement regarding the movement structure.

The next step of technical preparation is to perform the exercise with a wooden board and rig. This exercise increasingly improves the center of gravity in the direction of the correct movement execution in the water.

Those movement elements that have proved problematic in the representational structure can be trained specifically. The athlete should move from this suboptimal movement structure to an optimal movement structure. In this way, the execution of the movement can be trained by, for instance, special surveillance of shifting the center of gravity to the front, grabbing the sail close, or becoming compact (for more details, see Schack & Bar-Eli, 2005).

When the movement structure has been acquired up to this point of technical preparation, we suggest that the SDA-M method should be reapplied to examine the athlete's representation structure. This analysis can provide indications for further steps of technical preparation. At this point, the representation structure should be close to the expert's structure—at least in terms of its basic organization (see Figure 15.8). If major problems should still be apparent in the representation structure, we recommend moving technique execution and movement representation back to step 2 or even step 1, depending on the extent of the problems. If movement structure and representation structure prove to be stable, we proceed to step 4. Here, the movement is executed on sand dunes, introducing the wind as an additional factor. This exercise aims to stabilize the movement structure. In particular, utilizing the wind makes the basic technique available to the athlete under an increasing variety of conditions. The athlete now must apply the acquired basic technique under varying environmental circumstances as a means to secure a stable movement. In this step of technical preparation, it is additionally crucial to learn about the functional importance of the head as the leading instance in the movement. Athletes who do not turn their head over the distal end of their shoulder will land on their back because of the lack of rotational impulse. Athletes who turn their head toward the back of the neck during initialization of the movement will stop rotating and crash onto the water surface. On the shore, damage will be limited, but, overall, the correct movement of the head is an important cornerstone in the optimal movement structure. It is essential that the head be turned in the rotation phase and the horizon sighted.

The next step of technical preparation of the front loop is practicing it on the water. Here, the speed loop can be performed as the last preparation step. The speed loop is comparable to a skidding sideways purler, in which the board is pulled after the body. This involves an increase in the variability of the movement execution. Thus, the aim is a variable accommodation to varying environmental conditions. Herein, we attempt to further stabilize the structure of the movement. After this step, we move back to direct practice of the front loop. After a certain practice phase, or if problems show right after beginning the exercise, we incorporate the SDA-M method again to measure and evaluate the representation structures.

As this representative example of individual sport shows, the acquisition of representation structures can make a major contribution to the optimization of technique training. As measurement takes only about 15 minutes and results of the analysis are available immediately, many opportunities arise for technical preparation.

A further step in technical preparation is to conceptualize a mental training that begins with the representational structure of the athlete. Such a mental training based on mental representation takes account of the individual dispositions and concerns of the athlete.

NEW PATHS IN MENTAL TRAINING

Studies carried out during the first half of the twentieth century already revealed indications that performing tasks mentally leads to improvements in subsequent test performance (e.g., Sackett, 1935). Various fields of sport psychology have continued such research systematically, particularly since the 1960s (see, e.g., the meta-analysis of Driskell, Copper, & Morgan, 1994). The use of mental training in top-level sport has become particularly prominent.

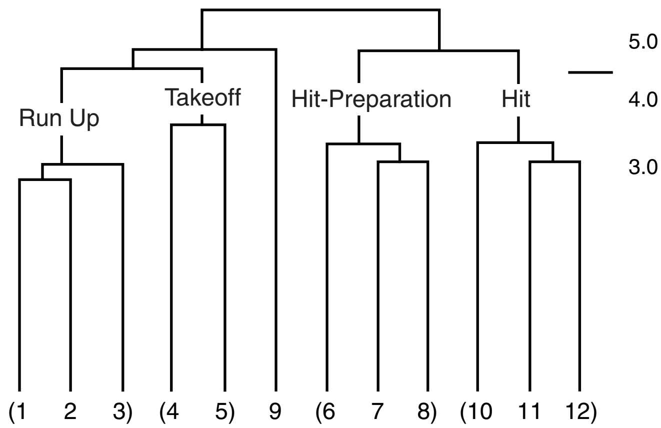
Various theories have been used to explain the effects of mental training (see, e.g., Driskell et al., 1994; Heuer, 1985). The major explanatory models based on current scientific findings can be differentiated according to whether they consider effects to be due to physically peripheral (neuromuscular) processes or central mechanisms (e.g., symbolic codes or programs). Our findings on the architecture of action extend the work on ideomotor action (Knuf et al., 2001; Koch et al., 2004) and current neurophysiological findings (Jeannerod, 1995, 2004) and open up a new explanation for the effects of mental training: the *perceptual-cognitive hypothesis.* This hypothesis posits a representation system in which more strongly cognitive representation units (nodes) are linked to perceptual representations (e.g., kinesthetic, optical, or acoustic effect codes). Because they possess a spatiotemporal structure, these representations can be translated directly into movement. This makes additional motor, spatial-pictorial, or other representations (see, for the symbolic hypothesis, Heuer, 1985) unnecessary for movement control. A further basic assumption of this model is that imaging a movement and performing it are based on the same representations (Jeannerod, 1995; Schack, 2002). This hypothesis explains the impact of mental training by proposing that it internally activates and stabilizes the representation system. Mental simulations of movement may forge, or strengthen, links between cognitive representation of intermediate states of the movement and the accompanying perceptual effect codes. At the same time, interfering perceptual inputs will be inhibited. Because these representations are conceived as being located on a hierarchy of levels, mental training also initiates feedback processes between various representation levels (see Jeannerod, 1995).

This makes the methods developed here (e.g., SDA-M) directly significant for developing new forms of mental training. The main disadvantage of traditional procedures is that they try to optimize performance through repeatedly imagining the movement without taking athletes' mental technique representation into account (i.e., they are representation-blind). However, if the movement's cognitive reference structure has structural gaps or errors, these will tend to be stabilized rather than overcome by repeated practice. The alternative developed here is to measure the mental representation of the movement before mental training and then integrate these results into the training. This mental training based on mental representations has now been applied successfully for several years in professional sports such as golf, volleyball (Schack, 2004a), gymnastics (Heinen, Schwaiger, & Schack, 2002; Schack & Heinen, 2000), and windsurfing (Schack & Heinen, 2000).

A contemporary study conducted in professional volleyball addresses the spike. This movement requires at least 12 substeps (BACs) that are stored in memory. Our primary focus is on the memory structure of the movement. In preparation for a mental training program, we studied this structure in the members of a Women's Volleyball Youth National Team. Figures 15.11 and 15.12 illustrate the results for two players who are both outside hitters.

Player A (Figure 15.11) holds a clearly structured, almost ideal movement representation in her movement memory. Basic action concepts 1 through 3 in connection with 4 and 5 form the *run-up* phase. Concepts 6, 7, and 8 combine for the *hit-preparation* phase, and 9, 10, and 11 make up the *hit* phase.

Player B (see Figure 15.12) had had difficulties in optimally executing the spike for several years. Our analysis reveals the cause: BACs 1 through 3 and 4 through 5, which are important for the sequence of impulses during run-up and takeoff, point to a less precise memory structure. For this player, run-up and takeoff are broken down into two inefficient memory sections (5-2 and 4-3). Subsequently, an individualized mental training program tackled the memory structure and developed movement imagery for an ideal takeoff and a proper spike. Additionally, the player went through a series of run-up and takeoff drills designed to bring out the optimal motion sequence. The focus was on making the player aware of the altered movement so that she could develop a new feeling for it. We subsequently

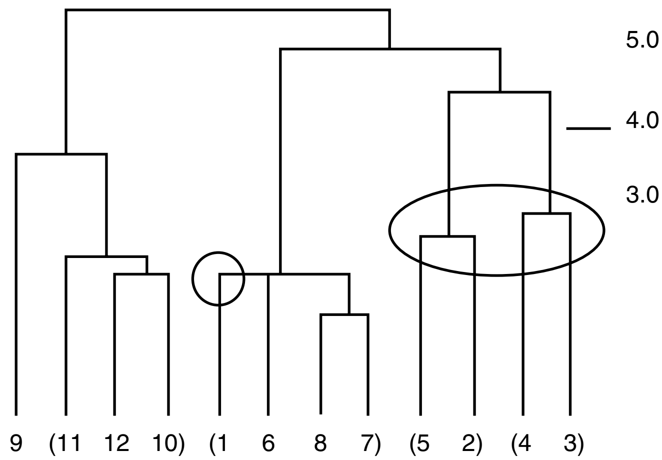


1. Taking arms back; 2. Stamp step; 3. Bending knees and trunk; 4. Swinging both arms forward; 5. Extending legs; 6. Body arching; 7. Spiking arm back; 8. High elbow; 9. Glance toward opponent 's block; 10. Spike emphasizing the wrist; 11. Whipping extension of arm; 12. Drawthrough of hitting arm

Figure 15.11 Memory profile of the spike in Player A's movement memory. The numbers correspond to the BAC numbers (see text). A scale indicating the distances of BAC representations in movement memory is located on the right side of the figure. The lower the value of a horizontal connection between two BACs, the lower the distance between them in movement memory. *Source:* "Cognitive Architecture of Complex Movement," by T. Schack, 2004, *International Journal of Sport and Exercise Psychology, 2*(4), p. 417. Reprinted with permission.

aimed to generate this optimal perception of the movement in the complementary mental training as well. This succeeded in improving Player B's spike significantly, and she is now a member of the Women's A-National Team. The advantage of this combination of mental training and memory analysis consists in the fact that athletes' memory structures are integrated into mental training providing sufficient consideration of their individual dispositions.

Mental training is now being applied not only in various professional and amateur sports but also in rehabilitation. In cases of injury, mental training offers a means of training even when active movement execution is severely impaired. As a result, new opportunities for the use of mental training have opened up in the fields of medical and orthopedic-traumatologic rehabilitation. In this context, mental training has proved to be of great use when it comes to regaining lost movement patterns after joint operations or joint replacements. Moreover, it can also be applied successfully in neurological rehabilitation for stroke patients by stabilizing and gradually improving their grasping movements. Thus, mental training provides a general means to link together imagery and movement in various areas of life.



1. Taking arms back; 2. Stamp step; 3. Bending knees and trunk; 4. Swinging both arms forward; 5. Extending legs; 6. Body arching; 7. Spiking arm back; 8. High elbow; 9. Glance toward opponent 's block; 10. Spike emphasizing the wrist; 11. Whipping extension of arm; 12. Drawthrough of hitting arm

Figure 15.12 Memory profile spike for Player B. *Source:* "Cognitive Architecture of Complex Movement," by T. Schack, *International Journal of Sport and Exercise Psychology, 2*(4), 2004, p. 430. Reprinted with permission.

ACTION-BASED STRATEGIES OF PSYCHOLOGICAL TRAINING IN APPLIED SPORT PSYCHOLOGY

Theoretical considerations regarding the construction of action are also helpful when trying to identify suitable psychological training methods for applied work. As before, we start by using specific diagnostic procedures to investigate the systems involved in the organization of action. Diagnosis and training methods on the mental representations level have previously been discussed at great length. In this context, it is important to note that we also apply the results of such experimental diagnoses in the consulting process so that athletes receive feedback on their memory structure (see Figure 15.13).

This diagnosis is important when deciding whether an athlete possesses good dispositions for optimal process regulation. Problems regarding the capacity to perform in competitive settings may be located in the field of process regulation, as well as in basic regulation. The term *process regulation* refers to the execution-related organization of an action, whereas *basic regulation* describes the generation of emotional and motivational conditions for the action. Basic regulation is primarily produced at the level of mental control. Therefore, we applied appropriate diagnostic tools to test components such as stress regulation,

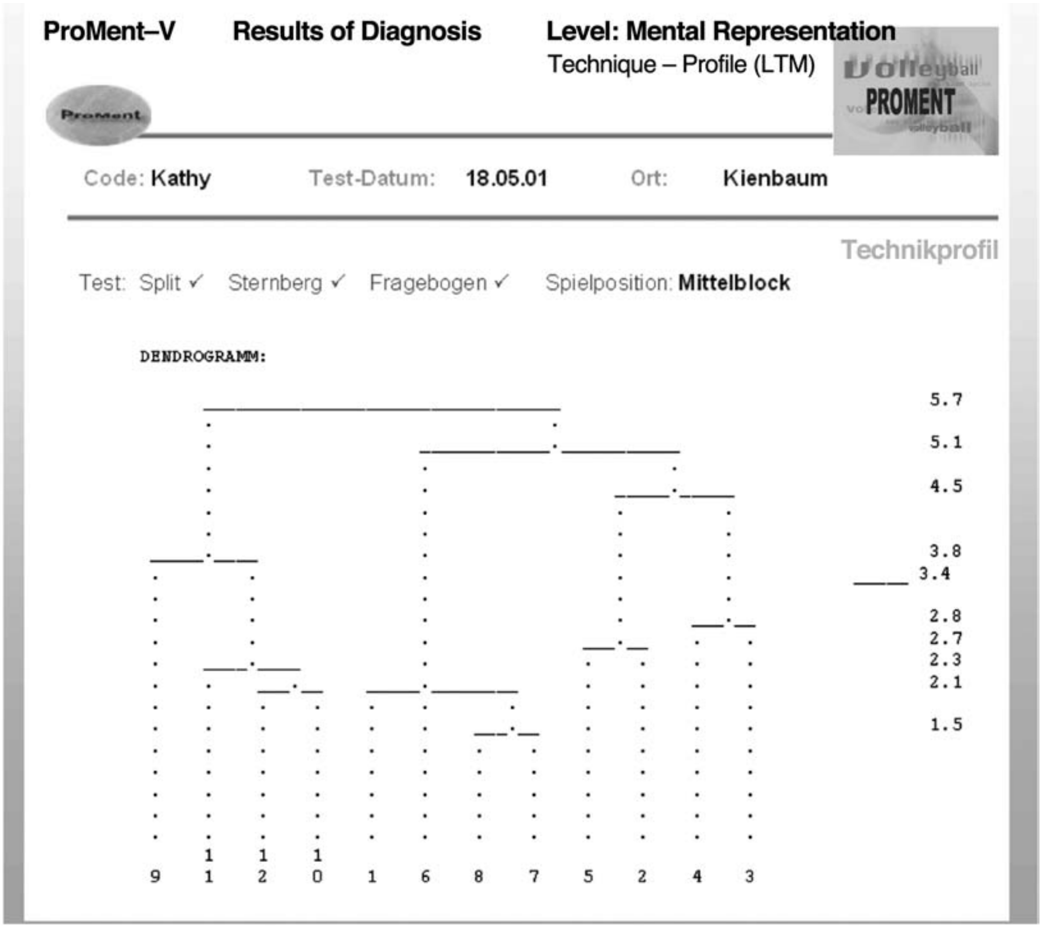


Figure 15.13 Results of the experimental diagnosis of mental movement representations for an athlete from the German National Team.

competition anxiety, self-talk, and different components of volition. The results are given to the athlete as a mental profile (see Figure 15.14).

Such results can be used to make better decisions on appropriate psychological training methods. If problems are diagnosed on the level of mental control, training methods to develop mental control should be preferred. These may be exercises to optimize self-talk, relaxation methods, or procedures for optimizing stress regulation. If problems concerning movement memory and motor coordination are diagnosed on the level of mental representations, imagery training or technical preparation would be more appropriate.

COMPUTER-BASED METHODS IN APPLIED SPORT PSYCHOLOGY

The development of digital video techniques has created a variety of new opportunities for analyzing and improving actions in sport, particularly in the field of mental training and technical preparation. As well as just displaying moving images, digital supplementation and the analysis of video images offer the greatest new perspectives. In this section, we introduce and systematize some of the computer-based procedures for visual feedback used in praxis.

Computer-based procedures for visual feedback can be subdivided into three groups (Seifriz, Schack, & Mester, 2004):

1. *Presenting video sequences subsequently or simultaneously:* Simultaneous forms of presentations are split-screen and cross-fading procedures. In the split-screen procedure, the two sequences to be compared are shown side by side on the screen. Cross-fading provides a playback of both sequences in one video (Figure 15.15). Such procedures are particularly appropriate to reveal differences in speed in, for example, downhill skiing. Furthermore, the simultaneous display also shows differences in movement

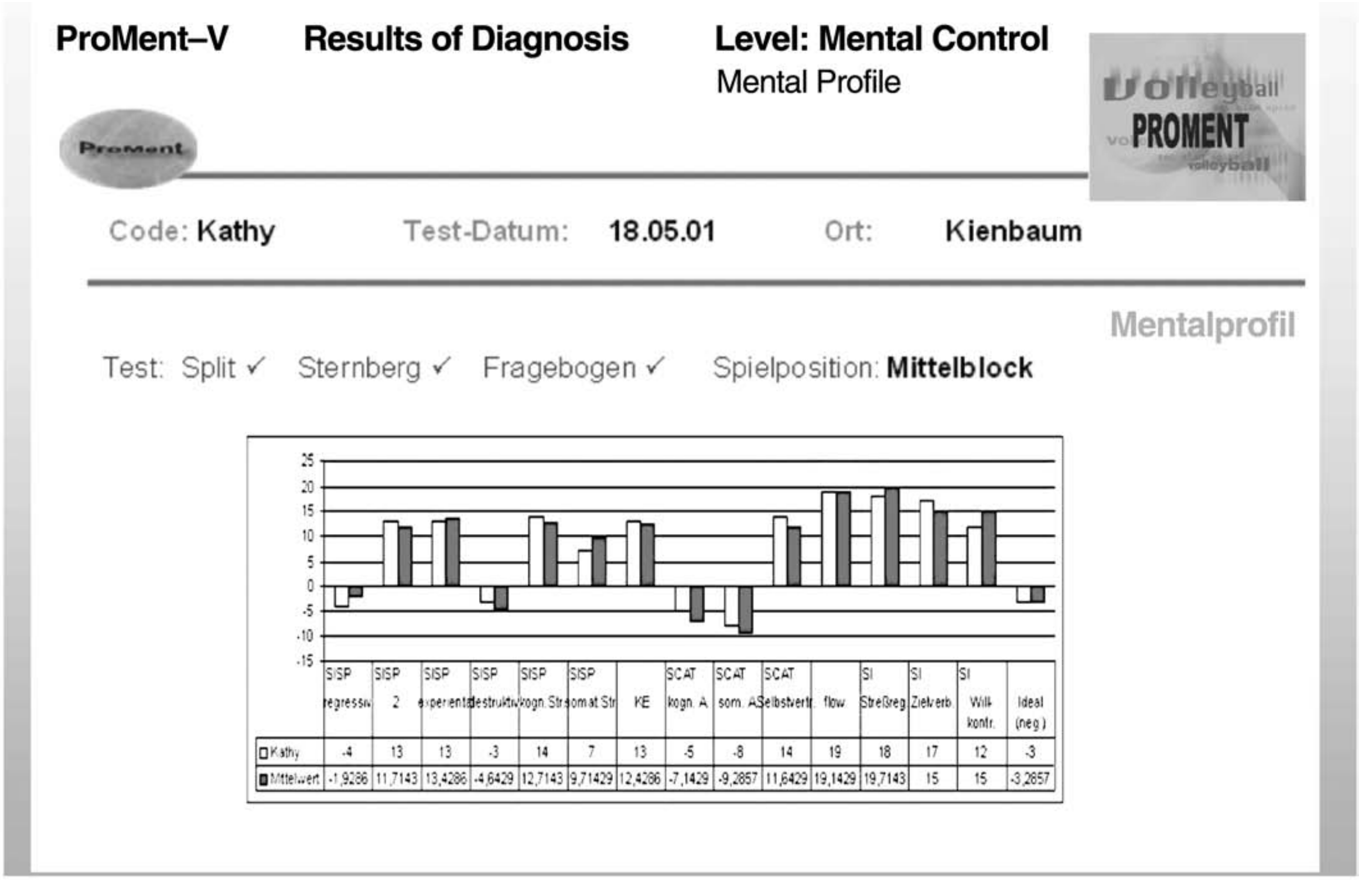


Figure 15.14 Results of a mental control diagnosis. The athlete receives feedback as a mental profile, indicating both own test results and mean results for all athletes in the specific playing position. These results are from the German Volleyball National Team. Each subtest (e.g., SCAT, sport competition anxiety test) has a scale. Emotional or motivational conditions that are rather negative (e.g., anxiety) are displayed as negative trends (below 0).

techniques. This makes it easy to emphasize key points and errors in motion sequences and use these to provide additional information in technique training.

2. *Adding movement paths to the video sequence:* By utilizing tracking procedures (see Intel, 2001) to follow objects on the basis of their structure and/or color information, movement paths of athletes or pieces of equipment can be recognized and highlighted in the video image. This can render visible movement paths that cannot be recognized directly or are extremely long. Figure 15.15 displays the tracked lanes of two downhill skiers using the cross-fading procedure.

3. *Creating and visualizing movements and movement paths on the computer screen with the help of mathematical models and simulated arithmetic (Seifriz, 2001):* Starting with tracked movement paths and kinematic analyses, optimized movement solutions can also be presented visually and compared with real movements. Figure 15.16 shows an image taken from an animation of an optimized lane on a slope created via GPS measurement. Such artificial tracks give athletes an opportunity to view alternative lanes and thus provide new impulses for future movement executions.

In numerous sports, these methods belong to routinely applied procedures in training and competition. There is a great interest in these methods from the mass media, and trainers now use some of these procedures on a regular basis.

As pointed out earlier, it is particularly important for coaches to possess information on their athletes' movement imagery (representation) and to influence this through technique training. For this aspect, we can assume that functional relations exist between experimentally acquired movement representations and kinematic parameters of movement execution (Schack, 2003).

On the basis of such considerations, we have further examined how to construct a modular measuring set that

Figure 15.15 Tracking of lanes using the cross-fading method.

would support motor learning processes by combining the kinematic analysis of movement technique with the analysis of mental parameters and applying these in technique training. We have called this modular measuring set e-BRAIN (translated into English: enhanced movement representation analysis inventory; Schack & Heinen, 2002).

Selected modules from e-BRAIN are acquirement of technomotor knowledge stock in long-term memory and acquirement of reaction time in short-term memory (SDA-M and CMC method; Schack, 2002). These experimental methods for the analysis of movement representations are supplemented by an analysis of movement kinematics (Heinen & Schack, 2003; Knoll, 1999). By using a subsequent simulation of isolated movement sequences, it becomes possible to illustrate new and optimized movement solutions and thus supplement technique training.

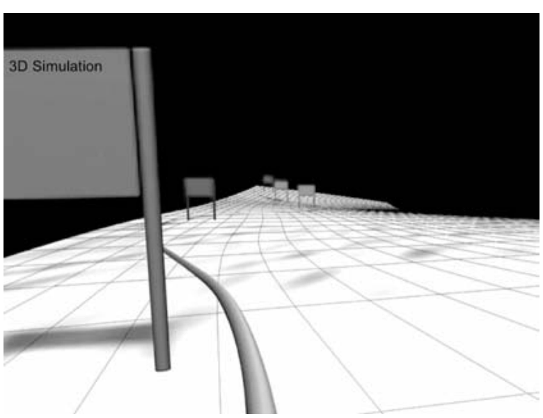


Figure 15.16 Visualization (animation) of simulated lanes.

To link kinematic and mental parameters, complex illustrative functions can be generated. Connections between parameters of movement kinematics and mental representations have been confirmed in apparatus gymnastics and volleyball (e.g., the prediction of the occurrence of the tipping angle in twisting somersaults based on data acquired through SDA-M analysis). This data can be transferred to an individual-oriented mental training program (Schack, 2002).

Module 1 of e-BRAIN contains the method for measuring mental movement representations presented earlier. These data provide vital information for technique training because they highlight the mental framework of movement organization. In contrast, the movement can be illustrated through biomechanical measurement procedures (Module 2). The parameters collected in this way form a complex yet structured web of parameters. The aim of e-BRAIN is not just to acquire such parameter webs separately, but also to establish a connective function between the pools of values (representation-related and biomechanical data), to use them as feedback in technique training, and to utilize them for simulations.

Figure 15.17 shows the measuring set design of e-BRAIN. On the left, we find the representation structure of the volleyball hit in an athlete's long-term memory. The center features a 3-D clip of his movement execution. These clips also constitute the basis for the analysis of

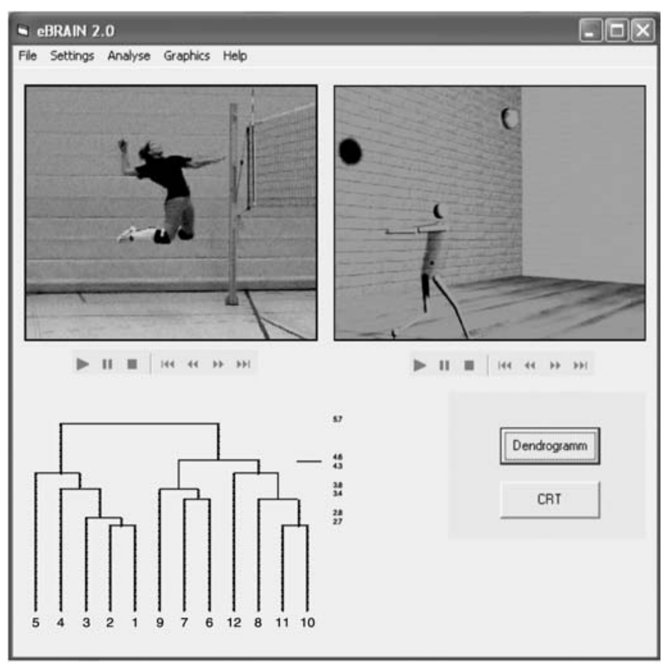


Figure 15.17 Split-screen presentation of e-BRAIN.

movement kinematics used to report the movement via an animation and simulate partial aspects of the movement (as in the context of technical errors; on the right). As a consequence, e-BRAIN not only provides data on the athlete's movement organization (structure of movement representation, kinematic data, and linkage of both sets of data), but also delivers clear information (Figure 15.17) that can be used as visual feedback.

CONCLUSION

This chapter has shown how the practical work of sport psychologists requires a theoretical foundation and intervention techniques based on appropriate methods. Such a perspective views theory as an instrument to be applied in practical work. Such an instrument either has to prove its worth or be further investigated and developed. In applied sport psychology, this results in a decisive triad composed of theory, technology, and practice.

To back up the techniques of sport psychologists, we present several methods that focus on precisely defined components of an action. It is clearly advantageous for a coach to know how mental structures form, stabilize, and change in sport action. A coach who possesses such knowledge is also better able to address the individual athlete on his or her current level of learning and shape instructions specifically so that the athlete understands them. The methods presented here make it possible to take the essential information on the underlying cognitive-perceptual action system into account and address the individual needs of an athlete in a better way. The theoretical perspective on the construction of action developed here (Schack, 2004a, 2004b) and the accompanying methods (technological steps) are therefore relevant not just for optimizing the daily work of the sport psychologist but also for opening up new perspectives to modify approaches to mental training and technical preparation.

The development of computer-based methods in applied sport psychology is also based on conceptual models of the construction of action. With the video-assisted presentation of movements, we try to influence precisely defined components of the action system (representations). Once these components have been defined, we can reap the benefits of new digital methods in applied sport psychology.

In the present approach, those working in applied sport psychology should try to be not only excellent scientists but also excellent practitioners. Although those engaged in applied sport psychology are naturally more interested in the practical field, they should not forget that the outcome of practical work depends decisively on whether the coach or the sport psychologist possesses a sound theory.

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CHAPTER 16

Eating Disorders in Sport

From Theory to Research to Intervention

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Sociocultural models (e.g., Garner & Garfinkel, 1980; Striegel-Moore, Silberstein, & Rodin, 1986) posit that factors in the environment may increase individuals' risk of developing eating disorders. General environmental factors include (a) society's focus on physical appearance, particularly in the form of a thin body type for women and a muscular somatotype for men, as the primary arbiter of attractiveness, status, and gender status (i.e., femininity versus masculinity); (b) diet, particularly in the form of extreme restraint, as the primary mechanism for achieving the female beauty ideal; and (c) physical activity, particularly in the form of high-level strength training and conditioning, as the avenue for attaining the male body ideal. In Western societies, these messages about body, self, and eating are ubiquitous, being communicated to men and women of all ages through the media (e.g., magazines, television), friends, and family (Stice, 1994). As a result, women, particularly those who internalize these messages, experience pressures to attain a body ideal that is physiologically impossible to reach (Brownell, 1991). Such pressures also have been suggested as the primary cause of the pervasive weight concerns and dieting that exist among young women (Rodin, Silberstein, & Striegel-Moore, 1985). Historically, these environmental factors have been much less present for men. In the past 2 decades, however, the pressure to achieve a certain male body ideal has increased and will likely continue in the future.

In addition to these general environmental factors, sociocultural models suggest that certain subcultures may exacerbate risk in already vulnerable groups or establish risk in groups that otherwise do not experience such pressures. Sport is one such subculture. Researchers (e.g., Swoap & Murphy, 1995; Thompson & Sherman, 1999) have hypothesized that specific factors in the sport environment may encourage an unhealthy focus on weight and body shape, including (a) sport-specific or coach-sanctioned weight limits, (b) judging criteria that emphasize thin and stereotypically attractive body builds, (c) team weigh-ins that emphasize obtaining specific weight as opposed to being physically healthy, (d) stereotypes regarding what the body build of an athlete in a certain sport "should" be, (e) performance demands that encourage a very low percentage of body fat, and (f) peer pressure to adopt pathogenic weight control behaviors. Because of these pressures and other factors, theoretically female *and* male athletes would be at risk for the development of disordered eating due to their involvement in a subculture that is focused on body, weight, appearance, and the pursuit of perfection (in performances and body).

In this chapter, we examine the influence of the sport environment by critically reviewing the extant empirical literature on athletes and eating disorders. Although the majority of research in this area has been conducted with female athletes, and thus is a focus of this chapter, we also review research on male athletes' experiences, including how these may be different from those of female athletes. Because studies involving athletes are limited in number, focus, and methodological rigor, we include information from general eating disorder investigations to provide a more complete picture of this area and to guide the development of an etiological model and suggestions for future research. Specifically, we begin our review by defining eating disorders and related conditions and syndromes. Second, we review prevalence research, including how measurement issues and certain factors influence the reported rates of these disorders. Third, we examine the issue of risk factors and introduce an etiological model to explain the development of disordered eating among athletes and to stimulate research in this area. Fourth, we address the issue of treatment, focusing primarily on prevention programs that have been shown to reduce putative risk factors and the development of subsequent disordered eating symptoms. Fifth, although we consider research issues throughout the chapter, in the final section, we review these suggestions and offer additional ones to guide and, we hope, advance future eating disorder studies.

WHAT ARE EATING DISORDERS?

In this section, we provide an overview of clinical eating disorders, such as bulimia nervosa and anorexia nervosa, introduce the concept of eating disorders that are subclinical in nature but nonetheless a cause for concern, and cover related psychological conditions, such as the female athlete triad and muscle dysmorphia.

Clinical Diagnoses

Eating disorders are potentially life-threatening psychiatric disorders typified by severely disturbed eating behaviors and perceptual/attitudinal distortions that require clinical treatment (American Psychiatric Association, 2000). Individuals with clinical eating disorders engage in pathogenic eating and weight control behaviors and have distorted body cognitions and perceptions that interfere with their daily lives and have deleterious effects on their physical and psychological functioning. There are three primary clinical eating disorders (American Psychiatric Association, 2000): Anorexia Nervosa (AN), Bulimia Nervosa (BN), and Eating Disorder Not Otherwise Specified (EDNOS).

Anorexia Nervosa

Anorexia Nervosa is characterized by a refusal to maintain normal body weight for age and height, an intense fear of weight gain despite being underweight, disturbed perceptions of body shape and weight, undue influences of weight and shape on self-evaluation, and amenorrhea (in post-menarcheal women). The intense body dissatisfaction and fear of weight gain that individuals with AN experience is associated with highly restrictive and ritualized eating behaviors as well as irrational food beliefs (American Psychiatric Association, 2000).

There are numerous medical, physical, psychological, and behavioral characteristics and complications associated with AN (see Table 16.1 for a detailed list; American Psychiatric Association, 2000; Halmi, 2003; Rome & Ammerman, 2003; Sundgot-Borgen, 2000). Individuals with AN may experience anxiety regarding eating in public and be preoccupied with thoughts about food and eating. Among common psychiatric disorders, AN has the highest associated levels of suicide attempts, mortality, and inpatient treatment (American Psychiatric Association, 2000; Newman et al., 1996).

Bulimia Nervosa

Bulimia Nervosa is characterized by (a) episodes of binge eating (i.e., eating a large amount of food in a discrete period of time and/or feeling out of control during the eating episode) that are followed by compensatory behaviors, such as self-induced vomiting, diuretic or laxative use, fasting or dieting, or excessive exercising; and (b) a self-evaluation that is strongly influenced by body shape and weight. The compensatory behaviors generally help reduce the fear of becoming fat, feelings of distress, and sense of being out of control. Despite their unhealthy eating behaviors, which they often recognize as such, individuals with BN often maintain normal weight, which makes it easier for them to hide their disorder.

Bulimia Nervosa has a variety of associated characteristics (see Table 16.1 for a detailed list; American Psychiatric Association, 2000; Rome & Ammerman, 2003; Sundgot-Borgen, 2000), such as depression, secret eating, and substance abuse (e.g., drugs, alcohol). For many, binging and purging is used as a coping strategy to manage feelings of stress and anxiety. The mortality rate of BN is unknown, though the prognosis of recovery is generally poor, marked by repeated instances of relapse and remission and by movement to subclinical levels of disordered eating (Fairburn, Cooper, Doll, Norman, & O'Connor, 2000).

Eating Disorder Not Otherwise Specified

Eating Disorder Not Otherwise Specified is diagnosed when some, but not all, of the criteria for either Anorexia Nervosa or Bulimia Nervosa are met. For example, a female may meet all of the criteria of AN except for menstrual dysfunction, or, despite losing a significant amount of weight, she may still be within the normal weight range. Or a male who is very dissatisfied with the size and shape of his body may engage in compensatory behaviors, such as exercising excessively or vomiting, after eating only small amounts of food.

Binge-Eating Disorder (BED), which involves repeated episodes of binge eating without subsequent compensatory

Table 16.1 Associated Features of Clinical Eating Disorders

Physical/Medical	Psychological	Behavioral
Abdominal pain	Anxiety	Avoidance of eating situations or secret eating
Amenorrhea or menstrual irregularity	Body image disturbance	Body checking
Bradycardia	Depression	Excessive weighing
Cardiac arrhythmia	External locus of control	Excessive/obligatory exercise
Constipation	Internalization of sociocultural values regarding attractiveness	Exercising despite injury
Decreased bone mineral density	Lack of assertiveness	Sleep disturbances
Dehydration	Obsessive-compulsive symptoms	Substance abuse
Dental decay[a]	Perfectionism	
Edema	Poor self-esteem	
Electrolyte imbalance	Rigidity	
Esophagitis (or esophageal tears)	Restlessness	
Gastrointestinal problems	Social withdrawal	
Hormone irregularities		
Hypotension		
Hypothermia[b]		
Lanugo[b]		
Muscle atrophy/weakness		
Muscle cramps		
Scarring on back of hand[a]		
Swollen parotid glands		
Weight loss and/or fluctuations		

[a] Characteristic of bulimia nervosa.
[b] Characteristic of anorexia nervosa.

behaviors, is included in this category. Binge-Eating Disorder is estimated to have a prevalence rate between 0.7% and 4% and often occurs following substantial weight loss that results from purposeful dieting (American Psychiatric Association, 2000). Recovery rates from Binge-Eating Disorder generally are high, with over 80% showing full remission of any eating disorder symptoms within 5 years (Fairburn et al., 2000).

Subclinical Conditions

Some researchers (Affenito, 2004; Beals & Manore, 1999, 2000) have used the terms *subclinical* or *symptomatic* to describe problematic eating behaviors and attitudes that are less severe than the clinical eating disorders identified in the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV-TR;* American Psychiatric Association, 2000). Although subclinical eating disorders fall short of diagnostic criteria, they are associated with severe psychological, physical, and behavioral disturbances. For example, individuals with subclinical eating disorders may be depressed, have low self-esteem, experience distortions in thinking, and report body image disturbances (Beals & Manore, 2000; Cohen & Petrie, 2005; Franko & Omori, 1999). Further, subclinical eating disorders are associated with the development of clinical eating disorders (Drewnowski, Yee, Kurth, & Krahn, 1994; Patton, Selzer, Coffey, Carlin, & Wolfe, 1999), suggesting that they are serious problems that warrant clinical and research attention.

Although subclinical eating disorders are characterized by disturbances in several common areas, including eating (e.g., dieting, binging), use of compensatory behaviors (e.g., excessive exercising, vomiting), and weight (e.g., overweight), investigators have conceptualized them differently across studies, making comparisons among research findings difficult because of the lack of consistency in operational definitions. Adoption and use of standard operational definitions is needed and will (a) allow researchers to determine the extent to which subclinical disorders differ from one another, if at all, on psychological and behavioral risk factors (e.g., cognitive distortions, body image disturbance); and (b) help clinicians develop treatments that are targeted at the specific features or pathologies associated with each one. Additional research is needed to clarify the usefulness of distinct subclinical categories and determine if symptomatic individuals are more similar than different from one another. We address this issue in more detail in the section on classification, measurement, and methodological issues in prevalence.

Related Conditions and Syndromes

There are a number of conditions and syndromes related to clinical and subclinical eating disorders. Although some of these conditions are seen primarily in athletic populations, they also are found among men and women who engage in high levels of physical activity.

Female Athlete Triad

The female athlete triad (FAT) refers to the co-occurrence of three conditions: disordered eating, amenorrhea, and osteoporosis. Disordered eating, including both clinical and subclinical conditions, contributes to restricted energy availability. Restricted energy availability combined with high levels of energy output can create an energy drain that can disrupt female athletes' menstrual cycles and subsequently have a negative influence on bone formation and density (Beals, Brey, & Gonyou, 1999; Manore, 2002). Irreversible bone loss can result from extended periods of amenorrhea (Hobart & Smuckler, 2000). Osteoporosis (i.e., bone mineral density levels at least 2.5 standard deviations below the mean of young adults) puts women at increased risk of developing stress fractures. Recently, some researchers (e.g., Khan et al., 2002), as well as professional sport organizations (e.g., International Olympic Committee, Medical Commission Working Group on Women, 2005), have suggested that researchers and clinicians (a) compare adolescent and premenopausal women's bone density to others their age, and (b) include osteopenia or low bone mass (i.e., bone mineral density between 1 and 2.5 standard deviations below the mean of young adults) as a risk factor in the diagnosis of FAT among athletes and physically active women. Although the actual prevalence of FAT is relatively unknown, Torstveit and Sundgot-Borgen (2005) reported that 60% of elite Norwegian athletes were at risk for the triad, with lean sport athletes having the highest risk, 69%.

Anorexia Athletica

Anorexia athletica (AA), sometimes referred to as activity anorexia, is a "state of reduced energy intake and reduced body mass despite high physical performance" (Sudi et al., 2004, p. 657). Sundgot-Borgen (1993) specified the following criteria for AA: (a) weight loss greater than 5% of expected body weight, (b) gastrointestinal complaints, (c) absence of illness or disorder to explain weight loss, (d) restricted caloric intake, and (e) an extreme fear of becoming fat. She also identified several "relative" criteria, of which one or more must be present, including delayed puberty, menstrual dysfunction, distorted body image, binge eating, purging, and excessive exercise. Sundgot-Borgen and Torstveit (2004) found that 1% of elite male and 4% of elite female Norwegian athletes met the criteria for this disorder. Because weight loss primarily is motivated by desired performance improvement, rather than appearance-related concerns, AA should dissipate after retirement from sport (Sudi et al., 2004). Although prospective investigations have yet to be undertaken to test this assumption, a study based on athletes' retrospective recall provides some preliminary support. Fifteen years after their college sport participation, female gymnasts reported being more satisfied with their body and less weight-preoccupied in comparison to current age-, height-, and weight-matched controls and how they perceived themselves when they were actively competing in college (O'Connor, Lewis, Kirchner, & Cook, 1996).

Exercise Dependence

Exercise dependence, or obligatory exercise, refers to a preoccupation with exercise accompanied by feelings of guilt and anxiety when unable to exercise. Early research focused on the idea of excessive exercise being a form of addiction (Morgan, 1979) or suggesting it was analogous to AN (Yates, Leehey, & Shisslak, 1983). Recently, however, researchers have conceptualized exercise dependence as being similar to other forms of psychological dependence, defining it as "a craving for leisure-time physical activity, resulting in uncontrollable excessive exercise behavior that manifests in physiological (e.g., tolerance/withdrawal) and/or psychological (e.g., anxiety, depression) symptoms" (Hausenblas & Symons Downs, 2002, p. 90). Because individuals feel driven to exercise at any cost, exercise dependence interferes with social and occupational functioning. Exercise-dependent individuals often schedule their work, family, and social activities around their exercise routines, continue to work out despite illness or injury, and experience strong feelings of guilt and anxiety if they do not work out "hard enough." Exercise dependence may be an independent condition (i.e., primary exercise dependence), or it may coexist with an eating disorder (i.e., secondary exercise dependence; Hausenblas & Symons Downs, 2002).

Symons Downs, Hausenblas, and Nigg (2004) found that between 3.6% and 5% of college students sampled could be classified as at risk for exercise dependence, whereas over 62% were considered symptomatic but not at-risk. When participant gender was considered, more men than women were classified as at risk (7.1% versus 3.1%) and symptomatic (68.6% versus 58.8%), whereas more women than men were asymptomatic (38.2% versus 24.2%). These results suggest that (a) although the prevalence of actual dependence is low, a large number of individuals are subclinical and may either be at risk for the development of more problems in the future or experience associated disturbances in current psychological and physical functioning; and (b) men, more than women, experience exercise-dependent symptoms, and thus may be more likely to report associated psychological disturbances, such as higher levels of perfectionism. Furthermore, exercise-dependent athletes may be at increased risk for disturbed eating (Blaydon & Linder, 2002; Pasman & Thompson, 1988; Slay, Hayaki, Napolitano, & Brownell, 1998). For example, research has revealed that obligatory exercisers, be they runners or weight lifters, report higher levels of eating disturbances than nonexercising or nonobligatory exercising controls (Pasman & Thompson, 1988; Slay et al., 1998). Further, Kiernan, Rodin, Brownell, Wilmore, and Crandall (1992) found that exercise level, defined as weekly mileage, was significantly and positively associated with excessive eating and weight concerns among male, but not female, runners.

Muscle Dysmorphia

Muscle dysmorphia is a form of Body Dysmorphic Disorder involving a preoccupation with a perceived lack of muscularity (Olivardia, 2001; Pope, Gruber, Choi, Olivardia, & Phillips, 1997) that results in impaired cognitive and social functioning. For example, similar to exercise dependence, individuals with muscle dysmorphia often give their exercise routines priority over other important social or occupational activities. Because muscle dysmorphia involves an intense self-consciousness about one's physique, individuals may avoid situations in which their body will be on display. The overwhelming concern among individuals with muscle dysmorphia is being too small (as opposed to being too fat), which manifests itself as a drive to attain greater muscularity (Maida & Armstrong, 2005; Pope et al., 1997).

Muscle dysmorphia may be associated with increased risk of eating disorders (Olivardia, Pope, Borowiecki, & Cohane, 2004; Olivardia, Pope, & Hudson, 2000; Pope, Phillips, & Olivardia, 2000). Olivardia et al. (2004), for example, found that men who reported muscle belittlement (i.e., the perception of being less muscular than one is) also reported disordered eating attitudes. In addition, the strong drive for muscularity associated with muscle dysmorphia can result in other maladaptive and unhealthy behaviors such as extreme exercise, steroid use, and purging. Muscle dysmorphia is associated with higher levels of neuroticism and self-oriented perfectionism and time spent on appearance and fitness-related activities (Davis, Karvinen, & McCreary, 2005). The prevalence of muscle dysmorphia reported in research has ranged between 8% and 25%, with higher rates reported among men (Olivardia, 2001), particularly those who participate in bodybuilding (Maida & Armstrong, 2005; Pope, Katz, & Hudson, 1993).

Summary

Eating disorders are psychological disorders that have severe medical and physical consequences, are associated with serious psychological and behavioral disturbances, and can lead to death. Although continuing to focus on these disorders is necessary in research and practice, subclinical concerns and the related conditions and syndromes should be given equal attention given that they also are associated with distinct physical and medical, psychological, and behavioral disturbances and may lead to the development of the clinical disorders. As we detail in the next section, although clinical and subclinical eating disorders are most prevalent among women, researchers and practitioners should not ignore the fact that men experience these disorders, in particular some of the related conditions, such as exercise dependence and muscle dysmorphia. We encourage researchers and clinicians to broaden their conceptualization of this area to include subclinical as well as clinical categorizations and to examine the related conditions in which men have higher prevalence levels.

PREVALENCE AND MEASUREMENT OF EATING DISORDERS

In this section, we provide general information concerning the prevalence of eating disorders among men and women and then examine factors that may influence their prevalence among athletes. In addition, we discuss the issue of eating disorder measurement and offer suggestions for conducting methodologically sound prevalence research.

Prevalence

In the general population, eating disorders are relatively uncommon. Anorexia Nervosa occurs in approximately 0.5% of females and 0.05% of males, whereas BN prevalence is estimated at 1% to 3% of females and 0.1% to 0.3% of males (American Psychiatric Association, 1994). Among athletes, reported prevalence rates have varied widely, ranging from 1% to 62% for female athletes and 0% to 57% for male athletes (Beals, 2004; Hausenblas & Carron, 1999). In controlled studies with broad samples, prevalence rates tend to be lower, with AN ranging between 0% and 2% for female athletes and 0% for male athletes, and BN ranging between 1.1% and 6% for female athletes and 0% and 3% for male athletes (Johnson, Powers, & Dick, 1999; Sundgot-Borgen & Torstveit, 2004). The prevalence of EDNOS is generally higher than that of BN, with rates of 8% for female athletes and 5% for male athletes being reported (Sundgot-Borgen & Torstveit, 2004).

As has been found in the general population (e.g., Mintz & Betz, 1988), subclinical eating disorders appear to be more prevalent than clinical eating disorders among athletes (Johnson et al., 1999; Sanford-Martens et al., 2005). For example, Sanford-Martens et al. found a higher prevalence rate of subclinical eating disorders (14.5% females; 21.2% males) compared to clinical eating disorders (5.1% females; 1.8% males) among collegiate athletes. Determining valid prevalence rates of subclinical eating disorders is important because individuals with subclinical eating disorders frequently engage in unhealthy eating behaviors, have disturbed body image, and evidence psychological distress (Mintz & Betz, 1988; Petrie, 1993). Shorter-term (i.e., less than 1 year), prospective studies with college students generally suggest that subclinical eating disorders do not predict the development of clinical problems (e.g., Striegel-Moore, Silberstein, Frensch, & Rodin, 1989; Thelen, Farmer, Mann, & Pruitt, 1990; Vohs, Heatherton, & Herrin, 2001), though this question has not been directly addressed with athletes using longer-term (e.g., 2+ years), prospective designs.

Classification, Measurement, and Methodological Issues in Prevalence

Two factors may contribute to the range of prevalence rates found among athlete samples: classification and measurement, and methodology and sample selection. Classification issues include varying diagnostic criteria used for the determination of eating disorders and the use of different measures to assess eating disorders (Beals, 2004; Patel, Greydanus, Pratt, & Phillips, 2003). First, the clinical criteria for eating disorder diagnoses have changed over time. For example, amenorrhea was not included as a criterion for Anorexia Nervosa in the *DSM-III* but is a part of the *DSM-IV* system. Second, researchers sometimes use their own criteria (e.g., Drive for Thinness score on the Eating Disorder Inventory exceeds the mean of eating disorder norms), develop their own measures in lieu of those with established psychometric properties, or focus on pathogenic eating behaviors (e.g., dietary restraint) rather than identifying specific eating disorders. For example, studies that have used author-developed, as opposed to externally validated, measures generally report the highest prevalence rates among athletes (e.g., Black & Burkes-Miller, 1988; Rosen & Hough, 1988; Rosen, McKeag, Hough, & Curley, 1986).

The use of different measurement instruments also may explain the large variation of prevalence rates among athletes. For example, researchers may use questionnaires that directly assess Bulimia Nervosa (e.g., Bulimia Test-Revised; Thelen, Farmer, Wonderlich, & Smith, 1991; Thelen, Mintz, & Vander Wal, 1996), drive for thinness, or general eating pathology (e.g., Eating Attitudes Test-26; Garner, Olmstead, Bohr, & Garfinkel, 1982). The measure used and how the disordered eating construct is defined in the study strongly influence the prevalence rates found in the sample. Thus, researchers and practitioners need to take care in their instrument selection and description of the disordered eating construct being measured so more direct comparisons can be made among studies. In addition, including only measures that have been standardized and have established psychometric properties, particularly those validated with current diagnostic criteria, should become a standard part of research and clinical methodologies.

A thorough review and critique of current measures of disordered eating and related constructs is beyond the scope of this chapter (see Kashubeck-West, Mintz, & Saunders, 2001, for a detailed review). However, because of this issue's importance, we provide an overview of two validated general eating disorder measures and highlight a few recently developed athlete-specific questionnaires. Although general eating disorder measures should continue to be used in the study of athletes, particularly those that have been tested in sport settings (e.g., Eating Attitudes Test-26; Doninger, Enders, & Burnett, 2005), including validated population-specific measures will aid in the assessment of the sport environment and improve our understanding of athletes' experiences. In addition, population-specific measures will provide differential validity information on general and athlete-specific measures.

Although the Eating Disorder Inventory and its revision (EDI-2; Garner, 1991) have been used extensively in athlete eating disorder research (Hausenblas & Carron, 1999), the Bulimia Test-Revised (BULIT-R; Thelen et al., 1991, 1996) and the Questionnaire for Eating Disorder Diagnoses

(Q-EDD; Mintz, O'Halloran, Mulholland, & Schneider, 1997) are two other general measures that may be useful in research and practice. The BULIT-R assesses bulimic symptoms and has been validated against diagnostic criteria (*DSM-IV;* American Psychiatric Association, 1994). In addition to providing continuous data that can be used to examine change in symptoms over time and a validated cutoff score for diagnosing BN, the BULIT-R contains items that are not part of the total score but provide specific information about frequencies of binge eating and compensatory behaviors. Finally, the BULIT-R has been used successfully with samples of athletes to determine eating disorder categories (Petrie, 1993) and prevalence rates (Petrie & Stoever, 1993).

The Q-EDD (Mintz et al., 1997) also was conceptualized and based on the diagnostic criteria of the *DSM-IV* (American Psychiatric Association, 1994) and differentiates between non-eating-disordered and eating disordered individuals. The non-eating-disordered category includes those who are asymptomatic (i.e., report no symptoms) and symptomatic (i.e., report some symptoms; subclinical). The eating disordered category includes AN, BN, and four EDNOS (i.e., subthreshold bulimia, menstruating anorexia, nonbinging bulimia, and BED). The Q-EDD has demonstrated evidence of internal and test-retest reliability, as well as convergent, criterion, and incremental validity (Mintz et al., 1997).

The Q-EDD also has been incorporated in recent studies with athletes to determine eating disorder diagnosis and categorization (e.g., Hausenblas & McNally, 2004; Sanford-Martens et al., 2005). If used with athletes, researchers should consider adjusting the one question concerning level of exercise to account for the fact that athletes generally report high levels of sport-specific exercise associated with their training, which may not be indicative of a pathological compensatory behavior. The question may be adjusted to read "Do you exercise in addition to your normal sport training/practice?" to correct for this potential confound.

Athlete-specific measures of eating disorders have appeared in the literature during the past few years: Athletic Milieu Direct Questionnaire (Nagel, Black, Leverenz, & Coster, 2000), which was based on *DSM-III-R* and *DSM-IV* criteria and designed for female athletes; Female Athlete Screening Test (K. Y. McNulty, Adams, Anderson, & Affenito, 2001), which identifies general eating pathology; Physiologic Screening Test (Black, Larkin, Coster, Leverenz, & Abood, 2003), which is a physiologically based screening questionnaire for female collegiate athletes; and College Health Related Information Survey (Steiner, Pyle, Brassington, Matheson, & King, 2003), which is a measure of four mental health domains, including eating problems, for collegiate athletes. Although these athlete-specific measures may serve as useful adjuncts to the more general eating disorder questionnaires, they have not received widespread use in research or practice, and more attention is needed to determine their utility.

In addition to concerns about classification and measurement, issues related to study methodology and sample selection have been identified. Research on athletes and eating disorders generally has employed small, nonrepresentative samples of convenience and has focused on the experiences of elite female athletes (Beals, 2004; Brownell & Rodin, 1992; Patel et al., 2003). Further, researchers generally have not considered potential differences in prevalence rates related to (a) athletes' race and ethnicity, (b) contextual factors in the sport environment, and (c) underreporting, particularly among male athletes who may be dealing with the social stigma of having a "female disorder." To understand how these factors may influence the prevalence of eating disorders among athletes, we evaluate eating disorder research with respect to athlete status (i.e., athlete versus nonathlete), competitive level, type of sport, and gender.

Athlete versus Nonathlete

Over the years, research examining the question of whether athletes are at increased risk for disordered eating has been equivocal, with some studies reporting that athletes, compared to nonathletes, are at increased risk of having eating disorders (DiBartolo & Shaffer, 2002; Sundgot-Borgen, Fasting, Brackenridge, Torstveit, & Berglund, 2003), other studies finding no differences between the groups (DePalma et al., 2002; Fulkerson, Keel, Leon, & Dorr, 1999; Skowron & Friedlander, 2001), and still others demonstrating that athletes have a lower risk than nonathletes (Hausenblas & McNally, 2004; Ryujin, Breaux, & Marks, 1999; Sanford-Martens et al., 2005; Wilkins, Boland, & Albinson, 1991). As discussed previously in this section, methodological issues, including the use of different measures with questionable psychometric properties, small or nonrepresentative samples, nonmatched control groups of nonathletes, and not employing structured diagnostic interviews may explain these varied results. Larger scale studies that have used clinical interviewing as part of the diagnostic process and recent meta-analyses, though, provide some clarity with respect to the influence of the sport environment.

Two studies conducted by Sundgot-Borgen and her colleagues (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004) shed some light on this question. In each study, the researchers surveyed the entire population of female elite athletes in Norway (in the second study, male elite athletes were included) and compared their responses against age-matched controls from the general population. Initially, athletes and nonathletes were screened via self-report questionnaires. Those individuals considered at risk for an eating disorder were interviewed and examined by eating disorder specialists and, based on *DSM* criteria, diagnosed. In the 1993 study, Sundgot-Borgen reported the following prevalences: AN (athletes 1.3% versus controls <.25%) and BN (athletes 8% versus controls 1.1%). In addition, athletes had a prevalence rate of 8.2% for AA. In the 2004 study, Sundgot-Borgen and Torstveit again found that athletes had higher levels of eating disturbances than the nonathlete controls: AN (females: athletes 2% versus controls <0.2%; males: athletes 0% versus controls <0.16%), BN (females: athletes 6% versus controls 3%; males: athletes 3% versus controls <0.16%), and EDNOS (females: athletes 8% versus controls 6%; males: athletes 5% versus controls <0.16%). The prevalence of AA was 4% for female and 1% for male athletes. Although there was a slight decrease in disordered eating from the first to the second study among the female elite athletes, which is a positive trend, in both studies athletes had higher prevalence rates than the nonathlete controls.

Although Sundgot-Borgen and colleagues' (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004) research is compelling based on their use of large and diverse samples, age-matched controls, and clinical interviews, it is limited in that it examined only elite-level athletes from a single country. Thus, it also is important to consider the results of two recent meta-analyses that broadly examined the issue of athletic status and disordered eating (Hausenblas & Caron, 1999; Smolak, Murnen, & Ruble, 2000). In their analysis, Hausenblas and Carron found an overall effect size (ES) of 0.12, which was significantly different from zero and suggests that athletes experience slightly higher levels of eating disorders (based on anorexic and bulimic indices and drive for thinness) compared to nonathletes. In particular, male athletes had higher reported levels of disordered eating in comparison to their controls than did female athletes. Smolak et al. examined only studies with female participants, including athletes, dancers, and aerobic exercisers. The overall ES (Cohen's *d*) was .07 ($p < .01$), indicating that female athletes had slightly higher levels of eating disorders compared to control groups or normative data. This effect was, however, marked by considerable heterogeneity, which is likely related to the athletes' competitive level (e.g., high school versus elite) and the type of sport (e.g., aesthetic versus ball game) in which they participated.

Competitive Level

A criticism of eating disorder research is that most has focused on elite-level athletes, which includes college participants. Results of the few studies conducted with high school athletes seem to indicate that eating disorders are no more prevalent among athletes than nonathletes (Fulkerson et al., 1999; Rhea, 1999; Smolak et al., 2000; Taub & Blinde, 1992). For example, in a study of 369 male and 309 female high school students, Fulkerson et al. found that male and female high school athletes reported levels of eating disorders similar to that found among male and female nonathletes. Similarly, Taub and Blinde found few differences between female high school athletes and nonathletes, concluding that the prevalence of disordered eating behaviors among female high school athletes is similar to the prevalence among the general female high school population, a conclusion confirmed by Rhea.

The picture at the collegiate and elite level is less clear. As discussed previously, Sundgot-Borgen and colleagues (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004) have demonstrated that elite athletes have higher levels of disordered eating than controls. Petrie (1996) corroborated this finding, though his results were moderated by gender and type of sport. Other researchers have found that college athletes actually are healthier than their nonathlete counterparts, reporting lower levels of eating disturbances and higher levels of psychological functioning and body satisfaction (e.g., DiBartolo & Shaffer, 2002; Sanford-Martens et al., 2005). Research comparing athletes and nonathletes also has shown that the two groups do not differ from one another on measures of disordered eating and psychological health, suggesting that college- and elite-level athletic participation is not a particular risk factor (e.g., Davis & Strachan, 2001; Hausenblas & Mack, 1999; Reinking & Alexander, 2005). Examination of the recent meta-analyses indicates that effect sizes for college and elite-level performers, although generally small, are significant (Hausenblas & Carron, 1999; Smolak et al., 2000). These findings suggest that elite-level athletes have a slight increased risk of disordered eating when compared to nonathlete controls, though the level of risk may be moderated by other factors (e.g., gender, sport type).

Sport Type

Sport type also appears to play a role in determining the prevalence rates of eating disorders, with athletes in sports that focus on aesthetics, emphasize leanness, and/or have weight requirements being at increased risk. Gymnasts, figure skaters, swimmers and divers, distance runners, wrestlers, and bodybuilders, for example, may face increased pressure to maintain a low body weight to impress judges, look good in their uniforms, improve performance, or qualify to compete in a specific weight division.

Research comparing athletes in different types of sports indicates that lean sport athletes are at increased risk of eating disorders (Beals & Manore, 2000; Petrie, 1996; Picard, 1999; Smolak et al., 2000; Zucker, Womble, Williams, & Perrin, 1999). For example, both Petrie and Picard found that female lean sport athletes had higher disordered eating scores, including drive for thinness and EAT scores, than female athletes in nonlean sports. Corroborating these findings, Smolak et al.'s meta-analysis revealed that female athletes in lean sports, particularly at the elite level, were at greater risk of eating disorders than nonathletes. Zucker et al. examined judged (i.e., diving, cheerleading, gymnastics) and refereed (i.e., tennis, basketball, volleyball, track) sports and found that female athletes in the former had higher drive for thinness scores than those in the latter. Further, female athletes in aesthetic sports had significantly higher disordered eating attitudes and a higher risk of having an eating disorder than endurance or team/anaerobic sport athletes (Beals & Manore, 2000).

In a study of elite female athletes that used a more specific classification system (i.e., technical, endurance, aesthetic, weight-dependent, ball games, power), Sundgot-Borgen (1993, 1994) found that a higher percentage of athletes in aesthetic (40%) and weight-dependent sports (37%) had high EDI scores, compared to athletes in endurance and ball sports. Similarly, eating disorders were more prevalent among athletes in aesthetic (34%) and weight-dependent sports (27%) compared to athletes in endurance, technical, and ball game sports. Hausenblas and Carron's (1999) meta-analysis confirms these findings. Compared to those in ball game sports, female athletes in aesthetic sports (ES = 0.09) reported higher drive for thinness scores. Similarly, compared to female endurance (ES = −0.04) and ball game sports (ES = −0.17), a larger effect size for anorexic symptomatology was found among female aesthetic sport athletes (ES = 0.38). Among male athletes, Hausenblas and Carron uncovered no differences based on sport type classification.

Although numerous studies have found that lean sport athletes have a higher incidence of eating disorder symptomatology, both Hausenblas and Mack (1999) and Sanford-Martens et al. (2005) failed to find differences between athletes in lean, weight-dependent sports and athletes in nonlean, non-weight-dependent sports. One reason for these equivocal findings is that researchers have used varying classifications to define sport groups. For example, in some studies, swimming has been considered a lean or weight-dependent sport (Petrie, 1996) yet in other studies an endurance sport (Beals & Manore, 2000; Sundgot-Borgen, 1993). Given such problems, Hausenblas and Carron (2002) suggested that researchers include samples of athletes who represent only single sports, as opposed to combining across sports into broader categories (e.g., aesthetic), even though doing so might make obtaining a large enough sample difficult. Although not substantial in quantity, we highlight the research that has been conducted on single sports, in particular gymnastics, figure skating, and wrestling.

The prevalence of eating disorders among female gymnasts and figure skaters seems to be relatively high (Dick, 1991; Monsma & Malina, 2004; Petrie, 1993; Petrie & Stover, 1993; Rosen & Hough, 1999; Rucinski, 1989; Taylor & Ste-Marie, 2001). Among female gymnasts, subclinical prevalence rates as high as 60% have been reported (Petrie, 1993), although rates of BN are lower (4.1%; Petrie & Stoever, 1993). The use of pathogenic weight control behaviors, including fasting, self-induced vomiting, and laxative use, also appears to be fairly widespread (Petrie & Stover, 1993; Rosen & Hough, 1988). Similarly, female figure skaters report high levels of eating disordered attitudes and behaviors (Monsma & Malina, 2004; Rucinski, 1989; Taylor & Ste-Marie, 2001), with rates of elevated EDI and EAT scores ranging between 38% and 54% (Monsma & Malina, 2004; Rucinski, 1989) and skaters scoring similar to AN controls on drive for thinness and body dissatisfaction (Taylor & Ste-Marie, 2001).

A number of studies have specifically examined eating disorders and disordered eating behaviors among male wrestlers (Dale & Landers, 1999; Lankin, Steen, & Oppliger, 1990; Oppliger, Landry, Foster, & Lambrecht, 1993; Steen & Brownell, 1990). For example, Oppliger et al. found that 1.7% of their sample met *DSM-III* criteria for BN, and 43% engaged in some type of pathogenic weight control behavior. The most commonly reported pathogenic weight control behaviors were fasting, fluid restriction, and self-induced vomiting (Lankin et al., 1990; Oppliger et al., 1993; Steen & Brownell, 1990). Dale and Landers questioned whether wrestlers, in trying to make weight, display disordered eating patterns or develop true eating disorders. To examine this question, they had junior and senior high school wrestlers complete the EDI 3 days prior to a competition and 4 to 6 weeks after the end of the season. During the season, 31% reported scores above eating disorder means on drive for thinness, bulimia, and body dissatisfaction, which was significantly higher than during the off-season (19%). This transient use of pathogenic weight control behaviors also has been found in other physically active male populations. P. A. McNulty (1997) examined active duty navy men and had them report their use of weight control behaviors in the past 3 months, in the time prior to their annual physical evaluation, and currently. She found that men's use of vomiting, water pills, fasting, diet pills, and laxatives was alarmingly higher when preparing for annual weight and fitness measurements than at any other time.

Similar to wrestlers, male bodybuilders and weight lifters have reported pathological eating attitudes and behaviors, including high levels of drive for thinness, body dissatisfaction, and disturbed eating (Blouin & Goldfield, 1995; Mangweth et al., 2001; Oliosi, Grave, & Burlini, 1999; Pickett, Lewis, & Cash, 2005; Pope, Katz, & Hudson, 1993). Furthermore, Davis and Scott-Robertson (2000) found that male bodybuilders were similar to women with AN in terms of obsessive-compulsive tendencies, perfectionism, and narcissism. One factor that may exacerbate the risk of disordered eating among bodybuilders and weight lifters is muscle dysmorphia (Olivardia et al., 2000). Olivardia et al. found that weight lifters with muscle dysmorphia reported greater disturbed eating compared to weight lifters without muscle dysmorphia. Similarly, Pope et al. (2000) reported that not only were weight lifters with muscle dysmorphia more likely to report disordered eating, but they were also more likely to use steroids.

Although problems have been identified with how sport types have been classified, there is evidence that it is correlated with the prevalence of disordered eating behaviors. Thus, researchers do need to pay attention to this variable when selecting their samples. Ideally, researchers should use large samples drawn from single high-risk sports (e.g., gymnastics, cross-country). However, if drawing single-sport samples is not practical, researchers would benefit from using an established classification system, such as the one described by Sundgot-Borgen (1993). Use of a standardized classification system across studies is important for two reasons. First, researchers will be able to make direct comparisons of findings across different studies. Second, through such comparisons, researchers will be able to determine exactly which sports are at high risk and thus will be able to target such groups with specific interventions designed to reduce the risk.

Gender

Female athletes are more likely than male athletes to have eating disorders and eating disorder symptomatology (Haase, Prapavessis, & Owens, 2002; Hausenblas & McNally, 2004; Hopkinson & Lock, 2004; Johnson et al., 1999; Petrie, 1996; Sanford-Marten et al., 2005; Sykora, Grilo, Wilfley, & Brownell, 1993; Yates, Edman, Crago, & Crowell, 2003). For example, in a study of runners, cyclists, and paddlers, a higher percentage of women, compared to men, reported symptoms of eating pathology (Yates et al., 2003). Similarly, Hopkinson and Lock found that female athletes involved in soccer, swimming, and running had higher rates of eating disorders compared to male athletes in the same sports, whereas Johnson et al. reported that more female college athletes met the criteria for clinical and subclinical eating disorders than male college athletes.

Hausenblas and Carron's (1999) meta-analysis corroborated these general gender findings, though they also noted that the difference between male athletes and male controls (ES = 0.27) was greater than the difference between female athletes and female controls (ES = 0.08). This gender variability between athletes and controls may be reflective of the "normative discontent" (Rodin et al., 1985) so prevalent among women in Western cultures. That is, women in general are dissatisfied and preoccupied with their body shape and weight and engage in a variety of weight control behaviors. Athletic status does significantly increase their risk for developing disordered eating, but not substantially so. For men, who do not experience such intense general pressures regarding weight and dissatisfaction with body size and shape, involvement in the sport subculture may substantially exacerbate weight concerns and elevate their eating disorder risk.

Sanford-Martens et al. (2005) and Hausenblas and McNally (2004) both used the Q-EDD and found that a larger percentage of female, compared to male, athletes were identified as eating disordered. Interestingly, Sanford-Martens et al. found that more male than female athletes were classified as subclinical, which they attributed to the fact that male athletes were more likely to report excessive exercise, even when injured. They suggested that male athletes might use excessive exercise to improve performance or compensate for binge eating behaviors.

Not surprisingly, the majority of research on eating disorders among athletes has focused on female athletes, which makes sense given that 90% of eating disorders occur among females (American Psychiatric Association, 1994). However, it is important to recognize that boys and men also experience eating disorders and engage in pathogenic eating behaviors. McKay Parks and Read (1997) found that adolescent male cross-country runners reported disturbed eating attitudes. Similarly, Stoutjesdyk and Jevne (1993) found that 7.7% of male lightweight rowers and 11.1% of those in judo had EAT scores in the anorexic range. One challenge in studying eating disorders among boys and men is that eating disorders are typically thought of as a "female problem" (Petrie & Rogers, 2001); therefore, male athletes may be less willing to report symptoms. Medical professionals, who also are likely to associate eating disorders with women, may not recognize symptoms of problematic eating in male athletes. Further, certain eating disorder behaviors, such as binge eating and excessive weight lifting or aerobic training, may be viewed as normative among men, and thus not perceived as a symptom.

Male and female athletes may experience different types of pressures in the athletic environment related to the demands of their sports. For example, female athletes may experience pressure to maintain a low body weight, perceived to be advantageous for performance, whereas male athletes may believe that increased body weight, and specifically increased muscle mass, is advantageous. Further, male athletes' symptoms may increase during the competitive season (e.g., wrestling) but dissipate during the off-season. Because the disordered eating experiences of male and female athletes may differ, researchers need to control for gender in their research and consider that the factors that increase the risk of developing or maintaining an eating disorder may vary across these two groups.

Summary

Overall, male and female athletes do appear to be at a slightly increased risk of eating disorders in comparison to their respective nonathlete counterparts. Effect sizes from meta-analyses, though, were generally small and marked by considerable heterogeneity, suggesting that various factors, such as competitive level, gender, and sport type, moderate the relationship between sport involvement and risk of disordered eating. Unfortunately, with one notable exception (Sundgot-Borgen, 1993; Sundgot-Borgen & Torstveit, 2004), eating disorder prevalence research with athletes has been severely limited by the (a) use of measures with questionable psychometric properties; (b) use of small, nonrepresentative samples of convenience; (c) exclusion of appropriate age-matched controls when comparisons are to be made; (d) overreliance on self-report measures, particularly those not designed to determine clinical status or diagnosis; (e) lack of use of clinical interviews to follow up on initial self-report screening of eating disorders; (f) a focus on female elite athletes to the exclusion of males and other competitive levels; and (g) sole use of cross-sectional, as opposed to longitudinal, methodologies. Thus, conclusions about prevalence rates are made tentatively, particularly as they relate to cause-effect relationships between sport type, competitive level, and presence of disordered eating. Although additional prevalence research is needed, it will need to be improved by addressing as many of these limitations as possible. Doing so will improve the accuracy of the data and provide a clearer picture of the status of eating disorders among athletes at all levels.

RISK FACTORS

Although biological factors play a role in determining risk and should be considered when possible, the reality is that most eating disorder research has examined psychosocial risk factors (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). Thus, our model emphasizes the psychosocial variables that increase athletes' risk of developing and maintaining disordered eating attitudes and behaviors. Because of the dearth of studies on risk factors among athletes, we relied on the general eating disorder research to support the pathways and factors included in the model (e.g., Jacobi et al., 2004; Stice, 1994, 2001a, 2002; Striegel-Moore & Cachelin, 2001). In taking this approach, we recognize that the model is based on research conducted primarily with women and thus most closely applies to the experiences of female athletes. However, where appropriate, we have included research on men and eating disorders, and thus this model also has applicability for male athletes. Because it is not based solely on the experiences of men, it should be considered as only a starting point for researchers who are interested in exploring the experiences of male athletes. Finally, we recognize that this model does not represent all potential influences in the development of eating disorders, and we encourage researchers to consider other constructs of interest in their studies.

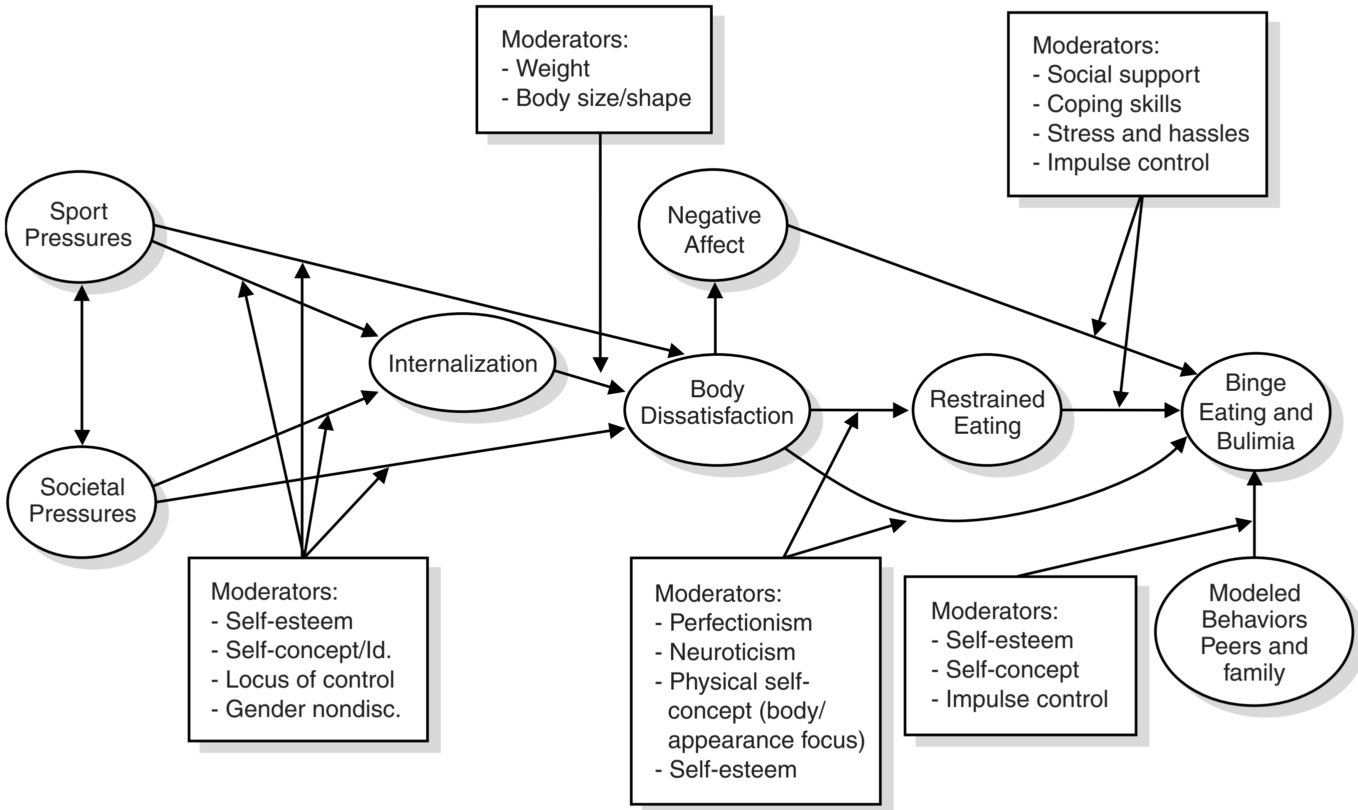

Figure 16.1 Etiological model of the interplay of eight risk or causal risk constructs determined to be factors in the development of disordered eating.

We begin this section by defining terms, such as "risk factor" and "moderator," that underlie etiological research. Next, we present the etiological model, specifically discussing how the factors interact with one another in the development of disordered eating attitudes and behaviors (see Figure 16.1). We conclude by providing an overview of the steps researchers might take to investigate components of this model.

Defining Terms

When discussing the etiology of any disorder, terminology must be clearly defined. Consistent with recent definitions (Jacobi et al., 2004; Kraemer et al., 1997), a *correlate* is any variable that has a statistically significant relationship with an outcome of interest, in this case, disordered eating. Although correlational studies are useful in identifying associations between proposed etiological factors and disordered eating outcomes, they are limited by their design in terms of the conclusions that can be drawn.

When a correlate, through longitudinal research, is found to predict disordered eating, it is referred to as a *risk factor* (i.e., a variable that precedes the development or worsening of disordered eating). A risk factor that has been shown through experimental manipulation to change the level of disordered eating symptoms is referred to as a *causal risk factor.* Although longitudinal designs can establish that a variable is a risk factor, only experimental studies with random assignment can establish precedence and determine causality by ruling out third-variable influences (Stice, 2002).

A *mediator* is a variable (correlate or risk factor) that explains the relationship between a predictor and an outcome; that is, the predictor influences the mediator, which in turn produces the outcome (Baron & Kenny, 1986). The mediator addresses the questions "how" or "why" the predictor causes or is associated with an outcome (Frazier, Tix, & Barron, 2004). For example, in the etiological model, internalization of the thin ideal is conceptualized as a mediator between general societal and sport-specific pressures and the development of body dissatisfaction. In other words, internalization as a mediating factor explains how societal and sport pressures predict increases in body dissatisfaction.

A *moderator* influences the direction and intensity of the relationship between a predictor (or independent variable) and a criterion (or dependent variable; Baron & Kenny, 1986). Moderators concern the issues of "when" and "for whom" the relationship between the predictor and criterion exist (Frazier et al., 2004). For example, in the etiological model, self-esteem and an internal locus of control are two of several variables hypothesized to moderate the relationship between societal and sport pressures and internalization of the thin ideal. In other words, societal and sport pressures may be associated with increases in the thin ideal internalization, but only for those athletes who are low in self-esteem or who have an external locus of control.

The core of the etiological model is the dual-pathway model proposed by Stice (1994), though we have expanded it to take into account factors unique to the sport environment. In considering the primary constructs in the model, with the exception of the sport-specific pressures, we have included only those that have been determined to be risk, or causal risk, factors in the general eating disorder literature (e.g., Jacobi et al., 2004; Stice, 2002). In addition, we have presented variables that have the potential to moderate the relationships among the proposed risk factors. Because little research has been done to test directly these variables as moderators, their inclusion is based primarily on theory and studies that have broadly related them to disordered eating, These suggested lists of moderator variables are not exhaustive and should be viewed as starting points for researchers. By addressing the mediational pathways as well as suggesting variables that might moderate them, we hope this model will stimulate a more sophisticated approach to studying eating disorders among athletes.

Etiological Model

The etiological model (see Figure 16.1) represents the interplay of eight constructs that have been determined to be risk, or causal risk, factors in the development of disordered eating (Jacobi et al., 2004; Stice, 2002): (1) general societal pressures to be thin or achieve a societally determined body shape (e.g., muscular for men); (2) sport-specific pressures regarding weight, body shape, and performance; (3) internalization of societal body ideals, be they thin or muscular; (4) body dissatisfaction; (5) negative affect; (6) dietary restraint; (7) modeling of disordered eating and other weight control behaviors by peers and family; and (8) binge eating and bulimia. In addition, variables thought to moderate the relationships among these constructs have been identified and included. Although we have not included the construct *level of physical activity* directly in the model, it must be considered by researchers because athletes are involved in high levels of exercise and training on a daily basis, and it has been associated with increases in body satisfaction (e.g., Hausenblas & Downs, 2001; Petrie, 1996), increases in weight and eating concerns (e.g., Kiernan et al., 1992), and decreases in the value associated with food (e.g., Davis, Kennedy, Ravelski, & Dionne, 1994; Eisler & Grange, 1990). Where body satisfaction might decrease athletes' risk, increases in concerns about weight and eating and reductions in food value may be associated with increases in dietary restraint, which may increase the risk of developing disordered eating. Thus, researchers should control for or at least assess this construct in studies on athletes and eating disorders.

Pressures regarding Weight and Body Size

Historically, societal pressures regarding the need to achieve a low weight and the attainment of a thin body size or shape have been ubiquitous for girls and women (Striegel-Moore et al., 1986), being communicated through the media, family members (e.g., parents), and friends (e.g., teammates, classmates). Over the past 2 decades, social pressures have increased for men, with messages suggesting that men need to engage in more health and fitness activities with the purpose of achieving a larger, stronger, and more muscular physique (Andersen & DiDomenico, 1992; Petrie et al., 1996). In the sport environment, specific pressures exist, such as judging criteria, body weight categories, coach expectations, and wearing revealing uniforms, that can exacerbate women's risk and establish risk among male athletes. Theoretically, consistently being exposed to these general and sport-specific pressures increases the likelihood of (a) internalizing society's (or a subculture's) body ideal and overemphasizing physical size, shape, and attractiveness when evaluating one's appearance; and (b) viewing one's own body as unacceptable and being dissatisfied with how one looks. Individuals who internalize a specific physical ideal and overemphasize weight, body size or shape, and appearance in their self-evaluation are hypothesized to be most at risk for the development of increased body dissatisfaction and ultimately negative affect and dietary restraint. Thus, in our model, the effects of general and sport-specific pressures on disordered eating are mediated through internalization and body dissatisfaction.

Prospective research has established that general pressures to be thin are an eating disorder risk factor (Stice, 2002) and, specifically, increase body dissatisfaction (Cattarin & Thompson, 1994; Stice, 2001a; Tylka & Subich, 2004). For example, Stice (2001a) found that, over a 20-month period, general pressures preceded and positively predicted increases in body dissatisfaction among female adolescents. Support for the link between general pressures and internalization has been equivocal, with some research demonstrating a connection (Tylka & Subich, 2004) and others not (Stice, Schupak-Neuberg, Shaw, & Stein, 1994; Stice & Shaw, 1994). We include that pathway in our model, however, for two reasons. First, it is a central component of general sociocultural models of eating disorders (e.g., Stice, 1994). Second, it has not been examined using a longitudinal design. In fact, the studies that failed to demonstrate a relationship were short term and conducted with female undergraduates. It may be that the influences of general societal pressures on internalization of the thin ideal occur earlier in life (e.g., childhood or early adolescence) and thus would not be found in studies using college-age samples. Prospective studies beginning in grade school are needed to establish the presence or absence of this pathway and determine the extent to which involvement in sport influences the internalization process.

Cross-sectional research examining the relationship of sport-specific pressures and eating disorders has indicated that athletes experience pressures concerning weight, dieting, body size, and performance (e.g., Harris & Greco, 1990; Reel & Gill, 1996); these pressures are associated with increased concern with the size and shape of their bodies (Williamson et al., 1995); and female athletes have body evaluations that are influenced negatively by media images emphasizing an athlete's physical beauty rather than her physical abilities (Thomsen, Bower, & Barnes, 2004). Although we found no studies that directly examined the relationship between sport-specific pressures and internalization, we have included that pathway in the model because of the reasons outlined previously.

There are several variables that may moderate the influences of societal and sport pressures on internalization and on the development of body image concerns. First, athletes with low self-esteem, or who lack a clear sense of who they are, might adopt external messages to increase self-acceptance, boost esteem, or gain a sense of identity (Stice, 1994). Second, athletes who believe that they have little control over themselves and their lives may look to external sources to define their beliefs and values. Third, athletes who perceive themselves as not being as independent or assertive as they would like (i.e., low in instrumental characteristics) may be less able to sufficiently counter messages from external sources and thus more likely to adopt them as their own. In all of these situations, athletes would be more likely to internalize societal and sport-specific messages, such as (a) body size or shape is central in determining one's physical attractiveness, sport performance, and overall success; (b) one's desired body size or shape is achieved by engaging in specific behaviors (e.g., excessive exercise, strength training, restricting food intake); and (c) physical attractiveness is the key factor in determining one's overall worth. In addition, repeated exposure to general and sport-specific messages that one's body is not ideal would increase the likelihood that athletes, particularly those with low self-esteem, a poor self-concept, an external locus of control, and few instrumental qualities, would develop a sense of their body as inadequate, worthless, or shameful. Because research also has shown that low self-esteem (Mintz & Betz, 1988; Petrie, 1993), undeveloped self-concept (e.g., Jacobi et al., 2004), an external locus of control (Rogers & Petrie, 2001), and a lack of instrumental qualities (Johnson & Petrie, 1995, 1996) are related to disordered eating attitudes and behaviors, we suggest that these variables be investigated as potential moderators in the relationship between general and sport-specific pressures and internalization and body dissatisfaction.

Internalization of the Thin Ideal

Most men and women cannot shape their bodies, through normal diet or exercise, to match their respective societal ideals (Brownell, 1991; Pope et al., 1997). Thus, individuals who have internalized these unattainable ideal body shapes and have made physical appearance a central part of their self-evaluation will perceive a discrepancy between what they really look like and what they would ideally like to be. In other words, they will compare their body size and shape to this ideal referent (be it based on societal or sport prescriptions) and, for many, find themselves lacking. When this discrepancy is large enough, they will become dissatisfied (even disgusted) with their current physical appearance and, ultimately, change their behaviors (e.g., diet, exercise) in hopes of altering their body.

Internalization has been associated with disordered eating behaviors in both correlational (e.g., Lester & Petrie, 1995, 1998) and longitudinal (e.g., Stice & Agras, 1998) studies. Regarding body dissatisfaction specifically, internalization has been established as a correlate for women (Heinberg, Thompson, & Stormer, 1995; Lester & Petrie, 1995, 1998; Stice et al., 1994) and for men (Cashel, Cunningham, Landeros, Cokley, & Muhammad, 2003). Prospective investigations of this relationship have demonstrated that changes in thin ideal internalization precede and predict changes in body dissatisfaction (e.g., Stice, 2001a). Further, experimental tests of prevention programs designed to reduce thin ideal internalization have resulted in decreases in body dissatisfaction among women (Stice, Chase, Stormer, & Appel, 2001; Stice, Mazotti, Weibel, & Agras, 2000). These and other studies led Stice (2002) to conclude that internalization is a causal risk factor in the development of body dissatisfaction and, subsequently, negative affect, dieting, and bulimic symptoms.

The primary moderator in the relationship between internalization and body dissatisfaction is weight/adiposity or body size and shape (in most research studies, these variables have been represented by body mass index: kg/m^2). Athletes who have accepted societal and sport-specific messages about how they should look have internalized an idealized body referent against which they ultimately compare their own body (Stice, 1994). Athletes whose body size and shape (either natural or developed through intensive physical training) is larger or smaller than this idealized referent would evaluate themselves as being discrepant. Greater real-ideal body discrepancies would be associated with increases in body dissatisfaction. Although the moderating effects of body size and weight on the relationship between internalization and body dissatisfaction have not been directly tested with athletes, adiposity has been related to higher levels of body dissatisfaction in both correlational (e.g., Petrie, 1996; Stice & Shaw, 1994) and prospective (e.g., Cattarin & Thompson, 1994) studies. Because body mass index is an accepted (and commonly used) proxy for adiposity and because accurate weight and height measures can be easily attained, researchers should include this variable in eating disorder studies with athletes.

Body Dissatisfaction

Body dissatisfaction is linked directly to eating disorders as well as through its influence on negative affect and dieting (Stice, 2001b). Individuals who perceive a substantial real-ideal body discrepancy, and subsequent body dissatisfaction, are hypothesized to react behaviorally and affectively. In terms of behaviors, because they believe dieting is an effective approach to losing weight, they restrict their food intake. Affectively, because physical appearance is a central component in their overall self-evaluation, they experience negative emotions (Stice, 2002). Clearly, this conceptualization directly addresses the experiences of individuals (mostly women) who believe they are too big in comparison to the internalized body ideal. For men (and some women) who perceive themselves as too small or not muscular enough, the behavioral reaction might be different, including increased food intake, ingestion of muscle-enhancing products (legal and illegal), and increased intensity and duration of physical workouts (particularly weight training). Researchers will need to keep this distinction in mind when examining components of this model with male and female athletes.

In his meta-analysis of the general eating disorder research, Stice (2002) concluded that body dissatisfaction was a risk factor in the development of negative affect, dieting, and disordered eating. For example, Stice (2001a) prospectively tested the dual-pathway model in a large community sample of female adolescents. Using growth curve modeling, he found that initial levels of body dissatisfaction predicted later growth in negative affect and dietary restraint, which in turn predicted the development of bulimic symptoms, over a 20-month period. In studies with female undergraduates, researchers have found strong support for a pathway from body dissatisfaction to disordered eating symptoms (Stice et al., 1994; Tylka & Subich, 2004). For athletes, cross-sectional research has demonstrated that body dissatisfaction is a correlate of negative mood and dieting and weight preoccupation (Petrie, 1996) and eating disorder symptoms (Williamson et al., 1995).

Theoretically, the (a) high standards (either set by self or incorporated from others) of perfectionistic athletes about how their body should look, (b) high emotional reactivity and threat to self experienced by neurotic athletes, (c) determination of self-identity primarily through physical appearance, and (d) poor self-acceptance of athletes with low self-esteem, all have the potential to moderate the relationship between body dissatisfaction and dieting and negative affect. In each instance, athletes who also were high in body dissatisfaction would be likely to react emotionally and be strongly motivated to decrease the real-ideal body discrepancy that existed (and subsequently the body dissatisfaction they are experiencing). In other words, the athletes would be motivated to reshape (e.g., increase muscularity) or shrink their current body size to approximate more closely the physical ideal they have internalized. Diet and exercise (i.e., strength training) are primary mechanisms for bringing about these bodily changes. Research has demonstrated that perfectionism is a risk factor for bulimia (Stice, 2002) and may interact with body dissatisfaction and low self-esteem to predict increases in disordered eating (Vohs, Voelz, et al., 2001). Although the design was correlational, perfectionism has been related to disordered eating among athletes (Hopkinson & Lock, 2004). Finally, Tylka (2004) found that neuroticism, as hypothesized, strengthened the relationship between body dissatisfaction and disordered eating symptoms.

Negative Affect and Dietary Restraint

Negative affect and dietary restraint are hypothesized to mediate the relationship between body dissatisfaction and bulimic symptoms. Theoretically, the tendency to react with negative emotions to stressful situations increases individuals' risk of overeating because binge eating provides self-comfort and distraction from their aversive affective state (Stice, 2001b). The dietary restraint model suggests that individuals increase their risk of binge eating by putting themselves into caloric deficit by following rigid rules about eating (e.g., "good" and "bad" foods) and limiting what is ingested. When in deficit, physiology may overwhelm cognitive restraint and individuals may violate their rules by eating forbidden foods. Once this violation occurs, the individual may experience intense negative emotions and disinhibition of eating, both of which contribute to a binge, the precursor to the development of bulimia (Polivy & Herman, 1985).

Stice (2002) concluded that negative affect was a risk factor for general eating pathology and a causal risk factor for increases in caloric intake. Specifically, in his review, he found that experimental studies where participants were able to eat during their negative mood state (as opposed to after) and experience general negative affect (as opposed to anxiety) had the strongest effects for increased caloric intake. In addition, Stice and Agras (1998) found that negative affect prospectively predicted the onset of binge eating and the use of compensatory behaviors, such as vomiting.

On the basis of longitudinal studies, self-reported dietary restraint would be a risk factor for binge eating (Stice & Agras, 1998) and bulimic symptoms (Stice, 2001a). However, after reviewing the research on experimentally manipulated dieting and subsequent caloric intake, Stice (2002) concluded that dieting was a proxy risk factor for binge eating and bulimic symptoms because of its association with overconsumption (individuals with a tendency toward overconsumption are more likely to report dieting and engaging in binge eating). Thus, it is not dieting per se that increases risk of binge eating, but an individual's chronic overconsumption of food. Stice (2001b) also suggested that (a) the influences of dieting may be different depending on body weight, with overweight individuals being less likely to binge eat than those with fewer adipose tissue reserves; and (b) individuals who go off their diets, which may occur in longitudinal but not experimental studies, are more at risk for binge eating because they have relaxed their strict rules about eating. Thus, given that multiple explanations have been offered for the relationship between dieting and binge eating and that athletes as a group generally are lean and would have few adipose tissue reserves, additional research is needed to test these propositions and clarify exactly how, if at all, dieting relates to a tendency to overconsume.

Individuals who possess inadequate coping skills, have insufficient support networks from which to draw, have difficulty controlling their impulses, and have high levels of life stress would be most at risk for succumbing to the pressures to binge eat that result from dietary restraint (Stice, 1994). In addition, these individuals would be likely to violate dietary rules (i.e., impulsively eat something) and self-comfort through eating as opposed to healthier alternatives, such as talking with friends and family. Research, albeit correlational, supports the connection between disordered eating and insufficient support from friends (Tylka & Subich, 2004), inadequate coping or use of poor coping strategies (Ball & Lee, 2000; Pike, 1995), poor impulse control (Tylka, 2004), and high levels of life stress (Ball & Lee, 2000).

Modeled Behaviors

Modeling and social conformity are processes that explain the acquisition of some behaviors, particularly for individuals who are part of cohesive units, such as sororities, athletic teams, and family units. In those situations, individuals may view respected others (a) engaging in behaviors such as binge eating and then being reinforced or perceived positively by the larger group (Crandall, 1988); or (b) expressing certain pathologies, such as with their body image. Through this exposure, individuals may adopt such behaviors and internalize the expressed pathological views. A meta-analysis of existing research demonstrated that modeling is a risk factor for disordered eating, though primarily for binge eating and bulimia and not body dissatisfaction or dieting (Stice, 2002). Because these results are based on only a few studies, the findings should be interpreted cautiously, and the influence of modeling on body dissatisfaction should be investigated further before it is ruled out completely as a potential risk factor.

Theoretically, individuals who are less accepting of themselves, have a poorly defined identity, and have difficulty controlling their impulses would be more susceptible to social influence processes (Crandall, 1988). These individuals would be more likely to adopt the behaviors to which they are exposed in their cohesive social environment, particularly when those behaviors are reinforced through social means, such as increased popularity or attractiveness to the group. As discussed previously, research supports associations between low self-esteem and poor self-concept (Jacobi et al., 2004) and poor impulse control (Tylka, 2004) and the presence of disordered eating symptoms. Research is needed to test directly the extent to which these variables moderate the relationship between modeled behaviors and binge eating.

Summary and Directions for Future Research

The model presented in this chapter incorporates many of the psychosocial variables that have been identified as risk factors in the development of eating disorders in nonathlete populations. Although we have not included all potential risk variables (e.g., age of menarche), this model can serve as an organizational catalyst for investigating eating disorders in athletes. On the basis of our review and the fact that this model is built primarily on research conducted with nonathlete populations, it is clear that research among athletes has been lacking in complexity, focusing primarily on studies that have compared athletes, whether separated into more specific categories (e.g., aesthetic, ball control) or not, to nonathletes. Although such between-group comparisons are useful and have provided important data, it is time for sport psychology researchers to use within-group designs to test potential risk factors. This model provides direction for such investigations, including (a) established risk factors, (b) interrelationships among the risk factors (i.e., mediational pathways), and (c) variables that potentially moderate the relationships among the risk factors. Directly testing the pathways in this model will allow researchers to determine why athletes are at risk for the development of eating disorders and whether these factors increase risk in the sport environment. Examining the potential moderators will uncover for which athletes and in what circumstances risk is highest. Such research will inform us as to the validity of this model for athletes and suggest other pathways and potential moderators to consider and test.

There are two issues to consider when conducting research that tests etiological models such as the one presented in this chapter (Jacobi et al., 2004). First, because there is variation across populations, it is necessary to examine putative risk factors within each population to establish their presence. As mentioned previously, the current model is based primarily on risk factor research conducted with nonathlete (and female) samples. Although we believe these risk factors apply to male and female athletes as well, this model needs to be corroborated empirically to establish that the variables indeed are risk factors and to determine if they apply equally well to men and women. Second, when examining etiological models, the study design will determine what can be concluded about the variables of interest. Cross-sectional studies allow researchers to designate a variable as a correlate, but prospective longitudinal designs can establish the precedence that is needed for a variable to be considered a risk factor. Once established as a risk factor, such variables should be tested using independent samples to replicate the etiological relationship.

Regarding the development and implementation of more programmatic research on etiological models of eating disorders, Stice (2001b, 2002) offered several suggestions that we summarize here in the context of the athlete eating disorder model presented in this chapter. First, researchers need to establish that there is a relationship (correlation) between the hypothesized risk factor and the outcome, such as between sport-specific pressures and body dissatisfaction or the internalization of a societal beauty ideal. Establishing such correlations (and testing for moderation of that relationship) can be accomplished using cross-sectional designs. Second, once a correlation has been established and replicated, researchers need to examine the putative risk factor using prospective longitudinal designs to establish the precedence of the variable. For example, researchers might follow athletes from the time they enter college through the end of their 1st year to determine if the sport pressures they experience precede the later development of body dissatisfaction. Third, once variables have been established as risk factors, they can be tested in combination to evaluate several of the proposed mediational pathways at one time. For example, researchers might include measures of body dissatisfaction, negative affect, dietary restraint, and bulimic symptoms and have athletes complete them at several measurement points across a 2- to 3-year period. Fourth, established risk factors can be tested experimentally under tightly controlled conditions to determine whether they are causal. For example, researchers might implement a prevention study that is designed to reduce internalization of the thin ideal and then follow athletes who participated in the program over a 3- to 6-month period to see if they experience reductions in body dissatisfaction, negative affect, or bulimic symptoms. Fifth, once lab-based causality has been established, risk factors can be field-tested to determine their ecological validity. For example, researchers might implement their prevention programs with an entire athletic department and then follow those participating athletes over the course of their involvement with their team to monitor how the risk factors interact over time (i.e., Do the hypothesized effects occur?).

Although these suggestions are specific to quantitative investigations, which are needed to test etiological models and establish causality, qualitative research also can be useful in furthering our understanding of how athletes, male and female, experience the sport environment and how those experiences influence their lives. In particular, in-depth interviewing with athletes can shed light on other potential etiological risk factors that could be tested via more traditional quantitative methodologies.

INTERVENTION

Eating disorder interventions involve three different, yet related, components: prevention, identification, and treatment. In this section, we focus on all three components, yet we emphasize the area of prevention because research has been based on risk factors elucidated in the previously presented etiological model. We discuss identification and treatment together because they represent two sides of the same coin, with the former being the pathway to the latter.

Prevention

The aim of primary prevention programs is to prevent new cases of a disorder or condition from emerging in the targeted population. Initial eating disorder primary prevention programs were psychoeducationally based, providing basic information about eating disorders in a didactic format (e.g., National Collegiate Athletic Association, 1989). The belief was that learning more about the adverse and deleterious effects of disordered eating behaviors would deter individuals from beginning unhealthy and dangerous eating and weight-loss behaviors themselves (Stice & Shaw, 2004). Although such programs sometimes increased knowledge about disordered eating, they were generally ineffective in reducing actual behaviors and other risk factors (e.g., Mann et al., 1997). Some researchers (Carter, Stewart, Dunn, & Fairburn, 1997; Mann et al., 1997) have argued that primary prevention programs might do more harm than good, perhaps by normalizing pathogenic weight control behaviors or by elevating body and weight concerns in already vulnerable individuals and causing subsequent increases in dieting behaviors.

More recent conceptualizations of eating disorder prevention programs have addressed the limitations of earlier models by changing the format of the programs, targeting individuals who are at risk for the development of eating disorders, and focusing on variables that have been proven to be risk factors in the development of eating disorders (Stice & Shaw, 2004). For example, Stice et al. (2000) evaluated the effectiveness of a three-session, interactive cognitive-dissonance-based program that focused on helping women with body image concerns challenge societal messages about the importance of physical attractiveness. In comparison to a wait-list control group, women who participated in the intervention reported decreases in body dissatisfaction, negative affect, internalization, and bulimic symptoms; all changes, with the exception of bulimic symptoms, were maintained at 1-month follow-up. In a second study, Stice et al. (2001) replicated their initial results but also noted similar changes in the disordered eating variables for their healthy weight management control group, which focused on good nutrition and beginning a healthy exercise routine. They suggested that their intervention's efficacy was based on successfully targeting and minimizing an eating disorder risk factor, in this case, internalization of the thin ideal.

The initial athlete eating disorder prevention literature has been based primarily on clinical experiences, with sport psychologists making recommendations for how to prevent eating disorders among athletes, including eliminating (or minimizing) weigh-ins, educating coaches about eating disorders and proper nutrition, educating athletes about proper nutrition, emphasizing physical abilities over physical appearance, eliminating sport-specific weight pressures from coaches and judges, and emphasizing physical health and performance over simply weight loss, to name a few (Petrie & Sherman, 1999; Ryan, 1992; Swoap & Murphy, 1995; Thompson & Sherman, 1999). Although many of these recommendations are clinically sound (and even address risk factors identified in the etiological model), for the most part, sport psychology researchers have not empirically investigated their efficacy. A need exists for research to determine if prevention programs, some of which may include these recommendations, are effective in lowering athletes' risk of developing disordered eating attitudes and behaviors.

Recently, researchers have begun the process of studying prevention programs among athletes, though we were able to locate only two controlled investigations. Abood and Black (2000) reported on the effectiveness of an 8-week interactive prevention program that focused on increasing knowledge and skills in self-esteem, handling performance pressures, nutrition, and managing stress; the researchers purposefully excluded information on disordered eating behaviors. In comparison to the study hall control group, the undergraduate female athletes who participated in the program had lower drive for thinness and body dissatisfaction and higher self-esteem and nutrition knowledge at the conclusion of the intervention. No follow-up data were collected, so the long-term effectiveness of the program cannot be determined. In an evaluation of the 8-week, peer-led ATHENA (Athletes Targeting Healthy Exercise and Nutrition Alternative) program, Elliot et al. (2004) found that at the end of their sport seasons, high school female athletes who had completed the intervention reported healthier behaviors (e.g., decrease in diet pill use, eating more protein), increased knowledge about unhealthy behaviors (e.g., effects of anabolic steroids, consequences of eating disorders), improved mood, and fewer intentions to engage in unhealthy behaviors in the future (e.g., vomit to lose weight) than athletes in the control condition. These two programs suggest that primary prevention can be effective with high school and college-age student athletes, particularly when the format is interactive and the content designed to address the unique needs of this population.

A recent meta-analysis of the general eating disorder prevention research (Stice & Shaw, 2004) suggests that, overall, prevention programs have small to medium effects in reducing a range of eating disorder risk factors, including body dissatisfaction, negative affect, internalization, eating pathology, and actual body mass. More specifically, by examining moderating influences, Stice and Shaw identified the key factors that determined a program's effectiveness. First, successful programs targeted at-risk populations, such as women with high levels of body dissatisfaction, instead of simply including all potential participants. Second, programs that were interactive, as opposed to simply didactic, had the strongest effects. By giving participants the opportunities to interact with one another, learn new skills and ideas, and practice new behaviors, changes in attitudes and behaviors occurred. Third, the interventions were most effective with participants age 15 and over, which is the time period of greatest risk for disordered eating pathology and when young women may be most motivated for change due to the psychological distress they are experiencing. Fourth, multi- versus single-session programs were more effective in promoting changes among participants. These effects are likely due to multisession programs being delivered over several weeks, which allow participants time to reflect on their experiences and try out new behaviors. Finally, the content of the program was less important in predicting outcome than the variables already mentioned. However, the most successful programs had both a cognitive component that focused on altering negative self-attitudes (e.g., body dissatisfaction) and a behavioral component that encouraged the adoption of healthier behaviors, such as nutritious eating and regular exercise.

The need exists for additional prevention studies, and we recommend that researchers follow Stice and Shaw's (2004) findings regarding moderating variables when designing their own programs. In addition, prevention programs should be based on etiological models that incorporate established risk factors. These models provide testable hypotheses about the relationships among putative risk factors and allow researchers to determine what causes (mediates) changes in the outcomes. For example, if a prevention program is designed to minimize internalization and body dissatisfaction, then decreases in negative affect and dietary restraint (and ultimately bulimic symptoms) would be expected over time and, if found, would support the proposed relationships among these variables. Second, in prevention studies, researchers should include wait-list and placebo control groups and obtain follow-up measures for 6 months to a year postintervention. With such follow-ups, researchers will be able to determine the long-term effectiveness of a program and decide if additional sessions may be needed to boost the initial effects over time. Third, researchers should consider the timing of prevention programs to determine when they will be most effective. For example, should programs be delivered to athletes immediately upon entry into a sport system, or can implementation occur over time? Fourth, researchers will need to determine if there are specific subgroups of athletes in which primary prevention is particularly effective. Stice and Shaw's review suggested that female athletes would be the ideal target audience, but the question arises as to which ones (e.g., only those in lean sports?) would benefit most. In addition, male athletes, by virtue of the unique pressures they experience in the sport environment, might benefit from a program that addresses specific issues, such as body image concerns, psychological drive for muscularity, and use of performance-enhancing drugs (e.g., steroids), to name a few. Finally, Stice and Shaw have suggested that the manner in which the prevention program is introduced to participants may influence the overall effectiveness of the intervention. Programs that promote "body acceptance" and do not specifically address the issue of eating disorder disturbances (i.e., are "covert" in nature; Stice & Ragan, 2002) may reduce participants' defensiveness and increase their openness to the intervention's content. Thus, researchers developing eating disorder prevention programs for athletes may want to introduce them as "body acceptance" or "healthy body" programs.

Identification and Treatment

Whereas the goal of prevention is to avoid the development of the disorder or illness, the focus of identification is on early detection and referral for treatment. Although identification of athletes with eating disorders may arise through the implementation of prevention programs, the sport environment offers other avenues for assessing athletes to determine their current level of eating disorder disturbance. Because athletes routinely go through medical screenings prior to beginning their competitive seasons, researchers, medical organizations, and sport psychology practitioners (e.g., Beals, 2003; IOC, 2005; Manore, 2002; Otis, Drinkwater, Johnson, Loucks, & Wilmore, 1997) have suggested that this time is ideal for gathering information related to their eating behaviors, nutritional status, body attitudes, mood states, body composition (e.g., percentage of body fat, bone mineral density), menstrual status (current and historical), and frequency and intensity of physical training. Such information can be gained through self-report questionnaires, such as those discussed earlier in the chapter, food logs and nutritional analyses, blood analyses, bone scans, and individual interviews by trained clinicians.

Ideally, such information would be reviewed by a team of experts (e.g., nutritionist, sports medicine physician, psychologist, exercise physiologist, sport psychologist, athletic trainer) to determine the athlete's current level of functioning and whether follow-up is needed. For example, athletes who are identified as at risk from self-report questionnaires might undergo more extensive testing (e.g., bone scan, nutritional analysis) and interviewing (e.g., diagnostic interview for eating disorders) to ascertain, specifically, the presence of symptoms and determine actual diagnosis. If a team approach is taken, the issues of confidentiality (how, and with whom, will information obtained from the athlete be shared) and informed consent (the athlete being aware of how information will be used or shared and approving of that in advance) are key and need to be established in the sport environment and clearly communicated to the athlete prior to beginning the identification process.

In addition to this initial screening, identification of disordered eating behaviors, and related problems such as the female athlete triad, may occur at any time during the competitive season through careful observation of athletes' behaviors, ongoing monitoring of their nutritional and performance status, and openness by key sport personnel (e.g., athletic trainers) to listen to athletes' concerns (Ryan, 1992). For example, the coach might notice a decrement in the athlete's normal level of performance, a teacher might notice that the athlete is not turning in homework and appears physically fatigued during class (a change from before), and the athletic trainer might hear from the athlete that she has not been sleeping well and has been severely restricting her food intake. Information obtained from such varied sources can be invaluable in identifying problems early in their development and proactively intervening with the athlete before more serious concerns arise. The key, though, is to have in place a team of individuals who can monitor and coordinate identification and treatment issues for athletes with disordered eating concerns (for detailed discussions on implementing positive team approaches for identification and treatment, see Petrie & Sherman, 1999; Thompson & Sherman, 1993).

Although identification takes time, money, organization, and openness in a normally closed system, there are two major benefits that may result from making it a priority. First, and most important, athletes will benefit through improvements in health and performance. Early identification can lead to treatment of subclinical (as opposed to clinical) problems and can prevent the development of more severe syndromes, such as the female athlete triad. Second, athletic departments and sport organizations who focus on creating a health-focused sport environment through education and prevention and who implement comprehensive identification and treatment programs may lower their legal liability should an athlete develop an eating disorder ("Starving for a Win," 2004). Athletic departments and sport organizations have an ethical and legal responsibility to make the health and well-being of their athletes their primary concern. Athletes who are exposed to negative sport-specific pressures about their weight, body size, and performance or who are surrounded by sport personnel who turn a blind eye to eating, nutrition, and body perception problems may needlessly develop and suffer from eating disorders and related problems. When athletes perform in environments that emphasize performance at the expense of physical and psychological well-being, some may seek legal redress. Thus, sport organizations, led by the sport and exercise psychologists who work within them, may want to develop comprehensive plans for education, identification, and treatment (Ryan, 1992).

A critical review of the eating disorder treatment literature is beyond the scope of this chapter, and we refer the reader to other sources to learn more about overall effectiveness (e.g., Agras, Walsh, Fairburn, Wilson, & Kraemer, 2000; Wilfley et al., 2000) and the different modalities and theoretical perspectives that exist (e.g., Brownell & Fairburn, 1995). However, we do want to highlight two unique issues with respect to the treatment of athletes with eating disorders. First, because eating disorder treatment generally is conducted by licensed mental health providers (e.g., psychologists, social workers) who are not likely to be a part of the athlete's immediate sport environment, confidentiality and potential communication among interested parties (e.g., coach, athletic trainer, parents, teammates) must be considered and addressed at the outset of treatment. Second, because of the almost year-round training associated with current sport involvement, athletes who are symptomatic may face the question of whether to continue training while in treatment. Athletes can remain involved in training *if* their overall health and nutritional status and *if* the treatment itself are not compromised. The decision on whether to train should be made collaboratively, with input from physicians, nutritionists, psychologists, and the athletes themselves being considered. If athletes continue to train and compete, mechanisms for effectively monitoring their health status and treatment goals need to be established.

Summary

For sport and exercise scientists, examining eating disorder prevention programs for athletes represents fertile ground for future investigations. Initial research with athletes suggests that multisession, interactive programs that focus on the unique needs of athletes can reduce eating disorder correlates and risk factors as well as disordered eating behaviors themselves. We encourage researchers to develop prevention programs that are based on the etiological model presented in this chapter (or other established theoretical models) because they provide a mechanism for establishing specific hypotheses that can be tested. Such prevention studies also should incorporate the suggestions made by Stice and Shaw (2004) to ensure a well-designed project.

CONCLUSION

In this chapter, we reviewed the existing literature on athletes and eating disorders and presented an etiological model illustrating the factors that may contribute to its development. In conclusion, we summarize the main findings and make some final general research recommendations. We hope that these concluding remarks, in addition to our critical review, will serve as a catalyst for a more programmatic, advanced study of this area.

- The preponderance of research, particularly that done using matched samples and clinical interviews, suggests that athletes (particularly at the elite level) have slightly elevated levels of disordered eating in comparison to nonathletes. Even so, additional prevalence research is needed that is population-based (or at least incorporates diverse samples), uses valid measures and clinical interviews when possible, includes non-elite-level athletes, and examines the experiences of males and athletes from a wider variety of racial and ethnic groups.
- Athletes experience subclinical concerns at rates substantially higher than clinical disorders and thus should be a focus in future studies. In particular, researchers might examine the course of disordered eating over time to determine if athletes with subclinical disorders ultimately develop clinical issues and, if so, when and under what conditions.
- The female athlete triad, muscle dysmorphia, and exercise dependence are three syndromes that deserve additional study. Because FAT involves changes in physical and physiological functioning, multiprofessional research teams will be needed to determine the extent to which the components coexist and how they interact in terms of development and maintenance. Muscle dysmorphia, because of its salience with men, represents a construct that may be important in understanding their experiences with and development of disordered eating attitudes and behaviors. Research on exercise dependence will be useful, not only with athlete populations, but with nonathletes who are physically active.
- A variety of psychosocial factors do increase the risk of developing disordered eating behaviors. Although developed primarily on the basis of the general eating disorder literature, the model presented in this chapter offers a framework for studying eating disorders among athletes. This model can help researchers develop testable hypotheses about the interrelationships among the risk factors (i.e., mediational pathways) and the ways other variables may influence those relationships (i.e., moderating effects). Using this model as a guide and following the protocol for conducting programmatic research offered by Stice (2001b, 2002) will help researchers design sophisticated

within-group studies to address important questions about eating disorders and sport.

• General prevention programs are effective in reducing disordered eating behaviors in nonathlete samples, and initial research supports similar outcomes with athletes. Because so little research has been done on preventing disordered eating in sport organizations, evaluating these types of programs is another fertile avenue of research for exercise and sport psychologists. Basing such programs on etiological models will lead to the development of theoretically based programs, whereas following the recommendations from Stice and Shaw's (2004) review will result in methodologically rigorous designs to accurately test them.

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CHAPTER 17

Psychosocial Antecedents of Sport Injury and Interventions for Risk Reduction

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The history of research into psychosocial antecedents of sport injuries reaches back 35 years (see T. H. Holmes, 1970). In the more than 3 decades of research into predictors of athletic injury, myriad articles have appeared in the literature, ranging from early psychodynamic formulations of injury (Sanderson, 1977, 1978) to the now more established models currently guiding the field (e.g., Williams & Andersen, 1998). There is little doubt about the significance of psychosocial variables' (e.g., stress, social support, coping) influences on injury risk and injury outcome. Since the last edition of this *Handbook,* relatively few studies have been conducted on the psychosocial antecedents of sport injury, probably due, in part, to how well those variables have been established in the literature. Another factor for the limited recent research may be that doing such studies has procedural and logistic difficulties (e.g., large numbers needed, record keeping). The long-term goal of injury antecedent research was to develop interventions aimed at modifying the identified psychosocial risk factors (e.g., reducing stress, increasing coping) to decrease injury occurrence and improve the quality of life and sporting experiences of athletes. Currently, intervention research is the cutting edge of sport injury inquiry and perhaps the most exciting aspect of this evolving field of sport science. Limited research into prevention has been conducted so far, but what we have holds substantial promise. We review the current injury prediction and prevention research as well as summarize the findings from earlier research. But first, some background on sport injuries is needed.

PREVALENCE OF INJURIES

In the arena of sport, Booth (1987) reported that there are more than 17 million sport injuries per year; in the most recent comprehensive survey of sport injuries (American Sports Data, 2002), the estimate is over 23 million sport injuries per year. For example, in Boyce and Sobolewski's (1989) study of 55,000 schoolchildren, they found that athletic participation accounted for 44% of the injuries to students 14 years and older. Other data indicate that each year nearly half of all amateur athletes suffer an injury that precludes participation (Garrick & Requa, 1978; Hardy & Crace, 1990). According to the Consumer Product Safety Commission, one quarter of these injuries require at least 1 week of nonparticipation (Hardy & Crace, 1990). Although many injuries are not severe or life-threatening, Burt and Overpeck (2001) reported that for 1 year (1997 to 1998) in the United States, 3.7 million children and adults visited emergency rooms for exercise- and sport-related injuries. From July 2000 to June 2001, Gotsch, Annest, and Holmgreen (2002) estimated, the number of sport- and recreation-related emergency room visits was 4.3 million. These statistics underscore the need for research that delves into the causes and the prevention of sport injuries.

In Europe, the European Home and Leisure Accident Surveillance System (EHLASS) has been compiling sport injury data from many countries since the late 1990s. For example, in Austria's EHLASS report it was estimated that there were 227,400 (29 per 1,000 person years) sport-related injuries in 2000, with direct medical costs of 66 million euros ($84 million in US dollars). When estimates for loss of production are included, the costs reach 302 million euros ($382 million in US dollars). In the Netherlands, it is estimated that about 1.5 million people experience a sport-related injury each year, with more than 170,000 presenting at hospital emergency departments. The EHLASS reporting varies widely among European nations, and we could find no central clearinghouse for the reports. A www.google.com search with the key word EHLASS will bring the reader to literally dozens of web sites with different nations' injury and accident reports.

MODEL OF STRESS AND ATHLETIC INJURY

Although many of the causes for injury are undoubtedly physical in nature (e.g., body build, level of conditioning, equipment failures, playing surface, faulty biomechanics) or just plain bad luck, psychosocial factors also play a role. Since the first study by T. H. Holmes (1970), growing numbers of sports medicine and sport psychology researchers have tried to determine which psychosocial variables influence vulnerability and resistance to injuries, the mechanisms whereby these psychosocial variables influence injury, and interventions that may reduce this injury risk. This chapter focuses on all these areas.

Initial attempts to identify psychosocial risk factors were narrow in scope and atheoretical. Researchers tended to look at either personality factors, life event stress, or both, but offered no theoretical foundation to explain how these factors might lead to injury. These limitations led Andersen and Williams in the mid-1980s (Andersen & Williams, 1988; Williams & Andersen, 1986) to develop a multicomponent theoretical model of stress and injury. Their model proposes that most psychological variables, if they influence injury at all, probably do so through a linkage with stress and the resulting stress response. The model evolved from a synthesis of the stress-illness, stress-injury, and stress-accident literature, and owes much to earlier stress theorizing by Allen (1983) and Smith (1979).

A review and critique of the original 1988 model found substantial support for the basic components and hypotheses of the model but also suggested some minor changes (see Figure 17.1) and words of caution (Williams & Andersen, 1998). Recently, Petrie and Perna (2004) made suggestions for expanding the model to include interactions of psychosocial variables and the intense physical training of athletes. They stated, "Psychosocially derived (dis)stress may combine additively with exercise-related stress to widen a *window of* susceptibility to injury and illness" (p. 557). Their suggestions expand the model to include outcomes beyond injury, such as infection, physical complaints, and poor adaptation to training. Their additions to the model, however, have not had time to be tested; future research will determine the usefulness of such additions.

Because of the support for the stress-injury model, and because the model provides a theoretical base for much of the psychology of injury research, it serves as the foundation in this chapter for organizing and summarizing past and more recent injury findings. Future research needs and directions are identified in the discussion of the different facets of the model as well as in a section near the end of the chapter. The chapter concludes with suggestions regarding implications for the practitioner.

According to the stress-injury model (see Figure 17.1), when sport participants experience stressful situations, such as a demanding practice or crucial competition, their history of stressors, personality characteristics, and coping resources contribute interactively, or in isolation, to the stress response. The central hypothesis of the model is that individuals with a history of many stressors, personality characteristics that tend to exacerbate the stress response, and few coping resources will, when placed in a stressful situation, be more likely to appraise the situation as stressful and to exhibit greater physiological activation and attentional disruptions. The severity of the resulting stress response, caused by the increased stress reactivity of at-risk individuals, is the proposed mechanism behind the increased injury risk.

The central core of the model, the *stress response,* is a bidirectional relationship between the person's cognitive appraisal of a potentially stressful external situation and the physiological and attention aspects of stress (see Figure 17.1). In terms of sport participation, the individual makes some cognitive appraisal of the demands of the practice or competitive situation, the adequacy of his or her ability to meet those demands, and the consequences of failure or success in meeting the demands. For example, if the athlete views competition as challenging, exciting, and fun, the resulting positive stress (eustress) may help the athlete remain on task, stay focused, and successfully flow with the competition. Injury risk in this situation would be lower than when the athlete feels negative stress (distress), such as appraising the competition as ego-threatening or anxiety-producing. Such an interpretation is most likely to occur when athletes perceive that they do not have the resources to meet the demands of the situation, and it is important to do so because failure will result in dire consequences.

Whether the cognitive appraisal is accurate or distorted by irrational beliefs or other maladaptive thought patterns is unimportant in the generation of the stress response. If athletes perceive they have inadequate resources to meet the demands of the situation, and it is important to succeed, the stress response activates and manifests itself physiologically, attentionally, and emotionally (e.g., increased state anxiety). Correspondingly, these cognitive

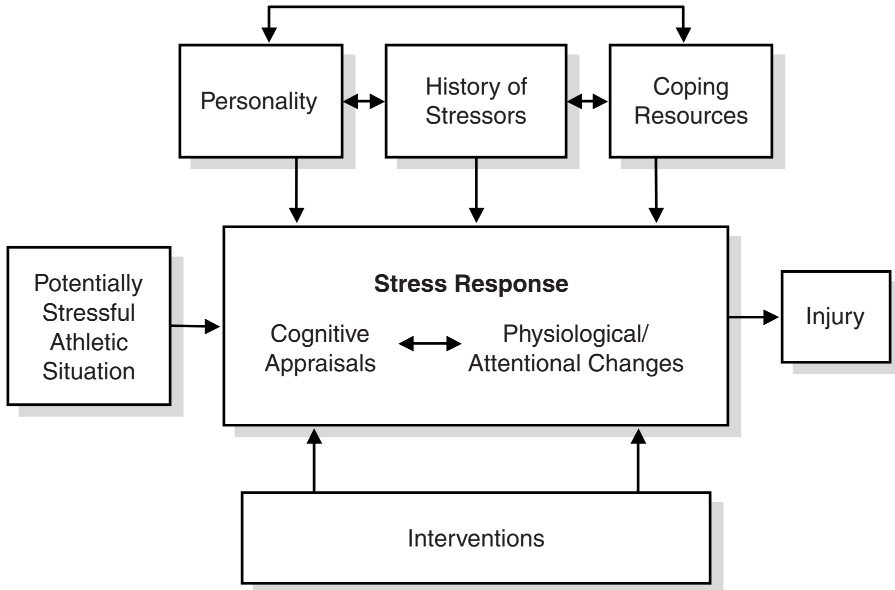

Figure 17.1 Revised version of the stress and injury model. *Note:* The original model had directional arrows only from personality to history of stressors and from coping resources to history of stressors; it had no bidirectional arrow between personality and coping resources. *Source:* "Psychosocial Antecedents of Sport Injury: Review and Critique of the Stress and Injury Model," by J. M. Williams and M. B. Andersen, 1998, *Journal of Applied Sport Psychology, 10,* pp. 5–25. Reprinted with permission.

appraisals and physiological, attentional, and emotional responses to stress constantly modify and remodify each other. For example, a relaxed body can help calm the mind, just as anxious thoughts can activate the sympathetic nervous system. The resulting individual differences in stress responsivity may either inoculate athletes against injury or increase their risk due to psychosocial variables.

The many physiological and attentional changes that potentially occur during the stress response led Andersen and Williams (1988) to hypothesize that increases in generalized muscle tension, narrowing of the visual field, and increased distractibility were the primary culprits in the stress-injury relationship. They derived these hypotheses from the recommendations of earlier researchers (e.g., Bramwell, Masuda, Wagner, & Holmes, 1975; Cryan & Alles, 1983; Nideffer, 1983; Williams, Haggert, Tonymon, & Wadsworth, 1986). Unwanted simultaneous contraction of agonist and antagonist muscle groups (often called bracing) is a common response to stressors. This generalized muscle tension can lead to fatigue and reduced flexibility, motor coordination difficulties, and muscle inefficiency. The end result is a greater risk for incurring injuries such as sprains, strains, and other musculoskeletal injuries.

Attentional disruptions may result from preoccupation with stressful events and their possible negative consequences or by a blocking of adaptive responses. If such disruptions lead to a narrowing of peripheral vision (e.g., Easterbrook, 1959), injury could result by not picking up or responding in time to danger cues in the periphery. For example, an injury to a quarterback from a blindside hit may occur because of not seeing or reacting quickly enough to a defensive player running in from the periphery. It is often the hit that one is not prepared for rather than the tackle one expects that leads to injury. Attentional disruptions, often due to focusing on task-irrelevant cues, may also result in failure to detect or respond quickly enough to relevant cues in the central field of vision. For example, a batter with a high psychosocial risk profile might not see or respond fast enough to avoid a pitch coming directly at his head.

PSYCHOSOCIAL INFLUENCES ON THE STRESS RESPONSE

Before addressing the research support that exists for the stress response mechanisms proposed in the model, the question of interest is What psychosocial factors influence the stress response? Above the stress response core of the model are three major areas: personality factors, history of stressors, and coping resources (see Figure 17.1). These variables may act in isolation, or in combination, in influencing the stress response and, ultimately, injury occurrence and possibly injury severity. The original model hypothesizes that an athlete's history of stressors (life event stress, daily hassles, previous injury) contributes directly to the stress response, whereas personality factors (hardiness, locus of control, sense of coherence, competitive trait anxiety, achievement motivation) and coping resources (general coping behaviors, social support systems, stress management, mental skills) act on the stress response either directly or through a moderating influence on the effects of the history of stressors. For example, the presence of desirable personality and/or coping variables may buffer individuals from stress and injury by helping them to perceive fewer situations and events as stressful or by lessening their susceptibility to the effects of their history of stressors. Conversely, the lack of desirable personality characteristics and coping resources, or the presence of undesirable characteristics (e.g., high competitive trait anxiety), may leave individuals vulnerable to higher stress (acute and chronic) and, presumably, greater injury risk.

In addition to the preceding, when Williams and Andersen (1998) critiqued and revised their stress-injury model 10 years after its initial publication, they added bidirectional arrows between personality and history of stressors and between coping resources and history of stressors (see Figure 17.1). The original model had only directional arrows from personality to history of stressors and from coping resources to history of stressors. They proposed adding the bidirectional arrows because there is evidence that the stressors people experience do affect how they develop and characteristically respond or cope. The most dramatic example of this is posttraumatic stress disorder (American Psychiatric Association, 2000). The field of rehabilitation offers plenty of evidence for personality change following injurious events. For example, some individuals who have experienced amputations or severe burns or spinal cord injuries become withdrawn, agoraphobic, depressed, and sometimes suicidal (e.g., Kishi, Robinson, & Forrester, 1994). Other major life events, such as a loved one contracting cancer, can increase general anxiety and depression, plus influence coping (Compas, Worsham, Ey, & Howell, 1996). Some support for adding the bidirectional arrows even exists in the earlier stress and sport injury literature (May, Veach, Reed, & Griffey, 1985). For example, May et al. suggested that when athletes experience psychological stress, their self-esteem and emotional balance deteriorates.

When Williams and Andersen (1998) modified their model, they also proposed adding a bidirectional arrow between personality and coping resources (see Figure 17.1). The original model had no directional arrow. The personality section later in this chapter provides the rationale for the modification. The proposal of the bidirectional arrow to the model is also consistent with the transactionist point of view currently espoused for gaining a better understanding of coping (e.g., Aldwin, 1994).

History of Stressors

This category includes major life events, daily hassles, and previous injury history. Of these factors, life event stress has received the most extensive research.

Life Events

Interest in life event stress evolved initially from the work of T. H. Holmes and Rahe (1967). They developed the Social Readjustment Rating Scale (SRRS), a questionnaire that identifies and ranks the magnitude of 40 life change events found in a general adult population. The scale is based on the assumption that the experiencing of life events places demands on the organism to adapt, and therefore, leads to stress on the body and an increased risk for illness. Examples of life events are the breakup of a relationship, taking a vacation, and death of a loved one. On the SRRS, each life event is given a preset numerical weighting based on the presumed degree of adaptation required for the typical individual in the general population. Individuals indicate the frequency of each event's occurrence during a specified period of time. A total life-change score is tabulated by adding the weighted scores for the checked items. Researchers have supported the relationship of high life event stress to illness, and even accidents (e.g., T. H. Holmes & Rahe, 1967; T. W. Miller, 1988; Sarason, Johnson, & Siegel, 1978; Savery & Wooden, 1994; Stuart & Brown, 1981; Theorell, 1992).

In 1970, T. H. Holmes administered the SRRS at the start of the football season to players on the University of Washington football team. He then compared players' life stress scores (tabulated by adding the preset weightings for the life events experienced during the preceding 12 months) to time-loss injury data monitored by athletic trainers throughout the football season. Holmes found that 50% of the athletes who experienced high life stress during the year prior to the football season incurred an athletic injury that required missing at least 3 days of practice or one game. In contrast, only 9% and 25%, respectively, of athletes with low and moderate levels of life stress experienced equivalent injuries. Holmes concluded that life stress relates to athletic injuries in much the same way as it does to the occurrence of illness.

The researchers (Bramwell et al., 1975) who conducted the next life stress-athletic injury study modified the SRRS to make it more appropriate to intercollegiate athletes by deleting the less applicable stressors and adding 20 more appropriate ones for college athletes (e.g., academic eligibility difficulties, trouble with the head coach, change in playing status). Results with the modified tool of 57 life events showed an even stronger relationship between life stress and athletic injuries. When categorized into low, medium, and high life stress groups, 30%, 50%, and 73%, respectively, of the college football players incurred athletic injuries.

Using the same tool, Cryan and Alles (1983) studied the Pennsylvania State University football team and replicated the Bramwell et al. (1970) findings. They also improved on the earlier design by assessing the severity as well as incidence of injuries. The standards of the National Athletic Injury Reporting System provided the breakdown for injury severity. A minor injury permitted returning to play within 7 days. Moderate and major injuries necessitated, respectively, missing between 8 and 21 days or more than 21 days. They found that life event stress did not differentially affect risk for incurring injuries of varying severity.

In 1983, Passer and Seese advanced the stress-athletic injury research by distinguishing between negative and positive life events and by examining personality variables thought to moderate the influence of life stress. In the earlier studies, life event stress was assessed without tools that distinguished between adaptation required by positive and negative life events. The tools also gave preset weightings to the life events rather than allowing the respondent to indicate the magnitude of effect. Sarason et al. (1978), developers of the Life Experience Survey (LES), contend that the effects from adaptation to negative life change events may differ from those life change events viewed as positive. They also challenged the ability of preset weightings to adequately reflect the interaction between the environment and the individual's perception of the stressfulness of environmental events. Respondents on the LES indicate whether they perceive a life change event as positive or negative and whether the event had no effect (0 score), a little effect (−1 or +1 score, depending on whether the event is rated negative or positive), a moderate effect (−2 or +2 score), or a great effect (−3 or +3 score). Thus, the LES provides an assessment for negative life events, positive life events, and total life events (absolute values of the positive and negative scores summed). As hypothesized, Sarason et al. found that positive life events had either no effect or a less detrimental effect on health-related dependent variables compared to the effects of negative life events. Passer and Seese, using a modified 70-item athletic version of the LES, found that a greater risk of injury occurred for only those football players who reported higher levels of negative life event stress.

Since Holmes conducted the first football investigation, at least 40 studies have examined the relationship of life stress to athletic injury risk. In our systematic review of the literature, we found that approximately 85% of the studies found some correlation between life event stress and injury (e.g., Andersen & Williams, 1999; Byrd, 1993; Falkstein, 2000; Fawkner, 1995; Ford, Eklund, & Gordon, 2000; Kolt & Kirkby, 1996; Meyer, 1995; Noh, Morris, & Andersen, 2005; Patterson, Smith, & Everett, 1998; F. Perna & McDowell, 1993; Petrie, 1993a, 1993b; Smith, Ptacek, & Patterson, 2000; Thompson & Morris, 1994; Van Mechelen et al., 1996; Williams & Andersen, 1997), but some researchers (e.g., Lavallee & Flint, 1996; Petrie & Stoever, 1995; Rider & Hicks, 1995) did not find the correlation. The best evidence for a relationship between life event stress and injury involved football (six studies), but similar findings occurred across other sports as diverse as Alpine skiing, race walking, figure skating, baseball, gymnastics, soccer, field hockey, wrestling, and track and field. Overall, the risk of injury increased in direct relationship to the level of life event stress. Williams and Roepke's 1993 review concluded that athletes with high life event stress were two to five times more likely to be injured than athletes with low life event stress.

The reported strength of the life stress-injury relationship, and whether the culprit was negative (NLE), positive (PLE), or total (TLE) life events, varied considerably across studies. Although the majority of the studies that distinguished between types of life stress indicated that only the *negatively* appraised life events put athletes at risk for injury (e.g., Byrd, 1993; Meyer, 1995; Passer & Seese, 1983; Patterson et al., 1998; Petrie, 1992, 1993b; Smith, Ptacek, & Smoll, 1992; Smith, Smoll, & Ptacek, 1990), others found support for TLE and PLE increasing risk of injury. For example, Blackwell and McCullagh (1990) noted that TLE stress contributed the most to injury occurrence and PLE contributed the most to the likelihood of receiving a severe injury. Hanson, McCullagh, and Tonymon (1992) reported that only PLE stress helped to differentiate among injury frequency groups, and Petrie (1993a) observed that PLE was the only life event stressor to predict time loss due to injury. Petrie suggested that the life events that athletes might initially rate as positive (e.g., major change in level of responsibility on team, receiving an athletic scholarship) may in the future produce considerable stress by putting more pressure on the athlete to perform well or to feel responsible for the team's performance. These changes are likely to lead to negative cognitive appraisals of athletic situations, and thereby a greater risk for injury.

Hardy and Riehl (1988) found that injured athletes overall had significantly higher NLE than noninjured athletes, but injured female athletes reported higher scores on TLE compared to uninjured females. Both TLE and NLE significantly predicted injury across sports, but analyses within sports indicated injured softball players reported higher TLE, baseball players higher NLE, and track athletes higher object loss (e.g., loss of a significant other through death, divorce, separation) compared to equivalent uninjured players. Except for track, none of the stress measures predicted injuries in the specific sports. In track, both TLE and object loss predicted injuries. These findings led Hardy and Riehl to conclude that the life stress injury relationship is influenced by both the athlete's sex and the sport. Hardy, O'Connor, and Geisler's (1990) study of Division I soccer players supported the conclusion that gender affects the relationship between life stress and injury. The reason gender would affect the stress-injury relationship, however, is unclear.

The preceding differences aside, almost all studies that assessed life events found at least some significant relationship between life stress and injury. This almost universal finding is itself compelling, but even more so considering it occurred across sports and competitive levels (youth to elite level) and with diverse measures of life stress and definitions of injury. Researchers used eight questionnaires to assess life stress, and the criteria for injury varied from requiring treatment from an athletic trainer but no need to reduce practice time or modify activity (e.g., Blackwell & McCullagh, 1990), to time loss requiring missing more than a week of practice (e.g., Coddington & Troxell, 1980). These different operational definitions make it impossible to determine relative injury risk across sports and competitive levels and across positive versus negative stressors. Diverse operational definitions also contribute to the difficulty in determining the effect of life stress on severity of injury. Approximately two-thirds of the studies found some relationship between life stress and injury severity (e.g., Blackwell & McCullagh, 1990; Hanson et al., 1992; Hardy et al., 1990; Hardy & Riehl, 1988; Kerr & Minden, 1988; Meyer, 1995; Petrie, 1992, 1993b), and one third found no effect (e.g., Cryan & Alles, 1983; Hardy, Richman, & Rosenfeld, 1991; Lavallee & Flint, 1996; Lysens, Vanden Auweele, & Ostyn, 1986; Williams, Tonymon, & Wadsworth, 1986), although that relationship would be expected to share substantial variance with injury occurrence. These studies did not control for injury incidence when looking at relationships between life events and injury severity (usually measured by duration). In regression designs, the variance due to injury occurrence would need to be partialed out of the equation before the relationship of injury severity and life events could be firmly established.

Daily Hassles

The history of stressors portion of the model also includes daily hassles. The stress from many minor daily problems, irritations, or changes may contribute to stress levels and injury risk as much as that encountered from major life events. Kanner, Coyne, Schaefer, and Lazarus (1981) suggested that one way major life events influence illness outcome is through all the minor hassles that accompany a major life stressor. For example, moving to a new city possibly involves loneliness, trying to adjust to a new climate, finding one's way around, and so forth. Daily hassles also occur independent of the experience of a major life event (Kanner et al., 1981). Most of the research efforts have not supported daily hassles as a contributor to injury risk (Blackwell & McCullagh, 1990; Hanson et al., 1992; Meyer, 1995; Smith, Smoll, & Ptacek, 1990; Van Mechelen et al., 1996), but these studies had methodological problems that prevented reaching a definitive conclusion. Each study measured daily hassles at only one time, either at the start or near the end of the season. Because of their ever-changing nature, daily hassles need frequent assessment throughout the athletic season. Researchers can then compare subsequent injuries to the immediately preceding score for stress from minor daily problems and hassles.

Fawkner, McMurray, and Summers (1999) employed such a design (i.e., assessed hassles on a weekly basis) and found that injured athletes had a significant increase in hassles (which they called minor life events) for the week prior to injury, whereas no significant changes occurred for the noninjured athletes. The researchers concluded that their results provided substantial evidence for a link between hassles and athletic injury. Byrd (1993) found modest support for a relationship between daily hassles and injury. Daily hassles predicted number of injuries in basketball (accounted for 13.1% of the variance), but not volleyball; nor did they predict days lost or modified due to injury. Although Byrd took monthly assessments of daily hassles, it appears as though the regression analysis included only the initial measure. For the correlations conducted between the 4 monthly measures of hassles and the injuries for the following month, the only significant association was between the preseason measure and the injuries during the 1st month. Fawkner et al.'s findings suggest that assessing changes in hassles on a weekly basis and noting increases in hassles may yield a more relevant measure of stress and risk for injury. Either way, these two studies offer some support for including daily hassles as an injury vulnerability factor. Measuring hassles may also form part of a prevention program in that athletes who begin to show increases in hassles may be targeted for some interventions to reduce those stressors and, one hopes, reduce their increasing injury risk.

Previous Injuries

The third component under history of stressors, previous injuries, was included in the stress-injury model for a number of reasons. If the athlete has not recovered enough to return to the sport, but does anyway, the probability of reinjury is high. Also, if the athlete is physically but not psychologically prepared to return to sport participation, problems may arise due to anxiety and negative cognitive appraisals. For example, in their initial stress-injury model paper, Andersen and Williams (1988) conjectured that fear of reinjury may lead to a considerable stress response, and thereby increase the probability of reinjury. Few researchers have examined the relationship of previous injury history to subsequent injury risk. Hanson et al. (1992) found that time since injury recovery was not related to frequency or severity of injury occurrence. In contrast, Williams, Hogan, and Andersen (1993) observed a positive correlation between prior injury and subsequent injury, and Lysens et al. (1984) found that physical education students with a prior history of injury were at higher risk of recurrence. Van Mechelen et al. (1996) noted that previous injury predicted sport injury better than psychological, psychosocial, physiological, and anthropometrical factors. One limitation of some of the preceding studies is that their design did not permit a distinction between the recurrence of an old injury and the occurrence of a new injury at another location. Another limitation of the Van Mechelen et al. study was that participation rates and injury incidence rates came from the participants' self-reports in daily entries on monthly logs kept for 12 months. One strength, however, was that they considered exposure time in their calculations of injury risk.

The most recent study (Maddison & Prapavesis, 2005) examining previous injury and psychosocial variables as conjunctive predictors of injury showed that athletes low in social support, high in avoidance coping, and with more previous injuries exhibited a stronger relationship between negative life events and injury outcome. These results are similar to the findings of Smith, Smoll, and Ptacek (1990), with the added conjunctive variable of previous injury. Smith et al., however, examined general coping, and not specifically avoidance coping.

In the history of stressors portion of the model, the life events-injury research has been the most robust area of inquiry into the psychosocial antecedents of sport injury. Daily hassles may prove to be an even better predictor of injury, if measured properly (see Fawkner et al., 1999). Injury risk, most assuredly, varies over a season, and a careful monitoring of athletes' stressors across a season may help identify those athletes who may benefit from interventions aimed at reducing stress and injury vulnerability.

Personality

Any comprehensive model of the relationship of stress to athletic injury would not be complete without considering personality. The stress-illness literature identifies many personality variables for their roles in moderating the stress-illness relationship. Certain personality characteristics may cause some individuals to perceive fewer situations and events as stressful or may predispose individuals to be less susceptible to the effects of stressors such as major life events and daily hassles. Most of the personality variables included in the initial stress-injury model (i.e., hardiness, locus of control, sense of coherence, competitive trait anxiety, achievement motivation) either moderated the stress-illness relationship or were examined in the sport injury literature.

The trait of psychological hardiness is a constellation of characteristics, such as curiosity, willingness to commit, seeing change as a challenge and stimulus to development, and having a sense of control over one's life (Kobasa, 1979). Locus of control (Rotter, 1966) and Antonovsky's sense of coherence (Antonovsky, 1985) were included in the list of personality factors because of their resemblance to the hardiness concept and because both constructs moderated the relationship between stress and illness. Locus of control is a concept dealing with the degree to which individuals view their lives and environment as under their personal control. An internal orientation is characterized by a belief that one's own actions control personal outcomes in life, whereas an external orientation is indicative of individuals who feel they are victims of chance or circumstances. Achievement motivation and competitive trait anxiety were included in the model because they are variables that appeared to relate to stress. Achievement motivation addresses both the need to succeed and the need to avoid failure. Trait anxiety is described as a general disposition or tendency to perceive situations as threatening and to react with an anxiety response (Spielberger, 1966).

Competitive trait anxiety is anxiety specific to competing in sport. Individuals with a high need to avoid failure, or who have high trait anxiety, may appraise more situations as stressful and consequently experience an elevated stress response compared to individuals with the opposite profile.

Of the five personality variables proposed in the initial presentation of the stress-injury model, no sport injury researchers assessed hardiness and sense of coherence, and only one study examined achievement motivation. In that study, Van Mechelen et al. (1996) found no relationship between achievement motivation and injury incidence. Mixed results occurred when researchers examined locus of control and trait anxiety. Pargman and Lunt (1989) reported that a higher injury rate correlated with an external locus of control in a sample of freshman college football players. In contrast, Kolt and Kirkby (1996) found no relationship in nonelite gymnasts, but a more internal locus of control significantly predicted injury in elite gymnasts. The other researchers who used nonsport measures to assess locus of control (Blackwell & McCullagh, 1990; Hanson et al., 1992; Kerr & Minden, 1988; McLeod & Kirkby, 1995) and trait anxiety (Kerr & Minden, 1988; Lysens et al., 1986; Passer & Seese, 1983) found no relationship between these variables and the incidence of injury. When researchers used sport-based tools to assess competitive trait anxiety rather than a general trait anxiety tool, athletes who scored high on competitive trait anxiety (Blackwell & McCullagh, 1990; Hanson et al., 1992; Lavallee & Flint, 1996; Passer & Seese, 1983; Petrie, 1993a) had more injuries or more severe injuries. It is only speculation, but anxiety about competition and return to play may have been associated with more severe injuries, measured by duration of time away from play, because those anxieties helped lengthen the recovery process. In Petrie's study, the finding that increases in trait anxiety were positively related to injury rate occurred for football starters, but not nonstarters. Petrie also found that competitive trait anxiety moderated the effects of positive life stress such that higher levels of anxiety and stress were associated with more days missed due to injury. He conjectured that the combination of starting and having high life stress and competitive trait anxiety

> may have negatively influenced these athletes' appraisals such that they either viewed practices and competitions as threatening/uncontrollable or believed they did not have the resources to cope. Such appraisals may have corresponded with attentional and physiological disruptions that would have increased the starters' vulnerability to injury. (p. 272)

Unfortunately, except for Petrie's (1993a), none of the preceding studies employed designs that permitted testing whether their personality variables interacted with history of stressors or with other personality and coping variables in influencing injury risk. Such limited designs will not elucidate the potential complexity of the relationship of personality factors to injury vulnerability and resiliency. This limitation, and the equivocal findings, indicates the need for more research into the relationship of locus of control and competitive trait anxiety to injury vulnerability. It also appears that sport-based instruments might yield more fruitful findings than general instruments.

In addition, when examining competitive trait anxiety, researchers may want to consider using a tool such as the Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, 1990) rather than the Sport Competition Anxiety Test (SCAT) used by previous researchers. The SCAT employs a unidimensional measure of anxiety, whereas SAS distinguishes between cognitive and somatic trait anxiety. Different levels of these subtypes of anxiety may differentially influence cognitive appraisals and attentional and physiological disruptions when in stressful practice or competitive situations. Contemporary anxiety researchers (e.g., Jones, 1995) also recommend assessing not merely the intensity of anxiety symptoms (e.g., using SCAT and SAS), but whether athletes interpret their anxiety symptoms as having a facilitative or debilitative effect on performance (referred to as direction of anxiety). The greatest vulnerability to injury may occur with athletes who have high anxiety and who interpret it as having a detrimental effect on performance. See Jones (1995) for a more thorough discussion of the conceptual distinctions between intensity and direction of anxiety, and for suggestions to modify current anxiety tools.

In terms of the postulated anxiety antecedents of injury, Cartoni (2005) found that among a sample of Italian gymnasts, fear of injury was greater for gymnasts with more experience in the sport. It may be that as one's career progresses and one experiences more injuries or sees more injuries among others, the anxiety over possible future injuries grows. That fear or anxiety may actually lead to greater risk of injury.

Andersen and Williams (1988) proposed that the personality factors they identified in the stress and injury model were primarily suggestions for initial research rather than an exhaustive list of potential factors. Recent findings with personality factors not included in the original model indicate merit for the inclusion of other personality variables in the stress and injury model. Although only one study examined the role of sensation seeking in injury risk, it clearly indicated that sensation seeking can moderate the effect of life event stress (Smith et al., 1992). According to Zuckerman (1979), sensation seeking represents a biologically based dispositional variable that reflects individual differences in optimal levels of arousal. High sensation seekers love an adrenaline rush, whereas sensation avoiders have a lower tolerance for arousal and, therefore, do not care for change, avoid the unfamiliar, and stay away from risky activities. Smith et al. determined that only those athletes who scored low in sensation seeking had a significant positive relationship between major negative sport-specific life events and subsequent injury time-loss. There was no support for a competing hypothesis that the characteristics of high sensation seeking (e.g., more risk-taking behaviors) would constitute an injury vulnerability factor. Also, although they found that sensation avoiders reported poorer stress management coping skills, no support existed for differences in coping skills mediating the injury vulnerability differences. The design of the Smith et al. study, which looked at potential interactions among their variables, provides an excellent prototype for the type of studies needed in future personality research.

Support also exists for adding personality mood states to the list of variables that influence injury data. Williams et al. (1993) concluded that intercollegiate football, volleyball, and cross-country athletes who experienced positive states of mind (e.g., ability to stay focused, keep relaxed, share with others) early in the season incurred significantly fewer injuries during their athletic seasons compared to athletes who had less positive states of mind. Perhaps even stronger findings might have resulted had they taken multiple assessments for positive states of mind and then compared subsequent injury rates to the immediately preceding positive states of mind measurement.

Whereas positive states of mind might buffer the effects of potentially stressful sport situations, thereby creating less stress and fewer injuries, the presence of negative states might do the opposite. Fawkner (1995) found exactly that when she assessed team and individual sport athletes' mood states (five negative and one positive) over the course of the competitive season. She noted significant increases in mood disturbance in the measurement immediately prior to injury. Lavallee and Flint (1996) also reported a relationship of negative mood states to injury vulnerability. Their significant correlation results indicated that a higher degree of tension/anxiety correlated with a higher rate of injury, and a higher degree of tension/anxiety, anger/hostility, and total negative mood state correlated with higher severity of injury. In a related study, Van Mechelen et al. (1996) stated that persons who reported vital exhaustion, which represented more feelings of depressed mood, malfunctioning, apathy, and anxiety, were more likely to sustain an injury. They "hypothesized that people in such a state may have exhausted their physical and mental resources and will respond inadequately or suboptimally to the physical and mental strain of sports participation" (p. 1177).

In other promising personality research, results indicated that some type of aggression, anger, or dominance measure is related to injury risk. Fields, Delaney, and Hinkle (1990) found that runners scoring high (e.g., more aggressive, hard-driving) on a Type A behavior screening questionnaire experienced significantly more injuries, especially multiple injuries, compared to runners scoring lower on this measure. In recent Type A behavior research with a large sample of Japanese collegiate athletes ($N =$ 2,164), Nigorikawa et al. (2003) found that athletes who rated high on Type A behaviors experienced more injuries than athletes with lower ratings. Personality data from Thompson and Morris (1994) indicated that high anger directed outward, but not inward, increases injury risk. Wittig and Schurr (1994) concluded that being tough-minded (i.e., more assertive, independent, self-assured) increased the likelihood of more severe injuries, but not the occurrence of injury. They conjectured that an athlete with this type of personality profile might take greater risks and, therefore, incur more severe injuries. Earlier research by Jackson et al. (1978) and Valiant (1981) revealed the opposite (i.e., tender-minded, dependent players received more injuries). Van Mechelen et al. (1996) determined that more dominant persons ran a higher risk of sports injury than those who were less dominant. Dominance was defined as self-reliance, trying to be or play the boss. Similar to the other researchers, they offered the possible explanation that dominant persons tend to play more central and more intense roles in sport situations and assume more risks to achieve their personal goals than persons with lower dominance. The apparent contradictory findings point to a general problem in personality research. Many personality variables (as measured by a wide variety of instruments) generally do not account for much variance in almost any outcome one wishes to measure. The personality variables included in the Williams and Andersen (1998) model, however, were chosen because they appeared most related to sport and stress. Some of the previous studies were atheoretical, not guided by models, and had somewhat shotgun or fishing approaches (e.g., using the 16-PF), and that may account for some of the disparities in findings.

Other researchers have examined defensive pessimism and obtained mixed results. F. Perna and McDowell (1993) reported that athletes who scored high on defensive pessimism, and who also experienced a high degree of life stress, experienced more illness and injury symptoms than did athletes scoring low on defensive pessimism and having fewer stressful life events. Of equal interest is their finding that athletes with the defensive pessimist profile took fewer rest days, especially under the high-stress conditions, than did optimists even though the pessimists experienced more illness and injury symptoms. Meyer (1995), however, in a similar study, did not replicate their results.

In their critique of the stress and injury model, Williams and Andersen (1998) proposed that more fruitful personality directions might occur from pursuing some of the variables identified in injury research since the development of the initial model. They also concluded that the identified personality factors (in research between 1988 and 1998), such as positive (Williams et al., 1993) and negative (Fawkner, 1995) states of mind, seem intimately tied to coping resources, thereby supporting modification of the stress-injury model to include a bidirectional arrow between personality and coping resources. For example, if athletes experience positive mood states, then it might follow that they could better use their coping resources when dealing with a stressful situation. Conversely, if they had poor cognitive and somatic coping skills, then stressful situations might more likely lead to negative states of mind. In a relatively recent study (Falkstein, 2000) that combined personality variables (sport anxiety, athletic identity) with coping (social support, coping resources) and situational (playing status) variables, the interconnectedness of psychosocial variables was extremely complex. Falkstein's doctoral dissertation on injury prediction and postinjury emotional responses provides evidence that negative life events were directly related to the occurrence of injury in U.S. collegiate football players. Social support, sport anxiety, coping, playing status, and athletic identity all had some moderating influence on the negative life stress-injury relationship. This study supported the Williams and Andersen (1998) model that suggests the psychosocial variables that may increase injury risk have both direct and complex indirect influences on injury outcomes. Future researchers may wish to examine the interplay between personality and coping resources and how they individually, or interactively, contribute to stress responsivity and, ultimately, injury outcome. Other avenues in personality, for example, physical self-concept and perfectionism, may also provide some insight into relationships between such factors and injury outcome. Perfectionism may be closely related to overuse injuries because athletes high in this variable may, in their quest to be perfect, have a tendency to overdo training and not allow enough time for recovery. Perfectionists might also be more prone to experiencing stress during practice and competition when their performance falls short of expectations.

Coping Resources

Coping resources comprise a wide variety of behaviors and social networks that aid the individual in dealing with the problems, joys, disappointments, and stresses of life. The resources may come from the environment, such as social support, or they may come from personal resources, such as emotional control and good nutrition. The presence of good coping resources may directly inoculate the individual against injury vulnerability or may attenuate the negative effects of stressors and personality traits (Williams, 1996).

The initial stress-injury model included general coping behaviors, social support systems, stress management and mental skills, and medication (self- or physician-prescribed) in the coping resources section. The general coping behaviors category encompasses such behaviors as sleep patterns, nutritional habits, and taking time for oneself. Agreement on what constitutes social support and the best way to measure it remains elusive. Social support is typically considered the presence of others who we know value and care for us and on whom we can rely (Sarason, Levine, Basham, & Sarason, 1983). The stress management techniques and mental skills (often referred to as psychological coping skills) an individual has at his or her disposal consist of psychological skills such as the ability to control arousal and to concentrate and think effectively under stress.

The last coping resource listed in the initial model was medication, self-selected or prescribed. Drug use is prevalent in society today. Many of these substances influence cognition, emotion, perception, and physiology and thus could affect the stress response and injury probability. Assessment of drug use is often difficult, if not impossible, because of the frequently clandestine nature of drug use. Unfortunately, researching the medication histories and practices of athletes poses too many problems (e.g., too few athletes taking the relevant drugs, lack of truthful reporting, the closeted nature of some drug taking) for researchers to have confidence in their results. Therefore, in their critique of the stress-injury model, Williams and Andersen (1998) recommended removal of this item from the model.

A lack of coping resources may easily lead to higher stress and thus greater risk of injury. In contrast, individuals may feel more capable of mastering the demands of stressful athletic environments when they possess one or all of the coping resources. Few researchers have examined whether the various coping resources listed in the model act singly or in combination. One might conjecture that the greatest stress response and stress-injury association would occur among sport participants low in all three variables (general coping behaviors, social support, and psychological coping skills). Correspondingly, the greatest injury resiliency would occur in sport participants possessing high levels of all three.

Considerable evidence exists for an athlete's coping resources either directly affecting injury outcome or moderating the influence life stress has on injury vulnerability. Williams, Tonymon, et al. (1986) found that the only predictor of injury among intercollegiate volleyball players was the level of coping resources (low levels associated with injury). Their measurement consisted of a rather simplistic, but easy to administer, global measure that included items assessing social support and general coping resources, such as eating and sleeping behaviors and taking time for oneself (L. H. Miller & Smith, 1982). Blackwell and McCullagh (1990) did not replicate the Williams et al. findings when they used the same coping resources questionnaire with intercollegiate football players. When Hanson et al. (1992) used a modification of the questionnaire (made it more appropriate for an athlete population), however, they found that coping resources contributed the most in discriminating group differences in both severity and frequency of injuries. Their injury groups had significantly fewer coping resources compared to the no-injury group.

Other researchers have examined social support alone or have separately assessed social support and psychological coping skills. Social support directly influenced sport injuries in three studies (Byrd, 1993; Hardy et al., 1990; Hardy, Prentice, Kirsanoff, Richman, & Rosenfeld, 1987). Athletes with high levels of social support had a lower incidence of injury, and those with low levels of social support had more injuries, regardless of life stress. These findings occurred only for males in the Hardy et al. (1990) study. In addition, Coddington and Troxell (1980), although they did not specifically examine social support, showed more injuries for high school football players who experienced family instabilities from life event stress object loss (e.g., separations, divorces, deaths) compared to those players who did not experience such object loss. In contrast, Lavallee and Flint (1996) and Rider and Hicks (1995) found no relationship between level of social support and injury vulnerability or resiliency.

Other researchers found that social support moderated the life stress-injury relationship, usually in the direction hypothesized by the stress-injury model, but not always. Studying female collegiate gymnasts, Petrie (1992) found that for gymnasts with low social support (bottom third scores on a measure of social support satisfaction), negative life stress accounted for 14% to 24% of the variance in minor, severe, and total injuries. No significant relationships between life stress and injury outcome occurred with any of the gymnasts in the high social support groups. Data on negative life stress alone accounted for only 6% to 12% of the variance in injury outcome. Petrie did not report statistics on whether social support directly influenced injury outcome. He proposed that social support, depending on the level, appears to function in two substantially different ways when athletes experience high negative life stress. High social support seems to protect the athletes from injury, but low social support appears to exacerbate the deleterious effects of life stress such that vulnerability to injury is increased significantly. Patterson et al. (1998) reached a similar conclusion when they studied ballet dancers. Among dancers who reported high levels of social support, negative life events were unrelated to injury, whereas stressful life events accounted for nearly 50% of the injury variance in dancers who reported low levels of social support in their lives.

In a subsequent study, Petrie (1993b) found that playing status moderated the social support-life stress injury relationship. No relationship emerged for nonstarters, but for football starters, more severe injuries, greater time loss, and more games missed occurred for players with high negative life stress and low social support. These findings replicated Petrie's (1992) findings and support the hypothesized relationship in the stress-injury model. Contrary to the 1992 study and the injury model, however, he also found that under conditions of lower stress, starters who reported high levels of social support were more likely to experience injury than those reporting low levels of support. As a possible explanation for this unexpected finding, he suggested that under conditions of lower stress, high social support may provide athletes with a greater sense of security and confidence. These, in turn, could translate into an increase in sport risk-taking behaviors and greater injury vulnerability.

In two studies, Hardy and colleagues (1990, 1991) found that social support moderated the relationship between life stress and injury depending on gender and the type of life stress. For females in the 1990 study, social support had both a negative and a positive effect on the relationship between life stress and injury. When low in social support (number of people and satisfaction), the life event measures accounted for 73% to 92% and 69% to 85%, respectively, of the variance in injury severity depending on whether TLE, NLE, or object loss (OL) scores were examined. For females high in social support (number of providers), TLE and OL scores accounted for 50% and 55%, respectively, of the variance in injury. The findings may have been an artifact of the small number of female players ($n = 20$) studied. Replication is needed before generalizing the results to other female soccer players.

In their 1991 study, Hardy and his colleagues found that high social support, when combined with high OL or PLE, had a negative rather than a positive effect on the well-being of male athletes. In contrast, for male athletes with high negative life events, injury rates decreased when the number of social support providers and the degree of fulfillment for emotional challenge support increased. The researchers concluded that social support was effective with the male athletes only to the degree that a match exists between the stressor and the support type. Hardy et al. (1991) also studied female athletes but found no relationship between social support and injury frequency and severity.

Andersen and Williams (1999) reported an injury outcome linkage between social support and stress responsivity. They examined the influence of life stress, social support, and stress responsivity (e.g., peripheral vision narrowing during stress) on injury outcome. For the entire sample of collegiate athletes, only negative life stress predicted injury outcome. When the sample was analyzed after dividing it into participants with high and low social support (median split), social support interacted with negative life stress and stress responsivity to predict injury outcome. For participants with low social support, higher negative life stress and increased peripheral narrowing during stress predicted 26% of injury variance. These results indicate that low levels of social support may directly influence the stress response and act in addition to life stress, leading to greater peripheral narrowing, and thus greater likelihood of injury.

A major methodological advance occurred when Smith, Smoll, and Ptacek (1990) studied life stress and two coping resources and then analyzed how the two moderators might interact with one another and life stress to increase or decrease vulnerability to injury. Their two coping resources included social support and psychological coping skills (e.g., the ability to think clearly under stress and to control arousal and concentration). The authors proposed a distinction between conjunctive moderation, in which multiple moderators must co-occur in a specific combination or pattern to maximize a relationship between a predictor (e.g., life events) and an outcome variable (i.e., some aspect of injury outcome), and disjunctive moderation, in which any one of a number of moderators contributes individually to the predictor-criterion relationship.

Smith, Smoll, and Ptacek (1990) found that coping resources moderated the life stress-injury relationship but did not directly affect injury occurrence. Athletes who were low in *both* social support and psychological coping skills exhibited the strongest correlation between major negative life events and subsequent injuries. For athletes who scored in the bottom third on both coping resource tools, negative life events accounted for 22% of the injury time-loss variance. The injury variance from life stress increased to more than 30% when comparing more extreme (lower quartile) social support and coping skills athletes. All groups having moderate to high levels of social support or psychological coping skills exhibited a nonsignificant relationship between life stress and injury. The results for athletes who had high stress but low coping resources suggest that social support and psychological coping skills operate in a conjunctive manner (need low scores on both) to produce high injury vulnerability for athletes with high negative life events. In contrast, for athletes with moderate or high scores on social support *or* psychological coping skills, disjunctive moderation led to a nonsignificant relationship between life stress and injury. That is, having either of the psychological assets reduced injury vulnerability.

The Smith, Smoll, and Ptacek (1990) study provides an excellent prototype for future injury research. Unfortunately, no other researchers have employed a similar design and statistics, perhaps because of the requirement for a large number of participants (e.g., Smith et al. studied 451 high school varsity athletes). In other studies that examined psychological coping skills using the same questionnaire as Smith and colleagues (Byrd, 1993; Lavallee & Flint, 1996; Petrie, 1993a; Rider & Hicks, 1995), no relationship was found to injury outcome. The difficulty in replicating the Smith, Smoll, and Ptacek findings is not surprising considering the differences in design and statistics among the studies. Byrd's study assessed only a direct relationship to injury vulnerability. The Lavallee and Flint and Rider and Hicks studies computed only a simple correlation between psychological coping skills and injury scores. These studies were also hampered by a small number of participants. Although Petrie used regression models that tested for both direct and interaction effects, Smith, Smoll, and Ptacek offered a compelling argument for why this type of analysis might mask significant results when differences are expected primarily because of individuals scoring more on the extreme ends than across the entire continuum of scores. Van Mechelen et al. (1996) also failed to link coping skills with injury. They are the first investigators to use a questionnaire that assesses problem-focused coping and emotion-focused coping.

In an area outside of sport but related to the physical demands of sport, Noh et al. (2005) measured coping in ballet dancers with a modified version of the Athletic Coping Skills Inventory-28 (ACSI-28). The participants were professional, university, and dance institute Korean ballet dancers. Noh et al. showed a relationship between coping and injury outcome. Freedom from worry and confidence were significant predictors of frequency of injury for ballet dancers. Those dancers who had more worries and lower confidence incurred more injuries.

Injury researchers may not know exactly how each type of coping resource affects injury vulnerability, but most research clearly supports the conclusion that social support either directly affects injury outcome, as hypothesized, or it moderates the life stress-injury relationship. Although more modest, support also exists for low levels of general coping behaviors putting athletes at greater risk of injury. Too few studies, however, have investigated general coping behaviors, particularly in terms of whether they might moderate level of stress, to reach any definitive conclusion. Another contaminate for reaching definitive conclusions is that coping and social support factors usually have been studied with questionnaires that yield single scores for these two multidimensional factors. More research also is needed to reach any conclusions regarding the relationship of psychological coping skills to injury. Although the preponderance of research evidence indicates that psychological coping skills do not influence injury, the strength of the design and the large subject pool in the one study that did find a positive finding (Smith, Smoll, & Ptacek, 1990) indicates that psychological coping skills should be studied further. This latter study also illustrates the importance of future researchers examining multiple coping resources and their interrelationships. One reason for the limited evidence for the relationship between coping and injury may be that most studies measure coping skills (e.g., ACSI-28) versus the more common measurement of coping in the general psychology literature (e.g., measuring coping styles such as problem-focused, emotion-focused, and avoidance coping; see Maddison & Prapavessis, 2005). Nevertheless, Van Mechelen et al. (1996) did not find support connecting these general coping styles with injury.

The Stress Response

Few researchers have tested the mechanisms proposed to explain how psychosocial factors influence the likelihood of injury. An elevated stress response, particularly the resulting increased muscle tension, narrowing of the visual field, and increased distractibility, is what Andersen and Williams (1988) hypothesized put individuals at greater risk for injuries. With one exception (Andersen & Williams, 1999), none of the studies of the stress response examined the relationship of stress reactivity to injury outcome. Instead, they examined the prediction of what should occur under low and high stress conditions to state anxiety, peripheral vision narrowing, central vision distractibility, and muscle tension for individuals with high compared to low injury risk profiles.

Only one study examined the connection between psychosocial factors and muscle tension under low and high stress conditions (Andersen, 1988). Andersen found increased muscle tension during the stress condition for the total group, but failed to support the model's hypothesis of even greater muscle tension for high-risk individuals. The failure to do so may have resulted from Andersen's studying the general population rather than a high-risk subpopulation.

When they compared performance under stressful and nonstressful laboratory conditions, Williams, Tonymon, and Andersen (1990, 1991) found that recreational athletes who had experienced many major life events during the preceding year reported higher state anxiety and greater peripheral vision narrowing during the high-stress condition compared to athletes who had experienced few major life events. The high-stress condition consisted of simultaneously performing the peripheral vision task and a Stroop color word task positioned in the central field of focus while listening to a tape that fed loud distracting phrases into the left ear and white noise and Stroop color words into the right ear. During the low-stress condition, the participants stayed in a quiet environment and performed just the peripheral vision task. A previous study (Andersen, 1988), which used a similar stress manipulation, found the same peripheral narrowing results for participants with high life stress as well as even greater narrowing when the experimenter moved the peripheral targets in slightly faster. The initial assessment moved the targets in as slowly as possible to eliminate any reaction time contaminate. In real-life situations, objects (e.g., people, balls) often approach from the periphery at very fast speeds, suggesting considerably greater deficits than those found in any of the laboratory studies.

The Williams et al. (1991) study assessed the effects of coping resources (social support and general coping behaviors such as diet, nutrition, and time for oneself) and daily hassles in addition to the effects of life change events. Coping resources did not affect stress reactivity directly but moderated the effects of the history of stressors. Recreational athletes with high negative life events or daily hassles, but who also had high coping resources, experienced less self-reported state anxiety during the stress condition compared to athletes with similar high stress but low coping resources. Coping resources, however, had no significant effect on peripheral narrowing.

Williams and Andersen (1997) were the first to determine if, under stressful conditions, performance by athletes with high injury risk profiles leads to experiencing greater distractibility in the central field of vision. Their measures of central vision deficits included missing or delayed response to important visual cues, responding to irrelevant cues, and lowering of perceptual sensitivity (d', a ratio of missing relative cues and reporting cues not present). They found that performance in the high- compared to low-stress condition led to significant deterioration on all the perceptual variables, but athletes with high negative life event scores experienced even slower central vision reaction time and greater peripheral narrowing than athletes with low life event stress. In addition, males with low versus high social support failed twice as often to detect central cues, whereas males with high negative life events, low social support, and low coping skills had the lowest perceptual sensitivity. For females, only one significant central vision deficit occurred. Females with high versus low negative life events had twice as many failures to detect central cues, but a significant interaction indicated that this failure occurred only with the group of females who also reported lower psychological coping skills.

None of the preceding studies tested the relationship of stress reactivity to injury outcome. In a later study, however, Andersen and Williams (1999) gathered relevant psychosocial data, tested their athletes' central and peripheral vision during high- and low-stress conditions, and then recorded the frequency of injuries for the following season. For their entire sample of athletes, only negative life events significantly accounted for variance in injury frequency (19%), but for athletes with low social support, negative life events coupled with changes in peripheral narrowing accounted for 26% of the variance in injury frequency. Low social support athletes with more negative life events and greater peripheral narrowing during stress incurred more injuries than low social support athletes with fewer negative life events and lesser peripheral narrowing during stress. Although modest, this study did connect the suggested mechanisms to actual injury outcome as proposed in the initial and modified stress and injury model (Andersen & Williams, 1988; Williams & Andersen, 1998). Recently, Rogers and Landers (2005) demonstrated that peripheral narrowing during stress mediated 8.1% of the negative life events-athletic injury relationship, providing further support for peripheral narrowing during stress contributing to injury outcome.

A completely different line of inquiry offers additional support for attentional disruptions mediating the stress-injury relationship. The Thompson and Morris (1994) study, cited under the history of stressors section, also determined whether the relationship of stressful life events to injury is mediated by impaired attention, either vigilant (broad, external) or focused (narrow, internal). Using the Symbol Digit Modalities test, they found that injury risk was elevated when recent life event stressors were present and when vigilance decreased, suggesting that stressful life events elevate injury risk by reducing vigilance. In addition, as the players' ability to focus attention increased, their likelihood of injury decreased significantly.

Although they did not study injury or psychosocial variables that might put participants at risk of injury, a perception study by Janelle, Singer, and Williams (1999) offers indirect support for the mechanisms proposed in the stress-injury model to explain why injury occurs with an elevated stress response. Janelle et al. examined distraction and attentional narrowing in a dual-task auto racing simulation. Participants assigned to the anxiety conditions were exposed to increasing levels of anxiety. The researchers found that at higher levels of anxiety, the identification of peripheral lights became slower and less accurate, and significant performance decrements occurred in central and peripheral tasks. The distraction anxiety group demonstrated the slowest response time and misidentified more peripheral lights than did any other group under high levels of anxiety. Assuming that athletes with a high psychosocial risk profile would respond to anxiety conditions with greater stress reactivity than athletes with a low psychosocial risk profile, these high-risk athletes should experience higher levels of the attention deficits found by Janelle et al., and these in turn could well place the individuals at greater risk of incurring an injury than athletes with a low-risk psychosocial profile.

When they critiqued their stress and injury model, Williams and Andersen (1998) recommended expanding the physiological and attentional aspects of the stress response section of the model to include audition deficits in addition to increased general muscle tension, narrowing of the visual field, and increased distractibility. In support of their recommendation, they cited the work of Landers, Wang, and Courtet (1985), which showed that deficits in audition occur under high-stress conditions in the sport of shooting. Shooters took significantly longer to respond to auditory cues when stressed. Although longer response times or failure to respond to auditory cues has little to do with injury for shooters, in other sports (e.g., contact sports) not responding or responding slowly to auditory warnings of danger could have serious implications for injury risk. Thus, Williams and Andersen believed there was merit for expanding the model, and the research, into the area of auditory detection during stress.

Finally, as discussed earlier, Petrie and Perna (2004) suggested expanding the model and the conceptualization of the stress response to include responses to physical training. They suggested that other outcomes, such as viral infections and maladaptation to training, should be included to gain a fuller picture of injury risk. These expansions to the model may provide fruitful avenues of research in the future.

INTERVENTIONS TO REDUCE INJURY VULNERABILITY

The least researched area in the stress-injury model is the implementation and assessment of interventions that might lessen the stress response and reduce injury vulnerability. The model suggests a two-pronged approach to prevent injuries from the increased stress reactivity of at-risk individuals. One set of interventions aims to change the cognitive appraisals of potentially stressful events, and the second set of interventions deals with modifying the physiological and attentional aspects of the stress response. In addition, these interventions and others may be used to directly influence the moderator variables under coping resources and personality factors. Interventions for the cognitive appraisal side of the stress response include techniques to eradicate thinking patterns that create maladaptive responses such as stress. Also included are interventions for fostering realistic expectations, a sense of belonging (e.g., team cohesiveness), and optimal coach-athlete communication. For example, if a sport psychologist can help coaches provide better communication with their athletes regarding their capabilities and potential, then the athletes may have more realistic appraisals of the demands and resources available in potentially stressful athletic situations. Hopefully, less maladaptive cognitive responses would result from this better coach-athlete communication. Interventions for the attentional and physiological aspects of the stress response aim at lowering physiological activation and enhancing concentration (e.g., progressive muscle relaxation, autogenics, concentration training).

Many sources provide detailed descriptions of the various interventions proposed to reduce the stress response. For example, Zinsser, Bunker, and Williams (2006) describe cognitive techniques such as thought stoppage and cognitive restructuring for both changing dysfunctional thinking and building confidence. Williams and Harris (2006) describe techniques to lower physiological activation levels (e.g., progressive muscle relaxation, meditation, autogenics, breathing exercises). Wilson, Schmid, and Peper (2006) describe numerous concentration training techniques to decrease distractibility and to help keep an appropriate attentional focus.

Partial support for the interventions portion of the model comes from a study in which DeWitt (1980) found that basketball and football players experienced noticeable decreases in minor injuries after participation in a cognitive and physiological (biofeedback) training program. Unfortunately, DeWitt gathered no objective data regarding physical injuries. Murphy (1988) described another psychological intervention program in which injuries were not the specific focus, but there may have been some injury benefits from the program. Murphy conducted relaxation sessions with 12 members of a team at the 1987 Olympic Sports Festival, five of whom had minor injuries and two serious injuries. They conducted relaxation sessions after every workout until competition and found that all 12 athletes were able to compete.

Davis (1991) reported an archival review of injury data collected by athletic trainers before and after two university teams practiced progressive relaxation and a technique/strategy imagery exercise during team workouts. Major findings included a 52% reduction in injuries to the swimmers and a 33% reduction in injuries to the football players during the athletic season in which they practiced relaxation and imagery skills. The results of these studies suggest that when sport psychologists initiate performance-enhancement programs, they should include assessment of possible injury-reduction benefits in addition to any assessment of improvement in performance.

Another favorable intervention study was conducted by May and Brown (1989), who used attention control, imagery, and other mental practice skills in their delivery of interventions to individuals, pairs, and groups of U.S. Alpine skiers in the Calgary Olympics. In addition to their mental skills training, they also employed team building, communication, relationship orientations, and crisis interventions. May and Brown reported that their interventions led to reduced injuries, increased self-confidence, and enhanced self-control. The injury benefits from the preceding intervention programs are even more impressive considering that none of them targeted athletes at risk of injury (they targeted athletes in general) and rarely did the intervention programs include cognitive or concentration training interventions.

A prospective injury prevention study conducted by Kerr and Goss (1996) offers more experimentally sound support for reducing stress and injuries through a stress management program. The participants were 24 gymnasts who competed at the national and international level. They were matched into pairs according to sex, age, and performance and then randomly assigned to a control or experimental group. Across an 8-month period, each experimental gymnast met individually with one of the experimenters for 16 one-hour, biweekly stress management sessions. Meichenbaum's stress inoculation training program provided the framework for the stress management program, which included skills such as cognitive restructuring, thought control, imagery, and simulations.

From midseason (4 months after preintervention assessment) to peak season (4 months following midseason and culminating at the national championships), the stress management group reported significantly less negative athletic stress and total negative stress and a trend toward more positive athletic stress compared to the controls. No differences existed at midseason (after 4 months). Although not statistically significant, from midseason to the national championships the stress management participants spent half the amount of time injured (5 versus 10 days) compared to the participants in the control group.

When discussing why the injury data did not reach significance, the experimenters speculated that their failure to introduce relaxation and distraction control skills until the 4th month may have meant that the gymnasts did not have the specific skills to cope with increased arousal and distractions soon enough to impact injuries. In a critique of the study, Andersen and Stoové (1998) proposed that not obtaining a statistically significant difference probably had more to do with the small number of participants in each group and the resultant low power than the effectiveness of the intervention. In fact, a substantial effect size occurred for injury incidence (i.e., 0.67, in the high-medium effect size range). Thus, the Kerr and Goss (1996) results are quite encouraging, both in terms of the injury prevention results and the reduction in stress from the psychological interventions.

The results of the earlier stress-injury studies that examined social support variables suggest that resiliency to sport injuries might increase with interventions designed to increase social support in athletes. Based on their disjunctive moderation findings for decreasing injury risk for athletes with high negative life stress, Smith, Smoll, and Ptacek (1990) proposed that, from an intervention perspective, resiliency to athletic injuries could be increased either by increasing social support in the athlete's life or by teaching athletes psychological coping skills. A number of strategies have been proposed for enhancing social support; some involved training of coaches (Smith, Smoll, & Curtis, 1979) and others team building (Nideffer, 1981). An article by Richman, Hardy, Rosenfeld, and Callahan (1989) is one of the best sources for a variety of strategies that coaches and sport psychologists could implement to affect the type and level of social support in student athletes. Also, Simpson, Byars, Hajart, and Garner (2003) have developed a program for sport injury rehabilitation that involves increasing social support. Their program can easily be modified for athletes in general and not just those in rehabilitation. To date, no researchers have tried to decrease stress or injuries by improving social support.

In an article that included a review of psychological interventions in sport injury prevention, Cupal (1998) concluded these past intervention studies have been based on cognitive appraisal models and have demonstrated a clear reduction in injuries or time loss due to injuries. She also states that in future intervention research, more sound research practices need to be observed. She suggests employing control and placebo groups, prospective longitudinal designs, and appropriate statistical analyses. She also recommends including larger sample sizes, matched participants, homogeneous populations, and randomization to control for extraneous variables that can affect treatment. Since Cupal's review, only a few intervention studies have emerged.

In their study of the effect of a video-based awareness program on reducing the rate of injuries in soccer players, Amason, Engebretsen, and Bahr (2005) reported that such a psychoeducational program, which involved information on injury risk, typical injuries, mechanisms of injuries, and the development of injury prevention strategies, had no effect on reducing injury rates. Their program was directed more at the physical aspects of injury prevention and did not address issues such as stress. Their findings suggest that greater knowledge of injury does not necessarily lead to lower risk.

In a recent study, Kolt, Hume, Smith, and Williams (2004) provided gymnasts with an injury prevention program of 12 1-hour sessions over 24 weeks (similar to the stress inoculation program in the Kerr & Goss, 1996, study). They found no statistically significant differences in injury between the control group and the gymnasts receiving the intervention. There was some effect size evidence that the program may have been effective (Cohen's *d* was .67, in the high-medium effect size range), but the statistical power of the study was quite low (only 10 participants in each group).

In a randomized clinical trial with collegiate athletes, F. M. Perna, Antoni, Baum, Gordon, and Schneiderman (2003; see also F. M. Perna, 2001) implemented a cognitive-behavioral stress management program. The program was based on Meichenbaum's stress inoculation training and was presented in seven sessions over 3.5 weeks. Male ($n = 14$) and female ($n = 20$) university rowers were randomly assigned to either a treatment group or a control group. F. M. Perna et al. found that athletes who had undergone the psychological intervention experienced fewer injury and illness days compared to the control group (Cohen's $d = .99$, a very large effect).

Although some of the previous studies did not have definitive results, the results they did have indicate that interventions to reduce injury risk may indeed be helpful. The promising results of these studies appear to suggest that psychological interventions are powerful risk-reducing tools given that none of the intervention programs actually targeted athletes at risk yet substantial changes in injury outcomes were noted. If low-, medium-, and high-risk athletes are not differentiated, and programs are given to all athletes regardless of risk status, then the effectiveness of intervention programs will be watered down because some participants are not likely to be injured. Even stronger findings might occur if only high-risk athletes were targeted for treatment. Recently, Johnson, Ekengren, and Andersen (2005) addressed this issue by first identifying high-risk soccer players in Sweden (those with many life events, low coping, high sport anxiety) and then dividing them into control and treatment groups. The soccer players in the treatment group received six cognitive-behavioral interventions (e.g., stress management, relaxation, goal setting, self-confidence training) and two telephone follow-up consultations about how the training was going. In the control group ($n = 13$), a total of 21 injuries occurred spread across 10 of the 13 participants (i.e., some athletes had two or three injuries during the season). In the treatment group, only three injuries occurred, one each for three of the 16 athletes who received the intervention. The results were statistically significant, but the statistical significance pales in comparison with the obvious and meaningful clinical significance of the results. Johnson et al.'s study provides a strong rationale for prescreening athletes to identify those at risk. From a cost-benefit point of view, such a tactic makes sense in that one does not use expensive resources (e.g., the time of the sport psychologist) needlessly. Also, from the low-risk athletes' point of view, the interventions may be time-consuming and probably of minimal benefit in reducing injuries. We note, however, that the design of earlier intervention studies provides no data on whether the injury reduction benefits of such interventions occur totally or primarily with high-risk athletes versus low-risk athletes.

In the most recent intervention study, Maddison and Prapavessis (2005) used a cognitive-behavioral stress management program for athletes identified as at risk (identified as either low in social support or high in avoidance coping or both). Their results showed that athletes in the intervention program reported missing less time due to injury than the at-risk athletes in the control group. The athletes in the intervention group also showed decreases in worry and improvements in coping after the stress management program. This study, along with Johnson et al.'s (2005), represent the latest research design models in prevention research; their results are encouraging.

SUMMARY OF FUTURE RESEARCH NEEDS AND DIRECTIONS

The complex, interactional stress-injury model proposed by Andersen and Williams (1988) has proven to be a viable theoretical foundation for conducting research on the psychology of injury risk. Considering the substantial support that exists for the different facets of the stress-injury model and for the hypotheses generated, Williams and Andersen (1998) concluded that no major changes in the model appear warranted. They did, however, offer some words of caution regarding acute and overuse injuries in addition to the minor model changes discussed earlier in this chapter.

According to Williams and Andersen (1998), the stress-injury model, as it stands, is probably most appropriate for acute injuries. For other types of injuries, such as overuse injuries, the causes and the mechanisms are largely known. Overuse injuries result from overuse and probably are not, or only minimally, mediated by mechanisms in the stress response. *Why* athletes overuse joints and muscle systems is another matter. Meyer (1995) has suggested that some personality traits may influence overuse injury outcome (e.g., perfectionism). Other chronic injuries, however, may come about through low-grade stress responsivity. In acute high-stress responses, all the attentional and physiological symptoms in the Andersen and Williams (1988) model may become manifest. In low-grade stress, possibly only generalized muscle tension is present. Some chronic injuries may result from performing with low-level antagonistic and agonistic muscles being simultaneously active, leading to undue strain on muscles and joints. This possibility of the development of chronic injuries through low-level stress responsivity has yet to be explored. Nor have previous researchers adequately addressed the general question of whether the mechanisms leading to an acute injury differ from those leading to overuse injuries.

Future researchers need to study multiple predictor and moderator variables and then determine the varying patterns by which these variables interact with one another to affect the hypothesized stress response and injury vulnerability and resiliency. In addition, the joint influence of social support and psychological coping skills found by Smith, Smoll, and Ptacek (1990) appears particularly promising as a focus for future research. Whether their disjunctive and conjunctive patterns apply to other sports and age groups (e.g., intercollegiate and professional athletes) and to other personality and coping resources variables remains to be determined. Researchers also should consider measuring their psychosocial variables on multiple occasions across the time period of interest, as recommended by Petrie and Falkstein (1998) in a paper on methodological, measurement, and statistical issues in research on sport injury prediction.

One difficulty in studying multiple predictor and moderator variables and, correspondingly, subgroups of individuals that fall in the extreme on the variables is the need for very large sample sizes. Practical necessity suggests that future researchers should consider involving investigators from a number of geographical areas. An additional benefit from such an approach is enhanced generalizability of the results. Regardless of where the sample of participants is drawn from, at the start of the study the athletes should be asymptomatic, that is, free from any time-loss injury or restrictions on type of participation. If researchers fail to follow this protocol, they should separate out injured athletes to determine what impact their existing injury has on future injuries and the relationship of predictor and moderator variables to injury outcome. As indicated in the Andersen and Williams (1988) model, prior injuries may be one source of stress in an individual's history of stressors that increases injury vulnerability.

Future researchers also need to determine if sport differences, gender, competitive level, and playing status differentially affect the relationship between psychosocial factors and injury outcome. Although most of the studies reviewed in the life event stress-athletic injury area found some association between life stress and injury outcome, there was considerable variance across studies in the strength of the relationship. Individual differences in relevant psychosocial variables that were not measured probably contributed to some of these differences, but so, too, may have differences in gender, sport, and competitive level. The risk for different types of injuries and the timing of injuries (e.g., whether before, during, or after competition and whether when winning or losing) also merits investigation when addressing the preceding suggestions.

In implementing these suggestions, and others, researchers should continue to use prospective designs and to gather objective injury data (i.e., monitored and recorded by certified athletic trainers or other qualified personnel) rather than a self-determination of injury. Fortunately, fewer than 20% of past stress-injury researchers have reported a retrospective design and/or failed to gather objective injury data.

Another dimension that affects one's ability to accurately make comparisons across studies is the operational definitions for psychosocial variables (particularly life event stress) and injury. As noted earlier, past researchers varied considerably in the tools used to measure life event stress and the criteria for being injured. Future researchers need to determine the optimal tools for measurement of stressors, personality variables, and coping resources as well as the most meaningful criteria for injury outcome. In terms of life event stress, tools that are sport-based and that measure stress through the respondent's perception of the life event's desirability and impact (e.g., Athletic Life Events Survey [ALES]) appear superior to those in which a standardized weighting is given (e.g., Social and Athletic Readjustment Rating Scale [SARRS]). Data on the newer Life Events Survey for Collegiate Athletes (LESCA) meet both those criteria, plus the survey demonstrates excellent content validity and provides a stable measure of life stress (Petrie, 1990b). It also was found to be a better predictor of athletic injury in collegiate gymnasts than the SARRS; the LESCA may be the best measure of life event stress in sport. In making decisions about instrumentation for personality variables and coping resources, future researchers also should consider whether the questionnaires under consideration are general or sports-based. Sports-based questionnaires appear more effective than general questionnaires in predicting athletic injury. This finding has occurred when measuring trait anxiety and locus of control as well as life event stress.

Regarding assessment of injuries, the most commonly used approach has been some type of time-loss measure. Another approach is the number of injuries received, and some researchers have even included injuries that required treatment but no modification of activity. When operationally defining injury, few injury researchers have made a correction to the injury measure based on exposure (i.e., the opportunity to incur an injury). Both Smith, Smoll, and Ptacek (1990) and Van Mechelen et al. (1996), who did so, discuss the importance of such an adjustment and illustrate how to operationalize exposure-corrected injuries. See Petrie and Falkstein (1998) for a more complete discussion of measurement issues.

New statistical analyses also might advance the effectiveness of future psychology of injury research. In assessing the effects of moderator variables, Smith, Smoll, and Ptacek (1990) made a compelling argument for their correlational approach rather than multiple regression analyses. They noted that a moderated regression analysis (Baron & Kenny, 1986; Cronbach, 1987) is the most frequently recommended approach for assessing moderator influences. Such an analysis examines the main effects of the predictor and moderator variables as well as the interactions between and among the variables. Smith, Smoll, and Ptacek and other researchers (e.g., Dunlap & Kemery, 1987; Hedges, 1987), however, note that this type of analysis often fails to reveal moderator effects, particularly when the significant predictor-criterion relation occurs in only a small subsample. A small at-risk subsample may well be the case in athletic injury research (e.g., Smith, Smoll, & Ptacek, 1990).

Petrie (1990a) offers another statistical suggestion for future researchers. He recommends that covariance structure modeling (CSM) be used to determine the validity and practical significance of the Andersen and Williams (1988) theoretical model. Covariance structure modeling allows for the simultaneous specification of the measurement and structural components of theoretical models. After obtaining as much data as possible on the stress history, personality, coping resources, and stress responsivity variables within the model, CSM can determine hypothesized relationships among the variables. The correlations or covariances among the measured variables are used to determine the plausibility of each causal model in the specified population. In addition, Petrie notes that CSM can investigate the psychometric adequacy (in terms of construct validity) of the variables.

Many of the injury prediction designs discussed here have employed multiple regression designs. There is, however, a problem with using such designs, which take a variety of psychosocial variables and try to predict some injury outcome (e.g., frequency of injury, severity). In most of the studies using regression designs, at least half (or more) of the athletes were uninjured over the course of the studies. So, for variables such as injury frequency or days lost due to injury, usually over 50% of the sample have scores of 0. Because the criterion or predicted variable in many of the studies is so radically skewed and violates a basic assumption of multiple regression (i.e., normality), one must be cautious in interpreting regression equations stemming from such data. A way around such problems is logistic regression using psychosocial variables (taken at the beginning of the season) to predict group membership (injured versus noninjured) at the end of the season.

Although support exists for the risk factors influencing the mechanisms proposed in the model, particularly peripheral narrowing, more research is needed to determine if experiencing the different perceptual and physiological aspects of the stress response influence the occurrence of injury. Stress responsivity data, when used in conjunction with paper-and-pencil tests, may provide the clearest picture of injury risk and the best foundation for designing intervention programs to reduce injury risk. Andersen and Williams (1993) noted that stress reactivity has been used for years in medical research. For example, in assessing risk of cardiac disease, paper-and-pencil tests for Type A behavior and other variables are administered and patients are monitored physiologically during a stress test. It is time for a similar approach to athletic injury research and assessment. See Andersen and Williams (1999) and Williams et al. (1990, 1991) for suggestions of how this might be done. Researchers also should consider simultaneously examining psychosocial variables and physical factors that can contribute to injury risk to determine the relative contribution of psychosocial factors compared to other factors. In one of the few studies in which this was done, Van Mechelen et al. (1996) found that physical fitness and anthropometrical variables were not related to the risk of sustaining a sports injury, whereas psychological factors did have a significant relationship.

One of the most exciting avenues for future researchers is the implementation and assessment of prospective injury prevention programs. More specifically, with what types of interventions and subpopulations are injury rates and severity of injures most likely to be improved? The variable of primary concern is injury rate, but another approach is to monitor the gains athletes make in controlling stress reactivity by retesting them on the psychophysiological and perceptual stress measures previously described. Moreover, does decreasing stress responsivity improve injury resiliency? Once these questions are answered, practitioners will be able to plan the most feasible, cost-effective, and beneficial interventions for reducing injury vulnerability.

Davis (1991) noted that additional pathways by which interventions might reduce injury vulnerability are through performance enhancement and better pain management. Although not documented, Davis noted that athletic trainers have experienced that athletes are more likely to report injuries following losses and less likely after wins. Regarding the pain management benefits (Kendal & Watson, 1981) of relaxation training, when athletes experience less pain from injuries, they may not complain as much to athletic trainers or they might recover quicker. A related issue in pain reporting is the culture of sport, where, in many cases, not complaining and playing with pain are cultural norms that represent injury-risk factors. At minimum, researchers of injury prevention interventions should consider monitoring potential performance as well as injury prevention benefits, and implementers of performance-enhancement programs should include assessment of possible injury-reduction benefits as well as improvements in performance.

IMPLICATIONS FOR THE PRACTITIONER

Injuries influenced by psychosocial variables need to be recognized and viewed more as avoidable rather than unavoidable events. In the same way that coaches and other sports personnel attempt to reduce injury risk through vehicles such as conditioning programs, teaching proper techniques, and providing advances in equipment and facilities design, the time has come to reduce injury risk from psychosocial causes. Some earlier researchers (e.g., Bramwell et al., 1975; Hardy & Riehl, 1988) argued that clinical use of knowledge regarding psychosocial injury risk factors is premature. We argue instead that the monetary, personal, and team or organizational cost of injuries is so serious that we should not overlook any potential means of reducing injuries.

At minimum, sport psychologists should start to educate coaches, athletic trainers, and other sports medicine personnel about the psychosocial variables that may influence injury. Such knowledge might lead to coaches and other relevant personnel increasing their awareness regarding non-sport aspects of an athlete's life that might be causing stress. This increased sensitivity may even lead to providing greater social support, and thus potentially buffering some of the harmful effects of stress. Coaches also may want to consider temporarily modifying training by reducing levels of intensity and risk for athletes who they know are currently experiencing many disruptive stressors and who do not have adequate coping resources. Other subtle, and not so subtle, modifications can be made to reduce unnecessary sources of psychological stress in the practice and competitive environments.

Ultimately, coaches and sport psychologists should consider implementing intervention programs for athletes with high injury risk profiles (e.g., many stressors, exacerbating personality characteristics, few coping resources). The Johnson et al. (2005) study provides a strong rationale for identifying and offering treatment to those athletes who appear to be at risk. Learning techniques for changing maladaptive thinking patterns and for recognizing and controlling indicants of physiological arousal should help athletes cope better with stressful events, thereby increasing injury resiliency. Teaching attentional skills designed to increase the ability to focus attention, particularly when under stress, is another potential strategy for injury prevention. Although data to support the injury prevention benefits from such intervention programs are limited, the few relevant studies have yielded only positive results, and a solid theoretical foundation exists for the recommendations. Another possible consequence of implementing such programs is that the athletes may merely experience performance benefits.

A more elaborate approach for identifying at-risk athletes in need of interventions is to include a psychosocial risk assessment as part of the general physical exam at the start of the athletic season. At minimum, assessment should include life events and coping resources. Until researchers can document a stronger and more consistent relationship between injury risk and personality variables and daily hassles, there does not appear to be merit in including these variables in the assessment. As new findings emerge, there also may be benefits to including an assessment of stress reactivity.

An important caution in any injury risk screening is that the information be used merely to design optimal, cost-effective injury prevention interventions and strategies and not for the purpose of excluding an athlete from sport participation (Andersen & Williams, 1993). Practitioners and researchers should never lose sight of the distinction between group and individual prediction. In all studies, there were many athletes with high-risk profiles not being injured and athletes with low-risk profiles sustaining injuries. The ultimate value of research dealing with psychosocial risk factors is the potential for using the knowledge to reduce the tragedy and expense caused by avoidable injuries. It is essential that this knowledge is interpreted properly and not used in any way that would prove detrimental to the athlete.

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CHAPTER 18

Psychology of Sport Injury Rehabilitation

BRITTON W. BREWER

Although sport and exercise participants may reap rewards as a result of their involvement in physical activity, so, too, may they encounter risks. Physical injury is paramount among these risks. Epidemiological data suggest that sport injury is a pervasive public health problem (Caine, Caine, & Lindner, 1996). In the United Kingdom, sport or exercise was the single leading source of injury in a population survey, accounting for approximately one-third of all injuries (Uitenbroek, 1996). In Australia, sport-related injuries were identified as responsible for 20% of child and 18% of adult hospital emergency room visits (Finch, Valuri, & Ozanne-Smith, 1998). In the United States, child and adult participants in sport and recreation sustain an estimated 7 million injuries annually (Conn, Annest, & Gilchrist, 2003), more than 2 million of which result in hospital emergency room visits (Burt & Overpeck, 2001). The personal and societal costs associated with sport injuries are astronomical. During a 1-year period in the state of North Carolina, injuries incurred by high school athletes in 12 sports were projected to produce long-term medical costs of $10 million and lost earnings of $19 million (Weaver et al., 1999).

In addition to the adverse impact sport injury can have on physical functioning and, concomitantly, on sport performance, sport injury can exact a psychological toll that is manifested in terms of cognition, affect, and behavior. Despite the traditional focus of sports medicine on identifying physical factors that improve the quality of rehabilitation and hasten the return to sport participation of athletes with injuries, appreciation of the role of psychological factors in sport injury rehabilitation has grown over the past 4 decades. The purpose of this chapter is to review research addressing the psychology of sport injury rehabilitation. Following a discussion of theoretical perspectives pertaining to psychological aspects of sport injury rehabilitation, research on psychological responses to sport injury, psychological factors in sport injury rehabilitation, and social interactions in sport injury rehabilitation is examined. Finally, directions for future psychological research on sport injury rehabilitation are provided.

THEORETICAL PERSPECTIVES

Theory is vital to the advancement of research on psychological aspects of sport injury rehabilitation. A biopsychosocial model and several psychological models have emerged to elucidate the role of psychological variables in sport injury rehabilitation.

Biopsychosocial Model

To examine psychological factors within the overall context of sport injury rehabilitation, a theoretical framework that merges medical and psychological viewpoints is needed. As with other health outcomes (Cohen & Rodriguez, 1995; Matthews et al., 1997), research on sport injury rehabilitation has given rise to an integrative model that incorporates myriad factors involved in sport injury rehabilitation processes and outcomes. Brewer, Andersen, and Van Raalte (2002) introduced a biopsychosocial model of sport injury rehabilitation designed to widen the focus of sport injury

Preparation of this chapter was supported in part by grant number R29 AR44484 from the National Institute of Arthritis and Musculoskeletal and Skin Diseases. Its contents are solely the responsibility of the author and do not represent the official views of the National Institute of Arthritis and Musculoskeletal and Skin Diseases.

rehabilitation research and provide an integrative framework to incorporate existing models pertaining to sport injury rehabilitation (cf. Flint, 1998; Wiese-Bjornstal, Smith, Shaffer, & Morrey, 1998).

As depicted in Figure 18.1, the model has seven key components: injury, sociodemographic factors, biological factors, psychological factors, social and contextual factors, intermediate biopsychological outcomes, and sport injury rehabilitation outcomes. According to the model, injury (the occurrence of physical damage) initiates the sport injury rehabilitation process. The type, cause, severity, location, and history of injury are thought to influence not only biological factors, but also psychological and social and contextual factors. In providing the background against which sport injury rehabilitation takes place, sociodemographic factors (e.g., age, gender, race and ethnicity, socioeconomic status) are posited to exert a parallel influence on biological, psychological, and social and contextual factors. Occupying a central role in the model, psychological factors are considered to have reciprocal relationships with both biological factors and social/contextual factors. Direct paths to the endpoint of the model, sport injury rehabilitation outcomes, are hypothesized for psychological factors and intermediate biopsychological outcomes (e.g., range of motion, strength,

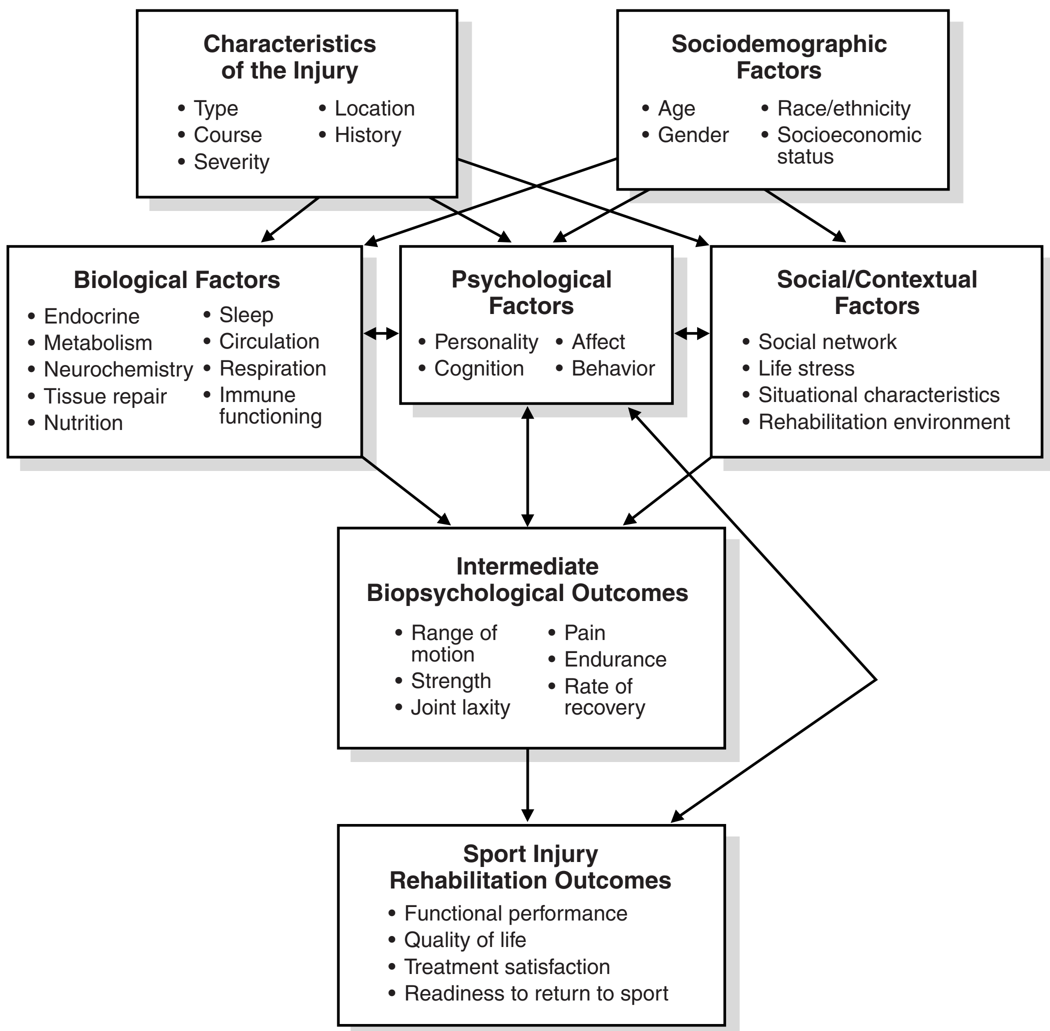

Figure 18.1 A biopsychosocial model of sport injury rehabilitation. *Source:* "Psychological Aspects of Sport Injury Rehabilitation: Toward a Biopsychosocial Approach" (pp. 41–54), by B. W. Brewer, M. B. Andersen, and J. L. Van Raalte, in *Medical and Psychological Aspects of Sport and Exercise,* D. Mostofsky and L. Zaichkowsky (Eds.), 2002, Morgantown, WV: Fitness Information Technology. Reprinted with permission.

joint laxity, pain, endurance, recovery rate), the latter of which are thought to be affected by biological and psychological factors. The paths between psychological factors and both intermediate biopsychological outcomes and sport injury rehabilitation outcomes are proposed as bidirectional.

Psychological Models

Although the biopsychosocial model (Brewer et al., 2002) provides a broad-based framework for investigating the sport injury rehabilitation process and offers potential explanations for how psychological factors can affect sport injury rehabilitation outcomes, it does not articulate proposed relationships among specific psychological factors. Consequently, to better understand the psychology of sport injury rehabilitation, it is instructive to examine psychological models that elaborate on some of the features of the biopsychosocial model. Most of the extant psychological models in the sport injury rehabilitation literature can be categorized as either stage models or cognitive appraisal models (Brewer, 1994).

Stage Models

Adapted to the context of sport injury from research on psychological reactions to terminal illness and other sources of grief and loss, stage models have been used to describe psychological responses to sport injury. The key assumptions of stage models are that injury constitutes a loss of an aspect of the self (Peretz, 1970) and that psychological responses to sport injury follow a predictable sequence. In applying the model proposed by Kübler-Ross (1969) to sport injury, researchers (e.g., Astle, 1986; Lynch, 1988; Rotella, 1985) have suggested that athletes with injuries pass sequentially through stages of denial, anger, bargaining, and depression before arriving at acceptance of their injuries. Although the Kübler-Ross model has been especially popular with sport psychologists, other, similar models of adjustment to sport injury, varying in number and content of stages, have been proposed (Evans & Hardy, 1995).

As described in the subsequent section on psychological responses to sport injury in this chapter, empirical support has accrued for the premise that sport injury can elicit reactions consistent with a grief response (Macchi & Crossman, 1996). Moreover, as hypothesized by most stage models, emotional responses to sport injury tend to become more adaptive over time (e.g., McDonald & Hardy, 1990; Smith, Scott, O'Fallon, & Young, 1990). Nevertheless, as with the extensive body of research on psychological reactions to undesirable events (see Silver & Wortman, 1980, for a review), the contention that athletes respond to sport injury in a stereotypic, stage-like manner has not stood up to empirical scrutiny (Brewer, 1994). Research has suggested that the way athletes react psychologically to injury is highly variable across individuals and depends on a variety of factors, including personal characteristics of the athletes and aspects of the situations in which injury and rehabilitation occur (Brewer, 1994; Wiese-Bjornstal et al., 1998).

Recent conceptualizations of the grief response are more dynamic and less stereotypic across individuals than those typically invoked by sport psychologists applying stage models to sport injury (Evans & Hardy, 1995, 1999). Although such theoretical developments weaken the precision and predictive value of stage models (Rape, Bush, & Slavin, 1992), they enable stage models of grief and loss to be integrated with (Evans & Hardy, 1995, 1999) or subsumed by (Wiese-Bjornstal et al., 1998) models that recognize the importance of individual and contextual differences in the psychological consequences of sport injury.

Cognitive Appraisal Models

Constituting the second major category of psychological models of response to sport injury, cognitive appraisal models are a group of related conceptual frameworks that borrow heavily from stress and coping theory and ascribe a central role to cognition in determining psychological reactions to sport injury. Although several cognitive appraisal models have been proposed (e.g., Gordon, 1986; Weiss & Troxel, 1986), the integrated model set forth by Wiese-Bjornstal et al. (1998) is perhaps the most evolved and well-developed.

As displayed in Figure 18.2, the integrated model holds that responses to injury are influenced by both preinjury variables (i.e., personality, history of stressors, coping resources, interventions) and postinjury variables. Of the postinjury variables, the way the injury and the rehabilitation process are interpreted (or appraised) is thought to affect three interrelated parameters: emotional responses, behavioral responses, and recovery outcomes. Characteristics of the person (i.e., injury attributes, individual difference variables) and the situation (i.e., sport-related variables and aspects of the social and physical environment in which rehabilitation is occurring) are posited to have a direct effect on cognitive appraisals. As assessed in research investigations, situational factors sometimes overlap with cognitive appraisals in that *perceptions* of the situation are measured in lieu of an objective evaluation of the situation itself (because, in many cases, objective indices of the situation may not exist or feasibly be created). Overlap

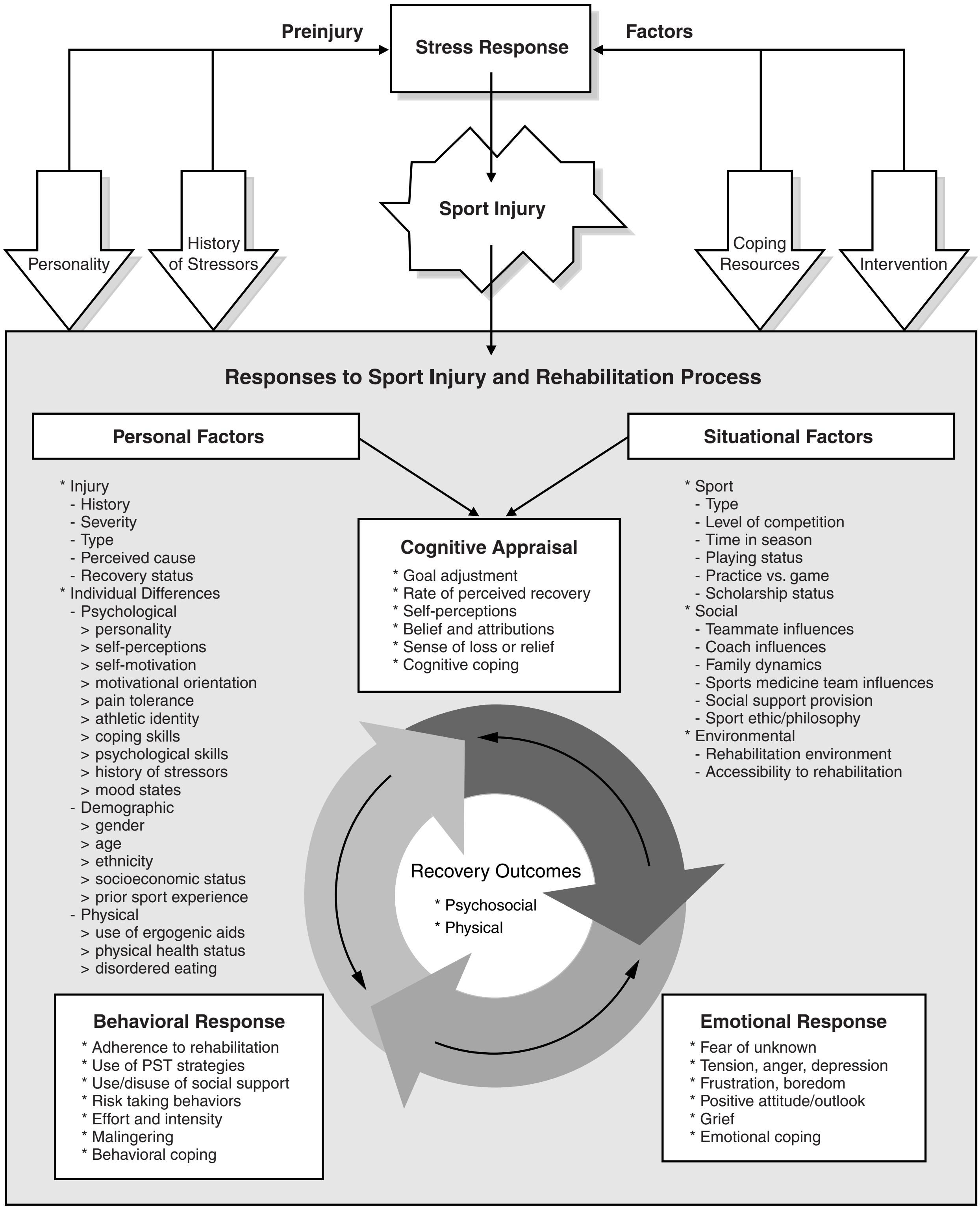

Figure 18.2 Integrated model of psychological response to the sport injury and rehabilitation process. *Source:* "An Integrated Model of Response to Sport Injury: Psychological and Sociological Dimensions," by D. M. Wiese-Bjornstal, A. M. Smith, S. M. Shaffer, and M. A. Morrey, 1998, *Journal of Applied Sport Psychology, 10,* p. 49. Copyright 1998 by the Association for the Advancement of Applied Sport Psychology. Reprinted with permission.

of this sort translates into difficulty in making inferences about whether it is a situational variable or a cognitive appraisal of the situation that is associated with another variable of interest. Similarly, the distinction between personal factors and situational factors is not always clear-cut. Although injury attributes indicate a characteristic of the person, for example, such attributes are highly variable over time and therefore reflective of the particular situation in which the person finds himself or herself. These limitations should be kept in mind when examining the review of research findings that follows.

Considerable empirical support has been amassed for aspects of cognitive appraisal models in general and the integrated model in particular. Research has indicated that sport injury is a significant source of stress (Bianco, Malo, & Orlick, 1999; Brewer & Petrie, 1995; Ford & Gordon, 1999; Gould, Udry, Bridges, & Beck, 1997b), that personal and situational factors are associated with psychological responses to sport injury (Brewer, 1994, 1999a), and that psychological responses are related to sport injury rehabilitation outcomes (Brewer et al., 2002). Although mediational predictions generated from cognitive appraisal models have not been supported in preliminary investigations (Brewer, Van Raalte, et al., 2000; Daly, Brewer, Van Raalte, Petitpas, & Sklar, 1995), the utility of cognitive appraisal models in offering a flexible yet testable conceptual framework has been demonstrated across a growing body of research.

PSYCHOLOGICAL RESPONSES TO SPORT INJURY

Since the publication of a seminal study by Little (1969) reporting that physical injury could precipitate neurotic symptoms in athletic men, the topic in the psychology of sport injury rehabilitation that has attracted the most empirical attention is the impact of sport injury on psychological functioning. In this section of the chapter, research on psychological responses to sport injury is reviewed. Cognitive, emotional, and behavioral responses are examined, consistent with a cognitive appraisal approach to investigating psychological aspects of sport injury rehabilitation.

Cognitive Responses

Given the centrality of cognition to cognitive appraisal models, relatively few studies have addressed cognitive processes in athletes with injuries. Research on cognitive responses to sport injury has focused on four main topics: attributions for injury, self-perceptions following injury, coping strategies, and perceived benefits of injury.

Attributions for Injury

Unexpected events have been shown to stimulate attributional processes (Wong & Weiner, 1981). As a generally unanticipated, sometimes traumatic occurrence, sport injury would be expected to produce attributional cognitive activity. Data in support of this position have been obtained in several studies in which athletes have had little difficulty generating causal attributions for their injuries (Brewer, 1999b; San Jose, 2003; Tedder & Biddle, 1998). Interestingly, whereas participants in the San Jose and Tedder and Biddle studies tended to attribute their injuries to behavioral factors, participants in the Brewer study tended to list mechanical or technical factors as responsible for their injuries. Consistent with a cognitive appraisal approach, it is likely that both personal factors (e.g., attributional style, locus of control) and situational factors (e.g., social context) contribute to the causal explanations for injury that athletes produce.

Self-Perceptions Following Injury

Recently, researchers have examined self-referent cognition in association with sport injury. They have assessed the self-perceptions (e.g., self-esteem, self-worth) of athletes with injuries both over time following injury and in relation to athletes without injuries. Findings are equivocal with respect to global self-esteem. Although some studies have documented decreases in global self-esteem after injury (Leddy, Lambert, & Ogles, 1994) or differences in global self-esteem as a function of injured/uninjured status (Chan & Grossman, 1988; Kleiber & Brock, 1992; Leddy et al., 1994; McGowan, Pierce, Williams, & Eastman, 1994), other studies have shown no preinjury-postinjury differences (Smith et al., 1993) or injury status differences (Brewer & Petrie, 1995) in global self-esteem. For domain-specific physical self-esteem, Leddy et al. reported a preinjury-postinjury decrement and lower scores for athletes with injuries than for athletes without injuries.

Consistent with what would be predicted from a cognitive appraisal perspective, two published studies have documented associations between self-referent cognitions and personal or situational factors. Kleiber and Brock (1992) found that athletes who were highly invested psychologically in playing sport professionally and who had sustained a career-ending injury had lower self-esteem than their counterparts who were less psychologically invested in being a professional athlete. Quinn and Fallon (1999) also found temporal differences in sport self-confidence over the sport injury rehabilitation period, with athletes starting rehabilitation high in confidence, experiencing a decline in confidence during rehabilitation, and increasing in confidence on attaining recovery. Thus, preliminary data suggest that self-related cognitions may be subject to personal and situational influences.

Coping Strategies

To deal with the physical and psychological trauma that can be associated with incurring a sport injury, athletes with injuries initiate coping efforts. Only recently, however, has the scientific study of coping become a part of the sport injury research agenda. Various methods (i.e., qualitative, quantitative) and measures have been used to investigate coping with sport injury. One regularity to emerge from the early data on coping with sport injury is that cognitive processes are used to combat the intrusive thoughts (Newcomer & Perna, 2003) and other psychological consequences of sport injury.

Qualitative studies, which have been conducted primarily with skiers, offer evidence that the use of cognitive coping strategies by athletes with injuries is common and is marked by themes such as accepting injury, focusing on getting better, thinking positively, and using imagery (Bianco et al., 1999; Gould, Udry, Bridges, & Beck, 1997a; Rose & Jevne, 1993; Tracey, 2003; Udry, Gould, Bridges, & Beck, 1997). These qualitative findings have been bolstered by the results of quantitative studies, which have substantiated the use of a similar array of cognitive coping strategies by athletes from a wide variety of sports following injury (Quinn & Fallon, 1999; Udry, 1997).

In line with a cognitive appraisal perspective, associations between reported use of certain coping strategies and selected personal and situational factors have been documented. Several researchers have reported temporal effects in the use of coping strategies, although the use of different coping measures in each study precludes making comparisons across studies. Udry (1997), in examining coping strategies over the course of rehabilitation following knee surgery, found that two emotion-focused coping strategies (i.e., negative emotion coping, palliative coping) varied depending on the particular stage of rehabilitation. Similarly, individuals participating in rehabilitation following an acute musculoskeletal injury indicated that they decreased the use of 9 out of 10 of the coping strategies assessed (Johnston & Carroll, 2000). In contrast to the findings of Udry and Johnston and Carroll, Quinn and Fallon (1999) reported that athletes did not differ in the use of passive coping and emotion-focused or denial coping strategies across multiple assessments of coping strategies during injury rehabilitation. The results of Quinn and Fallon notwithstanding, it is clear that athletes deploy a common core of strategies to cope with their injuries and that implementation of these strategies varies systematically with individual difference and contextual factors.

Perceived Benefits of Injury

Although the cognitive content of athletes with injuries is often characterized by appraisals of threat or loss (Ford & Gordon, 1999; Gould et al., 1997b), injury may produce more benign thought content in some instances. A growing body of qualitative research suggests that despite the psychological turmoil that can accompany sport injury, perceptions of benefit associated with injury occurrence and rehabilitation can emerge (Ford & Gordon, 1999; Rose & Jevne, 1993; San Jose, 2003; Tracey, 2003; Udry, Gould, Bridges, & Beck, 1997). Common benefit-related themes expressed by athletes with injuries include personal growth (e.g., opportunity for reflection, development of interests outside sport, self-discovery), challenge (e.g., test of character), and sport performance enhancement (e.g., improved mental strength, increased motivation, physical lessons learned). Additional research is needed, however, to elucidate the particular personal characteristics and situations that contribute to injury being perceived by athletes as beneficial (Udry, 1999).

Emotional Responses

Emotional reactions constitute the leading target of scientific investigation within the theme of psychological responses to sport injury. Numerous qualitative and quantitative studies have been conducted to examine how athletes' affects, moods, and emotions are influenced by sport injury.

Qualitative Studies

Over the past decade, qualitative inquiry on the emotional consequences of sport injury has become increasingly common. Qualitative research has provided rich descriptions of the emotions experienced by athletes with injuries, the process by which those emotions change over the course of rehabilitation, and factors influencing emotional reactions to sport injury.

Participants in qualitative studies have consistently reported that, in the initial phases of rehabilitation, they experience negative emotions such as depression, frustration, confusion, anger, and fear (Bianco et al., 1999; Gordon

& Lindgren, 1990; Johnston & Carroll, 1998a; Mainwaring, 1999; Sparkes, 1998; Tracey, 2003; Udry, Gould, Bridges, & Beck, 1997). During the middle phases of rehabilitation, reports of depression and frustration have been common, with the source of the dysphoria shifting from injury-related disruption of functioning to rehabilitation-related concerns (Bianco et al., 1999; Johnston & Carroll, 1998a). Qualitative data have suggested that as athletes with injury near full recovery and a return to sport, depression and frustration remain salient, with fear of reinjury emerging as a prominent emotion (Bianco et al., 1999; Johnston & Carroll, 1998a).

Consistent with cognitive appraisal models of psychological response to sport injury, potential contributors to emotional disturbance following sport injury identified in qualitative investigations include cognitive appraisals (Johnston & Carroll, 1998a) and selected personal and situational factors. Among the personal and situational factors implicated as influencing emotional responses to sport injury are athletic identity, previous injury experience, injury severity, injury type, time during the season, and rehabilitation progress (Bianco et al., 1999; Johnston & Carroll, 1998a; Sparkes, 1998). Thus, through qualitative inquiry, researchers have documented negative emotional responses to sport injury that seem to vary as a function of personal characteristics and the context in which rehabilitation occurs.

Quantitative Studies

Quantitative investigations, which constitute the bulk of studies examining emotional responses to sport injury, have provided descriptive data on and facilitated identification of factors related to emotional reactions following sport injury. Findings have enabled researchers to estimate the prevalence of clinical levels of psychological distress in athletes with injury and evaluate the utility of psychological models of response to sport injury.

The Profile of Mood States (McNair, Lorr, & Droppleman, 1971) and the Emotional Responses of Athletes to Injury Questionnaire (Smith, Scott, & Wiese, 1990) have been used most frequently to assess emotional responses in sport injury research. In convergence with the extant qualitative data, across numerous sport injury studies in which these and other inventories measuring emotions have been administered (for a review, see Wiese-Bjornstal et al., 1998), athletes with injuries have displayed a wide variety of negative emotions and, to a lesser extent, positive emotions. A comparison of the emotions of athletes with injuries to those without injuries indicates that sport injury is associated with emotional disturbance (Brewer & Petrie, 1995; Chan & Grossman, 1988; Johnson, 1997a, 1998; Leddy et al., 1994; Mainwaring et al., 2004; Pearson & Jones, 1992; Smith et al., 1993). Similarly, there is evidence that the emotional disturbance of athletes is greater following injury than it is prior to injury (Leddy et al., 1994; Mainwaring et al., 2004; Smith et al., 1993).

As noted by Heil (1993), the majority of psychological distress experienced by individuals with sport injuries is not of sufficient magnitude and duration to approach clinical levels. Nevertheless, epidemiological findings indicate that clinically meaningful levels of emotional disturbance are experienced by 5% to 27% of athletes with injuries (Brewer, Linder, & Phelps, 1995; Brewer, Petitpas, Van Raalte, Sklar, & Ditmar, 1995; Brewer & Petrie, 1995; Leddy et al., 1994; Manuel et al., 2002). In cases where the postinjury distress (especially depression) is severe, some athletes with injuries may even attempt suicide (Smith & Milliner, 1994).

Although there is evidence suggesting that a large portion of athletes experience most of the emotional responses to injury posited to occur by stage models of adjustment (e.g., Astle, 1986; Lynch, 1988; Rotella, 1985) at some point during rehabilitation, results of retrospective, cross-sectional, and longitudinal investigations indicate that emotional reactions to injury are more varied and less sequential than those hypothesized by stage models. In particular, the available research data suggest that positive emotions generally increase and negative emotions generally decrease over the course of rehabilitation (Crossman, Gluck, & Jamieson, 1995; Dawes & Roach, 1997; Leddy et al., 1994; Macchi & Crossman, 1996; Mainwaring et al., 2004; Manuel et al., 2002; McDonald & Hardy, 1990; Quackenbush & Crossman, 1994; Quinn & Fallon, 1999; Smith, Scott, O'Fallon, et al., 1990). An exception to these trends is that positive emotions have been found to decrease slightly and negative emotions have been found to increase slightly as individuals near the end of rehabilitation following reconstructive knee surgery (Morrey, Stuart, Smith, & Wiese-Bjornstal, 1999), perhaps reflecting apprehension about their return to sport activity.

In addition to analyzing temporal effects, researchers have accounted for some of the variability in emotional responses to sport injury by identifying personal, situational, and cognitive factors associated with athletes' postinjury status. In the integrated model of response to the sport injury and rehabilitation process (Wiese-Bjornstal et al., 1998), the influence of personal and situational factors is thought to be mediated by cognitive appraisals. Most researchers of this topic, however, have not examined the proposed mediational path, but have instead examined direct relationships between the emotional status of athletes with injuries and their personal characteristics and situational aspects, thereby testing indirectly the hypothesized relationships.

Personal factors positively associated with postinjury emotional disturbance include athletic identity (Brewer, 1993; Manuel et al., 2002), investment in playing professional sport (Kleiber & Brock, 1992), current injury status (Alzate Saez de Heredia, Ramirez, & Lazaro, 2004; Brewer, Linder, et al., 1995), and injury severity (Alzate Saez de Heredia et al., 2004; Manuel et al., 2002; Smith, Scott, O'Fallon, et al., 1990; Smith et al., 1993). Negative correlations have been obtained between emotional distress and both age (Brewer, Linder, et al., 1995; Smith, Scott, O'Fallon, et al., 1990) and recovery progress (McDonald & Hardy, 1990; Smith, Young, & Scott, 1988). Situational factors shown to be positively correlated with emotional distress in athletes with injury include impairment of daily activities (Crossman & Jamieson, 1985) and life stress (Albinson & Petrie, 2003; Brewer, 1993; Manuel et al., 2002). Level of sport participation (Crossman et al., 1995), social support for rehabilitation (Brewer, Linder, et al., 1995), and social support satisfaction (Green & Weinberg, 2001; Manuel et al., 2002) are situational factors that have been negatively associated with emotional disturbance following injury. It should be noted that in the biopsychosocial model, current injury status and recovery progress could be considered intermediate biopsychological outcomes.

As a central feature of the integrated model (Wiese-Bjornstal et al., 1998), cognitive appraisals are posited to influence emotional responses to sport injury. In support of this hypothesis, inverse relationships have been documented between postinjury emotional disturbance and several cognitive variables, including cognitive appraisals of injury coping ability (Albinson & Petrie, 2003; Daly et al., 1995), physical self-esteem (Brewer, 1993), and causal attribution of injury to internal and stable factors (Brewer, 1999b). In contrast to the results of Brewer (1999b), a positive association has been found between emotional distress following injury and causal attributions of injury to internal factors (Tedder & Biddle, 1998).

Behavioral Responses

In addition to eliciting cognitive and emotional reactions, sport injury can trigger behavioral responses. The behavior of athletes with injuries is thought to exert an important influence on the rehabilitation process (Wiese-Bjornstal et al., 1998). This section examines research on adherence to sport injury rehabilitation regimens, the class of behavioral response to sport injury that has generated the most research, and coping behaviors occurring in the aftermath of sport injury.

Adherence to Sport Injury Rehabilitation

Depending on the nature of the injury and the rehabilitation protocol, adherence to sport injury rehabilitation may involve a variety of behaviors in multiple settings. Typical adherence behaviors are participating in clinic-based activities (e.g., exercises, therapy), modifying physical activity (e.g., resting, cross-training), taking medications, and completing home-based activities (e.g., exercises, therapy) in accordance with rehabilitation practitioner recommendations (Brewer, 1999a). Given the wide range of behaviors involved in adherence to sport injury rehabilitation, researchers have developed numerous measures to assess the construct, the most frequently used of which have been patient attendance at clinic-based rehabilitation sessions, practitioner ratings of adherence during rehabilitation sessions, and patient self-reports of home exercise completion (Brewer, 1999a).

The various types of adherence measures administered across research studies make comparison of prevalence rates for adherence problematic. Some estimates of adherence are based on a percentage of adherent versus nonadherent individuals, whereas other estimates are expressed in terms of percentage of rehabilitation behaviors completed relative to those recommended. Nevertheless, adherence estimates ranging from 40% to 91% have been documented for sport injury rehabilitation regimens (Brewer, 1999a). Adherence rates tend to be higher for continuous indices of adherence, such as attendance at rehabilitation sessions (e.g., Almekinders & Almekinders, 1994; Daly et al., 1995; Laubach, Brewer, Van Raalte, & Petitpas, 1996) or amount of time spent on home rehabilitation activities (Penpraze & Mutrie, 1999), than for more discrete measures of adherence, which categorize individuals based on their level of adherence (e.g., Taylor & May, 1996).

In keeping with a cognitive appraisal approach to studying psychological responses to sport injury (see Figure 18.2), it would be expected that personal factors, situational factors, and, more directly, cognitive and emotional responses would be associated with a behavioral response such as adherence to sport injury rehabilitation. Consistent with this expectation, researchers have identified a multitude of variables that are correlated with adherence to sport injury rehabilitation programs.

Personal factors that have been positively correlated with sport injury rehabilitation adherence include internal health locus of control (Murphy, Foreman, Simpson, Molloy, & Molloy, 1999), perceived injury severity (Taylor & May, 1996), pain tolerance (Byerly, Worrell, Gahimer, & Domholdt, 1994; Fields, Murphey, Horodyski, & Stopka, 1995; Fisher, Domm, & Wuest, 1988), self-motivation (Brewer, Daly, Van Raalte, Petitpas, & Sklar, 1999; Brewer, Van Raalte, et al., 2000; Duda, Smart, & Tappe, 1989; Fields et al., 1995; Fisher et al., 1988; Noyes, Matthews, Mooar, & Grood, 1983), task involvement (Duda et al., 1989), and tough-mindedness (Wittig & Schurr, 1994). Qualitative research has affirmed the positive association between self-motivation and rehabilitation adherence (Pizzari, McBurney, Taylor, & Feller, 2002). Ego involvement is a personal factor that has been negatively correlated with adherence to sport injury rehabilitation (Duda et al., 1989).

Numerous situational factors have been found to correlate with adherence to sport injury rehabilitation programs. Positive associations have been documented between adherence and belief in the efficacy of the treatment (Brewer et al., 2003b; Duda et al., 1989; Noyes et al., 1983; Taylor & May, 1996), comfort of the clinical environment (Fields et al., 1995; Fisher et al., 1988), convenience of rehabilitation scheduling (Fields et al., 1995; Fisher et al., 1988), hours per week of involvement in sport (Johnston & Carroll, 2000), importance or value of rehabilitation to the athlete (Taylor & May, 1996), perceived exertion during rehabilitation activities (Fisher et al., 1988), perceived susceptibility to further complications without rehabilitation (Brewer et al., 2003b; Taylor & May, 1996), rehabilitation practitioner expectancy of patient adherence (Taylor & May, 1995), and social support for rehabilitation (Byerly et al., 1994; Duda et al., 1989; Fisher et al., 1988; Johnston & Carroll, 2000). Qualitative data obtained from individuals after anterior cruciate ligament (ACL) surgery have suggested that adequate time to do rehabilitation, rehabilitation practitioner support for rehabilitation, clinic comfort and convenience, and information about rehabilitation are positively related to rehabilitation adherence (Pizzari et al., 2002).

In accord with the joint influence of personal and situational factors on psychological responses to sport injury posited in cognitive appraisal models, Brewer et al. (2003a) found that age moderated the relationships between several personal factors and indices of adherence to sport injury rehabilitation. Self-motivation and social support were unrelated to home exercise completion following ACL surgery for younger individuals, but were positively correlated with home exercise completion for older individuals. Conversely, athletic identity was positively associated with home exercise completion for younger individuals, but was unrelated to home exercise completion for older individuals.

As indicated in Figure 18.2, direct paths between cognitions and behavior are posited in cognitive appraisal models. Consistent with this hypothesis, several cognitive responses have been associated with sport injury rehabilitation adherence. In particular, individuals who adhere well to sport injury rehabilitation protocols tend to report a high ability to cope with their injuries (Daly et al., 1995), express high rehabilitation self-efficacy (Brewer et al., 2003b; Milne, Hall, & Forwell, 2005; Taylor & May, 1996), have high self-esteem certainty (i.e., do not perceive a threat to their self-esteem; Lampton, Lambert, & Yost, 1993), attribute their recovery to stable and personally controllable factors (Laubach et al., 1996), set rehabilitation goals, use positive self-talk (Scherzer et al., 2001), and use imagery (Milne et al., 2005; Scherzer et al., 2001). Experimental evidence demonstrating the influence of cognitive factors on sport injury rehabilitation adherence has been obtained in two studies. Penpraze and Mutrie (1999) found that athletes who were assigned specific rehabilitation goals had greater understanding of and adherence to their injury rehabilitation protocols than athletes who were given nonspecific rehabilitation goals. Evans and Hardy (2002a) found that athletes who received a goal-setting intervention reported adhering better to their injury rehabilitation program than athletes who were given social support or no treatment. Potential explanations for the success of the goal-setting intervention in the Evans and Hardy study include increases in self-efficacy, attention to the rehabilitation program, and attribution of progress to internal, controllable factors in participants in the goal-setting intervention relative to those in the social support and no-treatment conditions (Evans & Hardy, 2002b).

Few studies have examined the hypothesized relationship between emotional responses and adherence to sport injury rehabilitation. Although Brewer, Van Raalte, et al. (2000) found no correlation between psychological distress and sport injury rehabilitation adherence, mood disturbance has been determined to be related (inversely) to sport injury rehabilitation adherence in other investigations (Alzate Saez de Heredia et al., 2004; Daly et al., 1995). In a qualitative study, Pizzari et al. (2002) found that fear of reinjury was identified as a barrier to adherence among individuals undergoing rehabilitation after ACL reconstruction.

As with emotional responses, little research has been conducted on behavioral correlates of sport injury rehabilitation adherence. Udry (1997) did, however, observe that athletes who adhered well to rehabilitation following knee surgery tended to report using instrumental coping behaviors (e.g., asking for additional information about the injury or rehabilitation program) to a greater extent than those who adhered poorly to rehabilitation.

Coping Behaviors

In addition to implementing cognitive coping strategies (discussed in the section on cognitive responses to sport injury), athletes may initiate behavioral efforts to cope with their injuries. Qualitative and quantitative studies have examined the coping behaviors of athletes with injury. In a qualitative investigation of skiers who had sustained season-ending injuries, Gould et al. (1997a) found that the most common coping behaviors were "driving through" (e.g., doing things normally, working hard to achieve rehabilitation goals), distracting oneself (e.g., keeping busy, seeking a change of scenery), seeking or using social resources (e.g., seeking social support), and avoiding others or isolating oneself. Additional qualitative results were obtained by Bianco et al. (1999), who determined that skiers with previous injuries reported that they had engaged in such behaviors as adopting an aggressive rehabilitation approach, trying alternative treatments, learning about their injuries, building physical strength, working or training at their own pace, and resting when tired. Bianco et al. noted that the coping behaviors used by the skiers varied over the course of the season.

In a quantitative study of the coping behaviors of athletes with injury, Udry (1997) found that instrumental coping was the mode of coping that athletes reported using most frequently throughout rehabilitation following knee surgery. Udry noted no temporal changes in instrumental coping over the course of rehabilitation. Similarly, Quinn and Fallon (1999) concluded that the coping strategies used by athletes with injuries were stable over time, with the exception of a small but significant trend (i.e., 3% of the variance) for athletes reporting making more active coping efforts two-thirds of the way through rehabilitation than they did one-third of the way through rehabilitation. Albinson and Petrie (2003) found that intercollegiate American football players who appraised their injury as highly stressful and difficult to cope with were more likely to report subsequent use of active behavioral coping strategies and less likely to report use of active cognitive coping strategies than those who viewed their injury as less stressful and less of a burden with which to cope. Reported use of active behavioral coping strategies was strongly and positively associated with concurrent mood disturbance, which suggests that distress may serve as a cue to action in rehabilitation. Like instrumental coping, active coping strategies involve initiating behavior or cognition in an attempt to deal directly with a stressor or its effects.

PSYCHOLOGICAL FACTORS IN SPORT INJURY REHABILITATION

As shown in Figures 18.1 and 18.2, psychological factors are thought to influence sport injury outcomes in both the biopsychosocial model of sport injury rehabilitation (Brewer et al., 2002) and the integrated model of psychological response to sport injury (Wiese-Bjornstal et al., 1998). Data from correlational studies and experimental studies have provided preliminary support for the hypothesized relationship between psychological factors and recovery from sport injury (Cupal, 1998).

Correlational Studies

Although causal inferences cannot be made from the results of correlational studies, correlational research designs have been useful in identifying potential psychological antecedents and concomitants of intermediate biopsychological outcomes and sport injury rehabilitation outcomes. Personal, situational, cognitive, emotional, and behavioral correlates of rehabilitation outcomes have been identified for a variety of injury types, consonant with the predictions of the integrated model (Wiese-Bjornstal et al., 1998).

Several personal factors have been linked to sport injury rehabilitation outcomes. In a seminal study, tendencies toward hysteria and hypochondriasis were inversely related to recovery following knee surgery (Wise, Jackson, & Rocchio, 1979). In more recent investigations, men have been more likely than women to recover adequately or exceptionally from sport injury (Johnson, 1996, 1997b), and athletic identity has been positively associated with outcome following ACL reconstruction (Brewer, Van Raalte, et al., 2000). The mechanisms underlying these intriguing associations are not yet known.

The social environment is the situational aspect of sport injury rehabilitation that has received the most empirical attention in relation to rehabilitation outcomes. However, results have been inconsistent and difficult to interpret. For example, a positive relationship between social support and rehabilitation outcome has been documented (Tuffey, 1991), a nonsignificant relationship has been reported (Brewer, Van Raalte, et al., 2000), and an inverse relationship has also been obtained (Quinn & Fallon, 2000). These inconsistencies may be due to differences across studies in the ways social support and rehabilitation outcome have been measured. Gould et al. (1997b) found that, relative to skiers who experienced unsuccessful injury rehabilitation, those who had successful injury rehabilitation were less likely to perceive a lack of attention or empathy from others, less likely to encounter negative social relationships during rehabilitation, and *more* likely to indicate feeling socially isolated during rehabilitation. The disparate findings reviewed in this section suggest that extensive, in-depth investigation is needed to unravel the complexities of social influences on sport injury rehabilitation outcomes.

Numerous cognitive factors have been linked to sport injury rehabilitation outcomes. Positive associations with rehabilitation outcome have been documented for attribution of recovery to stable and personally controllable factors (Brewer, Cornelius, et al., 2000; Laubach et al., 1996), cognitive appraisals of the injury situation (Johnson, 1996, 1997b), denial (Quinn & Fallon, 2000), emotion-focused coping (Quinn & Fallon, 2000), management of thoughts and emotions (Gould et al., 1997a), number of rehabilitation goals (Johnson, 1996, 1997b), positive attitude toward rehabilitation (Johnson, 1996, 1997b), recovery confidence (Quinn & Fallon, 2000), self-confidence (Johnson, 1996, 1997b), use of goal setting (Gould et al., 1997a; Ievleva & Orlick, 1991), use of healing or recovery imagery (Ievleva & Orlick, 1991), and use of imagery or visualization (Gould et al., 1997a). Available research suggests that positive cognitions and use of psychological skills are related to enhanced rehabilitation outcome. However, caution is advised in making strong inferences about these findings due to the retrospective nature of some of the studies and inconsistent or nonsignificant results for denial as a coping strategy (Quinn & Fallon, 2000) and psychological skill usage (Tuffey, 1991).

Associations between emotional variables and sport injury rehabilitation outcomes have been found in four studies. In particular, general well-being (Johnson, 1996, 1997b) and vigor (Quinn & Fallon, 2000) have been positively correlated with rehabilitation outcome, and injury rehabilitation anxiety (Johnson, 1996, 1997b), psychological distress (Brewer, Van Raalte, et al., 2000), anger (Alzate Saez de Heredia et al., 2004), mood disturbance, depression, fatigue, and tension (Alzate Saez de Heredia et al., 2004) have been negatively correlated with rehabilitation outcome. Thus, negative emotions seem to be related to a poorer response to rehabilitation.

Adherence to sport injury rehabilitation is the behavioral factor that has been examined most frequently in relation to rehabilitation outcome. Although adherence has been positively associated with outcome in several investigations (Alzate Saez de Heredia et al., 2004; Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Brewer, Van Raalte, et al., 2000; Derscheid & Feiring, 1987; Pizzari, Taylor, McBurney, & Feller, 2005; Treacy, Barron, Brunet, & Barrack, 1997; Tuffey, 1991), nonsignificant (Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Brewer, Van Raalte, et al., 2000; Feller, Webster, Taylor, Payne, & Pizzari, 2004; Noyes et al., 1983) and negative (Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Feller et al., 2004; Pizzari et al., 2005; Shelbourne & Wilckens, 1990) correlations between adherence and outcome have been obtained in other studies (or analyses within studies). It is likely that the magnitude and direction of the adherence-outcome correlation depends on a variety of factors, including the nature of the injury, the rehabilitation protocol, the phase of rehabilitation, the particular measures of adherence and outcome (Brewer, 1999a), and the age of the individuals undergoing rehabilitation (Pizzari et al., 2005). Further complicating the adherence-outcome relationship is the possibility that athletes who find themselves healing quickly from injury may perceive their recovery as independent from their behavior and reduce their adherence to rehabilitation accordingly. With regard to behavioral factors other than adherence, better sport injury rehabilitation outcomes have been associated with higher levels of active coping (Quinn & Fallon, 2000; Rosenberger, Ickovics, Epel, D'Entremont, & Jokl, 2004) and lower levels of physical inactivity (Gould et al., 1997a) and seeking social support (Gould et al., 1997a; Johnson, 1996, 1997b).

Experimental Studies

The best evidence of causal links between psychological factors and sport injury rehabilitation outcome has been obtained in experimental studies evaluating the effects of psychological interventions on rehabilitation outcomes. As noted by Cupal (1998) in her review of the literature, in general, biofeedback has had a favorable influence on rehabilitation outcomes among athletes with injuries (Draper, 1990; Draper & Ballard, 1991; Krebs, 1981; Levitt, Deisinger, Wall, Ford, & Cassisi, 1995). Goal setting (Theodorakis, Beneca, Malliou, & Goudas, 1997; Theodorakis, Malliou, Papaioannou, Beneca, & Filactakidou, 1996), imagery and relaxation (Cupal & Brewer, 2001), stress inoculation training (Ross & Berger, 1996), and a multimodal intervention that featured goal setting, imagery, relaxation, and stress management (Johnson, 2000) have also been effective in enhancing the rate or quality of sport injury rehabilitation. Imagery has also been shown to minimize the loss of muscle strength that can occur due to immobilization (Newsom, Knight, & Balnave, 2003). The mechanisms by which the psychological interventions affected sport injury rehabilitation outcomes are not well understood. From a biopsychosocial perspective (see Figure 18.1), it is likely that the interventions have both direct effects and indirect effects (mediated by biological factors) on rehabilitation outcome. Thus, psychological interventions may elicit changes in psychological (e.g., adherence to rehabilitation) and biological (e.g., circulation) parameters that contribute to therapeutic outcome.

SOCIAL INTERACTIONS IN SPORT INJURY REHABILITATION

Although biological processes are by definition a primary focus of sport injury rehabilitation, rehabilitation is inevitably a social process as well. From the time athletes are injured to the time they conclude rehabilitation, they generally have contact with a number of individuals varying in proximity to the rehabilitation environment (e.g., physicians, physical therapists, athletic trainers, support staff, other athletes with injuries, coaches, teammates, family members, friends). As shown in the preceding sections of this chapter, situational factors (some of which are social variables) have been linked to cognitive, emotional, behavioral, and physical responses to sport injury. Consequently, this section addresses the construct of social support, which, in the context of sport injury rehabilitation, reflects the quantity, quality, and type of interactions that athletes with injuries have with other people (Bianco & Eklund, 2001; Udry, 1996). Research on the dimensions of social support experienced by athletes with injury, the providers of support to athletes with injury, the dynamics of social support in sport injury rehabilitation, and patient-practitioner interactions is examined.

Dimensions of Social Support

Social support is widely recognized as a multidimensional construct (Bianco & Eklund, 2001; Udry, 1996). Multiple types of social support have been documented in association with sport injury rehabilitation. The social support framework proposed by Richman, Rosenfeld, and Hardy (1993) has been particularly influential in guiding sport injury rehabilitation research (e.g., Ford & Gordon, 1993; Johnston & Carroll, 1998b; Robbins & Rosenfeld, 2001). Richman et al. identified eight types of social support: listening support, emotional support, emotional challenge, task appreciation, task challenge, reality confirmation, material assistance, and personal assistance. The extent to which these dimensions are salient may vary across both providers and stages of the rehabilitation process. Also, the various dimensions of social support notwithstanding, apparently supportive actions by others may not always be perceived as supportive by athletes with injuries (Bianco, 2001; Rees, Smith, & Sparkes, 2003; Tracey, 2003; Udry, Gould, Bridges, & Tuffey, 1997).

Social Support Providers

Athletes may receive social support from a variety of individuals while undergoing injury rehabilitation, including coaches, family members, friends, medical personnel, teammates, significant others, and sport administrators (Bianco, 2001; Bianco & Eklund, 2001; Johnston & Carroll, 1998b; Macchi & Crossman, 1996; Rees et al., 2003; Robbins & Rosenfeld, 2001; Udry, Gould, Bridges, & Tuffey, 1997). Athletes with injuries have reported different levels of satisfaction with the social support that they have received from various sources. In general, family members and teammates have been perceived as more supportive than coaches and medical professionals (Macchi & Crossman, 1996; Udry, Gould, Bridges, & Tuffey, 1997). Further, some individuals may be more likely than others to provide certain types of social support. Friends, family members, and significant others seem to be the most prevalent providers of emotional support, whereas medical practitioners and coaches have been cited as the most frequent providers of informational and technical support (Johnston & Carroll, 1998b; Udry, Gould, Bridges, & Tuffey, 1997). It is interesting to note that although it would be logical for sport psychologists to serve as providers of social support to athletes with injuries, little research has examined this possibility, perhaps reflecting a relatively minor role of sport psychologists in sports medicine service delivery.

Dynamics of Social Support

Temporal variations in types of social support preferred and received over the course of rehabilitation have been observed for athletes with injuries. Although Udry (1997) obtained no significant differences in global social support for athletes with injuries over the course of rehabilitation, Johnston and Carroll (1998b) found that athletes' perceptions of "technical appreciation support received" increased and "listening support received" decreased across the rehabilitation period. These perceptions coincided with the athletes' preferences for social support over the course of rehabilitation. Based on the findings of Johnston and Carroll, it appears that the need for emotional support wanes as rehabilitation progresses, with a possible increased need for emotional support as athletes return to sport participation at the end of rehabilitation. The relative salience of various potential providers of social support to athletes with injuries may also vary over the course of rehabilitation, but little systematic research has examined this issue.

Patient-Practitioner Interactions

Among the most frequent social interactions experienced by athletes during the injury rehabilitation process are those with sports medicine practitioners (e.g., physiotherapists, athletic trainers), who not only facilitate physical recovery following sport injury but also provide social support (Brewer, Van Raalte, & Petitpas, 1999). In recognition of the important role of communication in the patient-practitioner dyad, researchers have examined concordances and discrepancies in the perceptions held by athletes with injuries and their rehabilitation practitioners.

Although athletes with injuries have reported receiving informational and technical support to a greater extent than emotional support from sport injury rehabilitation professionals (Johnston & Carroll, 1998b; Udry, Gould, Bridges, & Tuffey, 1997), athletes' perception of such supportive communication is not tantamount to comprehension of the communication. Indeed, Kahanov and Fairchild (1994) documented discrepancies between athletes with injuries and their athletic trainers in terms of their perceptions of patient-practitioner communication. Approximately one-third of the athletes, for example, reported that they had summarized the explanations for injury given by their athletic trainers when, according to the athletic trainers, no such summary process had taken place. Similarly, Webborn, Carbon, and Miller (1997) found that a majority of sport injury clinic patients (77%) misunderstood at least part of their rehabilitation regimen.

Other discrepancies in patient and practitioner perceptions have been identified in the context of sport injury rehabilitation. Relative to the perceptions of sport rehabilitation practitioners, athletes with injuries tend to overestimate the seriousness of their injuries (Crossman & Jamieson, 1985) and underestimate the disruptive impact of their injuries (Crossman & Jamieson, 1985; Crossman, Jamieson, & Hume, 1990). These discrepancies are noteworthy because misunderstandings between patients and practitioners may contribute to patient pain, emotional distress (Crossman et al., 1985), and nonadherence to the rehabilitation program. Nevertheless, it is important to note that patient and practitioner perceptions of the patient's injury status are generally positively correlated (Brewer, Linder, et al., 1995; Brewer, Van Raalte, Petitpas, Sklar, & Ditmar, 1995; Crossman & Jamieson, 1985), although patients and practitioners seem, on occasion, to use different ends of the scale.

CURRENT TRENDS AND FUTURE RESEARCH DIRECTIONS

Major advances in the quantity and quality of research on psychological aspects of sport injury rehabilitation have occurred over the past 3 decades. Reflecting on the state of the science in the early 1990s, Williams and Roepke (1993) and Brewer (1994) offered substantive and methodological recommendations for psychological research on sport injury rehabilitation. These recommendations have been heeded to a large extent, contributing greatly to research on this topic. In accord with the suggestions of Williams and Roepke, researchers have (a) identified cognitive and emotional responses to injury that are characteristic of athlete populations (e.g., Leddy et al., 1994; Quinn & Fallon, 1999; Tracey, 2003); (b) investigated the effects of psychological interventions on sport injury rehabilitation (e.g., Cupal & Brewer, 2001; Johnson, 2000; Ross & Berger, 1996; Theodorakis et al., 1996, 1997); and (c) initiated education of sports medicine practitioners on the psychological aspects of injury rehabilitation (e.g., Ford & Gordon, 1998; Gordon, Potter, & Ford, 1998).

Consistent with the recommendations of Brewer (1994), researchers have (a) advanced theory (e.g., Brewer et al., 2002; Evans & Hardy, 1995; Johnston & Carroll, 1998a; Wiese-Bjornstal et al., 1998); (b) included both psychological *and* physical variables in their analyses (e.g., Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Brewer, Van Raalte, et al., 2000; Cupal & Brewer, 2001; Morrey et al., 1999; Rosenberger et al., 2004; Ross & Berger, 1996; Theodorakis et al., 1996, 1997); (c) assessed the prevalence of clinical levels of psychological distress (Brewer, Linder, et al., 1995; Brewer, Petitpas, et al., 1995; Brewer & Petrie, 1995; Leddy et al., 1994; Manuel et al., 2002); (d) implemented prospective, longitudinal research designs (e.g., Albinson & Petrie, 2003; Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Brewer, Van Raalte, et al., 2000; Leddy et al., 1994; Mainwaring et al., 2004; Rosenberger et al., 2004; Ross & Berger, 1996; Smith et al., 1993; Udry, 1997); (e) conducted qualitative investigations (e.g., Bianco, 2001; Bianco et al., 1999; Gould et al., 1997a, 1997b; Johnston & Carroll, 1998a, 1998b; Pizzari et al., 2002; Tracey, 2003; Udry, Gould, Bridges, & Beck, 1997; Udry, Gould, Bridges, & Tuffey, 1997); (f) used control groups of athletes without injuries (e.g., Brewer & Petrie, 1995; Mainwaring et al., 2004; Perna, Ahlgren, & Zaichkowsky, 1999); (g) examined groups of athletes that are homogeneous with respect to injury type, severity, and prognosis (e.g., Brewer, Cornelius, Van Raalte, Brickner, Sklar, et al., 2004; Brewer, Cornelius, et al., 2000; Brewer et al., 2003a, 2003b; Brewer, Van Raalte, et al., 2000; Cupal & Brewer, 2001; Morrey et al., 1999; Ross & Berger, 1996; Theodorakis et al., 1996, 1997; Udry, 1997); and (h) used experimental research designs (e.g., Cupal & Brewer, 2001; Ross & Berger, 1996; Theodorakis et al., 1996, 1997).

The expansion of research on psychological aspects of sport injury rehabilitation throughout the late twentieth and early twenty-first centuries and the trend toward increased methodological rigor are encouraging. Nevertheless, continued proliferation of research and attention to methodological details is needed to develop further knowledge on the role of psychological factors in the rehabilitation of sport injuries. As recognition of the diverse array of variables contributing to sport injury rehabilitation processes and outcomes grows, research investigations should become increasingly integrated, including measures of multiple parameters of the biopsychosocial model (see Figure 18.1). An example of such an integrated investigation is the study by Rosenberger et al. (2004), in which measures of pain, coping, physical functioning, and serum cortisol (a neuroendocrine variable) were collected. In addition, more frequent assessment of psychological factors and intraindividual analyses are needed to capture the dynamic quality of the rehabilitation process (Evans & Hardy, 1999).

As in many emerging areas of inquiry, research on psychological aspects of sport injury rehabilitation has been eclectic in orientation and fragmented across studies. There is much to be gained, however, by a more focused and unified research agenda. Greater consistency in the measures and methods used and the research questions asked should help to develop a cohesive foundation of knowledge (Evans & Hardy, 1999). Coping with sport injury, as reviewed in the sections on cognitive and behavioral responses to sport injury, is a prime example of a topic that could benefit markedly from increased standardization of research practices. Due to the heterogeneity of extant research in terms of methods (i.e., qualitative, quantitative) and measures of coping, it is difficult to make meaningful comparisons across studies.

Development of psychological measures specific to the sport injury rehabilitation context may help not only in providing researchers with standardized instruments to measure pertinent constructs, but also in enabling researchers to ask more fine-grained research questions. Increased relevance to sport injury rehabilitation is not sufficient, however. As illustrated by studies in which measures specific to sport injury rehabilitation have failed to stand up to psychometric scrutiny (Brewer, Daly, et al., 1999; Slattery, 1999), establishment of reliability and validity is essential for measures designed for the sport injury rehabilitation context (Evans & Hardy, 1999).

As research on the effects of psychological interventions on sport injury rehabilitation processes and outcomes continues to increase, it will be useful to attempt to identify the degree of effectiveness of the interventions for various medical conditions and explore the mechanisms of effect for the interventions. Such inquiry will enable researchers to better determine "what specific interventions seem to work best under what conditions and with what type of personality characteristics to influence outcomes such as lowering incidences of reinjury, expediting return to previous level of functioning, and restoring confidence" (Williams & Roepke, 1993, p. 835).

Three other promising topical directions for future research have emerged recently. One such topic area is pain, which can be a central aspect of the injury experience for athletes. Injury-related pain has been examined primarily in studies of athletes who have had knee surgery (Brewer, Cornelius, Van Raalte, Brickner, Tennen, et al., 2004; Rosenberger et al., 2004; Tripp, Stanish, Coady, & Reardon, 2004; Tripp, Stanish, Reardon, Coady, & Sullivan, 2003). A second emerging area of inquiry pertains to psychological aspects of the return to sport after sustaining an injury. Among the return-to-sport topics investigators have studied are psychological factors associated with favorable cognitions, emotions, and behaviors after returning to sport activities following injury (Evans, Hardy, & Fleming, 2000; Magyar & Duda, 2000; Podlog & Eklund, 2005) and psychological issues involved in the decisions of coaches (Vergeer & Hogg, 1999) and sports medicine professionals (Beardmore, Handcock, & Rehrer, 2005; Safai, 2003) to permit athletes with injuries to return to sport involvement. A third burgeoning line of research involves psychological aspects of sport-related head injury. Topics such as preventive behavior (Kahanov, Dusa, Wilkinson, & Roberts, 2005), cognitive (e.g., Bruce & Echemendia, 2003; Webbe & Ochs, 2003) and emotional (Mainwaring et al., 2004) responses to sport-related head trauma, and assessment of postconcussive functioning in athletes (Erlanger, Feldman, & Kutner, 2003; Schatz & Zillmer, 2003) have been examined. Further empirical exploration in each of these three cutting-edge domains is warranted.

Finally, from a theoretical standpoint, there is much to be gained by developing a comprehensive model of sport injury in an attempt to describe and explain the processes by which athletes incur and recover from injuries. The components and interrelationships among variables in the model of psychological response to sport injury proposed by Wiese-Bjornstal et al. (1998) closely resemble those in the model of sport injury occurrence offered by Williams and Andersen (1998). Presumably, these two models can be integrated to provide a dynamic, psychologically based conceptualization of sport injury from preinjury to postrehabilitation. At a more global level, the biopsychosocial framework depicted in Figure 18.1 can be adapted to accommodate a focus on the antecedents of injury by altering the pathways connecting the injury characteristics box with the biological factors, psychological factors, and social and contextual factors boxes to denote bidirectional relationships. A modification of this sort to the biopsychosocial model would be consistent with research on factors associated with the occurrence of sport injury (Meeuwisse & Fowler, 1988; Williams & Andersen, 1998) and other physical conditions (Cohen & Rodriguez, 1995). By integrating research on the causes and consequences of sport injury, a more complete picture of sport injury is likely to result.

CONCLUSION

A growing, increasingly rigorous body of research has provided strong evidence for the relevance of psychological factors to processes and outcomes in sport injury rehabilitation. Descriptive and inferential studies have presented an emerging picture of the role of cognitive, emotional, and behavioral factors within the broader biological and social contexts in which sport injury rehabilitation occurs. A consequence of research in this area is the development, implementation, and evaluation of psychological interventions that have the potential to enhance the rehabilitation experience of athletes with injury.

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CHAPTER 19

Why Do Athletes Choke under Pressure?

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Picture it: A PGA (Professional Golfers' Association) tour player is on the final hole of a major tournament. All he needs to do to win the tournament is sink a simple 5-foot putt on a flat, straight green. This is a putt he has sunk so many times in practice he has lost count. This is a putt he knows, he understands, he can execute without a second thought. But, on this day, on this putt, there are other thoughts. He notices the crowd, the leader board, and thinks about how many people are counting on him to make the shot and win the tournament. He thinks about all those individuals, including himself, who expect him to finish at the top. Thus, this putt is not exactly the same as all of the simple 5-foot putts he has taken in practice. And when he steps up to the ball, performs his preshot routine, and executes his shot it becomes apparent how different this pressure-filled putt actually is. Our golfer does the unthinkable, the unexpected, and the unwarranted given his ability: He misses the putt, he loses the tournament, he *chokes under the pressure.*

We have all heard the term "choking" before. In the sports arena, we talk about the "bricks" in basketball, when the game-winning free throw manifests itself as an air ball, or we speak of the "yips" in golf, when an easy putt to win the tournament stops short. In more academic domains, we refer to "cracking" in important test-taking situations, when a test score much lower than expected results in a failing course grade or prevents the all-important college admission. But what exactly do these terms mean, and, more important, why do less-than-optimal performances occur—especially when the incentives to perform at one's best are at a maximum?

In this chapter, we describe the research to date conducted on the phenomenon of choking under pressure. We begin by defining what we mean by "choking under pressure." We also highlight the circumstances under which choking is most likely to occur. Subsequent sections detail how the choking phenomenon is studied and the mechanisms believed to govern performance failure under pressure. Once we have established what choking is and why it occurs, we examine individual difference variables that may serve to exacerbate the choking phenomenon (e.g., self-consciousness, trait anxiety). Finally, we highlight research attempting to alleviate choking and present future directions for this exciting line of work. Choking under pressure has received a lot of attention in recent years—attention from researchers, practitioners, coaches, and players themselves. It is our hope that this chapter will serve as both a review of the choking work that exists and a catalyst for what is yet to come.

CHOKING UNDER PRESSURE: WHAT IT IS AND WHAT IT IS NOT

The desire to perform as well as possible in situations with a high degree of personally felt importance is thought to create *performance pressure* (Baumeister, 1984; Hardy, Mullen, & Jones, 1996). Paradoxically, despite the fact that performance pressure often results from aspirations to function at one's best, pressure-packed situations are where suboptimal skill execution may be most visible. The term *choking under pressure* has been used to describe this phenomenon. Choking is defined as performing more poorly than expected given one's skill level and is thought to

This work was supported by U.S. Department of Education (Institute of Education Sciences) grant R305H050004 and National Science Foundation grant BCS-0601148 to S. L. Beilock.

occur across many diverse task domains where incentives for optimal performance are at a maximum (Beilock & Carr, 2001; Lewis & Linder, 1997; Masters, 1992).

Choking under pressure is not just poor performance. Rather, choking is suboptimal performance—worse performance than expected given what a performer is capable of doing and what this performer has achieved in the past. This less-than-optimal performance does not reflect a random fluctuation in skill level (we all have performance ups and downs), but rather occurs in response to a high-pressure situation. Inherent in this definition is the notion that choking is a relatively discrete performance state. By this we mean that choking has a noticeable beginning and end that corresponds to what the performer interprets as a high-pressure situation. A baseball player in a slump may be performing poorly and at a lower level than what he has demonstrated he can accomplish in the past, but to the extent that this prolonged period of poor performance does not have a high-pressure situation as a catalyst, we would not consider this to be an example of choking.

In particular, extended periods of below-average performance (relative to one's usual performance level) are thought to constitute performance slumps (Grove, 2004). The main difference between performance slumps and choking is that the latter is initiated by perceived feelings of performance pressure, and the suboptimal performance that results in response to pressure is attenuated when the source of this pressure subsides. A slump, on the other hand, is characterized by an inability (in most cases) to pinpoint a specific cause of extended poor performance (Grove, 2004; Prapavessis, Grove, Maddison, & Zillmann, 2003).

This does not mean that the cognitive mechanisms responsible for a performance slump (e.g., a baseball infielder who made only 10 fielding errors all of last season but has made 8 errors in the past month) and an instance of choking (e.g., an infielder who feels a high degree of pressure and muffs an easy play that allows the winning run to score) are not similar; rather, this just sets limits on what we define as choking and what we explore in this chapter. Nonetheless, to the extent that similar cognitive mechanisms may govern different types of performance failures, an exploration of the choking-under-pressure phenomenon can open a new window into the processes responsible for less-than-optimal execution, whether pressure-induced or not.

Choking is thus poor performance in response to what an individual perceives as an important and stress-filled situation. Here we define choking behaviorally in terms of performance outcomes. This does not mean that pressure cannot manifest itself physiologically in terms of heightened levels of arousal or drive (Spence & Spence, 1966), or cognitively in terms of heightened levels of worry or anxiety (Beilock, Kulp, Holt, & Carr, 2004; Wine, 1971). Physiological arousal and anxiety may accompany choking, and dispositional trait anxiety may make an individual more prone to performance failure under pressure (see "Individual Differences" section). However, we believe that heightened levels of perceived pressure accompanied by a suboptimal performance level are necessary and sufficient criteria to classify the performance as an example of choking under pressure. This definition of performance failure (a) makes it easier to diagnose choking (as one must demonstrate only a link between perceived pressure and performance, rather than additional links with anxiety, physiological arousal, and worry); (b) provides a parsimonious definition that can be applied quite easily to a variety of situations; (c) gets around problems associated with the known difficulty of introspecting on one's level of anxiety (Nisbett & Wilson, 1977) and inherent variability associated with physiological measurements of arousal (Baumeister & Showers, 1986); and (d) is as limited as possible in terms of the assumptions it makes regarding the cognitive or physiological criteria necessary to classify an instance of performance as an example of choking. This last point is extremely important, as there should not be theoretical assumptions about the correlates of choking inherent in its definition.

HOW IS CHOKING UNDER PRESSURE STUDIED?

Now that we have established what we believe choking under pressure is, and what it is not, we can move on to the important question of how it is studied. Although we often refer to real-world examples of performance failure under pressure (e.g., the professional golfer missing a final shot to win the tournament, the field goal kicker missing the extra point to win the game), a significant amount of research on choking under pressure has examined the phenomenon in laboratory settings rather than in actual game situations.

What are the benefits of studying choking under pressure in the laboratory? First, this environment provides a controlled setting with which to examine performance failure. The amount of pressure can be manipulated, and players' perceptions of pressure, and their subsequent performance, can be measured. This not only allows one to directly correlate perceived pressure and performance, but it provides a nice test bed to examine the impact of other variables (e.g., skill level of the performer, task difficulty) on the pressure-performance relationship.

Obviously, however, the benefit of control in the laboratory is accompanied by problems of ecological validity: the extent to which a pressure situation created in the lab (and resultant performance failure) is really reflective of real-world occurrences. One way to counter this problem is to create an environment that contains multiple sources of pressure commonly seen in the real world. We have accomplished this in our work (e.g., Beilock & Carr, 2001; Gray, 2004) by administering pressure scenarios that involve monetary incentives, peer pressure, and social evaluation components. In athletics, performance is often judged by coaches, fans, and teammates (i.e., social evaluation); there are monetary consequences for winning and losing (i.e., monetary incentives); and team success is dependent on the performance of individual athletes, which may generate peer pressure to perform at an optimal level. It is an empirical question as to exactly how these different sources of pressure exert their influence. However, our goal in the laboratory is to capture the real-world phenomenon of choking, thus we incorporate as many components of pressure as possible.

Other researchers have induced choking in laboratory settings by merely making salient the concept of pressure-induced skill failure, something that is likely to occur in important competition situations. For example, Leith (1988) found that individuals shooting free throws who were made aware of the fact that "some people have the tendency to choke at the free throw line" performed worse than those who had not received this information.

Not only is it crucial for laboratory studies to attempt to mimic the types of pressure situations found in the real world, but recent work has highlighted the importance of taking a number of manipulation checks to ensure that the instantiated pressure scenario produced its desired effects (e.g., increased perceptions of pressure). For example, following pressure manipulations, individuals are often asked about their levels of state anxiety (e.g., via the State-Trait Anxiety Inventory; Spielberger, Gorsuch, & Lushene, 1970), how important they felt it was to perform at a high level in the pressure situation, how much pressure they felt, and to report the thoughts and worries they experienced while performing under pressure (see Beilock & Carr, 2005; Beilock, Kulp, et al., 2004; Tenenbaum, Reeves, & Acharya, 2005; Wang, Marchant, Morris, & Gibbs, 2004). Recent work has demonstrated across a number of different tasks that, under pressure, individuals do perceive the task at hand to be important; moreover, the extent of pressure-induced performance decrements is often correlated with perceived performance pressure and state anxiety (Beilock, Kulp, et al., 2004; Wang et al., 2004).

Importing choking research into a more controlled laboratory setting is beneficial because it allows one to directly examine the relationship between what is being manipulated (i.e., pressure) and what is being measured (i.e., performance, perceived feelings of pressure). Moreover, if individuals are randomly assigned to no-pressure and pressure groups, laboratory studies decrease the likelihood that individual differences in performance history or trait variables, such as anxiety, will influence the results. However, it is important to remember that the purpose of laboratory studies is to shed light on the real-world choking phenomenon. Thus, one must also demonstrate that choking occurs outside the laboratory.

In an attempt to explore real-world instances of pressure-induced failure, Baumeister and Steinhilber (1984) examined the performance of teams in the Baseball World Series and the National Basketball Association (NBA) finals. The authors hypothesized that heightened self-attention caused by the prospect of success ironically may hamper skill execution (resulting in choking under pressure). Using archival data of athletic performance in these contests, Baumeister and Steinhilber postulated that self-attention would be greater in situations that garnered significant audience support (when a team is playing at home in front of their loyal fans).

Early versus late games of the World Series and NBA finals were compared. In both basketball and baseball, the home team tended to win the first two games but lose the last (and decisive) game in these series. The authors concluded that this difference between performances in the early versus late games represented an example of the "home choke" in the later games, when the pressure was on to win the championship. In support of the notion that the home team was doing worse (rather than the visiting team performing better) in these games, Baumeister and Steinhilber (1984) reported data in baseball demonstrating that the incidence of fielding errors for the home team increased in the final games. Moreover, in basketball, although the home and visiting team performed at a similar level in free throw shooting in the early games, the visiting team outshot the home team in the late games. Thus, the presence of a supportive home crowd may cause the home team to perform more poorly than expected when on the brink of a championship (for a recent review of the impact of supportive audiences on performance, see Wallas, Baumeister, & Vohs, 2005).

Although the notion of the home choke is intriguing, there have been counters to this idea suggesting that professional athletes in their home territory do not show signs of choking when the pressure is on (Schlenker, Phillips, Boniecki, & Schlenker, 1995). Moreover, recent work examining whether choking under pressure occurs in professional golf (i.e., the PGA tour, Senior PGA Tour, and LPGA) suggests that contrary to popular opinion, those players leading going into the final round won the majority of the time (Clark, 2002a; see also Clark, 2002b). That is, the leaders did not play worse than the nonleaders in the final and pressure-filled situation, as Baumeister and Steinhilber's (1984) data might suggest. However, when interpreting the results of archival data analysis, it is important to have a clear picture of the data being considered and the analyses being performed. Clark's (2002a) analysis of choking, for example, involved comparisons of final-round scores across different golfers. No within-golfer comparisons were performed. Because choking is defined as performing more poorly than expected in a high-pressure condition (i.e., a deviation from one's average or expected performance), another approach to diagnosing choking is to perform a within-golfer comparison. That is, one might compare a golfer's initial-round score (or an average over a few initial or nonpressure rounds) with his or her final-round "pressure" score. Golfers with a higher score in the final round than in their initial rounds could be thought of as choking. It may be that comparing across golfers obscures such differences because two golfers could have the same final-round score, yet one is performing better than his or her average, and one is performing worse.

Thus, there is a debate concerning the frequency with which high-level athletes choke in real-world situations. It may be the case that choking studies in the lab lead us to overestimate the extent to which the phenomenon occurs in real life. However, the types of pressure created in the lab are likely multiplied many times over in real-world settings. Using this logic, instances of choking in laboratory settings should only be amplified in the real world (Wang et al., 2004). On the other hand, one might argue that real-world instances of choking are overestimated, as, by definition, they occur in response to an important or novel situation, which increases the likelihood that such an event will be remembered. However, to the extent that such paradoxical performance decrements can occur at all in situations where individuals are motivated to perform their best, understanding the processes underlying this phenomenon is very important.

MECHANISMS OF CHOKING UNDER PRESSURE

Although documenting instances of choking under pressure (in both laboratory and real-world settings) provides insight into the conditions under which this type of skill failure occurs, it is an understanding of the mechanisms underlying pressure-induced failure (i.e., the psychological, physiological, and biomechanical processes associated with less-than-optimal performance) that will truly advance our knowledge of the choking phenomenon. Moreover, a clear picture of choking processes sets the stage for the development of training regimens designed to alleviate these unwanted performance failures.

A number of theories have been proposed to account for choking under pressure. We have divided these theories into three categories: drive theories, attentional theories, and biomechanical theories. Although drive theories are consistent with pressure-induced skill decrements in some situations, they are generally limited in usefulness in that they do not provide a mechanistic explanation for why such performance failures occur. In this section, we focus more attention on attentional theories (no pun intended), as these theories attempt to describe how one's cognitive representation of a skill changes under heightened pressure conditions. Finally, we turn to biomechanical theories of choking. These theories provide hypotheses about how the biomechanical components directly implement one's skill change in response to pressure. It is important to note that the attentional and biomechanical theories described here should not be thought of as competing alternatives. Rather, it may be that pressure produces attentional changes, which in turn result in changes in the biomechanical implementation of one's skill, ultimately leading to performance decrements. By examining how pressure exerts its impact on multiple levels, we gain a better understanding of how exactly high levels of pressure result in low levels of performance.

Drive Theories

According to general drive theory models, an individual's performance level is determined by his or her current level of arousal, or "drive" (Spence & Spence, 1966). Although drive theories have been useful in accounting for some types of performance failures, they fall short in a number of ways. First, drive theories are more descriptive than prescriptive. That is, drive theories link arousal and performance, but they do not explain *how* arousal exerts its impact. Second, in drive theory models, there are often debates concerning how the notion of arousal should be conceptualized (e.g., as a physiological construct, emotional construct, or both). Third, as will be seen, there are situations in which certain drive theories have trouble accounting for observed behavior.

Yerkes-Dodson Effect

The Yerkes-Dodson (1908) effect, often termed the inverted-U theory, refers to the idea that as arousal increases, so does performance, but only to a certain point. In essence, performance is optimal at intermediate levels of arousal. Too little arousal, and the basketball player will not have the tools necessary to make the shot. Too much arousal, and again the shot will be missed. In the context of such theories, arousal has often been conceptualized as a physiological state (e.g., in terms of heart rate, blood pressure). The inverted-U hypothesis can, in general, account for performance failure under high-pressure situations. But, as mentioned earlier, such a theory is merely descriptive in nature in that it postulates a connection between arousal and performance but does not explain how different levels of arousal serve to alter skill execution processes.

Easterbrook's (1959) cue utilization hypothesis is one variant of the inverted-U that has attempted to apply a mechanistic explanation to the arousal-performance relationship. Easterbrook argues that increasing arousal reduces the range of cues used in a task. At low levels of arousal, the basketball player's attention may be too broad, encompassing both play on the court and her mom in the stands. At high levels of arousal, our player may be attending too narrowly to the player she intends to pass the ball to and, as a result, fails to notice the opponent about to steal her pass. Thus, Easterbrook's hypothesis suggests that arousal exerts its impact on performance by changing the player's selection of stimuli in the environment to attend to.

Another variant of the inverted-U is Hardy's (1996) sport adaptation of the cusp catastrophe model (CCM). The inverted-U and CCM are similar in that both predict that increases in arousal will facilitate performance to a certain degree. The two theories then diverge in their predictions regarding performance outcomes following optimal arousal (Gould & Krane, 1992). Once an optimal arousal-performance relationship is reached, the inverted-U predicts a monotonic decrease in performance associated with similar increases in arousal levels. The CCM makes a different prediction. Specifically, CCM suggests that small increases in arousal following an optimal arousal-performance relationship can be catastrophic, leading to large drops in performance. And, once such catastrophic performance drops have occurred, CCM postulates that recovering to previously high performance levels is difficult. Moreover, whereas traditional inverted-U hypotheses conceptualize arousal in largely physiological terms, the CCM suggests that it is the interaction of physiological arousal and cognitive anxiety that serve to impact performance, as opposed to physiological arousal alone. Although a full review of CCM is outside the scope of this chapter (including the precise nature of the relationship between cognitive anxiety and physiological arousal and how these constructs combine to impact performance differently at different stages along each of their respective continuums), the CCM's recognition of sudden performance drops suggests that this model may account for the types of performance decrements characteristic of the choking-under-pressure phenomenon. Future research is thus warranted here. See Hardy, Woodman, and Carrington (2004) and Tenenbaum and Becker's (2005) methodological critique for a recent discussion of the CCM and its predictions.

Social Facilitation

Zajonc's (1965) theory of social facilitation is another version of drive theory that postulates a relationship between arousal and performance. Social facilitation captures the notion that as drive increases, so, too, will the likelihood that one's dominant response will be exhibited. Under heightened levels of drive (often created by the presence of an audience), social facilitation theory argues, novices are likely to exhibit poor performance (i.e., their dominant response), whereas experts should perform at a high level (i.e., their dominant response). Although theories of social facilitation are intuitively appealing, they have received mixed support in motor skill research (for a review, see Strauss, 2002). Furthermore, it is easy to think of real-world examples where these predictions fall short. Namely, if one's dominant response was always displayed in high-drive situations, then professional athletes should never choke under pressure. This is because their dominant response (which is presumably high-level performance) should always be exhibited under stressful conditions where drive is at a maximum. Thus, instances where highly skilled individuals exhibit poor performance appear to be at odds with the idea that increased drive leads to the exhibition of one's dominant skill response.

To address these contrasting notions, C. E. Kimble and Rezabek (1992) attempted to directly pit social facilitation and choking theories against each other by examining *Tetris* video game performance in the presence of an audience (which was designed to increase participants' level of drive or arousal). In terms of performance on a complex *Tetris* game, social facilitation theory would suggest that the good players should perform well in the presence of an audience (i.e., exhibiting their dominant response). In contrast, from a choking-under-pressure perspective, such players might perform more poorly under audience pressure in comparison to an unobserved situation. This is exactly what occurred. Highly skilled *Tetris* players performed worse in the presence of an audience in comparison to a nonaudience situation. Thus, the notion that one's dominant response will be exhibited in high-arousal or high-drive situations does not always hold when the pressure is on.

Attentional Theories

Attentional theories seek to describe the cognitive processes governing pressure-induced failure: how pressure changes the attentional mechanisms and memory structures supporting performance. In this light, it may have been more appropriate to include Easterbrook's (1959) attentional cue utilization theory here (Lewis & Linder, 1997). However, because this theory is based on the notion of arousal or drive, we chose to describe it earlier.

The various attentional theories of choking make somewhat different claims concerning how pressure impacts performance. Nonetheless, as will be clarified in the following several paragraphs, there may not be just one attentional mechanism by which pressure can exert its impact. Rather, it may be the case that the cognitive demands of the skill one is performing predict how (and if) it will be susceptible to failure. Such a conclusion obviously makes the answer to the question of *why* skills fail under pressure more complicated. At the same time, however, it provides a more unified framework for understanding the choking phenomenon across diverse task domains (i.e., from cognitive to motor skills) and skill levels (i.e., from novice to expert performance).

Distraction Theories

Distraction theories propose that pressure influences task performance by creating a distracting environment that compromises one's working memory capacity resources. Working memory is a short-term memory system that maintains, in an active state, a limited amount of information with immediate relevance to the task at hand while preventing distractions from the environment and irrelevant thoughts (Kane & Engle, 2000). If the ability of working memory to maintain task focus is disrupted, performance may suffer. Distraction-based accounts of suboptimal performance suggest that performance pressure shifts attentional focus to task-irrelevant cues, such as worries about the situation and its consequences. This shift of focus changes what was single-task performance into a dual-task situation in which controlling the task at hand and worrying about the situation compete for the limited working memory resources of the performer.

The most notable arguments for the distraction hypothesis come from research involving academic test anxiety (Ashcraft & Kirk, 2001; Eysenck, 1979; Wine, 1971). Individuals who become highly anxious during test situations, and consequently perform at a suboptimal level, are thought to divide their attention between task-relevant and task-irrelevant thoughts more so than those who do not become overly anxious in high-pressure situations (Wine, 1971). Additional support for a distraction account of choking comes from recent work specifically examining the impact of performance pressure on cognitive task performance. Beilock, Kulp, et al. (2004) had individuals perform easy math problems as well as difficult problems (that placed heavy demands on working memory) in both low- and high-pressure situations. It was found that pressure does indeed cause individuals to worry. Moreover, only those math problems that were strongly reliant on the working memory resources that worries are thought to consume (i.e., the difficult problems) showed signs of failure under pressure.

Thus, there is evidence that pressure can compromise working memory resources, causing failure in tasks that rely heavily on this system. But not all tasks *do* rely heavily on working memory. Specifically, the types of high-level motor skills that have been the subject of the majority of choking research in sport (e.g., well-learned golf putting, baseball batting, soccer dribbling) are thought to become proceduralized with practice. Proceduralized skills do not require constant online attentional control and are in fact thought to run largely outside of working memory (e.g., Beilock, Carr, et al., 2002; Fitts & Posner, 1967; Proctor & Dutta, 1995). Such skills, then, should be relatively robust to conditions that consume working memory resources, as distraction theory proposes. However, these types of skills may be sensitive to other attention-induced disruptions under pressure. A second class of theories, generally known as explicit monitoring theories, has been used to explain such failures.

Explicit Monitoring Theories

Explicit monitoring theories suggest that pressure situations raise self-consciousness and anxiety about performing correctly (Baumeister, 1984). This focus on the self is thought to prompt individuals to turn their attention inward to the specific processes of performance in an attempt to exert more explicit monitoring and control than would be applied in a nonpressure situation (Baumeister, 1984; Beilock & Carr, 2001; Lewis & Linder, 1997). Explicit attention to step-by-step skill processes and procedures is thought to disrupt well-learned or proceduralized performance processes that normally run largely outside of conscious awareness (Beilock, Bertenthal, McCoy, & Carr, 2004; G. A. Kimble & Perlmuter, 1970; Langer & Imber, 1979).

Masters's (1992) reinvestment theory suggests that the specific mechanism governing explicit monitoring is "dechunking." Pressure-induced attention to execution causes an integrated or proceduralized control structure that normally operates without interruptions to be broken back down into a sequence of smaller, independent units, similar to how the performance was organized early in learning. Once dechunked, each unit must be activated and run separately. Not only does this process slow performance, but it also creates an opportunity for error at each transition between units that was not present in the integrated control structure.

A number of recent studies have attempted to examine the attentional correlates of suboptimal performance under pressure in high-level sensorimotor skills using explicit monitoring theories as a guideline. Many of these studies do not involve pressure at all, but rather attempt to mimic the attentional demands that pressure might induce. The logic here is that if researchers can uncover the types of attentional manipulations that compromise performance, they can use this evidence to begin to infer how pressure might exert its impact.

Beilock, Carr, et al. (2002) directly manipulated the attentional focus of experienced soccer players performing a soccer-dribbling task. Experienced soccer players dribbled a soccer ball through a series of pylons while performing either a secondary auditory monitoring task (designed to distract attention away from execution, mimicking distraction theories' proposed choking mechanism) or a skill-focused task in which the dribblers monitored the side of the foot that most recently contacted the ball (designed to draw attention to a component process of performance, mimicking explicit monitoring theories' proposed mechanism). Performing in a dual-task environment did not harm experienced soccer players' dribbling skill in comparison to a single-task practice condition used as a baseline. However, when the soccer players were instructed to attend to performance (i.e., monitoring the side of the foot that most recently contacted the ball), their dribbling skill deteriorated in comparison to both the dual-task condition and a single-task baseline. Consistent with explicit monitoring theories of choking, step-by-step attention to skill processes and procedures appears to harm well-learned performance (see Figure 19.1).

Gray (2004) reports analogous results in an investigation of baseball batting. Highly skilled Division I intercollegiate baseball players were asked to perform a hitting task while at the same time listening for a randomly presented tone to judge whether the tone was high or low in frequency. This external dual-task had little effect on the baseball players' temporal swing error. Because experienced batters are thought to not explicitly attend step-by-step to execution, attentional capacity was available to devote to secondary task demands (i.e., judging the frequency of the tone) without significantly disrupting primary skill execution. However, when

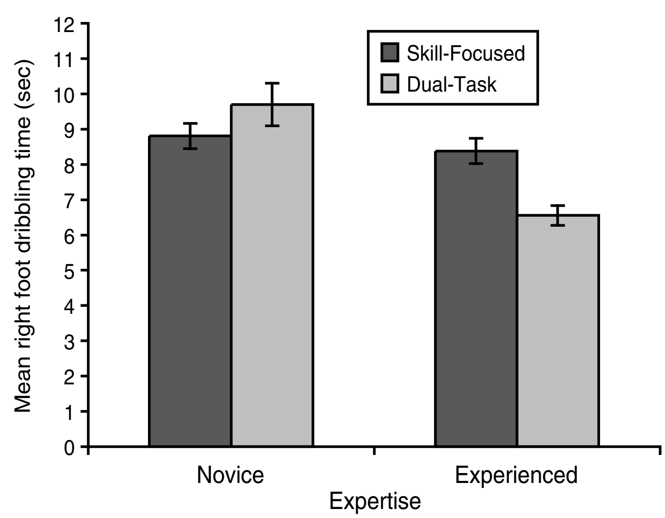

Figure 19.1 Mean right foot dribbling time(s) in the skill-focused and dual-task attention conditions for novice and experienced performers. Error bars represent standard errors. *Source:* "When Paying Attention Becomes Counterproductive: Impact of Divided versus Skill-Focused Attention on Novice and Experienced Performance of Sensorimotor Skills," by S. L. Beilock, T. H. Carr, C. MacMahon, and J. L. Starkes, 2002, *Journal of Experimental Psychology: Applied, 8,* pp. 6–16. Copyright American Psychological Association. Reprinted with permission.

the same batters were required (in a skill-focused condition) to attend to a specific component of swing execution in a manner to which they are not accustomed, their performance suffered. In this skill-focused condition, baseball players heard a randomly presented tone and were instructed to indicate whether their bat was moving downward or upward at the instant the tone was presented. Kinematic swing analyses revealed that the observed performance failure was at least partially due to the fact that skill-focused attention interfered with the sequencing and timing of the different motor responses involved in swinging (Welch, Banks, Cook, & Draovitch, 1995), a finding consistent with Masters's (1992) notions of pressure-induced skill dechunking.

One might be concerned that the pattern of results just reported was merely due to different attentional demands in the external dual-task and skill-focused conditions (i.e., the skill-focused condition just required more attentional resources). However, there is evidence that this is not the case. Novice performers were also included in Gray's (2004) work and in Beilock, Carr, et al.'s (2002) work, and these novices showed the opposite pattern of results. For example, novices were harmed by the external dual-task but not the skill-focused condition in Beilock, Carr, et al.'s soccer dribbling study (see Figure 19.1). Unlike expert performance, novice performance is thought to require explicit attentional control (Beilock & Carr, 2001; Fitts & Posner, 1967; Proctor & Dutta, 1995). As a result, novices are hurt when attention is taken away from execution rather than by conditions that draw attention to performance. If the skill-focused condition had just required more attention in both Gray's and Beilock, Carr, et al.'s work, then novices should have been harmed by this condition as well, but they were not.

It should be noted that skill-focused attention may not always be detrimental to well-learned performances. For example, when the goal is to explicitly alter or change performance processes to achieve a different outcome rather than to maximize real-time performance, attention to performance may be beneficial. High-level performers will likely have to slow down and dechunk previous execution procedures to alter these processes, which may result in temporarily poor performance (e.g., Tiger Woods's less-than-optimal performance while he changed of his golf swing). Ultimately, however, these changes should produce performance benefits as skill execution will more closely mirror desired outcomes (see Beilock, Carr, et al., 2002, for further discussion of this issue).

The types of attention studies outlined here lend indirect insight into the cognitive mechanisms driving skill failure in high stakes situations, but it is also possible to more directly assess the impact of pressure to perform at a high level on skill execution. In a separate experiment in his 2004 study, Gray directly investigated the effects of performance pressure on baseball batting in college baseball players. Following a series of pretests in which individuals performed the virtual batting task under the two dual-task conditions described earlier (i.e., judging tone frequency or direction of bat movement), batters were split into two groups. Batters in the pressure group were instructed that they had been paired with one other batter in the study, and that if both they and their teammate could increase their total number of hits in the next block of trials by a designated amount, they would receive a monetary reward. Batters in this group were further instructed that their teammate had already successfully reached the criterion for reward. Thus, both social pressure and monetary incentive were used to induce feelings of performance pressure in the baseball players (a manipulation first used by Beilock & Carr, 2001). Batters in a second, control group were not presented with the above pressure scenario, they were simply told to try to perform the task to the best of their ability. Both groups then performed the batting task under the same two dual-task conditions used in the pretests.

Batters in the pressure group exhibited clear choking effects. Mean temporal batting errors were significantly higher following the pressure manipulation in comparison to before the pressure manipulation. Not only did these batters fail to reach the incentive criterion, but their performance under pressure was actually worse than their baseline performance—direct evidence for choking. In terms of batters in the control group, there was no significant difference between mean temporal errors in the two blocks of trials.

How exactly did performance pressure cause batting performance to degrade in these highly skilled baseball players? One mechanism that appeared to be related to choking was a change in these players' attentional focus. Figure 19.2 shows the mean number of judgment errors in the two secondary tasks before (pretest) and after (posttest) the pressure manipulations. In the pressure group, there was a significant decrease in the percentage of judgment errors in the skill-focused secondary task (judging the direction of the bat movement) from pre- to posttest. This indicates that the pressure caused these batters to turn their attention inward and explicitly monitor their swing execution, resulting in better skill-focused judgments. To our knowledge, this finding provides the first direct evidence that pressure increases attention to execution, in line with explicit monitoring theories of chok-

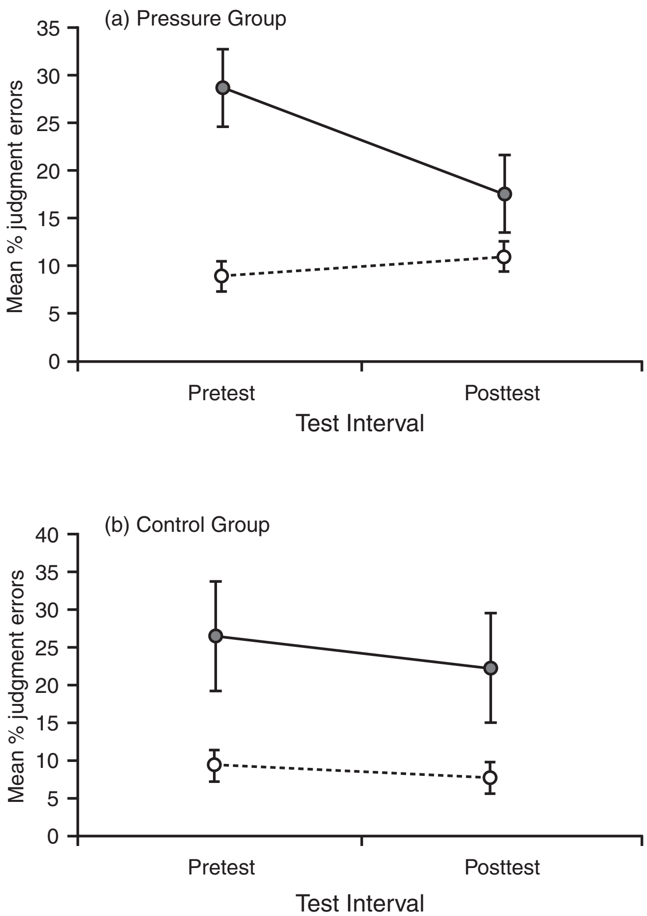

Figure 19.2 Mean percentage of judgment errors for dual-task judgments in the pre- and posttest conditions. (a) Pressure group. (b) Control group. Solid symbols and solid lines plot data for the skill-focused dual task (judging direction of bat movement), and open symbols and dashed lines plot data for the extraneous dual task (judging tone frequency). Error bars are standard deviations. *Source:* "Attending to the Execution of a Complex Sensorimotor Skill: Expertise Differences, Choking and Slumps," by R. Gray, 2004, *Journal of Experimental Psychology: Applied, 10,* pp. 42–54. Copyright American Psychological Association. Reprinted with permission.

ing (Baumeister, 1984; Beilock & Carr, 2001). A second, possibly related mechanism associated with the choking effect in this study was a change in the swing biomechanics. Batters in the pressure group exhibited an increased amount of variability in the timing of the different stages of their swing, consistent with Masters's (1992) notion of pressure-induced dechunking of well-learned processes.

As one may have noticed, the work presented above in support of explicit monitoring theories largely deals with athletes performing at a high skill level. What about novices? Theories of skill acquisition and automaticity suggest that the attentional mechanisms governing novice and expert performance are quite different. Although novice performance is thought to be supported by declarative or explicit knowledge that is held in working memory and attended to in step-by-step fashion, expert performance (at least for highly practiced skill components) is thought to occur more automatically, largely controlled by procedures that run outside of working memory during execution (Anderson, 1993; Fitts & Posner, 1967). Thus, from the standpoint of explicit monitoring theories, unskilled performers should not choke if pressure prompts attention to execution. This is due to the fact that these performers are already attending to their skill in real time. In an attempt to explore this notion, Beilock and Carr (2001) had participants practice a golf-putting task. The participants were exposed to a high-pressure situation both early and late in practice. Early in practice, pressure to do well actually facilitated execution. Only at the later stages of learning did performance decrements under pressure emerge.

Thus, it appears that the proceduralized performances of experts are negatively affected by performance pressure, whereas novice skill execution, which is already attended to in real time, is not harmed by pressure-induced attention to execution. This finding is consisting with Marchant and Wang's (2001) assertion that most of the evidence for choking under pressure has been derived from well-learned sensorimotor tasks that automate via proceduralization with extended practice. Mirroring this idea, Paulus, Shannon, Wilson, and Boone (1972) found a positive correlation between high school students' gymnastic ability and audience-induced performance decrements. That is, the better gymnasts were more likely to perform poorly in front of an audience. Furthermore, Mullen and Hardy's (2000) work exploring the effects of anxiety and performance pressure on golf putting shows a similar pattern of results. Less skilled golfers' putting performance (as measured by absolute putting error scores) was not significantly harmed by a high-anxiety pressure situation in comparison to a low-pressure control condition, but highly skilled golfers showed performance decrements under pressure.

It should be noted that the viewpoint put forth in the skill acquisition and automaticity literature that high-level performance is based, at least in part, on automated performance processes that are best run without conscious awareness is not held by all those who study skilled performance. Specifically, Ericsson and Lehmann (1996, p. 291) have suggested that "most forms of expert performance remain mediated by attention-demanding cognitive processes." In this view, pressure-induced attention to execution should not disrupt high-level skills because such skills are already attended to in real time.

What can one make of this notion given the preponderance of evidence presented in support of the idea that explicit attention to high-level skills disrupts execution? In line with skill acquisition and automaticity theories, we argue that some components of high-level performance become proceduralized with practice in such a way that explicitly trying to access these processes disrupts execution. One consequence of such proceduralization is that skilled performers' attentional resources are freed up to monitor higher level, metacognitive, and self-regulatory goals that are important aspects of exceptional performance (Kanfer & Ackerman, 1989). Unfortunately, under pressure, individuals may discard metacognitive strategies in favor of trying to control execution processes that are best left unattended. This shift in attention may not only disrupt proceduralized performance processes, but may limit strategic thinking as well. Of course, more research in this area will benefit not only the choking literature, but also the skill acquisition and expertise literature.

Pressure's Double Whammy

Explicit monitoring and distraction theories essentially make opposite predictions regarding how pressure exerts its impact. Whereas distraction theories suggest that pressure shifts needed attention away from execution, explicit monitoring theories suggest that pressure shifts too much attention to skill execution processes. Can both theories be correct?

Beilock, Kulp, et al. (2004) have suggested that performance pressure creates two effects that alter how attention is allocated to execution: (1) Pressure induces worries about the situation and its consequences, thereby reducing working memory capacity available for performance, as distraction theories would propose; and (2) at the same time, pressure prompts individuals to attempt to control execution to ensure optimal performance, in line with explicit monitoring theories. This suggests that how a skill fails is dependent on performance representation and implementation. That is, skills that rely heavily on working memory will fail when pressure consumes the resources necessary for performance, and proceduralized skills that run largely outside of working memory will fail when pressure-induced attention brings such processes back into conscious awareness. And, skills that concurrently load on working memory and rely upon proceduralized skills might be susceptible to both effects at once.

It is important to note that it does not seem to be merely a cognitive versus motor distinction that predicts how a skill will fail under pressure. That is, just because one is performing an academically based cognitive task does not mean this task will show signs of failure via pressure-induced distraction. Likewise, sports skills do not necessarily fail via pressure-induced explicit monitoring. Rather, it appears to be the manner in which skills utilize online attentional resources that dictates how they will fail (though often, this is related to skill domain). Thus, sports skills that make heavy demands on working memory, such as strategizing, problem solving, and decision making (i.e., skills that involve considering multiple options simultaneously and updating information in real time), will likely fail as a result of pressure-induced working memory consumption, similar to a working-memory-dependent academic task. In contrast, motor skills that run largely outside of working memory (e.g., a highly practiced golf putt or baseball swing) will fail when pressure-induced attention disrupts automated control processes.

Although these ideas are consistent with the pressure data to date, future work is needed to flesh out these important issues. For example, why don't novice sensorimotor skills fail via pressure-induced distraction, as shown for the working-memory-demanding cognitive tasks presented? Although unpracticed motor skills are based, in part, on explicitly accessible declarative knowledge (Beilock, Wierenga, et al., 2002) and may be harmed by dual-task situations (Beilock, Carr, et al., 2002; Beilock, Wierenga, et al., 2002), this knowledge does not appear to be organized in such a fashion that pressure-induced strains on working memory necessarily disrupt execution. Indeed, much like easy cognitive tasks that do not fall prey to pressure-induced failure (see Beilock, Kulp, et al., 2004), it may be that novice sensorimotor skills are not demanding enough on working memory (or demanding in the right way) to show signs of failure via distraction.

Behavioral Theories

Attentional theories of performance pressure account for how pressure changes the attentional processes and memory structures supporting skill execution. However, to gain a complete understanding of the choking phenomenon, one must not only understand the cognitive processes that govern failure, one must also explore how the biomechanical processes that actually implement skills are compromised by performance pressure. We have already described some evidence for biomechanical changes associated with pressure (see Gray's, 2004, work, described earlier). In this section, we outline the main theory that has tried to capture pressure-induced changes in the motor implementation of skill execution.

Freezing Degrees of Freedom

One of the most prominent theories of the biomechanical processes associated with performance stress is the idea of "freezing degrees of freedom" (*df*), first proposed by Bernstein (1967) and studied in more detail by Vereijken, van Emmerik, Whiting, and Newell (1992). When we first learn to perform a complex motor task, such as throwing a ball, there are innumerable possible ways the action could be coordinated because each joint involved (e.g., wrist, elbow, shoulder) has multiple degrees of freedom (*df*). As a solution to this *df* problem, Bernstein suggested that novice performers may "freeze" the *df* by keeping some joints rigidly locked in place and/or by tightly coupling the movements of different joints. With practice, performers will begin to "unfreeze" the rigid couplings between parts of the body to allow for more flexible movement control. Bernstein further proposed that under conditions of high stress, expert performers may revert to the novice freezing strategy to reduce task complexity.

Recently, evidence has been provided to support Bernstein's (1967) account of the biomechanical changes associated with performance stress. Collins, Jones, Fairweather, Doolan, and Priestley (2001) investigated the movement patterns of weight lifters under training and competitive conditions. Under conditions in which a lift made in practice was not successfully completed during competition (i.e., the lifter choked), there was a higher cross-correlation between the neck and hip joints in some lifters, consistent with freezing *df*. A similar finding was reported by Higuchi, Imanaka, and Hatayama (2002) for a computer-simulated batting task. Pressure was induced in this study by negative feedback (via mild shocks) for performance errors. In the pressure condition, there was a higher correlation between the onset times of the kinematic events involved in the hitting movement (e.g., movement initiation, end of backswing), consistent with a reduction in the number of *df* for movement control. Finally, Pijpers, Oudejans, Holsheimer, and Bakker (2003) recently investigated the effects of anxiety on the movement behavior of novice rock climbers. Anxiety was manipulated by having participants climb at two different heights on an indoor climbing wall. Consistent with a freezing *df* theory, when climbing high on the wall, participants exhibited movements that were more rigid and less fluent compared to climbers at the low level on the wall. This promising line of research is a good example of how the dynamic systems approach to perceptual-motor control used in ecological psychology (Kelso & Schöner, 1988) can be applied to the choking-under-pressure phenomenon.

How does the phenomenon of freezing *df* relate to the dechunking results found by Gray (2004)? On the surface, these two biomechanical processes seem to predict opposite effects. When an action is broken down into smaller, independent subunits during dechunking, one would expect to see a increase in movement variability because errors and delays can occur for each subunit. Alternatively, when a performer freezes the *df* by increasing the coupling between joints, one would expect to see a decrease in movement variability. We would argue that both dechunking and freezing *df* represent a temporary regress to a lower-skill level (associated with an earlier stage of skill acquisition) brought on by an increase in explicit monitoring of the motor action. Whether increased or decreased movement variability is observed will depend on what aspect of the movement is being measured. Take, for example, the climbing study by Pijpers et al. (2003). In a follow-up to this study, Pijpers, Oudejans, and Bakker (2005) reported that along with rigid, low-variability, whole-body movements reported in their 2003 study, there were some aspects of the climbing behavior that became more variable under the high-anxiety condition. When climbing high on the wall, participants exhibited greater variability in the number of exploratory hand movements used to test for holds, the movement time for the climb, and the length of rest between traverses. Similarly, we would expect that if the cross-correlations between the movements of different joints had been measured in the baseball batting study by Gray (2004), a decrease in movement variability (as indexed by an increase in the cross-correlation) would have been observed. Therefore, it appears that performance stress induces a variety of changes in movement behavior. It will be important for future research to identify which of these changes are the most detrimental to overall performance and how their incidence can be reduced.

INDIVIDUAL DIFFERENCES AND SUSCEPTIBILITY TO PRESSURE-INDUCED FAILURE

In the previous section, we examined the causal mechanisms of choking under pressure. A dominant theme that emerged was that a skill's susceptibility to pressure-induced failure is dependent on the types of resources that skill relies on most heavily (e.g., working memory capacity; proceduralized control structures). In this section, rather than examining differences as a function of the type of skill being performed, we look to a number of individual differences in the performer as predictors of susceptibility to performance decrements under pressure.

Dispositional Self-Consciousness

Self-consciousness refers to one's level of awareness about internal states and processes (Baumeister, 1984; Fenigstein, Scheier, & Buss, 1975). Using a version of explicit monitoring theory as a guideline, Baumeister hypothesized that individuals low in dispositional self-consciousness would be more prone to performance decrements under pressure than those high in self-consciousness. High self-conscious individuals are accustomed to attending to their performance. Thus, to the extent that pressure prompts attention to execution (as explicit monitoring theories would predict), those who are accustomed to performance monitoring (i.e., high self-conscious individuals) should be less impacted by increased self-awareness than those who are not (i.e., low self-conscious individuals). In a series of experiments, participants performed an unfamiliar ball roll-up motor task in which the goal was to maneuver a ball into various target holes. Baumeister found that those scoring higher in dispositional self-consciousness were less prone to choke under pressure than those who scored lower.

Although Baumeister's (1984) findings are consistent with explicit monitoring theories of choking, more recent work has called the specifics of these results into question. In particular, Wang et al. (2004) examined individual differences in self-consciousness as a predictor of choking under pressure in a well-learned basketball free-throw shooting task. It was found that highly self-conscious athletes (specifically, privately self-conscious; see Fenigstein et al., 1975) were *more* susceptible to choking under pressure, not *less,* as Baumeister had found.

Wang et al. (2004) suggest that these disparate findings may be due to differences in the skill level of the performers in the two studies. Baumeister's (1984) participants were relatively unskilled at performing the ball-rolling task. In contrast, Wang et al.'s participants were skilled basketball players performing a well-learned free-throw shooting task. It may be that at low levels of learning, individuals high in self-consciousness are less prone to choke, not because they are adapted to performing in a self-focused state, but because they are more likely to allocate attentional processes to execution. As mentioned earlier, such attentional processes seem to be beneficial in the initial stages of learning yet disrupt well-learned, automated performance processes (Beilock, Carr, et al., 2002). Thus, in Wang et al.'s work, attention to execution (increased by high levels of dispositional self-consciousness) may have harmed a *well-learned* skill. And in Baumeister's work, these same attentional processes may have aided (or at least did not hurt) performance of a relatively *unpracticed* task.

Reinvestment

Similar to the notion that individuals high in self-consciousness may be most prone to pressure-induced failure, Masters, Polman, and Hammond (1993) proposed an individual difference personality variable termed "reinvestment" that may predict an individual's propensity for performance failure under stress. To assess this personality variable, Masters et al. (1993) developed the Reinvestment Scale, which is loosely based on the Cognitive Failures Questionnaire (Broadbent, Cooper, FitzGerald, & Parkes, 1982), the Emotional Control Questionnaire (Roger & Nesshoever, 1987), and the Private and Public factors of the Self-Consciousness Scale (Fenigstein et al., 1975). The Reinvestment Scale attempts to capture the likelihood that one will try to "reinvest" explicit knowledge or attempt to perform one's skill using conscious control in certain situations. Masters et al. (1993) suggested that under high-pressure conditions, those scoring higher on the Reinvestment Scale should be more likely to show signs of stress-induced performance failure. And, indeed, this is what he found. Under low-pressure conditions, the performance of low and high reinvesters did not differ on a well-learned golf-putting task. However, in a heightened pressure situation, high reinvesters were more likely to show performance decrements than their low reinvester counterparts (for confirmatory evidence, see Jackson, Ashford, & Norsworthy, 2006). Moreover, in a subsequent study using university squash and tennis players, Masters et al. found that one's Reinvestment Scale score correlated with the extent to which one's teammates reported that one was likely to choke under pressure.

Although more work is needed to determine the exact relationship between reinvestment, self-consciousness, and choking under pressure, the work discussed here suggests that it may be possible to identify a priori those athletes who will be most susceptible to unwanted performance breakdowns in high-stakes situations. Furthermore, when high-level skills are being performed, it looks like those who have the tendency to monitor their performance (e.g., as measured by high scores on the self-consciousness and reinvestment scales) will be most likely to choke under pressure.

Trait Anxiety

In the academic test anxiety literature, a number of studies have demonstrated that individuals with high levels of trait anxiety are especially vulnerable to the detrimental impact of stressful situations (Eysenck, 1992). Do the same sort of effects apply in sporting tasks under pressure? Recent work by Wang et al. (2004) suggests that they do. Individuals who reported higher levels of trait anxiety (assessed using the Sport Anxiety Scale; R. E. Smith, Smoll, & Shutz, 1990) performed more poorly on a well-learned basketball task under pressure than those who did not. Furthermore, this effect was magnified for highly trait-anxious athletes who were also high in self-consciousness (see previous section).

Murray and Janelle (2003) also found that individuals higher in trait anxiety are more susceptible to stress-induced performance decrements than their low-anxious counterparts. In one study, participants performed a simulated driving task and a secondary visual search task (requiring that participants respond as quickly as possible to visual cues presented in either central or peripheral vision) under baseline and competition conditions. Although driving performance did not significantly change as a function of condition, response times showed a different pattern of results. In competition, response times were reduced for the low-anxious group but increased for the high-anxious group in comparison to the baseline condition. Murray and Janelle suggest that those with higher dispositional levels of anxiety may not be as efficient in processing information under stress. It should be noted, however, that this inefficient search strategy under stress is not necessarily limited to those high in trait anxiety. Janelle (2002) suggests that anxiety in general may alter visual search and gaze behavior, resulting in inefficient and ineffective search strategies.

One reason individuals high in trait anxiety may perform differently under pressure in comparison to their low-anxious counterparts is that low- and high-anxious individuals appear to interpret pressure in fundamentally different ways. Giacobbi and Weinberg (2000) examined the coping responses of low and high trait-anxious athletes. They found that in response to stressful situations, high trait-anxious athletes used different and often nonproductive coping behaviors (e.g., self-blame) in comparison to low trait-anxious athletes. Thus, individuals high in trait anxiety may actually view pressure differently than low trait-anxious individuals, which may explain, at least in part, why their performance seems to suffer more under stress. Future work in this area will certainly shed additional light on this issue.

ALLEVIATING PRESSURE-INDUCED FAILURE

One of the main goals of choking under pressure research is to understand unwanted performance decrements to the extent necessary to develop strategies to alleviate failure. In this section, we describe some of the work that has been conducted on this issue. As a preview, it does not appear that there is one *correct* pressure-inoculation strategy. Rather, there appear to be a number of training mechanisms and techniques through which pressure-induced failures may be lessened. For instance, as will be seen in the following paragraphs, some training conditions have attempted to adapt individuals to the types of attentional monitoring that pressure is thought to induce, and others have prevented participants from gaining the type of knowledge that pressure situations may exploit.

Skill Monitoring

Beilock and Carr (2001) examined performance under pressure in a golf-putting task to determine whether practice at dealing with the causal mechanisms proposed by explicit monitoring theories of choking would reduce pressure-induced failure. Here we describe an abbreviated version of this training paradigm.

Participants were trained to a high-skill level on a golf putting task under one of two learning conditions and then exposed to a pressure situation. The first training condition involved ordinary single-task practice, which provided a baseline measure of choking. In the second, "self-conscious" or "skill-focus" training condition, participants learned the putting task while being videotaped for subsequent public analysis by experts, a manipulation first used by Lewis and Linder (1997). This manipulation was designed to expose performers to having attention called to themselves and their performance in a way intended to induce explicit monitoring of skill execution—the aspect of pressure that explicit monitoring theories propose causes failure. Following training, all groups were exposed to the same pressure situation created by a performance-contingent monetary award.

Choking occurred for those individuals who were trained on the putting task in the single-task condition used as a baseline. However, choking did not occur for those trained in the self-conscious condition. Beilock and Carr (2001) concluded that training under conditions that prompted attention to the component processes of execution enabled performers to adapt to the type of attentional focus that often occurs under pressure. In this way, self-consciousness training served to inoculate individuals against the negative consequences of overattending to well-learned performance processes, the mechanism that explicit monitoring theories suggest is responsible for performance decrements in high-pressure situations.

It should be noted that measures were not taken to ensure that individuals were attending to their skill under the self-consciousness condition in Beilock and Carr's (2001) work. However, to the extent that pressure harms performance by prompting explicit attention to execution in this type of task, and individuals in the self-consciousness condition did not fall prey to pressure's impact, it follows that participants were performing the task in a manner that adapted them to attending to execution. It is also possible that self-consciousness training may serve another purpose in addition to or instead of adapting individuals to explicitly monitoring execution. Namely, it may adapt individuals to the pressure situation in general. To the extent that athletes become accustomed to performing under pressure, a high-stakes situation may not represent much that is new to them. In turn, when this type of situation arises, they may not feel as much pressure as nonadapted individuals, and suboptimal skill execution may be avoided.

Distraction under Pressure

Using the same technique of videotaping for subsequent analysis by experts described in Beilock and Carr's (2001) work, Lewis and Linder (1997) also demonstrated that learning a golf-putting skill in a self-awareness-heightened environment inoculates individuals against pressure-induced failure at high levels of practice. Like Beilock and Carr, Lewis and Linder found that pressure caused choking in those individuals who had not been adapted to self-awareness. Furthermore, they found that the introduction of a secondary task (counting backward from 100) while performing under pressure helped to alleviate the performance decrements shown by the nonadapted golfers. Lewis and Linder concluded that the secondary backward-counting task occupied working memory, preventing attention from being focused on the proceduralized processes that controlled performance. As a consequence, choking under pressure was ameliorated, another finding that is consistent with explicit monitoring theories.

It may also be possible to limit attention to execution under pressure without adding a distracting secondary task. Beilock, Bertenthal, et al. (2004) recently found that simply limiting the opportunity for skill-focused explicit monitoring through instructions to perform a putting task rapidly improved the performance of experienced golfers, relative to a condition in which the same golfers were told to take as much time as they needed to be accurate. The impact of this manipulation was phenomenologically noticeable: Several golfers reported that the speed instructions aided their performance by keeping them from thinking too much about execution. Thus, under pressure, making individuals perform their well-learned skill at a faster rate may actually prevent them from thinking too much about execution. Future research is needed to explicitly test this idea.

Implicit Learning

Rather than training individuals to adapt to the type of pressure-induced attention that explicit monitoring theories propose pressure induces, Masters (1992) argues that it may be better to train individuals without this type of knowledge to begin with (see Magill, 1998, for a general review of implicit motor learning). Masters suggests that, under pressure, performers may reinvest the explicit or declarative knowledge acquired during the early stages of skill acquisition, leading to a disruption of procedural performance processes. Under this logic, if performers do not have such knowledge to reinvest (i.e., they do not have a large body of declarative knowledge), they may not fall prey to pressure's negative effects.

Support for this idea comes from work in which Masters (1992) trained individuals on a golf-putting task under either explicit or implicit learning conditions and then exposed them to a high-pressure environment. In the explicit training condition, individuals were asked to follow a detailed set of instructions regarding how to putt. In the implicit training condition, participants received no putting instructions and were asked to carry out a secondary, random-letter-generation task while putting. Comparisons from the last training session to the high-pressure situation demonstrated that although the implicit group improved under pressure, the explicit group did not. Masters has taken this pattern of results as support for the notion that training individuals without explicit knowledge of their performance helps prevent breakdowns under pressure (see also Hardy et al., 1996).

It should be noted, however, that in Masters's (1992) study, the performance of the dual-task implicit group was at a substantially lower accuracy level than the explicit learning group prior to the high-pressure situation (as measured by the mean number of putts holed during the last training session). If pressure prompts attention to execution, and this attention to performance has differential effects as a function of skill level (i.e., novice performers benefit from attention to performance, but highly skilled individuals are harmed), another possible interpretation of the results of Masters's study is that pressure-induced attention to performance aided the implicit learning group because they were less skilled, whereas the explicit group, operating at a higher skill level, was harmed by such attention. Recent work shows, however, that it is possible to circumvent this issue regarding differences in performance after training in explicit and implicit motor learning conditions via prolonged periods of practice (Maxwell, Masters, & Eves, 2000). And, moreover, there is a growing body of work suggesting that implicit training may prove to be a useful tool in preventing choking under pressure (Poolton, Maxwell, & Masters, 2004, 2005). Thus, more work is needed to further our understanding of the inoculation benefits that implicit learning may afford in terms of success under stress (MacMahon & Masters, 2002; see also Masters, 2000, for a discussion of implicit learning and its consequences).

OTHER FORMS OF CHOKING

In an earlier section of this chapter we spent time outlining what we felt choking under pressure was and what it was not. Not only is it important to agree on a concrete operational definition of choking, but it is also imperative that we understand similarities and differences between what we have termed choking under pressure and other performance-failure phenomena. We outline two such types of failures that have received considerable interest in sport. Our goal is to try to understand how these failures relate to the choking research presented earlier.

The Yips

The yips have been described as a disruption in the execution of a fine motor skill as a result of involuntary jerks, tremors, and spasms of the extremities. The yips are often accompanied by increased levels of anxiety and a heightened fear of failure. Although the yips are most often talked about in relation to golf putting, they have also been documented in other complex motor skills, such as in cricket (Bawden & Maynard, 2001).

The yips have commonly been described in one of two ways: as a form of dystonia or as a type of choking under pressure (A. M. Smith et al., 2003). Dystonia is a neurological disorder typified by involuntary movements that result in a twisting and spasming of body parts. Task-specific dystonias are isolated to specific tasks or particular situations in which an individual is required to perform a well-learned and repetitive movement, such as playing a musical instrument, performing an intricate medical surgery procedure, or golf putting. The cause of dystonia has been linked to abnormalities in the functioning of the basal ganglia and motor pathways, as well as to head injuries and stroke.

A. M. Smith and colleagues (2003) developed a model in which performance anxiety exacerbates either of two types of yips. In the case of Type I yips, increased performance anxiety is thought to prompt a form of focal dystonia. In the case of Type II yips, the same form of anxiety is proposed to increase self-awareness and attention to performance, ultimately resulting in choking. Although both Type I and Type II yips are characterized by different intermediary processes, both forms are thought to manifest themselves in terms of a jerk, twitch, tremor, or freezing of the putting stroke, which disrupts putting execution. Thus, documentation of the yips seems to involve both attentional and biomechanical correlates of failure, similar to the work currently being done on the choking phenomenon.

Stereotype Threat

Choking under pressure has been characterized as suboptimal performance in response to heightened levels of pressure. Introducing a negative stereotype about a social group in a particular domain can reduce one's quality of performance as well. For example, when negative stereotypes are activated, African Americans perform worse on math tasks described as assessing intelligence (Steele & Aronson, 1995), and Whites perform worse on golf-putting tasks described as assessing natural athletic ability (Stone, Lynch, Sjomeling, & Darley, 1999).

The performance failure that results from making salient a negative group stereotype has been termed *stereotype threat* (Steele, 1997). Although stereotype threat has been repeatedly demonstrated, little is known about why it occurs or how it relates to other types of skill failure. One possibility is that stereotype threat is one form of choking under pressure (Beilock & McConnell, 2004). That is, activating a negative stereotype about how one should perform leads to suboptimal performance, much in the way that making salient the consequences of losing an important game may result in choking under pressure. To test this idea, Beilock and colleagues (Beilock, Jellison, Rydell, McConnell, & Carr, in press) examined whether stereotype threat and performance pressure led to the same patterns of skill failure and, moreover, whether the cognitive mechanisms responsible for pressure-induced failure and those responsible for stereotype threat were similar.

We first examined whether, similar to performance pressure, expert golfers are susceptible to the negative effects of stereotype threat (Beilock, Jellison, et al., in press). Male athletes who were skilled golfers performed a series of golf putts on an indoor putting green before (pretest) and after (posttest) receiving either a negative stereotype about their golf-putting performance (ST condition) or no information (control condition). All participants read that the study involved researching golf ability. In addition, participants in the ST condition read that previous research had demonstrated that women actually tend to be better putters than men. Thus, we were attempting to create a negative stereotype about how male golfers in our study should perform (i.e., worse than women). Results showed no difference in putting performance as a function of group in the pretest. However, in the posttest, the ST group performed significantly worse than the control group (see Figure 19.3). Thus, this first experiment succeeding in demonstrating that highly skilled golfers show patterns of failure under stereotype threat similar to that previously seen in high-pressure situations (see Gray, 2004; Jackson et al., 2006).

In a follow-up experiment, we examined whether the mechanisms governing stereotype threat were similar to those seen in pressure-induced failure situations. As mentioned above, previous work has demonstrated that well-learned sensorimotor skills fail under pressure via the prompting of explicit attention to execution processes that are best left outside of conscious control (Beilock & Carr, 2001; Gray, 2004; Jackson et al., 2006; Lewis & Linder, 1997; Masters, 1992). If stereotype threat operates in a similar manner to pressure in highly skilled golf putting, then not only should skilled golfers fail in stereotype threat situations, but drawing attention away from performance under stereotype threat should reduce this type of maladaptive attentional control. That is, to the extent that, similar to performance pressure, stereotype threat harms high-level putting by inducing attention to execution processes that are best left outside of explicit awareness, then the addition of a secondary task that reduces attention to the step-by-step unfolding of performance should lessen stereotype threat effects.

Male athletes who were skilled golfers performed a series of golf putts under both single-task and dual-task conditions, both before and after receiving a negative stereotype about how they should perform (Beilock, Jellison, et al., in press). As can be seen in Figure 19.4, prior to the introduction of the negative performance stereotype, there was no significant difference between single-task and dual-task performance. In contrast, following the introduction of ST, golfers performed significantly worse in the single-task than in the dual-task condition. These results suggest that, similar to pressure-induced failure in high-level proceduralized skills such as putting, stereotype threat occurs because the introduction of a negative stereotype prompts attention to execution in a manner that disrupts the automated processes of such skills. Adding a secondary task prevents this type of maladaptive attention to execution. In a subsequent study (Beilock, Jellison, et al., in press) we determined that this secondary task did not just divert skilled golfers' attention away from the stereotype presented to participants, as even a secondary

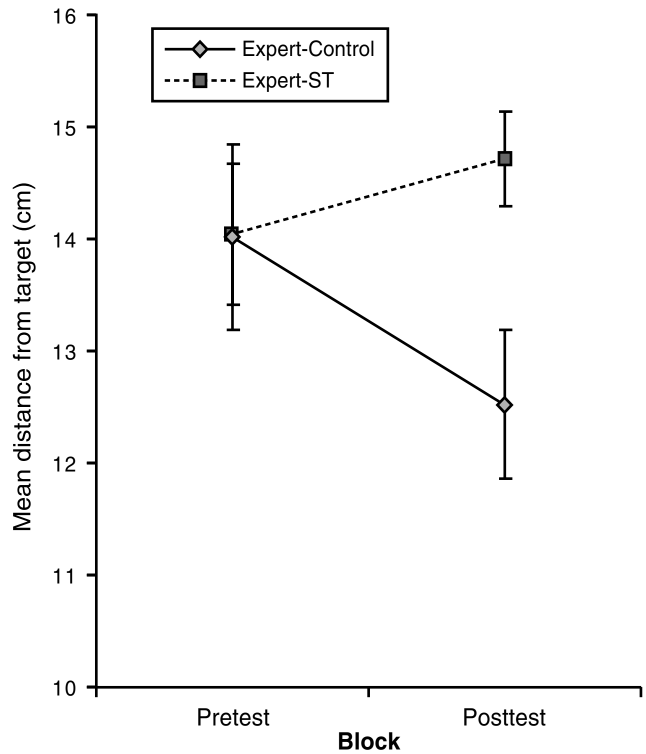

Figure 19.3 Mean distance from the target (cm) that the ball stopped after each putt in the pretest and posttest for expert golfers under stereotype threat (ST) and control conditions. Error bars represent standard errors. *Source:* "On the Causal Mechanisms of Stereotype Threat: Can Skills That Don't Rely Heavily on Working Memory Still Be Threatened? by S. L Beilock, W. A. Jellison, R. J. Rydell, A. R. McConnell, and T. H. Carr, in press, *Personality and Social Psychology Bulletin.* Reprinted with permission.

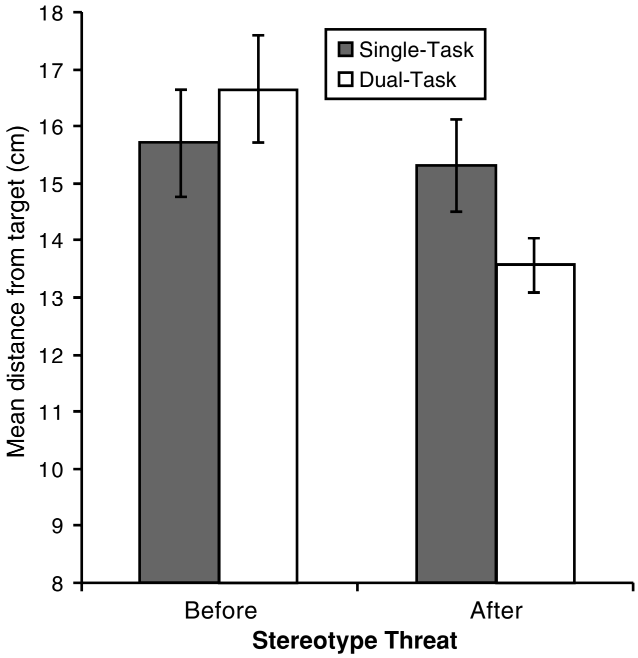

Figure 19.4 Mean distance from the target (cm) that the ball stopped after each putt in the single-task and dual-task conditions both before and after the introduction of stereotype threat. Error bars represent standard errors. *Source:* "On the Causal Mechanisms of Stereotype Threat: Can Skills That Don't Rely Heavily on Working Memory Still Be Threatened? by S. L Beilock, W. A. Jellison, R. J. Rydell, A. R. McConnell, and T. H. Carr, in press, *Personality and Social Psychology Bulletin.* Reprinted with permission.

task itself that required processing and responding to stereotype-relevant information produced the same pattern of results as that just described.

Thus, both the yips and stereotype threat seem to have a lot in common with the choking-under-pressure phenomenon. More work is needed to understand precisely how these instances of failure are similar and how they are different. Only then will we have a fuller understanding of why suboptimal performance occurs and how it can be alleviated.

CONCLUSION

Choking under pressure can be a very serious problem for skilled athletes. A single instance of this nefarious phenomenon may mark the abrupt end of a previously successful career. For example, kicker Scott Norwood of the Buffalo Bills retired the year after missing the potential game-winning field goal in Super Bowl XXV. Although one can only speculate about the relative causes of Norwood's career end, his missed field goal will forever mark his NFL career. Evidence for this comes from the fact that other instances of choking have resulted in players being ostracized and ridiculed by fans for years after their playing career is over. Take, for example, Boston Red Sox first baseman Bill Buckner, who muffed the ground ball in the 1986 World Series; this is an event he has never lived down. Thus, choking is an important phenomenon that attracts attention not only from sport researchers, but from coaches, players, and fans alike. In this chapter, we examined several aspects of the choking phenomenon, with the ultimate goal of providing a comprehensive review of work in this area.

In an attempt to understand why athletes choke under pressure, researchers have examined the underlying causes of pressure-induced failure. Work in this area suggests that choking is a highly complex phenomenon with underlying mechanisms that depend on the cognitive demands of the skill being investigated as well as individual characteristics of the performer. Moreover, not only are researchers examining the attentional correlates associated with less-than-optimal performance, but recent work has begun to capture how performance pressure serves to alter the biomechanical components that implement a skill. Of course, more work is needed to provide a comprehensive view of pressure-induced failure that simultaneously takes into account the attentional mechanisms and biomechanical correlates of skill breakdown.

Attention has also been devoted to the individual differences that separate those most likely to fail under pressure from those whose performances are immune to the same levels of stress. Several researchers have examined personality traits that may be predictors of performance failure under pressure, including dispositional self-consciousness, reinvestment, and trait anxiety.

Using findings regarding how skills fail under pressure as a jumping board, techniques for inoculating performers against choking have also been established. Work by Beilock and Carr (2001), Lewis and Linder (1997), and others (e.g., Tenenbaum et al., 2005) has demonstrated that giving athletes practice at dealing with the types of attentional demands that performance pressure induces can reduce skill failure when the stakes are high. Others (e.g., Masters, 1992) have demonstrated that preventing athletes from acquiring the type of explicit knowledge that pressure may exploit to begin with may also help to quell the negative effects of stress at high levels of performance.

Clearly, much work still needs to be done before we gain a full understanding of this complex phenomenon.

Nonetheless, from the work highlighted in this chapter, it is clear that we are making headway in understanding the choking phenomenon. One area that deserves more attention relates to instances of choking under pressure in the real world. As we discussed, it is not clear from past research how frequently choking under pressure actually occurs in high-level athletes and what situations tend to increase the probability of such occurrences. One problem with this line of research has been that comparisons between high-pressure and low-pressure performance in the real world are often made across athletes. As we have defined it here, choking under pressure is an individual phenomenon: It is performance under pressure by an athlete that is poorer than that particular athlete's typical level of performance. Therefore, future research examining real-world performance across low- and high-pressure situations with the same athlete is needed.

Another interesting issue that has been addressed in only a small number of studies is the connection between the attentional and biomechanical processes associated with choking. For example, are dechunking and freezing degrees of freedom both associated with an increase in skill-focused attention? For what types of skills do each of these biomechanical correlates of pressure occur? Addressing questions such as these will require more research along the lines of Gray's (2004) work that measures a performer's attentional processes and movement patterns simultaneously. Finally, another promising future direction involves the examination of the various task and individual difference variables (e.g., attentional requirements of the task being performed, skill level, trait anxiety levels) that seem to produce some interesting boundary conditions for the choking phenomenon.

In conclusion, although we have learned a lot about why skills may be prone to failure in important situations, there is still much work to be done. It is our hope that this chapter facilitates new research into the choking phenomenon—research that will benefit coaches, practitioners, and performers alike.

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CHAPTER 20

Preparatory Routines in Self-Paced Events

Do They Benefit the Skilled Athletes? Can They Help the Beginners?

RONNIE LIDOR

Prior to each free-throw shot, NBA star Karl Malone used the following routine: holding the ball, self-talking, dribbling, and focusing attention. David Beckham, the international British soccer star, used a similar routine before each kick, regardless of its distance to the goal. Top athletes, such as tennis players Lleyton Hewitt and Roger Federer and golfer Tiger Woods, maintain a constant set of behaviors before hitting the ball.

Virtually all skilled athletes who are involved in sports that contain brief self-paced events, such as serving in tennis, putting in golf, and shooting free throws in basketball, have preperformance routines, either taught or developed intuitively (Cohn, 1990; Jackson, 2001; Lidor & Singer, 2003). Anecdotal (e.g., Amberry, 1996; Jordan, 1994; Rotella & Bunker, 1981) and empirical (e.g., Lidor & Mayan, 2005; Wrisberg & Anshel, 1989) evidence has shown that effective preparatory routines enhance performance when individuals are engaged in self-paced motor tasks. Routines that were only briefly performed before action execution were found to assist performers to be more accurate and consistent in their respective tasks.

The consistent use of preparatory routines by skilled performers engaged in self-paced events raises two instructional questions: Do skilled performers improve their performance outcome by the use of preparatory routines? That is to say, can preparatory routines be considered an effective instructional tool in preparing oneself for the execution of a self-paced task? And can novice learners also benefit from the use of an effective preparatory routine? If they do, how can we teach them effective routines at early stages of skill acquisition and development?

One of the main objectives of instructors and consultants in the motor domain is to develop a learning environment that provides learners with the experiences and opportunities to realize their potential (Lee, Chamberlin, & Hodges, 2001; McMorris, 2004). If preparatory routines, which are often used by skilled performers, do help them to enhance performance outcome, then it might be appropriate to provide beginners with preparatory routines at an early phase of motor learning. At the initial stage of skill learning and development, learners are asked to acquire not only motor skills but also knowledge of action planning, sequence memorization, and task readiness (Singer, 2002; Woolfolk, 1998). Apparently, preparatory routines have the potential to assist learners in their attempts to learn self-paced tasks. But do we have the empirical support, as well as the practical guidance, to promote preparatory routines for beginning learners?

The purpose of this chapter is threefold: (1) to review the related literature on the use of preparatory routines in self-paced events (findings from both observational and experimental inquiries are reviewed); (2) to discuss knowledge based on preparatory routines that can be useful for sport consultants and educators who assist learners in acquiring self-paced tasks; and (3) to propose a model for teaching preparatory routines for beginning learners. The model is based partly on data from inquiries on preparatory routines and partly on anecdotal knowledge.

This chapter consists of seven parts. In the first and second parts, the definition and introduction of *self-paced event* and *preparatory routine* are presented. The third part is a review of literature on observational and experimental studies in the use of preparatory routines in self-paced tasks. The fourth and fifth parts provide short reviews on the usefulness of learning strategies and attentional instructions in self-paced tasks. The sixth part provides psychological, instructional, and pedagogical reflections on the data presented in the previous sections. The seventh part presents a model for teaching beginners preparatory routines.

SELF-PACED EVENTS: DEFINITION AND CHARACTERISTICS

Classifications of motor tasks have been widely reported in the literature on motor skill acquisition (e.g., McMorris, 2004; Schmidt & Lee, 2005; Schmidt & Wrisberg, 2004). One of the objectives of these classifications is to determine prominent characteristics of motor tasks that researchers and practitioners alike can use to distinguish one task from another. Among the classifications that have been widely used in the scientific as well as the applied literature on motor learning is one that classifies the skills by the level of environmental predictability, that is, the extent to which the environment is stable and predictable during performance (Poulton, 1957; Schmidt & Wrisberg, 2004; Tenenbaum & Lidor, 2005). According to this view, skills can be classified as open or closed. Open skills are performed in varied and unpredictable environments; examples are dribbling in basketball, passing in team handball, and attacking an opponent in judo. In these tasks, performers are unable to anticipate with confidence their motor responses. Closed skills are performed in stable and predictable environments; examples are shooting free throws in basketball, performing routines in gymnastics, and putting in golf. In these tasks, performers can preplan their actions; in essence, they know in advance their upcoming response.

Closed motor tasks can be further classified as either self- or externally paced (Singer, 2000; see Figure 20.1). Self-paced tasks are those taking place in a relatively stable and predictable environment in which performers can determine the timing and form of their motor response. For example, according to European basketball rules, free-throw shooters are allowed 5 seconds to ready themselves for the act of shooting. Within this period of time, the shooters can select the most appropriate time to initiate the throw. Although the preparatory phase is constrained by a time limit, performers can decide when to initiate the throw. Externally paced tasks also take place in a relatively stable and predictable environment, but performers are required to initiate their act only after being signaled. For example, a 100 m sprinter is externally signaled to begin the takeoff act. This means that the athlete's actions depend on the onset of an external signal.

Lidor and Singer (2003, p. 70) proposed that closed tasks, either self- or externally paced, can also be performed in "semi-stable and almost predictable" settings

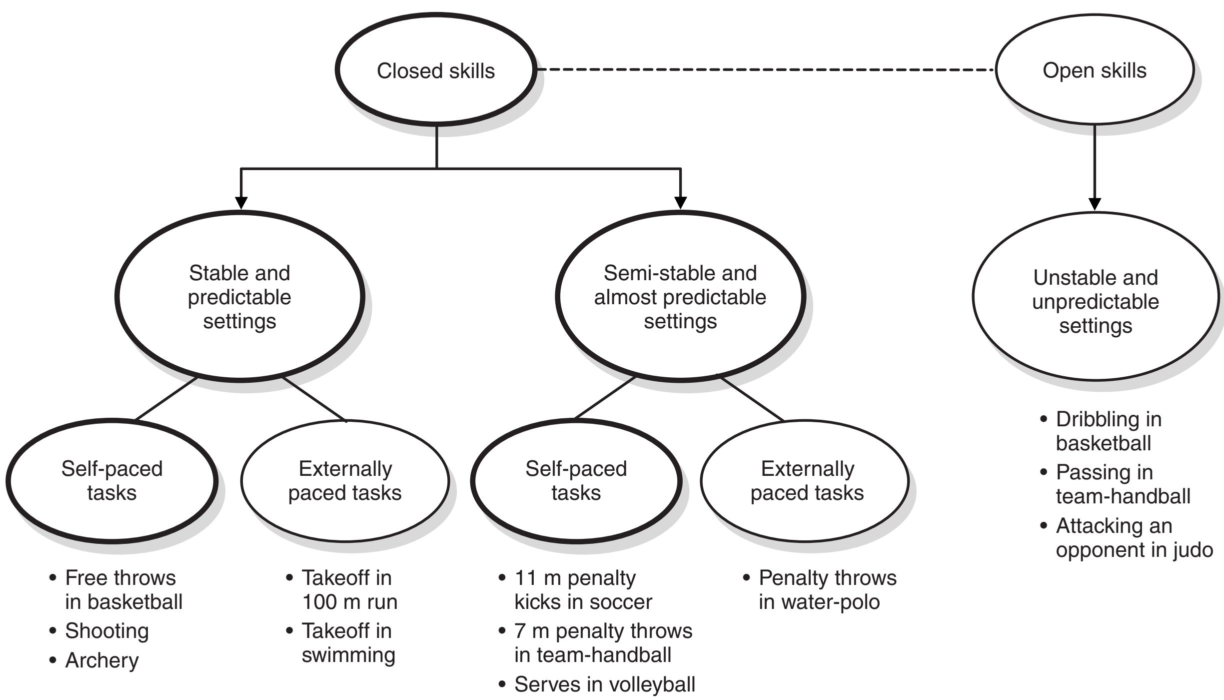

Figure 20.1 The stability-predictability—instability-unpredictability continuum.

(see also Figure 20.1). In these settings, prior to response initiation, performers consider a few relevant environmental conditions that might not be fully stable and predictable. For example, when performing the 11 m penalty kick in soccer (a self-paced task), the 7 m penalty throw in team handball (a self-paced task), or the penalty throw in water polo (an external-paced task), performers who prepare themselves for the kicking or throwing actions consider environmental factors such as the stance of the goalkeeper or the goalkeeper's anticipated movements before the initiation of the act. Although these conditions are not stable and might be difficult to anticipate (e.g., the goalkeeper's acts), performers can still preplan or alter their plan before initiating their motor response.

In stable and predictable settings, as well as in semistable and almost predictable settings, performers can activate any of the following: a plan, a strategy, a protocol, a procedure, a preevent routine, a ritual, or what we term here a "preperformance routine" (Lidor & Mayan, 2005; Lidor & Singer, 2003; Singer, 2002). Preparatory routines are implemented because of the stability and predictability characteristics of the closed settings. Once all, or at least most, conditions are fixed and anticipated, performers can activate routines that are prepared in advance and can be effectively carried out before the initiation of the task.

PREPARATORY ROUTINES: DEFINITION AND CONTENT

A preperformance routine has been defined as a systematic sequence of motor, emotional, and cognitive behaviors that are performed immediately before the execution of self-paced tasks (Boutcher, 1990; Cohn, 1990; Lidor & Mayan, 2005). According to Moran (1996, p. 177), a preperformance routine is "a systematic sequence of task-relevant thoughts and actions which an athlete engages in systematically prior to his or her performance of a specific sport skill." Lidor and Singer (2003) added that preperformance routines may occur during a relatively brief period of time (e.g., 5 to 25 sec) before the initiation of the act, depending on the performer and the sporting event.

An effective preperformance routine encompasses movements, thoughts, and emotions prior to the act, and sometimes even during the act, with the intention of optimizing the preparatory state and execution capabilities of the performer (Kingston & Hardy, 2001; Lidor & Singer, 2003). A good routine should provide individuals with the physical, cognitive, and emotional tools to appropriately manage the time period allotted to them before the initiation of the task. It should aid performers to put themselves in an optimally aroused, self-expectant, confident, and focused state immediately prior to as well as during execution.

Throughout the past 3 decades, starting at the early 1980s and continuing in the 1st decade of the twenty-first century, researchers and practitioners have examined the effectiveness of preperformance routines in self-paced tasks. The purpose was not only to describe what skilled performers do before the execution of a self-paced task, but also to study the effectiveness of certain preparatory behaviors on achievement in individuals at mostly advanced, but also at early stages of, skill learning and development.

PREPERFORMANCE ROUTINES IN SELF-PACED TASKS: EMPIRICAL SUPPORT

The review on the effectiveness of preperformance routines in self-paced tasks is composed of 20 studies, which are divided into two categories: observational and experimental. In observational studies, the researcher observed the overt behaviors of the performer in a natural setting, such as when the performer is readying himself or herself for the execution of a self-paced sport task (Thomas & Nelson, 2005). Based on these observations, the researcher can accurately describe unique phenomena of the observed event, such as the pattern of behaviors demonstrated by an individual during his or her readying phase for the self-paced act. In experimental studies, the researcher can manipulate treatments or conditions, which have the potential to enhance behavior (Thomas & Nelson, 2005). One of the main objectives of experimental studies on preperformance routines is to examine the effectiveness of task-pertinent routines on performance quality.

Most of the studies on preperformance routines were conducted on two tasks: free throws in basketball and drives in golf. Only a few investigations were carried out on other self-paced events, such as kicking in rugby and serving in volleyball. Table 20.1 presents a summary of 20 (6 observational and 14 experimental) studies conducted on preperformance routines in self-paced tasks. The observational and experimental studies are presented in chronological order according to the designated self-paced task and type of study.

Preperformance Routines in Free Throws in Basketball

Ten studies are presented, one observational and nine experimental.

Table 20.1 Observational and Experimental Studies on Preperformance Routines in Self-Paced Tasks: A Chronological Perspective

Study	Type	Participants	Preparatory Routine	Motor Task	Results
Hall and Erffemeyer (1983)	Experimental	10 highly skilled female members of an intercollegiate basketball team	Visuomotor behavior rehearsal (VMBR): relaxation phase, visualizing performance during a specific stressful situation, and performing the skill during a simulated stressful situation.	Free throws in basketball	VMBR modeling improved free throw shooting accuracy.
Crews and Boutcher (1986)	Experimental	30 undergraduate college students who enrolled in two classes of beginning golf (17 men and 13 women)	The preshot routine was composed of (a) two continuous practice swings from behind the ball, followed by visualizing an imaginary line from the target to the ball; (b) standing beside the ball, setting the club face square, and glancing once at the target; (c) setting the grip; (d) setting the feet; (e) glancing at the target once more; and (g) swinging.	A full swing in golf	Trained men had higher posttraining scores than controls and trained women; no significant differences were found between trained women and other groups.
Lobmeyer and Wasserman (1986)	Experimental	Varsity basketball players: 15 university females, 12 university males, 6 high school females, and 10 high school males.	Regular condition: normal preliminary response patterns before each shot. Without condition: without these preliminary routines.	Free throws in basketball	Free-throw accuracy was higher in the Regular condition than in the Without condition.
Crews and Boutcher (1987)	Observational	12 tour players of the Ladies Professional Golf Association	Full-swing preshot routine: (a) standing behind the ball; (b) moving beside the ball; (c) setting the club behind the ball with one glance at the target; (d) setting the feet; (e) a combination of three waggles with two glances toward the target; (f) swinging. Putting preshot routine: (a) standing behind the ball; (b) moving beside the ball; (c) performing two practice swings; (d) setting the club behind the ball with one glance at the target; (e) setting the feet; (f) performing two glances at the target; (g) putting.	Full swing and putt in golf	Golfers were consistent with regard to time and behavioral actions such as waggles and glances at the hole; the lower rated players (more successful) had longer total times for the full shot and putting routines and a lower score over the observed holes.
Boutcher and Crews (1987)	Experimental	12 collegiate golfers (6 males and 6 females)	Preputt routines composed of focusing on specific cues and actions, such as performing a number of practice strokes.	Golf putting	Routines groups significantly increased the time between addressing and striking the ball and decreased variability on the putting task; female routine group improved putting performances

Table 20.1 (Continued)

Study	Type	Participants	Preparatory Routine	Motor Task	Results
Southard, Miracle, and Landwer (1989)	Experimental	10 varsity female basketball players	Ritual condition: unlimited time and freedom of movement prior to each free-throw attempt. Nonritual condition: shooting the ball without utilizing any movements other than those required to shoot the ball under nonrestricted period of time.	Free throws in basketball	No differences between conditions for free-throw success; duration of behaviors was most crucial to free-throw shooting success.
Wrisberg and Anshel (1989)	Experimental	40 summer sports camp boys (ages 10.2–12.4 years)	(a) Mental imagery; (b) an arousal adjustment strategy; (c) a combined imagery with arousal adjustment.	Free throws in basketball	Mental imagery combined with arousal adjustment enhanced free-throw shooting performance.
Gayton, Cielinski, Francis-Keniston, and Hearns (1989)	Experimental	25 male high school basketball players	Preshot routine: players shot as they normally did, using their own preshoot routine. No routine: players performed the shot without using any kind of preshot preparation.	Free throws in basketball	A larger number of baskets were made in the preshot routine condition than without the routine.
Boutcher and Zinsser (1990)	Observational	15 beginning and 15 elite golfers	Total length of subjects' preputt behaviors and the amount of time after the putter was grounded behind the ball; number of practice swings and glances at the hole.	Golf putting	Elite golfers had longer, more complicated preputt behaviors, yet were more consistent than the beginning golfers.
Cohn, Rotella, and Lloyd (1990)	Experimental	3 elite collegiate golfers	Behavioral routine: proper alignment to the target, good posture, and consistent ball positions. Cognitive routine: making a strong decision and commitment to the club selected, the type of shot to be played, and the position of the target.	Shots and putts in golf	Immediate improvements in performance did not occur. Posttreatment interviews showed that the golfers felt the intervention had a positive effect on performance.
Wrisberg and Pein (1992)	Observational	Varsity and intramural basketball players at an NCAA Division I university	Preshot interval data were obtained.	Free throws in basketball	Higher percentage shooters maintained a higher level of temporal consistency in executing their preshot routines than did lower percentage shooters.
Predebon and Docker (1992)	Experimental	30 basketball players, all of whom had at least 5 years of experience playing competitive basketball	No-routine condition: players were instructed not to perform a preshot routine, namely, to aim and shoot. Routine condition: players were asked to sight the basket, bounce the ball three times, and shoot the ball. Imagery/physical condition: players were told to imagine the shot sequence without the ball first and while bouncing the ball.	Free throws in basketball	The imagery group performed better than the routine group, which performed better than the no-routine group.

(continued)

Table 20.1 (Continued)

Study	Type	Participants	Preparatory Routine	Motor Task	Results
Southard and Miracle (1993)	Experimental	8 female players of a university varsity basketball team	Four preperformance conditions: Condition 1: standard free-throw ritual prior to shooting. Condition 2: maintaining the relative timing of ritual behaviors but reducing the absolute time of the ritual by one-half. Condition 3: maintaining the relative timing but doubling the absolute time of the ritual. Condition 4: the same behaviors and the same absolute time as the standard ritual, but the relative time of the ritual was altered.	Free throws in basketball	Behaviors most important to free-throw success were those that might be totally controlled by the player yet remained stable with changing conditions.
Lamirand and Rainey (1994)	Experimental	18 NCAA Division III female basketball players	Imagery training: focusing on kinesthetic, visual, and auditory stimuli. Relaxation training: a diaphragmatic breathing technique.	Free throws in basketball	Neither the imagery nor the relaxation training enhanced accuracy of free throws.
Southard and Amos (1996)	Observational	7 males experienced in basketball, golf, and tennis	Free throw in basketball: (a) dribble; (b) pause, no movement for 1 sec or more; (c) dip, bend the knees and/or waist; (d) up-ball, moving the ball upward with the arms; (e) spin; (f) up to shoot, bringing the ball to an initial shooting position; (g) shoot. Golf putting: (a) swing; (b) pause, no movement for 1 sec or more; (c) foot up and down, moving the toes of either foot up and down; (d) sway, moving the body back and forth without swinging the club; (e) lift, lifting the club vertically; (f) stroke, swinging the club to contact the ball. Tennis serve: (a) ball bounce; (b) pause, no movement for 1 sec or more; (c) racket forward; (d) racket back and forward; (e) prep to hit, moving the racket to a ready position to move forward and contact the ball; (f) hit.	Free throws in basketball, golf putting, and tennis serve	Periodic stability of behaviors through the persistence of relative time within participants across activities promoted successful performance.

Table 20.1 (Continued)

Study	Type	Participants	Preparatory Routine	Motor Task	Results
Beauchamp, Halliwell, Fournier, and Koestner (1996)	Experimental	65 junior college students enrolled in an introductory golf class	Cognitive-behavioral group: (a) a sport analysis phase; (b) an individual assessment phase; (c) a motivation phase; (d) a final phase of integrating of mental skills and evaluation. Physical skill group: emphasizing the physical skills and mechanics of putting. Control group: a regular golf instructional program.	Golf putting	Cognitive-behavioral participants displayed enhanced intrinsic motivation, more consistent use of preputt routines, and improved putting performance compared with the physical skill and control participants.
Jackson and Baker (2001)	Observational	1 elite rugby goal kicker	Physical preparation time: the time from when the kicker's hands left the ball to the end of the physical preparation period. Concentration time: the time from the end of the physical preparation period to the point when the run-up was initiated.	Kicking in rugby	Concentration time and physical preparation time increased with kick difficulty; the kicker reported on the use of a number of psychological skills in his preparatory routine.
Mack (2001)	Experimental	17 members of an intercollegiate men's basketball team	(a) Normal routine and time; (b) normal routine with altered time; (c) altered routine with normal time; (d) altered routine with altered time.	Free throws in basketball	Altering the movements in the routine had a significant effect on performance, but lengthening the time did not.
Jackson (2003)	Observational	20 players participating in the 1999 Rugby Union World Cup	Physical preparation time: the time from when the kicker takes his hands away from the ball after placing it on the sand or kicking tee to the end of the walk back. Concentration time: the time from the end of the walk back to the initiation of the run-up.	Kicking in rugby	Players had longer concentration times and shorter physical preparation times when the scores were close; no differences between the best and worst kickers in the tournament on routine time, consistency, or rhythmicity.
Lidor and Mayan (2005)	Observational (Study 1); Experimental (Study 2)	12 Division I male volleyball players (Study 1); 60 female high school learners who were not familiar with the game of volleyball	Study 2: Motor-emphasized preparatory routine: an implementation of a consistent routine of motor behaviors before serving the ball. Cognitive-emphasized preparatory routine: an implementation of imagery and focus-att ention techniques. Control: an additional technical information on serving in volleyball.	Serving in volleyball	Study 1: the elite servers demonstrated a 4-component preparatory routine: (a) walking toward the serving zone; (b) organizing themselves while standing at the selected serving point; (c) dribbling; and (d) looking at the ball or the net. Study 2: learners who were taught a motor-emphasized preperformance routine were more accurate in the retention trials than both learners who were instructed to use a cognitive-emphasized routine and those who were provided with only technical information.

Observational Studies

In one observational study, Wrisberg and Pein (1992) examined the relationship between preperformance behavior and performance accuracy of free throws in the context of a competitive basketball event. They measured the length of the preshot interval and the number of free throws made by varsity and intramural basketball players during Division I games. From these data, the mean and the standard deviation of the preshot interval were calculated to reflect the average duration and within-player temporal consistency, respectively, of preperformance accuracy. As expected by the researchers, a negative relationship resulted between the standard deviation of the preshot duration and the free-throw success. This indicated that the more accurate shooters were more consistent in the amount of time they spent preparing themselves for the shooting event than were the lower percentage shooters. In addition, the average time duration a player took before shooting was a matter of personal preference, and there was no optimal time associated with greater accuracy. In this respect, Wrisberg and Pein argued that "the athlete should be allowed the freedom to develop a ritual that is subjectively most comfortable" (p. 22).

Experimental Studies

Two types of manipulations were performed in the experimental studies examining the use of preperformance routines in free-throw performance. The first manipulation type consisted of regular routines that had already been used by the performer. For instance, the performer was asked to alter the routines he or she used to perform on a regular basis before shooting the ball, or to use a different amount of time for the shooting preparation phase than the time he or she had used on a regular basis. The second manipulation consisted of different preparatory treatment techniques, which were presented to the participants to study their effectiveness on shooting accuracy.

Manipulations of Regular Routines Performed by the Participants. In one study, Lobmeyer and Wasserman (1986) examined the accuracy of free-throw shots in basketball among high school and university varsity basketball players. The players were asked to perform the free throws under two conditions: (1) a regular condition, in which free throws and any preliminaries were performed as usual; and (2) a condition in which players attempted the free throws without any preliminary response pattern. Results revealed that players made more baskets in the regular condition than when omitting a commonly used routine. It was concluded that, even if considered a superstitious act, the preperformance routine of free-throw shooting did appear to contribute to the accuracy of the shot.

In another study, Southard, Miracle, and Landwer (1989) asked 10 varsity female basketball players to perform 10 free throws under two conditions: ritual and nonritual. Under the ritual condition, the players were provided with unlimited time and freedom of movement before each of the free throws. Under the nonritual condition, the players were not restricted by time but were told to shoot the ball without utilizing any movements other than those required to perform the shot. High-speed analyses indicated 10 stages of preshot behaviors, among them dribbling, holding the ball, moving the ball down using the arms, and releasing the ball. Accuracy of shooting did not differ under the two conditions; however, the duration of the behaviors was crucial to the success of the free throw. The duration of movements performed by the shooter before the shot should be consistent to preserve the rhythmic nature of the ritual and to reduce variability in performance.

A manipulation of environmental conditions was also performed by Southard and Miracle (1993) to examine the effect of timing of ritual behavior on a free-throw shooting task in basketball. Eight female college players were asked to perform 15 free throws in four different conditions: (1) standard ritual (SR), in which players were encouraged to use their SR prior to shooting a free throw in a game situation; (2) half-time ritual (HTR), in which players were instructed to use the same sequence of behaviors as in the SR condition but perform it in half the time; (3) double-time ritual (DTR), using the same sequence of behaviors as in the SR condition but completing it in twice the standard time; and (4) variable time ritual (VTR), in which players were told to use the same sequence of behaviors as those in the SR condition in their standard time, but that the goal was to vary the relative time of ritual behaviors. Players displayed a number of ritual behaviors, among them dribbling, holding the ball, bringing the ball to position prior to release, and shooting the ball. It was revealed that the relative time to complete the ritual behaviors remained constant, although the players were required to either double their SR or reduce it by half. Consistent rhythmicity of preperformance ritual behaviors was more important to free-throw success than maintaining the absolute time of the rituals. Thus, basketball players should maintain a consistent rhythm to secure optimal performance.

Using a similar paradigm, Mack (2001) asked 17 members of an NCAA Division I men's basketball team to perform free throws in basketball under four conditions: (1) normal routine and time condition, in which players were asked to shoot free throws exactly as they would in an actual game situation; (2) normal routine with altered time condition, in which players performed their normal routine but were required to lengthen the amount of time taken for the routine by a minimum of 200% of their baseline time; (3) altered routine with normal time condition, in which players were asked to maintain their normal length of preshot routine while using a routine provided by the researcher; and (4) altered routine with altered time, in which players were taught to use the new preshot routine (as in condition c) and to lengthen the amount of time taken for the routine by a minimum of 200% of their baseline time (as in condition b). The new preparatory routine was composed of (a) slapping the ball from one hand to the other three times, (b) throwing the ball up in the air with two hands, (c) catching the ball with two hands, and (d) shooting. The act of dribbling was excluded from the preshot routine because all the players included it in their normal preparatory routine. The results indicated that altering the movements in the routine had a negative effect on shooting accuracy, whereas maintaining a consistent behavioral sequence resulted in better shooting success. In addition, the length of the preparatory routine did not affect shooting performance. Based on these findings, one concludes that players must establish and maintain a consistent behavioral sequence, and not necessarily preserve the temporal aspects of the preshot routine.

In another study (Gayton, Cielinski, Francis-Keniston, & Hearns, 1989), the effects of competitive pressure on the accuracy in free throws were investigated. Male high school basketball players were asked to perform free-throw shots under two conditions: preshot routine and absence of routine, as administered in Lobmeyer and Wasserman's (1986) study. To make the situation competitive, players ran in groups of five before performing the shots. More baskets were made when preshot routines were practiced.

To conclude: (a) As long as performers acquire a regular routine, it is probably better for them to carry out the routine without altering it; and (b) skilled performers demonstrate similar patterns of preparatory behaviors; these behaviors are related to the task's demands and the device (e.g., a ball) used.

Manipulations of Imposed Psychological Preparatory Routines. In one of the early studies on the effectiveness of preshot intervals on free-throw performances in basketball, intercollegiate female basketball players practiced the visuomotor behavior rehearsal (VMBR) for 10 days (Hall & Erffmeyer, 1983). The VMBR was composed of (a) an initial relaxation phase, (b) visualizing performance during a specific stressful situation, and (c) performing the skill during a simulated stressful situation. The players were trained how to implement the technique during 10 sessions in which videotape modeling was used. Visuomotor behavior rehearsal modeling resulted in significant improvement in foul-shooting performance.

In another study, Wrisberg and Anshel (1989) examined the effectiveness of three cognitive strategies on the free-throw shooting performance of 10- to 12-year-old boys who were classified by their counselor as "good" or "excellent" in basketball shooting skills. The players were randomly assigned to four training groups: (1) a group that learned and practiced mental imagery, (2) a group that learned an arousal adjustment strategy, (3) a group that combined imagery with arousal adjustment techniques, and (4) a no-strategy (control) group. Players who were taught a preshot strategy involving a combination of imagery and arousal adjustment were more accurate in their free-throw shooting performance than players who were taught either an imagery technique or an arousal adjustment technique or were not taught a preshot strategy. According to the researchers, "The present study appears to offer support for the notion that young athletes are able to learn and use cognitive techniques to enhance their performance" (p. 102). However, it should be noted that the young players in this study had already attained a high level of skill and were familiar with the task prior to the experiment.

The effectiveness of imagery on free-throw shots was investigated in two other studies. In the first study, the effectiveness of imagery and relaxation on the accuracy of foul shooting was studied among 18 NCAA Division III female basketball players (Lamirand & Rainey, 1994). The players were ranked according to varsity playing experience and assigned to either imagery or relaxation training groups. The imagery training was based on Vealey and Walter's (1993) guidelines and was composed of focusing on kinesthetic, visual, and auditory stimuli. The relaxation training was designed according to Davis, Eshelman, and McKay's (1982) instructions and provided players with a diaphragmatic breathing technique. The players were exposed to four training sessions, 5 minutes each. The posttraining analyses did not reveal any differences between the groups' performances. The mean accuracy of the imagery players decreased between the posttraining (70%) and the pretraining (71%), whereas the mean accuracy of the relaxation players increased from the pretraining (65%)

to the posttraining (74%). It was speculated that it was difficult for the researchers to assess whether the players were actually practicing or using the preparatory skills, due to the fact that the training was not individualized.

The second imagery study (Predebon & Docker, 1992) assessed the effectiveness of three preshot routines on free-throw shooting accuracy in experienced male basketball players. In the routine condition, players were instructed to look at the basket, dribble the ball a few times, and shoot the ball. In the imagery/physical condition, players were taught to imagine the shot sequence first without the ball, and then while bouncing the ball. In the no-routine condition, players were told not to perform a preshot routine but to aim at the basket and shoot. All players took part in three training sessions. Findings revealed that imagery/physical routines led to better performance than the routine alone, which was superior to a lack of any mental routine. In addition, it was indicated that withdrawing players' regular preshot routines seemed to have a relatively long-lasting detrimental effect on shooting performance.

Two main observations emerged from the experimental studies. First, imagery was a frequently used preparatory technique in these studies. Second, imagery was found to enhance accuracy in free throws in basketball.

Preperformance Routines in Golf

In golf, the usefulness of preparatory routines was examined in two self-paced shots: swings and putts. Compared with free throws in basketball, which are performed in a constant and closed setting, shots in golf can be performed under many variations, depending on the terrain, the distance of the golfer from the hole, and various visual conditions. In spite of these variations, shots in golf can be classified as self-paced events. Six studies are presented in this part, two observational and four experimental.

Observational Studies

In one observational study, Crews and Boutcher (1987) analyzed the preshot routines for both full-swing and putting strokes among 12 tour players of the Ladies Professional Golf Association (LPGA). The observational results indicated that all golfers were remarkably consistent with regard to time and behavioral actions, such as waggles and glances at the hole. Among the preshot routines observed for the full swing were standing behind the ball, setting the club behind the ball with one glance at the target, setting the feet, and then swinging. Among the preshot routines that were observed for the putt were standing behind the ball, moving beside the ball, setting the club behind the ball with one glance at the target, setting the feet, and then putting. In addition, it was observed that the more successful golfers used longer time periods for the full shot and putting routines.

In a second observational study, preshot routines among elite and beginning golfers performing six 4-feet and six 12-feet putts were observed (Boutcher & Zinsser, 1990). Cardiac, respiratory, and behavioral patterns of putting were measured. It was revealed that elite golfers had longer, more complicated preputt behaviors, and they were more consistent than the beginning golfers. More specifically, beginning golfers failed to demonstrate consistent behavioral preputt routines, such as the number of practice swings and glances at the hole. Both elite and beginning golfers showed significantly decelerated heart rate during the 4- and 12-feet putts. However, within four cardiac cycles before striking the ball, the elite golfers recorded significantly slower heart rates compared with the beginners for the interbeat intervals immediately before, during, and after the 12-feet putt's ball strike. Verbal reports collected from the golfers at the end of the putting performance indicated that the elite golfers tended to focus on single external and internal cues, such as the back of the ball or the feel and rhythm of the putt, whereas beginning golfers tended to have multiple analytical thoughts concerning putting mechanics and focused on avoiding hitting the ball too hard. Boutcher and Zinsser assumed that the cardiac deceleration of elite golfers may be influenced by their tendency to use a more nonanalytical attentional focus.

The observational data obtained from the studies conducted by Crews and Boutcher (1987) and Boutcher and Zinsser (1990) revealed that skilled golfers used consistent preparatory routines before hitting the ball. In addition, their routines were more complicated than those used by beginners.

Experimental Studies

The experimental preparatory routines studies in golf examined (a) the sequences of motor behaviors, namely, physical preparation; and (b) the effect of imposed cognitive-behavioral techniques on motor performance.

Physical Preparatory Routines. In one study, Crews and Boutcher (1986) examined the effectiveness of a physical preshot routine on performances of beginning male and female golf students. The preshot routine was composed of six steps: (1) two continuous practice swings from behind the ball followed by visualizing an imaginary line from the target to the ball; (2) standing beside the ball, setting the club face square, and glancing once at the target; (3) setting the grip; (4) setting the feet; (5) glancing at the target once more; and (6) swinging. During an 8-week period all students were provided with full skill instruction. During the second 8-week period, the preshot students were given the preshot routine practice together with full-swing practice, and the control students continued to practice only their full swing. Results revealed that preshot male students had higher posttraining scores than the trained female students; however, the preshot male students demonstrated better skill before training as well. It was argued that perhaps a certain level of skill must be established before a preshot routine may be effective.

Cognitive-Behavioral Preparatory Routines. The effect of an attentional preshot routine on a golf-putting task was studied by Boutcher and Crews (1987). Twelve collegiate golfers were randomly assigned to four groups: male routine (MR), female routine (FR), male control (MC), and female control (FC). The MR and FR were trained in how to use a preshot routine, which consisted of focusing on specific cues and actions. The focusing instructions asked participants to center on a series of specific cues determined by the participants themselves. The purpose of the attentional training was to prevent the learners from thinking about different parts of the skill. Among the actions were performing a number of practice strokes and using one word for the initiation of the putting task. The control golfers practiced the skill without being exposed to preshot instructions. It was revealed that both MR and FR increased the time period between addressing and striking the ball and decreased the variability of the putting task. Only the FR group improved putting performance. Boutcher and Crews concluded that "these routines seem to provide a way of effectively controlling mental and physiological states before the performance of closed-skills" (p. 37).

In another experimental study, the effects of a 14-week cognitive-behavioral program on the motivation, preparation, and putting performance of junior college students who enrolled in an introductory golf class were examined (Beauchamp, Halliwell, Fournier, & Koestner, 1996). The students were assigned to one of three interventional conditions. In the cognitive-behavioral condition, a 4-phase program consisted of (1) a sport analysis phase that involved the teaching of knowledge and the practice of golf putting; (2) an individual assessment phase, which introduced the learners to such psychological techniques as stress management, self-regulation, and concentration; (3) a motivation phase, which presented goal setting and mental skills' training for preperformance routines in golf putting; and (4) a final phase of integration of mental skills and evaluation. In the physical skills condition, students were taught physical skills and the mechanics of putting. In the control condition, students received no instructions in putting. Findings showed that the students who were taught the cognitive-behavioral technique displayed enhanced intrinsic motivation, more consistent use of preputt routines, and facilitated putting performance compared with the physical skills and control students. In addition, the cognitive-behavioral students showed a reduced use of introjection.

The effects of a cognitive-behavioral intervention on adherence of preshot routines of elite collegiate golf players was examined in a multiple baseline (across-subjects) design (Cohn, Rotella, & Lloyd, 1990). In this design, the effects of the treatment are demonstrated by introducing the intervention to the players at different times. The objective of the preshot intervention was to develop more concise and systematic behavioral and cognitive preparation prior to full swings. Three golfers were given behavioral and cognitive interventions. The behavioral intervention focused on such aspects as proper alignment to the target, good posture, and consistent ball position. The cognitive intervention stressed strong decision making and commitment to the club selected, the type of shot to be played, and the position of the target. The treatments improved the players' adherence to both behavioral and cognitive preshot routines. Although immediate improvement was not observed, the golfers indicated that they felt that the intervention had a positive effect on their shooting and putting performance.

The experimental studies' findings indicate that skilled performers, both females and males, improve performance through the use of cognitive-behavioral preparatory techniques. Furthermore, the use of mental routines resulted in more consistent behavior prior to response initiation.

Preperformance Routines in Other Self-Paced Tasks

In addition to self-paced tasks such as free throws in basketball and shots in golf, the usefulness of preparatory routines was investigated in volleyball serving and rugby kicking. Four studies are reported, three observational and one experimental.

Observational Studies

Southard and Amos (1996) aimed at determining if preperformance behaviors displayed a consistent rhythm across different activities, as well as establishing the relationship of periodicity for such preperformance routines to successful performance. They measured the types of preperformance behaviors, absolute timing of behaviors, relative timing of behaviors, differences in relative times across activities, and mechanical variables related to performance in seven experienced males who performed three closed skills: the free throw in basketball, golf putting, and the tennis serve. Participants displayed different behaviors in each task; however, each participant had the exact same behaviors for each trial according to the activity. In addition, the sequences in which behaviors occurred within the activity were also identical within participants. It was revealed that periodic stability of behaviors was evident through the persistence of relative time within participants across activities. Therefore, performers are advised to select preperformance behaviors that favor periodic stability. Performing such patterns of behavior in a constant rhythm was shown to enhance consistent performance in this study.

In another observational study, Jackson (2003) challenged the view that increasing the temporal consistency of a routine would result in improved performance. Kicking performances of 20 players who took part in the 1999 Rugby Union World Cup were observed. Two preparatory variables were measured: (1) physical preparation time, the time lapse from the kicker's release of the ball after placing it on the sand until the end of the walk back; and (2) concentration time, the time lapse from the end of the walk to the beginning of the run-up, namely, the time the kicker spent standing after stepping back from the ball. Considering the difficulty of the kick (i.e., four levels of difficulty based on post angle) and the situational pressure (i.e., when the score was close, 0 to 3 points difference, or when there was a gap of 4 or more points between the teams), the routine times were dependent on the difficulty of a kick. The concentration time data revealed a marginally significant increase in times when the score was close, and the physical preparation time data showed a difference in the reverse direction. Jackson suggested that "although intuitively appealing, the notion that performance will be enhanced merely through the temporal consistency of a preperformance routine lacks both empirical and a sound theoretical rationale" (p. 812).

Using a case study approach, Jackson and Baker (2001) studied the consistency of preperformance routines in one world-caliber rugby goal kicker. More specifically, they looked at two aspects of the kickers' preparatory routines: physical preparation time (PPT) and concentration time (CT). The PPT was defined as the time lapse between the kicker's release of the ball to the end of the physical preparation period. The CT was defined as the time lapse between the end of the physical preparation period to the point when the run-up was initiated. The researchers revealed that PPT, CT, and the number of glances measured during PPT increased as the kicks became more difficult. A postperformance interview with the kicker indicated that he incorporated a number of psychological techniques into his preparatory routines, such as thought stopping, cueing, and imagery. The kicker also reported that he perceived the timing of his routine to be highly consistent. The researchers suggested that "both task difficulty and situational factors should be taken into consideration before applied practitioners recommend that performers strive for consistency in the time they spend on their preperformance routines" (p. 63).

A somewhat surprising finding has emerged from Jackson et al.'s (Jackson, 2003; Jackson & Baker, 2001) studies: Preparatory routines might be altered during an actual sporting event due to factors such as task difficulty. In other words, maintaining consistent routines may not benefit performers; thus, they should prepare themselves to use a few variations of their regular routines when performing tasks such as kicking in rugby and soccer. In terms of educational perspectives, performers should be aware of these needs and practice their routines under a variety of conditions.

Experimental Studies

In a recent study, Lidor and Mayan (2005) conducted two studies utilizing preperformance routines in volleyball serving. In Study 1, observational data were collected on preserving behaviors of 12 elite male volleyball players. It was observed that the servers demonstrated a 4-component preparatory routine before serving the ball: (1) walking toward the serving zone, (2) organizing movement while standing at a selected serving point, (3) dribbling, and (4) looking at the ball or the net. The players usually completed their routine in about 12 s. Interview responses indicated that the players focused attention on external cues such as the upper edge of the volleyball net. In Study 2, two preperformance routines were developed based on the data collected in Study 1, motor and cognitive. In the motor-emphasized routine, learners were asked to (a) be in a ready position on the serving line, (b) feel the ball with two hands while being in a ready position, (c) dribble the ball with the dominant hand (up to 4 to 5 times), and (d) hold the ball with the nondominant hand and then execute the serve. In the cognitive-emphasized routine, learners were taught to (a) stand in a ready position on the serving line, (b) imagine themselves successfully performing the serving task, (c) focus attention on an external cue related to the task or learning environment, and (d) execute the serve. The two preparatory groups were compared to a control condition, in which the learners were provided with additional technical information on volleyball serving but were not exposed to any preparatory routine instructions. The results indicated that the learners who were taught a motor-emphasized preperformance routine were more accurate in the retention phase than both learners who were instructed to use a cognitive-emphasized routine and learners who were provided with only technical information. It was suggested that "to decrease the instructional load placed on beginners, it might be more helpful to first teach a routine in which the emphasis is on motor readiness and only then to add preparatory components that emerge from a cognitive-oriented routine" (p. 361).

Preparatory Routines in Self-Paced Tasks: Conclusions and Benefits

Four conclusions are derived from the observational and experimental studies on preparatory routines. First, imposed preparatory techniques such as imagery and relaxation can facilitate accuracy of self-paced tasks (e.g., Lamirand & Rainey, 1994). Second, maintaining a consistent sequence of preparatory routines may result in a higher level of performance (e.g., Crews & Boutcher, 1986). Third, preparatory routines by skilled performers during actual self-paced events may be changed according to situational factors, such as task difficulty (Jackson, 2003). Fourth, as soon as skilled athletes perform their regular preparatory routines, it might be better to refrain from altering the sequence of the routine and its timing (Southard & Miracle, 1993).

A few suggestions have been made to explain the benefits obtained by the effective use of preperformance routines. First, individuals can carry out a plan of action before they begin to perform a self-paced task. They can imagine themselves performing the act, think about their movements, and rehearse what they have to do (Boutcher, 1990; Lidor & Singer, 2003). Second, they can maintain their focus of attention before and during the act (Boutcher, 1990; Moran, 1996). For example, they can cope better with both internal (e.g., negative thoughts) and external (e.g., noise) distractions. Third, they can develop the feeling that they are in optimal control of what they are doing (Cohn, 1990). In essence, they believe that they will perform the task with a high level of proficiency.

Support for the observation that imposed preparatory techniques enhance self-paced tasks can be found in two other techniques: the use of learning strategies in self-paced events and the provision of attentional instructions in closed motor tasks. Both techniques can be implemented effectively by individuals who attempt to ready themselves before the execution of self-paced tasks. A brief review of the effectiveness of learning strategies and attentional instructions is given next.

LEARNING STRATEGIES AS PREPARATORY ROUTINES IN SELF-PACED TASKS

A learning strategy has been defined as a form of guidance for learners in acquiring skills, as well as an approach that should aid learners and performers in selecting performance strategies and in building or repairing them (Lidor & Singer, 2005). Task-pertinent learning strategies refer to the behaviors and thoughts that learners and performers activate deliberately or subconsciously to facilitate self-paced motor tasks. Practically speaking, an effective learning strategy provides learners and performers with the cognitive tools they need to systematically manage thought processes associated with knowledge and skill acquisition.

Laboratory (e.g., Kim, Singer, & Radlo, 1996; Lidor, Tennant, & Singer, 1996; Singer, Lidor, & Cauraugh, 1993, 1994) and field (e.g., Lidor, 2004; Lidor, Arnon, & Bronstein, 1999) inquiries have revealed that learners who were taught the use of learning strategies achieved a higher level of proficiency than learners who were not taught. A variety of self-paced tasks, such as ball throwing, free-throw shooting, and bowling-simulated tasks, were performed more accurately by the strategy learners than the nonstrategy learners. In addition, in a few laboratory tasks, such as key pressing, the strategy participants performed more rapidly than their nonstrategy counterparts.

Several strategies have been studied. The Five-Step Approach (5-SA) involves readying (trying to be consistent in attaining the preparatory state for the act), imaging (mentally picturing oneself performing the act), focusing attention (concentrating intensely on one relevant feature of the situation), executing (performing without thinking about the act itself or the possible outcome), and evaluating (using available feedback information from which to learn) before, during, and at the end of the learned self-paced task. An awareness strategy for learning and performance of self-paced motor skills calls for being aware of body sensations while the movement is carried out and using self-feedback information. A nonawareness strategy for learning and performance of self-paced motor skills requires preplanning the act and focusing on one relevant cue (Lidor, 1999; Singer, 2000). A comparison of the three strategies revealed that the 5-SA and the nonawareness strategies are more useful than the awareness approach (e.g., Lidor, 2004; Singer et al., 1993, 1994).

Of particular interest for the purpose of this chapter are a few studies examining the effectiveness of learning strategies in learning and performance of self-paced sport tasks such as free throws in basketball (Lidor, 2004; Lidor et al., 1999) and air-gun shooting (Chung, Kim, Janelle, & Radlo, 1996). In these studies, the participants were taught to use the principles of the strategies as a cognitive preparatory routine. In one study conducted in field settings, the effectiveness of the 5-SA, awareness, and nonawareness strategies was examined in beginning junior high female basketball players (Lidor, 2004). The learners took part in five physical education classes in which the components of the strategies were presented to them by a physical educator who had been trained to administer the different strategies. The strategy learners were compared to control learners, who were not provided with the principles of the strategies but were given additional technical instructions on basketball shooting. Accuracy of shooting and preparation time (the amount of time the participants took before they shot the ball at the basket) were measured. The standard deviations of the preparation times were calculated as well. It was revealed that the 5-SA and the nonawareness learners were more accurate than the awareness and the control learners. Interestingly, the learners who were taught how to use the strategies increased their preparatory time intervals compared to the control learners. It was suggested that beginning learners are also able to benefit from the use of cognitive preparatory routines.

In another study (Lidor et al., 1999), the 5-SA strategy was introduced during six strategy sessions to 13-year-old female and male basketball players who performed free-throw shots. The strategy players were compared to control players who were provided with expanded technical information on free-throw shots in basketball. Results revealed that the 5-SA produced enhanced shooting performance, which exceeded that of technical information enhancement.

Support for the effective use of learning strategies was also found in another real-world study in which the usefulness of the 5-SA was examined in experienced shooters who performed an air-pistol shooting task in a natural shooting environment (Chung et al., 1996). One group of shooters was provided with 5-SA instructions, and another group was given irrelevant information regarding types of shooting errors. Shooters in the 5-SA group outperformed shooters in the control group in two measures: accuracy and variability of shooting performance. The results of this study validated the effective use of a learning strategy such as the 5-SA in real-world sport skills performed by experienced shooters.

Evidence from strategy research indicates that strategy instructions can be efficiently used by learners and performers as preparatory guidance prior to the execution of self-paced motor tasks. Preplanning the act and focusing attention on one relevant external cue have been found to be an effective routine. Support for the use of external focusing while performing self-paced tasks can also be found in empirical investigations examining internal versus external attentional instructions.

ATTENTIONAL INSTRUCTIONS IN SELF-PACED TASKS: THE INTERNAL-EXTERNAL PARADIGM

The ability to focus prior to and during a self-paced task is crucial in achieving a high level of proficiency (Lidor & Singer, 2003; Moran, 1996). In a self-paced event, the individual has the time to select the relevant cue and to appropriately focus attention. Due to the fact that the activity is repeated under almost the same conditions, he or she is also able to develop an optimal state of attentional focus.

In an extensive line of studies, Wulf and colleagues (McNevin & Wulf, 2002; Totsika & Wulf, 2003; Wulf, Lauterbach, & Toole, 1999; Wulf, McConnel, Gartner, & Schwarz, 2002; Wulf, McNevin, Fuchs, Ritter, & Toole, 2000; Wulf, Shea, & Park, 2001; Wulf, Wächter, & Wortmann, 2003) have examined the usefulness of attentional instructions in motor task performance. The data from these studies were in line with findings obtained from learning strategy research: External focus has an advantage over internal focus for the performance of self-paced tasks.

In a typical study on attentional instructions, one group of participants was taught to direct attention to internal cues (e.g., the participant's body parts), and a second group was asked to direct attention to external cues (e.g., objects in the near environment). For example, in one study, undergraduate students performed a ski-simulator task (Experiment 1) and a stabilometer task (Experiment 2; Wulf, Höß, & Prinz, 1998). The students were instructed to be either internally or externally focused. Those who were asked to focus on the force exerted on the wheels of the ski simulator's platform on which they stood (an external focus) demonstrated more effective performance than those who were instructed to focus on their feet, which were exerting the force (an internal focus). In the stabilometer balancing task, similar results were obtained: Those who focused on the markers attached to the platform in front of their feet (an external focus) achieved better results than those who focused on their feet (an internal focus).

In another study conducted by Wulf and her colleagues (Wulf et al., 2002, Experiment 1), novice and advanced volleyball players practiced simulated tennis serves under internal-focus or external-focus feedback conditions. Independent of the level of expertise, it was found that external-focused feedback resulted in greater accuracy of the serves than the internal-focus feedback during both practice and retention.

In a recent study, the effectiveness of internal and external attentional instructions was investigated in three different ball-aiming tasks among college sport and fitness students (Lidor & Yanovitz, 2005). The students were asked to perform the following tasks: aiming at a target apparatus, which required throwing a ball at a circular target apparatus located on a wall in front of the participants' throwing position (Task 1); searching for a particular target and aiming at a target apparatus, which required throwing a ball at only one target apparatus among a 5-target apparatus, also located on a wall in front of the participants' throwing position (Task 2); and shifting attention, which required throwing a ball at one of three targets located on the front wall, the right wall, and the left wall in relation to the participants' throwing position (Task 3). In line with Wulf and colleagues' (e.g., Wulf et al., 1998, 2002) studies, it was evident that the external instructions enhanced performance in Task 1 compared to the internal and control conditions. However, performance in Tasks 2 and 3 was not improved either by the use of the external instructions or the internal ones. It was recommended that a more global technique be used to facilitate performance in self-paced tasks that require not only aiming at a target but also searching for a target or shifting attention.

One of the explanations for the finding that external focusing instructions enhanced proficiency in self-paced tasks compared with internal focusing instructions is that focusing on the movements themselves and attempting to think about one's own movements may interfere with automatic motor control processes that would normally supervise the movements (Wulf et al., 2002). Focusing on the effect of the movements, namely, on external cues, enables the motor system to use automatic processes. Practically speaking, the external focusing attention instructions probably enable performers to (a) block out any internal or external distractions, (b) reduce information-processing activity, and (c) perform the task without conscious attention, as if in a state of automaticity (Lidor & Singer, 2003; Singer, 2002).

PREPERFORMANCE ROUTINES IN SELF-PACED TASKS: PSYCHOLOGICAL, INSTRUCTIONAL, AND PEDAGOGICAL REFLECTIONS

The last three parts of the chapter review three areas of knowledge related to the use of preparatory routines in self-paced tasks: physical and cognitive preperformance routines, learning strategies, and attentional instructions. Observational and experimental studies of preparatory routines in self-paced tasks were discussed in detail. The contribution of learning strategies and attentional instructions to performing self-paced tasks was also discussed. Based on these reviews, five psychological, instructional, and pedagogical reflections can be made:

1. Participants who took part in either the observational (e.g., Jackson, 2003) or the experimental (e.g., Predebon & Docker, 1992) studies were experienced and skilled individuals. Only six studies (Gayton et al., 1989; Lidor, 2004; Lidor et al., 1999; Lidor & Mayan, 2005, Study 2; Lobmeyer & Wasserman, 1986; Wrisberg & Anshel, 1989) included beginning learners. Among these six studies, in only three (Lidor, 2004; Lidor et al., 1999; Lidor & Mayan, 2005, Study 2) were beginning learners taught how to acquire the fundamentals of a task-pertinent preparatory routine. Obviously, only a few investigations utilized preperformance routines in beginning learners. This provides support for the contention that psychological techniques are best taught after the learners have already practiced the skill repeatedly (Lidor & Singer, 2003).

2. The number of preparatory sessions in the experimental studies of preperformance routines varied between 2 and 24 (see Table 20.2). It seems that in most studies (e.g., Beauchamp et al., 1996; Crews & Boutcher, 1986), participants were provided with a reasonable number of sessions to practice their routines. Comparing the tasks performed in these studies, participants who practiced shots in golf, for example, were provided with a larger number of preparatory routine sessions than those who practiced free throws in basketball. Therefore, the number of preparatory sessions given to learners or performers should reflect such instructional factors as type of self-paced task and the task's complexity. Apparently, learners and performers need a series of sessions (i.e., 5 to 10) to acquire

Table 20.2 Instructional Preparatory Information: Task, Number of Preparatory Routine Sessions, and Length of Instructional Sessions

Study	Task	Number of Preparatory Routine Sessions	Length of Instructional Sessions
Hall and Erffemeyer (1983)	Free throws in basketball	10	5 sessions: 30 min; 5 sessions: 40 min
Crews and Boutcher (1986)	Full swing in golf	24	50 min
Boutcher and Crews (1987)	Golf putting	24	20 min
Wrisberg and Anshel (1989)	Free throws in basketball	2	15 min
Cohn, Rotella, and Lloyd (1990)	Shots and putts in golf	9, 6, and 5	90–120 min
Predebon and Docker (1992)	Free throws in basketball	3	N/A
Lamirand and Rainey (1994)	Free throws in basketball	4	5 min
Beauchamp, Halliwell, Fournier, and Koestner (1996)	Golf putting	14	105 min
Lidor and Mayan (2005)	Serving in volleyball	2	10 min

the fundamentals of either physical or cognitive preparatory routines.

3. Time duration of instructional sessions provided as preparatory routine instructions varied in the studies between 5 and 90 to 120 minutes (see Table 20.2). Similarly to the number of preparatory sessions provided to the participants in the experimental studies, participants who practiced shots in golf were given instructional sessions of longer durations than those who practiced free throws in basketball. The time spent for preparatory instruction should also reflect the type of the learned or performed task, the characteristics of the task, and its complexity. The more complex the skill, the more time is required for explaining how to develop an effective preparatory routine for the skill.

4. Two main variables were measured in the observational studies, as well as in some of the experimental studies on preperformance routines: (1) the sequence of the behavioral routines demonstrated by skilled performers (e.g., Crews & Boutcher, 1987; Lidor & Mayan, 2005, Study 1), and (2) the time it took the performers to prepare themselves for the self-paced act (e.g., Jackson, 2003; Lidor & Mayan, 2005, Study 1). However, a reasonable amount of information is known only on the sequences of preparatory routines performed by skilled performers. For example, in self-paced tasks, such as free throws in basketball, swings and putts in golf, and kicks in rugby, the routines of skilled performers were explored. However, in most studies, the time it took the individuals to ready themselves for the task was not measured. Time duration of preparatory routines used by skilled performers before beginning to perform a self-paced task must guide the instructions provided to beginners. It is argued that not only the sequence of movements of which the preparatory routine is composed should be taught, but also the time required by the individual to perform this sequence, particularly in real-world self-paced events. In this respect, the sequence should fit the time allocated by the official rules of the sport activity for preparing the self-paced event.

5. Consistency of sequence was found to be a major contributor in achieving success in self-paced tasks (e.g., Crews & Boutcher, 1987; Lidor & Mayan, 2005, Study 1). Performers should not only use a routine before they begin to perform the self-paced act, but they also should maintain the same order of behaviors within the routine. This observation may be true for self-paced tasks such as free throws in basketball, which are performed under fixed conditions during the activity; however, when the conditions in which the self-paced act are performed have been varied, such as in kicking in rugby, consistency may not be maintained. For example, the time for task preparation may decrease (i.e., short distance from the goal) or increase (i.e., long distance from the goal) according to the situational condition.

PREPERFORMANCE ROUTINES IN BEGINNING LEARNERS: A PROPOSED TEACHING MODEL

A number of psychological programs and instructional tips for self-paced skill performance enhancement have been proposed in the sport and exercise psychology literature (e.g., Boutcher, 1990; Boutcher & Rotella, 1987; Cohn, 1990). For example, Boutcher outlined seven components of a typical routine by professional golfers before they perform their shots. Among the routines were shot analysis (choice of club), setting (establishing optimal physiological arousal level), kinesthetic coupling (practicing and feeling the upcoming shot), and waggle (small movements of the club). According to Boutcher, each component of the routine needs to be developed and refined from previous psychological skills acquired by the performer.

Boutcher and Rotella (1987) proposed a four-phase psychological skills educational program for closed-skill performance enhancement. The program is composed of (1) sport analysis (analyzing the unique characteristics and demands of a particular activity or sport); (2) individual assessment (establishing an individual profile of the athlete's strength and weaknesses); (3) conceptualization/motivation (providing information on the athlete-athletic situation interaction, the kind of commitment required for changing inappropriate behaviors, and the importance of establishing an efficient goal-setting strategy); and (4) mental skill development (focusing on the development of general and specific mental skills).

Sport-specific instructions for the use of preparatory routines in beginning and advanced individuals were also provided by Cohn (1990). Sets of sequences of routines were proposed for tasks such as a golf putt, tennis serve, baseball pitch, and basketball free throw. For example, Cohn proposed five preparatory routines for beginners and five for the advanced who were preparing themselves for the execution of self-paced tasks. Among the routines for beginning learners were deciding on area of pitch, seeing self-pitching or seeing positive outcome, and using a cue word such as "smooth" or "push off." Among the routines for the advanced were deciding on a target, seeing the ball fly to the target, and focusing on the target.

Some of the educational programs for self-paced tasks performance enhancement (e.g., Boutcher & Rotella, 1987) were developed particularly for use by skilled performers who are required to perform these tasks in real-world events. Other tips proposed by sport psychologists for developing effective preparatory routines (e.g., Cohn, 1990) lack an instructional framework that can be used by instructors when working with beginners who attempt to acquire self-paced tasks.

It is our intention to propose an instructional model for effective teaching of preperformance routines in self-paced tasks. The main assumption is that beginners should be taught preperformance routines in the early stages of learning, so that they may benefit from them as do performers who are already skilled in their use. This assumption has been supported by sport psychologists (e.g., Sherman, 1999; Sinclair & Sinclair, 1994) who argued that psychological management skill instruction integrated with traditional physical education curricula will help learners acquire and perform physical skills. For example, Sinclair and Sinclair argued that psychological management skills are an integral part of the learning process. Early practice of these skills at initial stages of learning would enable learners to integrate the "physical, mental, and emotional aspects of talent" (p. 15). In addition, by being exposed early enough to psychological skills such as preparatory routines, learners would probably be able to link a "new psychological knowledge," namely, a preparatory routine, with a "new technical knowledge," namely, the basic fundamentals of the learned self-paced skill (Lidor & Singer, 2003, p. 75).

The proposed teaching model consists of findings from studies examining (a) the effectiveness of preparatory routines on self-paced tasks in beginning learners (e.g., Lidor & Mayan, 2005), (b) the usefulness of learning strategies in beginners (e.g., Lidor, 2004; Lidor et al., 1999), and (c) the effectiveness of attentional instructions in motor skill acquisition (e.g., Wulf et al., 2001, 2002). (See also third, fourth, and fifth parts in this chapter.) Anecdotal evidence (e.g., Lidor & Singer, 2003) has been taken into account as well in the development of the model.

The proposed model is composed of three phases (see Figure 20.2): preliminary preparatory instructions (Phase 1), task-specific preparatory instructions (Phase 2), and preparatory instructions for the real-life self-paced event (Phase 3). A brief explanation of each phase is provided.

Phase 1: Preliminary Preparatory Instructions

In this phase, learners are provided with information on the techniques of the new learned self-paced task, combined with preliminary information on basic fundamentals of preparatory routines. The objectives of Phase 1 are to expose learners to basic principles of preparatory routines while they are involved in learning a self-paced task and to enable learners to experience different routines while practicing the skill. Emphasis should be placed on the effective presentation of psychological preparatory routines in terms of mode of presentation (i.e., illustrated instructions) and motivation (i.e., fun activities; see Lidor, 1997, for specific examples). It is assumed that physical routines are naturally integrated into the specific technical task

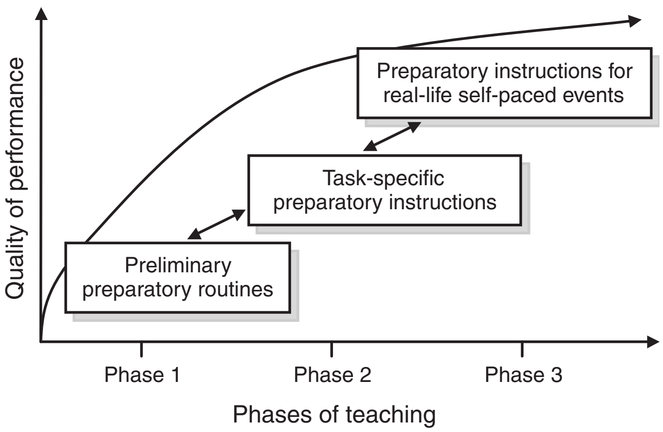

Figure 20.2 A three-phase model for teaching preparatory routines to beginners.

instructions, and thus learners should be aware of the use of psychological routines (Lidor & Mayan, 2005). Among the psychological routines that can be used in Phase 1 are external focusing of attention and imagery. For example, while being taught how to focus attention before and during free throws in basketball, learners are asked to focus on the external cue that is most relevant to the task or environment (i.e., the front area of the rim). The attentional cue is selected by the learners, who can in turn select different cues to focus on each time they perform the shot. The learners can alter both their physical preparatory routines (e.g., the number of times they dribble the ball before shooting the free throws) as well as the psychological preparatory routines (e.g., the external cue to focus on). They should be provided with the opportunity to experience a variety of preparatory behaviors before adopting a constant pattern of behavioral and cognitive routines to be used on a regular basis.

Phase 2: Task-Specific Preparatory Instructions

Phase 2 provides learners with task-specific preparatory instructions. The objective of this phase is to enable learners to adopt a set of consistent patterns of preparatory behaviors. They are expected to use a consistent set of behaviors each time before they perform the new self-paced task. In turn, instructors should help the learner develop the routines by selecting the most appropriate patterns of behaviors for them. This means that learners should feel comfortable with their routines and synthesize them naturally with the mechanics of the learned task.

After exposing the learners to a variety of preparatory experiences in Phase 1, instructors can use the "listen to the expert" approach in Phase 2, by which beginners can imitate what the experts do when they prepare themselves for the self-paced act. Observational data that emerged from studies on self-paced tasks (e.g., Crews & Boutcher, 1987; Jackson, 2003; Lidor & Mayan, 2005, Study 2) can be used by instructors. More specifically, instructors can provide learners with routines that are consistently, as well as effectively, used by skilled performers. The preparatory activities that the learners experienced in Phase 1, combined with task-specific recommendations given in Phase 2, should aid learners in selecting, developing, and practicing a routine that helps them to better prepare for the self-paced event.

Phase 3: Preparatory Instructions for the Real-Life Self-Paced Event

In Phase 3, learners are taught how to use the routine in real-life self-paced events. The objective of this phase is to expose the learners to certain simulated self-paced events that reflect potential real-life situations that learners may face in actual competitions or games. In most self-paced events, performers are provided with time constraints when readying themselves for the act. For example, according to the rules of volleyball (Fédération Internationale de Volleyball, 2004), servers are given 8 s to prepare themselves for the serving act. Therefore, those learners who intend to perform real-life self-paced tasks in stable conditions, such as free throws in basketball, or in semistable conditions, such as kicking in soccer and rugby, should be able to use their routines under constraints such as time limitations. Practically speaking, learners have to adapt their routines, which have been acquired under sterile learning conditions (i.e., Phases 1 and 2), to more challenging situations (i.e., Phase 3) that demand them to alter some of their routines' behaviors. In Phase 3, learners are exposed to these challenging situations, and thus are able to refine their ability to prepare for the self-paced act. This phase may be optional for those learners who are not going to participate in actual game situations. For them, the preparatory instructions presented to them in Phases 1 and 2 should be sufficient.

CONCLUSION

It is assumed that the quality of the self-paced performance will be improved by the use of the proposed instructional model. It is recommended that instructors and sport consultants use the principles of this model by combining skill instructions and preparatory routine instructions. However, the model has not yet been assessed by empirical inquiry. Experimental studies should examine not only the usefulness of this model in teaching preparatory routines to beginning learners, but also the instructional framework of other preparatory routines in early stages of skill learning and development. More knowledge is required to understand the effectiveness of preparatory routines in beginners. At this stage of inquiry, it is believed that skilled performers do benefit from an appropriate use of preperformance routines. In the next scientific stage, a similar observation should be made for the beginners.

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PART V

Exercise and Health Psychology

CHAPTER 21

Physical Activity and Mental Health

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It is becoming increasingly apparent that exercise is not only good for one's physical health, but that it is also good for one's mental health. It is now commonplace to read in magazines and health newsletters that exercise can reduce symptoms of anxiety (Gorman, 2002) and depression (Mayo Clinic Staff, 2005b) and can promote better mental functioning across the age span (Mayo Clinic Staff, 2005a; Warner, 2004). This relatively recent optimism is in stark contrast to the scientific conclusions that were presented in the mid-1990s. The conclusions of the U.S. Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services, 1996) were tenuous at best in stating that "physical activity appears to relieve symptoms of depression and anxiety and improve mood" and that "regular physical activity may reduce the risk of developing depression, although further research is needed on this topic" (Corbin & Pangrazi, 1996, p. 4). Since that time, much more research has been conducted, and some scientists (Landers, 1999; Mutrie, 2000) have suggested that much stronger wording (e.g., "is related to" or "causes a reduction in") is justified to describe the relationship between exercise and depression. In this chapter, we attempt to discern which of these conclusions is warranted for describing the current state for exercise as it relates to cognitive functioning, anxiety, depression, positive mood, stress reactivity, and self-esteem.

Since the time of the Surgeon General's report, the research literature on most mental health topics has improved dramatically. There are now more experimental studies with clinical and "normal" samples and more quantitative and qualitative reviews of this literature, some of which have focused solely on true experimental studies. The underlying biological mechanisms are now better understood, primarily due to experiments using animal models. There are also studies comparing exercise to other, more traditional treatments for anxiety and depression (e.g., drugs, psychotherapy). All of this evidence is important in efforts to draw conclusions about the relationship between exercise and mental health.

To better understand how conclusions can be weighted in science, Hill (1965) suggested a number of criteria for determining causation (see Table 21.1). Though these were originally applied to the evaluation of epidemiological evidence, they have also been used to examine research pertaining to exercise and mental health (Arent, Rogers, & Landers, 2001; Dishman, 1995; Mutrie, 2000). In epidemiology, strength of association is often evaluated based on estimations of mortality rates and odds ratios. On the other hand, experimental research often relies on an effect size (ES). An ES is typically calculated by taking the mean difference (e.g., experimental/treatment group minus no-treatment/control group, or pretest minus posttest values) and dividing by the pooled variability (i.e., pooled standard deviation or standard error) that exists among the groups in a study. Conceptually, an ES is a measure of the magnitude of the relationship, which may ultimately be used to infer meaningfulness. Effect sizes can range from zero to infinity, with small ESs ranging from 0.20 to 0.40, moderate ranging from 0.41 to 0.70, and large ranging from 0.71 on up (Cohen, 1992).

A preferable source of ES is usually a meta-analysis because the calculated values are considered more stable and representative than ESs derived from individual studies. Additionally, meta-analyses greatly increase the ability to detect potentially important differences due to the combined subject pool across the studies. Considering

Table 21.1 Hill's (1965) Guidelines and Criteria for Causation

Strength of association: An average ES from several studies.

Consistency: Effect seen in different places, by different people, at different times, and in different circumstances.

Specificity: Limited to a single cause for a single effect, but if other criteria are met, lack of specificity is not a fatal flaw.

Temporal sequence: Does physical activity precede changes in mental health?

Dose-response gradient: Change in the dependent variable is dependent on increased dose or duration of exposure (e.g., exercise).

Biological plausibility: Results are in harmony with understanding of the response to cells, tissues, organs, and organisms to stimuli.

Coherence: Possible mechanisms should not conflict with our understanding of the natural history and biology of mental illness.

Experimental evidence: Several Grade A and B studies support the predicted relationship.

Source: "The Environment and Disease: Association or Causation?" by A. B. Hill, 1965, *Proceedings of the Royal Society of Medicine, 58,* pp. 295–300.

guidelines that have been established for evaluating overviews of research evidence (Oxman & Guyatt, 1988), meta-analyses have other distinct advantages beyond just the use of a standardized metric such as the ES. For instance, with meta-analysis, the reporting of a clearly defined sequence of steps makes meta-analyses amenable to replication. An additional advantage that meta-analysis has over a traditional narrative review is the ability to examine potential moderating variables to determine if they influence exercise-mental health relationships.

In addition to strength of association, Hill's (1965) other criteria include consistency of the findings, specificity, temporal sequence, dose-response gradient, biological plausibility, and coherence (Table 21.1). Hill has noted the difficulty in meeting the specificity criterion and has said that failure to meet it is not a fatal flaw as long as the other criteria for causation are met. Evidence for biological plausibility and coherence can be found in human and animal studies that have examined exercise in relation to physiological mechanisms believed to be important for creating better mood states, cognitive functioning, and ability to handle environmental stressors. Animal studies offer the investigators control of variables that are often uncontrollable in human research, but there is always the concern about the validity of the models used to examine depression and anxiety in animals generalizing to human mental health issues (Dishman, 1997). Although biological plausibility must typically be satisfied for a relationship to be causative, psychological explanations can also be considered where appropriate.

When evaluating the criteria outlined by Hill (1965) and trying to draw conclusions from meta-analyses and the overall body of literature in an area, it makes sense to give the greatest weight to studies of higher scientific quality. With this in mind, Sackett (1989) devised a system for classifying the quality of experimental studies (Levels 1 to 5) and assigned each level a letter grade (A through C). As can be seen in Table 21.2, the best research evidence (Grade A) comes from large randomized trials with clear-cut results. Level 2 evidence is derived from small randomized trials with uncertain results. In this case, the study receives a grade of B because there is a moderate to high risk of error. The major difference between Levels 1 and 2 is that Level 1 research has a very large sample size, thus increasing the power of the study. One advantage of meta-analyses is that by combining the results of several Grade B studies, Grade A evidence can be produced because of the increase in sample size. However, even if the sample size was vastly increased in Grade C studies (Levels 3, 4, and 5), this could not produce Level 1 or 2 evidence because of the inherent threats to internal validity in Grade C studies.

Another consideration when evaluating studies in the area of exercise and mental health is the source of the data. With questionnaire results there is the possibility that the response by study participants could be due to behavioral artifacts (e.g., demand characteristics, expectancy effects). For instance, how do we know that the subject's expectation that "exercise is good for one's health" is not the reason for his or her responses on questionnaires rather than exercise per se? One way to guard against behavioral artifacts is to use multioperational measures, which do not share the same weaknesses (Webb, Campbell, Schwartz, & Sechrest, 1966). For example, it would be advisable to supplement questionnaire information with physiological and behavioral measures. If the results are consistent with questionnaire responses, there is greater assurance that exercise, and not behavioral artifacts, is producing the

Table 21.2 Levels of Evidence and Grades of Recommendations

Level	Type of Experimental Study	Grade
1	Large randomized trials with clear-cut results (low error)	A
2	Small randomized trials with uncertain results (moderately high error)	B
3	Nonrandomized contemporaneous controls (high error)	C
4	Nonrandomized, historical control (high error)	C
5	No controls, case study only (high error)	C

result. The availability of animal studies is also useful in assuring that research findings are not due to behavioral artifacts. Cognitive performance in rodents is typically studied by observing how quickly they complete maze tasks, whereas emotionality or anxiety has been studied by observing lack of free-roaming, exploratory behavior (i.e., "freezing") following exposure to a novel, and thereby stressful, environment (see Dishman, 1997, for a review). It would be hard to conceive that a rat or mouse in these situations would be concerned about responding in such a way as to impress a study investigator, or that it would have an expectation about the health benefits of exercise. Thus, parsimonious animal and human findings, even if derived only from questionnaires, helps to counter arguments that human results may simply be due to behavior artifacts.

Taking into account Hill's (1965) criteria, Sackett's (1989) classification of evidence quality, and the advantages of meta-analysis, we focus primarily on results derived from large-scale epidemiological studies, experimental studies, and meta-analytic reviews where available. By focusing on these sources of information we attempt to adequately evaluate the current state of the literature linking physical activity to different components of mental health.

EXERCISE AND COGNITIVE FUNCTIONING

The relationship between the body and the mind has been debated for centuries. During the twentieth century, the debate shifted to questions such as whether or not exercising the body has a beneficial effect on brain functioning (Etnier et al., 1997). One of the first investigations in this area (Spirduso & Clifford, 1978) found that high-fit younger subjects' reaction time (RT) performance was better than older high-fit subjects, but the older high-fit adults had much better RTs than low-fit (sedentary) adults and comparable RTs to young sedentary adults. This study is illustrative of research that shows that exercise can delay the aging process. More recent studies have focused on children and adolescents whose intellectual functioning may be compromised by declines in physical activity. The research evidence reviewed next offers some insight into whether physical activity is an important contributor to cognitive functioning across the age span.

Overall Findings

There are at least 14 narrative (e.g., Fratiglioni, Paillard-Borg, & Winblad, 2004; Spirduso, 1980) and four meta-analytic reviews (Colcombe & Kramer, 2003; Etnier et al., 1997; Heyn, Abreu, & Ottenbacher, 2004; Sibley & Etnier, 2003) dealing with exercise and cognitive functioning. Whether these studies focused on young, middle-aged, or older subjects, the general finding across all of these reviews is that exercise enhances cognitive function, with the quantitative reviews providing further information regarding the magnitude of these effects. In a meta-analysis of 134 studies, Etnier et al. concluded that, across tasks such as RT, memory, reasoning, and academic achievement tests, exercise had a small (ES = 0.29) but significant effect on cognitive functioning compared to groups of nonexercisers. In a meta-analysis limited to 44 studies of children and adolescents (ages 4 to 18), Sibley and Etnier found a significant overall mean ES of 0.32. The prepost gain score for the exercise group (ES = 0.52) was significantly higher than it was for the control group of nonexercisers (ES = 0.12).

Whereas the previously described meta-analyses contained several Grade C studies, Heyn et al. (2004) and Colcombe and Kramer (2003) reviewed 30 (85 ESs) and 18 (197 ESs) studies, respectively, but these were all longitudinal experimental studies. Both reviews limited studies to those having participants at least 55 or older. Across an intervention period, Colcombe and Kramer found a larger overall improvement in cognitive functioning for the exercise group (ES = 0.48) compared to the control (no exercise) group (ES = 0.16). Heyn et al. found an overall effect size of 0.62, and when moderating variables were examined, exercise training (means = 23 weeks, 3.6 xs/wk, 45 min duration) had a significant positive effect on the physical performance of 1,142 cognitively impaired older adults (ES = 0.69). Relative to control subjects, older cognitive impaired adults participating in strength training improved their strength (ES = 0.75), cardiovascular fitness (ES = 0.62), functional performance (ES = 0.59), and performance on behavioral (ES = 0.54) and cognitive tasks (ES = 0.57). A major advantage of these findings is that by combining the results of Grade B experimental studies, the resulting large sample size made it possible to arrive at Grade A evidence.

Moderating Variables

An analysis of moderating variables revealed that acute exercise produced smaller effects (ES = 0.16) than chronic exercise (ES = 0.33; Etnier et al., 1997). Colcombe and Kramer (2003) found that (a) combined aerobic and strength training (ES = 0.59) produced better cognitive functioning than aerobic exercise alone (ES = 0.41); (b) 1 to 3 months of training had cognitive benefits comparable to 4 to 6 months of training, but these cognitive gains were not as good as 6 or more months of training; and (c) exercise durations less than 30 minutes had no significant effect on cognitive functioning, whereas durations of more than 30 minutes did increase cognitive functioning.

Colcombe and Kramer (2003) also found that the ESs were essentially the same for clinical and normal populations. The clinical samples consisted of depressed persons, geriatric mental patients, and patients with cardiopulmonary obstructive disorders. These findings are consistent with observational longitudinal studies that focused on dementia and Alzheimer's disease (AD). In a narrative review of nine studies that were embedded in large longitudinal, population-based studies on aging (sample sizes ranging from 469 to 4,615), Fratiglioni et al. (2004) found that participation in physical activity earlier in life was associated with less dementia and AD in six of nine studies. Some of these studies, though, have been criticized for having relatively short follow-up times (3 to 7 years). More recent epidemiological evidence with a follow-up time of 21 years showed that physical activity at least twice a week at midlife was related to a reduced risk of dementia and AD (Rovio et al., 2005).

There are also differential exercise effects for different kinds of cognitive tasks. Among older subjects, Colcombe and Kramer (2003) found that exercise produced larger cognitive gains for tasks that were categorized as involving executive processes. These tasks involved planning, inhibition, and scheduling of mental procedures. In essence, subjects who were exercise-trained showed improvement on all types of cognitive tasks (speed, visuospatial, controlled processing, and executive control processing), but the ES for executive control processes (0.68) was significantly greater than ESs for the other types of cognitive tasks (ES_{range}= 0.27 to 0.46).

Time in Physical Education, Physical Fitness, and Academic Performance

Nearly all states in the United States have increased classroom time for core academic subjects by taking time away from noncore subjects like physical education (PE). This trend has resulted in only 50% of schools requiring PE programs in grades 1 to 5, 25% requiring it in grade 8, and only 5% requiring it in grade 12 (Sibley & Etnier, 2003). Ironically, in three out of four large-scale longitudinal studies (see Sibley & Etnier, 2003), academic performance was found to improve as PE class time was increased. In none of the studies was greater time spent in PE related to a decline in academic test performance. In their meta-analysis of 44 studies of children and adolescents (ages 4 to 18), Sibley and Etnier found that physical activity was positively related to cognitive performance. They also found larger ESs for perceptual tasks than for verbal and memory tasks.

Similar results have recently been found when children's fitness levels have been compared to their academic test performance. Castelli (2005) matched schools on achievement and demographic characteristics and examined third-, fourth-, and fifth-grade students' physical fitness and related this to their performance on achievement tests. She found that the overall relationship between fitness and academic achievement scores was statistically significant ($r = +.63$). Total fitness was most related to performance in science ($r = +.73$) and math ($r = +.58$).

Thus far, studies in this area have been either cross-sectional or quasi-experimental. It is very difficult to get the cooperation of school officials to conduct Grade A or B experimental research. In spite of this, the major implication derived from these studies has been that school policy makers need to be more cognizant of the benefits that regular PE, or a student's level of physical fitness, has in enhancing children's cognitive functioning.

Explanations and Mechanisms

Many mechanisms (primarily physiological) have been advanced in an attempt to explain the exercise-cognitive performance relationship. Though many of these explanations have been theoretical, it is only recently that direct scientific evidence has been provided that links exercise to genes, brain morphology and biochemistry, and cognitive performance. As exciting as this new knowledge has been, it has been restricted to experimental studies in animals (i.e., rats and mice). However, this research may provide clues as to what may be happening in human brains.

DNA microarray analyses of rats (Tong, Shen, Perreau, Balazs, & Cotman, 2001) and mice (Lazarov et al., 2005) that voluntarily ran long distances on running wheels found a selective increase (i.e., "up-regulation") in several gene transcripts associated with learning and memory, development of capillaries, synapses, and nerves in the brain (i.e., vasculogenesis, synaptogenesis, and neurogenesis), cell survival pathways, neuronal plasticity, inhibition of beta-amyloid (Aß) development, and galanin synthesis. These changes primarily occurred at the level of the hippocampus, a brain site known to be primarily associated with memory and learning. Aß is a peptide, and its cerebral distribution is an invariant hallmark in brains of patients with Alzheimer's disease. Studies have shown that exercise alone (Adlard, Perreau, Pop, & Cotman, 2005) or as part of an enriched environment (Lazarov et al., 2005) resulted in pronounced reductions in cerebral Aß levels and amyloid deposits. Galanin is both a neurotrophin and a neurotransmitter and has been implicated as a mediator of enhanced contextual fear conditioning (a widely studied type of learning) after chronic physical activity (Van Hoomissen, Holmes, Zellner, Poudevigne, & Dishman, 2004).

Other investigators (Cotman & Engesser-Cesar, 2002) have found that voluntary running led to increases in brain-derived neurotrophic factor (BDNF), insulin-like growth factor 1 (IGF-1), and nerve growth factor (NGF). Of these chemicals, BDNF has been investigated the most. Compared to sedentary rats, 2 to 7 days of running at least 500 meters resulted in a 20% increase in BDNF levels. The increase in BDNF, IGF-1, and NGF brought about by exercise has been shown to be associated with morphological changes, such as greater neurogenesis, vasculogenesis, synaptogenesis, and synaptic plasticity in the rodent brain (e.g., Black, Isaacs, Anderson, Alcantara, & Greenough, 1990; H. M. van Praag, Christie, Sejnowski, & Gage, 1999), all of which are believed to be important in effective and efficient cognitive functioning. Some neurotransmitters associated with exercise (e.g., acetylcholine) have also been found to interact with the secretion of BDNF, suggesting a synergistic or positive feedback mechanism at work (Cotman & Berchtold, 1998). Before sacrificing these animals to determine the biochemical and structural changes in the rodent hippocampus, some investigators (e.g., Black et al., 1990; H. M. van Praag et al., 1999; H. H. van Praag, Shubert, Zhao, & Gage, 2005) had them perform maze-learning tasks. These studies found that exercise-trained rats learned to negotiate the mazes more quickly and had better retention than sedentary rats.

Some of these studies examined exercise as one component of an "enriched environment" (besides running wheels, colorful tunnels and assorted toys were included in animal cages). Animals placed in these environments had enhanced memory function (Fordyce & Wehner, 1993), enhanced survival of newborn cells in the dentate gyrus (Kempermann, Kuhn, & Gage, 1997), increased number and branching of dendritic spines and number of synapses per neuron (Fratiglioni et al., 2004), and quicker recovery from lesion-induced memory deficits (Rampon et al., 2000) compared to rodents exposed to an impoverished environment. H. M. van Praag et al. (1999) disentangled the ingredients of the enriched environment and demonstrated that exercise was the key ingredient. In this study, mice were exposed to conditions of swimming, swimming and learning, voluntary wheel running, or an enriched environment. The investigators concluded that running alone is sufficient to promote neurogenesis and the strengthening of neuronal connections.

Many investigators believe that this clear pattern of findings in animals can relate to mental functioning in humans (Churchill et al., 2002). For example, the process of neurogenesis is seen not only in rodents but in primates and human beings (Churchill et al., 2002). In studies where people practiced juggling for 3 months or bicycled around London for 2 years in an attempt to memorize street routes, results from magnetic resonance imaging showed that gray matter in the hippocampus, a brain area rich in neurons, was enlarged relative to the white matter in the brain (Draganski et al., 2004; Maguire et al., 2000). The increased vasculogenesis following exercise in animals may also relate to suggestions that exercise redistributes blood supply to areas of the human brain needed in cognitive functioning.

Other human evidence also shows that physical activity enhances brain activity. Hillman, Belopolsky, Snook, Kramer, and McAuley (2004) found that moderately and highly active older adults had increased P3 amplitude, an event-related electrical potential in the human brain known to be related to memory and attentional processes, for the incompatible condition in an executive control task (i.e., Flankers test). Similar P3 results have been found in college students after they engaged in a 30-minute acute bout of treadmill running (Hillman, Snook, & Jerome, 2003). These results suggest that exercise helps to promote greater neural efficiency and plasticity in both younger and older adults. Proponents of a neurotrophic stimulation mechanism also assert that exercise may offset age-related changes, such as reduced neurotransmitter synthesis, structural alterations to neurons, and degradation of the central nervous system.

Summary

The literature reviews in this area show consistency in finding that exercise is related to better cognitive functioning. Meta-analyses show that the magnitude of this effect is small to moderate (ESs = 0.29 to 0.62), and several experimental and longitudinal studies demonstrate a temporal sequence leading from exercise earlier in time to better cognitive functioning at a later point in time. From the experimental studies on animals, there is evidence for biological plausibility and coherence. Although there is some dose-response evidence in animals for the amount of exercise needed to increase BDNF, there is a paucity of evidence in the animal and human literature for the optimal amount of exercise needed to enhance cognitive functioning. Future research is needed to examine dose-response issues. Longitudinal experimental research with humans is also needed to examine effects of exercise on cognitive functioning and molecular, biochemical, morphological, and physiological changes underlying these effects.

EXERCISE AND REDUCTIONS IN ANXIETY AND DEPRESSION AND INCREASES IN POSITIVE MOOD

The constructs of anxiety and depression are linked in that they are concepts typically included under the more general rubric of affect or *mood* (specifically, negative mood). *Mood,* according to Lazarus (1991), represents a transient state, whereas *affect* represents something more enduring. However, given that affect and mood are often used interchangeably, and to remain consistent with the current exercise literature, depression, anxiety, and positive and negative mood are all included under the rubric of mood in this chapter. Gauvin and Brawley (1993) argue that this approach may be better suited to understanding the relationship of affect and exercise because the models derived from it are intended to be broad and encompassing conceptualizations of affective experience.

In established market economies, such as the United States, mental disorders are second only to heart disease in disability-adjusted life years, a measure of years of life lost to premature death and years lived with a disability of specified severity and duration (Murray & Lopez, 1997). This represents 22% of the total burden of disease, with anxiety, depression, and substance use disorders accounting for three-quarters of all mental disorders. Among American adults, anxiety and depression affect approximately 19 million and 18.8 million people, respectively (Narrow, Rae, & Regier, 1998; Robins & Regier, 1990). Nearly half of these cases occur before 14 years of age, and often those who are anxious as children end up being depressed as adults (Gorman, 2002). It is estimated that only half of all mental disorders can be averted with existing treatment methods (e.g., psychological and pharmacological) and that either more effective treatment methods need to be developed or better preventive interventions need to be employed (Andrews & Wilkinson, 2002). Exercise is considered by many to be a very promising preventative and a less costly intervention than psychotherapy or drug treatments.

Anxiety is an unpleasant emotional state associated with a negative form of cognitive appraisal typified by worry, self-doubt, and apprehension and psychophysiological responses (e.g., heart and respiration rate, sweating, trembling, weakness and fatigue). This emotional state may be in anticipation of unreal or imagined danger, powerlessness, apprehension, and tension, ostensibly resulting from unrecognized intrapsychic conflict. Anxiety usually arises "in the face of *demands that tax or exceed the resources of the system* or . . . demands to which there are no readily available or automatic adaptive responses" (Lazarus & Cohen, 1977, p. 109).

In psychiatry, depression is characterized by feelings of sadness, despair, and discouragement. There are often feelings of low self-esteem, guilt and self-reproach, withdrawal from interpersonal contact, and somatic symptoms such as eating and sleep disturbances. The American Psychiatric Association (1994) has developed diagnostic guidelines for many psychological disorders, and Table 21.3 provides examples of guidelines for panic attack and Major Depression. For a comprehensive review of the etiology and standard treatments of both depression and anxiety, see Dishman, Washburn, and Heath (2004).

Table 21.3 *DSM-IV* Diagnostic Criteria for Panic Attack and Major Depression

Panic Attack

A discrete period of intense fear or discomfort, in which four (or more) of the following symptoms develop abruptly and reach a peak within 10 minutes:

1. Palpitations	5. Feeling of choking
2. Sweating	6. Chest pain/discomfort
3. Trembling	7. Nausea or dizziness
4. Shortness of breath	8. Feeling of unreality

Major Depression

A clinical syndrome that includes a persistent sad mood or loss of interest in activities that persist at least 2 weeks in the absence of external precipitants (e.g., death of a loved one). Features may include changes in eating habits, insomnia, early morning wakening, lack of interest, depressed mood, fatigue, and suicidal thoughts.

Must have had one or more Major Depressive Episodes and no Manic Episodes, and to be counted as two separate Episodes, the interval between Episodes needs to be 2 or more months.

The Episodes are not better accounted for by Schizoaffective Disorder or superimposed on Schizophrenia, Delusional Disorder, or Psychotic Disorder.

Severity of Major Depressive Disorder can be "mild," "moderate," or "severe" without psychotic features, and "severe" with psychotic features.

Source: Diagnostic and Statistical Manual of Mental Disorders, fourth edition, by American Psychiatric Association, 1994, Washington, DC: Author. Reprinted with permission.

Questionnaire instruments are generally used to measure anxiety, depression, and positive mood states. However, with animals, anxiety is inferred from behavioral measures in which it is reasoned that nonanxious animals will display less freezing and more free-roaming behaviors when examined on a floor grid. Likewise, depression in rodents is inferred from behavioral measures such as lack of sexual activity, excessive sleeping, weight gain, and lack of activity. The questionnaire measures used with human subjects are sometimes accompanied by physiological or biochemical measures. For anxiety, these include measures of heightened arousal or anxiety (e.g., heart rate, blood pressure, skin conductance, muscle tension). For depression, measures might include levels of serotonin and norepinephrine.

Overall Effects

In a previous review of exercise and mental health, Landers and Arent (2001) examined evidence from 27 narrative reviews and six meta-analytic reviews for exercise and anxiety and six other meta-analytic reviews dealing with exercise and depression. The ESs for anxiety ranged from 0.15 to 0.56, and for depression, they ranged from 0.53 to 0.72. For 81% of the narrative reviews and for all of the meta-analytic reviews that met the inclusion criteria, it was concluded that exercise was associated with a reduction in anxiety and depression scores. Epidemiological evidence reviewed by Mutrie (2000) and Dishman et al. (2004) provides further support for a significant relationship between physical activity and depression, with less activity being associated with a greater incidence of depression.

Since publication of the review by Landers and Arent (2001), Lawlor and Hopker (2001) conducted a meta-analysis that was restricted to only randomized controlled trials with clinical patients or people scoring high on depression screening instruments. They located 10 randomized controlled trials comparing exercise to no treatment and four studies comparing exercise to cognitive therapy. Their results for the 10 studies showed that exercisers had lower depression scores, which was supported by a very large ES of 1.10. There was no difference between exercise and cognitive therapy (ES = 0.03). In discussing the large effect, Lawlor and Hopker attributed this result not to the effect of exercise, but instead to methodological problems in the studies reviewed. Because these studies were experiments, the problems they were talking about were concealment of treatment allocation, intention to treat, the use of a clinical interview to confirm the presence of depression, and whether the assessment of outcome was blind. Unfortunately, Lawlor and Hopker did not present results for moderator variables. Thus, it remains to be determined if the methodological differences among studies really made a difference in the overall ES. Even if some moderators were shown to affect the results, Schulz, Chalmers, Hayes, and Altman (1995) have shown that lack of concealment or double blinding would only produce an exaggerated odds ratio of 41% and 17%, respectively. Thus, it is unlikely that these methodological problems would reduce the overall ES any lower than 0.69.

In addition to the benefits of exercise for depression, the cumulative evidence also provides support for the beneficial effect of exercise on both negative and positive mood. In a meta-analytic review of 32 studies (158 ESs), Arent, Landers, and Etnier (2000) reviewed the effects of exercise on positive and negative mood in older adults (i.e., >65 years of age). The overall ESs were small to moderate, showing that exercise was associated with significantly enhanced positive mood and reduced negative mood. Specifically, exercisers had increased positive affect (ES = 0.35) and decreased negative affect (ES = 0.39) from pretest to posttest compared to controls (ESs = 0.16 and 0.04, respectively). The overall mean ES for correlational studies was significant (0.46), indicating that mood is better in elderly, physically active people than it is in nonactive elderly people. Consistent with the Arent et al. meta-analytic findings, studies with subjects less than 65 years of age have revealed a small but consistent increase in positive mood following exercise (see Landers & Arent, 2001). This effect has also been reported in a review (Stephens, 1988) of four large-scale epidemiological surveys ($N > 55{,}000$), with positive affect being associated with physical activity, particularly for women and those individuals over 40 years of age.

Moderator Variables

There are a number of characteristics related to either the subjects or the exercise itself that likely influence the nature and magnitude of the relationship between exercise and depression, anxiety, or affect. Evidence related to the potential moderator variables is reviewed next.

Subject Effects

Meta-analytic evidence has generally demonstrated a robust effect for exercise, as reduction in anxiety and depression scores occur for all types of people (i.e., male and female, fit and unfit, active and inactive, clinically anxious and nonanxious, clinically depressed and normal, healthy and unhealthy, young and old). However, the magnitude of these effects varies as a function of certain subject characteristics. Although meta-analyses indicate that normal people significantly reduce anxiety and depression scores with exercise, clinical patients with moderate to severe Major Depression or anxiety disorders show even greater reductions (Craft & Landers, 1998; Stich, 1998). Additionally, patients who are very unfit (i.e., cardiac rehabilitation patients, psychiatric patients) often demonstrate even greater mental health benefits from exercise compared to people who are mentally and physically healthy.

The results of two randomized clinical trials (RCTs) shed light on the potential value of exercise compared to other traditional treatments for mental health disorders. Using a sample of 46 patients with moderate to severe anxiety disorders (i.e., Panic Disorder and Agoraphobia), Broocks et al. (1998) showed that, in comparison to a placebo condition, either medication or a 10-week program of regular endurance running (walk/run 4 miles 3x/wk) was associated with significant and clinically relevant decreases in anxiety ratings. Exercise was shown to produce decreases in anxiety scores (ES = 1.41) comparable to the drug clomipramine (ES = 1.35) by the end of the study, and both of these treatments were significantly better than a placebo. In another clinical trial, Blumenthal et al. (1999) randomly assigned 156 men and women who suffered from Major Depressive Disorder to either a supervised aerobic exercise program (3x/wk), a medication treatment (sertraline), or a combined treatment of medication and exercise. The results showed that, despite a more rapid initial response in the medication group, all three groups had significantly reduced depressive symptoms to a comparable degree by the end of the 16-week treatment. Perhaps more important, a 6-month follow-up revealed that those in the exercise group were significantly less likely to have a depressive relapse (Babyak et al., 2000). It is worth noting that although patients with Panic Disorder or Major Depression have a lower capacity for exercise (i.e., lower aerobic fitness) than nonclinical samples, they are generally not any more intolerant of exercise than controls (Broocks et al., 1998; Stein et al., 1992).

The body of human and animal research comparing exercise to other treatments for anxiety and depression has recently been reviewed (see Landers & Alderman, in press; Stich, 1998). Overall, it was concluded that exercise produces consistent affective, anxiolytic, and antidepressant effects that are of similar magnitude to drugs or many of the common psychological interventions, particularly after the initial stages of the intervention. In addition, compared to many other treatments, exercise has minimal adverse side effects (e.g., time and effort, sore muscles, perspiration, and fatigue) and many physical and mental health benefits (e.g., improved body composition and reduced risk of coronary heart disease; dementia or Alzheimer's disease; hypertension; falling; peripheral artery disease; colon, prostate, or breast cancer; arthritis; and Type II diabetes mellitus). Exercise combined with psychotherapy appears to produce even better results than either by itself, but it is unclear at this time whether exercise is more effective for reducing depression when combined with drugs. There is also some evidence (Babyak et al., 2000) that compared to drugs, exercise is related to lower relapse rates and better adherence at a 6-month follow-up. However, Broocks et al. (1998) found adherence to be better with drugs than with exercise in a 10-week program. Future research is clearly warranted to examine these issues.

The cumulative evidence has recently led to the suggestion that primary care providers recommend exercise as either adjunct therapy (Craft & Perna, 2004) or an alternative to drug therapy (Hardie, 2005) for people with *mild* to *moderate* depression. In fact, the guidelines of the Mental Health Foundation in the United Kingdom now state that antidepressant drugs should be avoided as a first-line treatment for mild depression and that primary care physicians should more often recommend exercise as a first-line treatment. Despite this, it appears that a majority of general practitioners are not regularly suggesting an intervention (i.e., exercise) that has been demonstrated by extensive research as being an effective treatment option (Hardie, 2005).

These findings may hold particular relevance for obese individuals. Recent reviews (e.g., Stunkard, Faith, & Allison, 2003) and results of a longitudinal epidemiological study (Carr & Friedman, 2005) are consistent in concluding that severely obese people are significantly more likely to be depressed and have lower levels of positive affect and higher levels of negative affect than people of normal weight. Ironically, pharmacological treatments for depression have often been found to cause weight gain (Fava, 2000), which is likely counterproductive for depressed obese individuals, as well as medically unsafe. Exercise may play a role of dual beneficence in this group by addressing the comorbid conditions effectively and simultaneously.

Individual difference factors related to body composition, such as social physique anxiety (SPA; Hart, Leary, & Rejeski, 1989), can also interact with environmental cues to influence affective response to an exercise bout as well as impact adherence. Social physique anxiety is defined as the anxiety that individuals experience in response to others' evaluations of their physique. Research has isolated factors that influence the exercise experience for those high in SPA (e.g., Arent, Tuzzolino, Smith, & Friedman, 2005; Martin Ginis, Jung, & Gauvin, 2003). A major influence on affective response to exercise is whether the environment increases the perceived evaluative threat to one's physique (Martin Ginis et al., 2003). In examining this, previous studies have not controlled for exercise intensity; thus, it is difficult to discriminate between affective response due to the setting and affective response due to the intensity of exercise. However, Arent, Tuzzolino, et al. recently found different cortisol responses in coed versus single-sex exercise conditions while controlling exercise intensity, thus suggesting enhanced perceived evaluative threat in the coed condition. Furthermore, those individuals in the high SPA group had higher state anxiety compared to the low SPA participants across both conditions, though both groups experienced affective benefit from the aerobic exercise. Future research in this area might help guide intervention strategies aimed at increasing exercise adherence and positive affective outcomes.

Exercise Effects

There is now evidence to indicate that both aerobic (e.g., running, swimming, cycling) and anaerobic (e.g., resistance training) exercise reduces anxiety and depression scores. Although earlier reviews on this topic (Landers & Arent, 2001) concluded this for reductions in depression, there was at the time scant evidence that anaerobic or resistance-training exercise reduced anxiety scores. Several resistance-training studies examined anxiety reduction, but they either allowed subjects to take a shower during the postexercise period or allowed them to leave the laboratory and return later to complete anxiety questionnaires. This practice potentially confounded the effects of exercise. Additionally, there were other methodological and conceptual problems related to the exercise mode in many of these studies (see Arent, Landers, Matt, & Etnier, 2005).

There are now experimental resistance-training studies (e.g., Arent, Landers, et al., 2005; Bartholomew & Linder, 1998) where exercise effects on postexercise anxiety reduction are not confounded. In each of these studies, the anxiolytic effects of resistance training were dependent on the intensity of the exercise. Bartholomew and Linder found that state anxiety was reduced following 20 min of resistance training at 40% to 50% of one repetition maximum (1RM). However, they found a transient increase in anxiety following 20 min of 75% to 85% 1RM. It appeared, though, that this latter condition might have included "momentary muscular failure," which would be indicative of high-intensity training. To address the conceptual issues surrounding resistance exercise intensity, Arent, Landers, et al. employed multiple resistance training protocols (no-exercise control, 40%, 70%, and 100% 10RM) while controlling for exercise volume. Findings supported a significant difference in physiological demand (heart rate, rating of perceived exertion, and cortisol) between each of the three resistance training protocols. The results showed that moderate-intensity training (70% 10RM) was the only condition to result in immediate, large, and enduring anxiolytic responses. Additionally, this condition also produced significant reductions in negative affect and tiredness and significant increases in positive affect, energy, and calmness compared to the other conditions. Meta-analytic evidence from studies using older adults (Arent et al., 2000) provides further support for the effectiveness of both aerobic and resistance exercise in producing beneficial changes in both positive and negative mood.

Overall, studies clearly show that both aerobic and anaerobic exercise are effective in reducing anxiety and depression scores and increasing positive mood. Recent evidence also indicates that resistance exercise is most effective when intensity is properly defined and controlled in the moderate range. Similar intensity and workload considerations also appear to apply to aerobic exercise. He (1998) systematically varied exercise intensity and duration together and found that, for moderately fit college students, exercise in the midrange of total work output (i.e., 15 and 30 min of exercise at 70% of max and 30 and 45 min of exercise at 50% of max) had larger anxiety-reducing effects than aerobic exercise that was outside of this range (i.e., 15 min at 50% of max and 45 min at 70% of max). Ekkekakis and Petruzzello (1999) have indicated that in-task affect is also negatively impacted by high-intensity exercise. Further elucidation of dose-response models may become possible as researchers consider individual factors that could influence affective responses to exercise load, such as intensity preference and tolerance (Ekkekakis, Hall, & Petruzzello, 2005). Additionally, Chrousos and Gold (1992) have suggested that there may be a "family" of dose-response curves relating stressor (i.e., exercise) intensity to affective outcomes, depending on subject characteristics. There is also some evidence that exercise intensity relative to certain biological thresholds (e.g., ventilatory threshold, lactate threshold, hormonal response thresholds) is an important determinant of affective and anxiety responses (Arent, Landers, et al., 2005; Ekkekakis, Hall, & Petruzzello, 2004).

The modest dose-response evidence for depression consists of one RCT and two prospective epidemiological studies. Mildly to moderately depressed men and women (age 20 to 24) were randomly assigned to varying combinations of two levels of energy expenditure and two levels of exercise frequency for a 12-week training program (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005). Patients assigned to the "public health dose" (17.5 kcal/kg/wk) had a 47% reduction in depressive symptoms compared to a 30% reduction for the low-dose group (7.0 kcal/kg/wk). There was no difference between exercising for 3 days versus 5 days per week. The prospective epidemiological studies (Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991; Paffenbarger, Lee, & Leung, 1994) also show some support for a dose-response gradient, with the least active at baseline being the most at risk of developing depression at follow-up. Compared to low-active people, individuals who were moderately active in 1965 were at a significantly lower risk of developing depression in 1974 (Camacho et al., 1991), and those who expended 2,500 kcal or more per week had a 28% lower risk of developing clinical depression than men who expended less than 1,000 kcal/wk (Paffenbarger et al., 1994). At the very least, it appears that there is a threshold effect for physical activity dose and reductions in depressive symptoms or risk of depression.

In other studies, the anxiety-reducing effects of exercise were also larger when the length of the aerobic training program was at least 10 weeks and, preferably, greater than 15 weeks (Landers & Petruzzello, 1994). Exercise produced larger antidepressant effects when the exercise-training program was longer than 9 weeks and involved a greater number of sessions (Craft & Landers, 1998; North, McCullagh, & Tran, 1990). In addition, postexercise reductions in anxiety and depression scores begin almost immediately after exercise (depending on intensity) and extend beyond the end of the exercise session (4 to 6 hours for anxiety) or the end of the exercise program (Craft & Landers, 1998; Landers & Petruzzello, 1994; North et al., 1990).

Explanations for the Anxiolytic and Antidepressant Effects of Exercise

There are a number of explanations that have surfaced over the years to account for the reductions in anxiety and depression scores and increases in positive mood scores resulting from exercise. Some of these explanations still remain viable in that the research literature has not shown consistent evidence to refute them. Other explanations (e.g., the Pitts-McClure hypothesis, the thermogenic hypothesis, the time-out hypothesis, and the behavioral artifact hypothesis) have not been consistent with existing research evidence and therefore are not addressed here (see Landers & Arent, 2001, for a discussion of the shortcomings of these hypotheses). In addition, there are other explanations that have been advanced (mental health model), but at the present time, these explanations have very little, if any, Grade A or B scientific support. The mechanisms examined here are those that have more experimental support from human and animal studies and are plausible explanations. These include psychological explanations, the BDNF hypothesis, the endorphin hypothesis, the endocannabinoid hypothesis, the serotonin (5-HT) hypothesis, the norepinephrine (NE) hypothesis, and the hypothalamic-pituitary-adrenal (HPA) axis hypothesis.

Psychological Hypotheses

As mentioned earlier, a number of psychological hypotheses have not withstood the test of time and are no longer consistent with the scientific animal and human literature on anxiety, depression, and positive mood state. However, some psychological hypotheses still remain viable. For instance, sense of mastery and self-efficacy have been suggested as possible mechanisms for the exercise-mood relationship (Landers & Arent, 2001; Mutrie, 2000). As people exercise and their sense of mastery and confidence in exercising and dealing with their environment increases, they may become less depressed and anxious. Additionally, exercise (and related mastery experiences) may function to increase self-esteem and self-concept, particularly for physical attributes (Sonstroem, 1998), thus influencing depressive or anxious symptomatology. Although this may be the case, most of the studies examining this have been correlational in nature. The lack of experimental studies examining changes in self-efficacy, mastery, and self-esteem brought about by exercise training, and its effects on anxiety, depression, and positive mood, limit these psychological hypotheses as viable mechanisms. These variables may be more relevant to exercise adherence than they are to the relationship between exercise and positive mood state.

Social interaction and social support have also been mentioned as possible explanations. Landers and Alderman (in press) have reported that there are no significant differences between exercise and structured social interactions in reducing depression scores. More experimental studies comparing exercise alone versus exercise in groups are needed to better determine the viability of the social interaction factor in the exercise-positive mood relationship.

Ekkekakis (2003) has proposed the "dual-mode model" as a possible explanation for some of the individual variability that appears to exist for in-task affective responses to exercise. According to this model, cognitive factors (e.g., individual goals, self-efficacy, attributions, social setting) may play an important role in the affective regulation during steady-state exercise. However, once the intensity of the exercise crosses a physiological threshold, such as ventilatory threshold, interoceptive cues begin to play a larger role in the in-task affective response and likely override or supersede the cognitive cues. It is at this point that affective ratings become more consistent across individuals and tend to exhibit a negative valence both during and immediately after exercise. This threshold likely corresponds to the physiological point at which exercise moves from eustress to distress (Selye, 1956), and there is some initial support for this model (Ekkekakis & Petruzzello, 1999; Ekkekakis et al., 2004). Future research is needed to determine the biological markers associated with the potential intensity thresholds and the implications for both in-task and postexercise affective responses and the impact on exercise adoption and adherence.

Brain-Derived Neurotrophic Factor Hypothesis

In the section on cognitive function, BDNF was shown to be involved in mediating the beneficial effects of exercise on brain plasticity. Brain-derived neurotrophic factor is one of several neurotrophic factors that support the health of glutamatergic neurons, which connect to cognitive, sensory, and motor regions of the brain (Cotman & Engesser-Cesar, 2002), and BDNF also has antidepressant effects (Siuciak, Lewis, Wiegand, & Lindsay, 1997). Hippocampal levels of BDNF have been shown to increase with either exercise or antidepressant drugs (Russo-Neustadt, Ha, Ramirez, & Kesslak, 2001; Van Hoomissen, Chambliss, Holmes, & Dishman, 2003). Additionally, Van Hoomisen et al. found that exercise also enhanced BDNF mRNA in the ventral tegmental area/substantia nigra, which is associated with mesolimbic dopaminergic function. Russo-Neustadt et al. found that exercise combined with an antidepressant drug hastened the time it took BDNF levels to increase in the rat brain. If either exercise or antidepressant medication is used alone, it can take up to 2 weeks for BDNF levels to increase, similar to the time that it takes drugs to begin to be effective in treating anxiety and depressive disorders. In combination, Russo-Neustadt et al. noted, drugs and exercise can increase BDNF levels in as little as 2 days, though this additive effect has not been consistently found (Van Hoomisen et al., 2003). Overall, though, this has led Cotman and Engesser-Cesar (2002, p. 78) to suggest that "exercise may decrease the time required for antidepressants to be effective, a finding that is potentially clinically significant."

Endorphin Hypothesis

There is considerable evidence that endogenous opioids, like ß-endorphins, are secreted as a result of long-duration aerobic exercise (Hoffmann, 1997) as well as high-intensity resistance training (Kraemer et al., 1993). Though it is unlikely that plasma ß-endorphins act directly on the brain due to impermeability of the blood-brain barrier to them, they are related to behavioral effects that suggest a general calming in animals and humans. Experimental studies in which a specific endorphin blocker, such as naloxone, has been administered have produced mixed results (Hoffmann, 1997). In some human studies where attempts have been made to block the effects of endorphins, anxiety reductions following exercise have been attenuated (Allen & Coen, 1987; Daniel, Martin, & Carter, 1992). However, other studies (e.g., Farrell et al., 1986) have not shown this response. Hoffmann suggested that this may be due to the use of low doses of naloxone in these latter studies. He points out that it takes large doses of naloxone to block all of the mu, delta, and kappa endorphin receptor sites. Interestingly, researchers who have administered higher doses of naloxone have generally supported the endorphin hypothesis (Allen & Coen, 1987) as it relates to the effects of exercise on anxiety responses.

There is evidence that low-frequency peripheral transcutaneous or direct stimulation of afferent nerves for a total of 60 min, as would occur with skeletal muscle stretch and contraction with exercise, is associated with an analgesic response in rats and a drop in blood pressure (BP) lasting as long as 10 hours (Yao, Andersson, & Thoren, 1982a, 1982b). In other animal studies, BP dropped after a cessation of repeated electrical muscle stimulation, and this "was accompanied by a behavioral calm with a markedly reduced spontaneous [motor] activity" (Hoffmann, 1997, p. 175). These BP and behavioral effects were reversed with high (15 mm/kg), but not low, doses of naloxone. These findings support an influence of ß-endorphins in producing analgesic, calming effects in humans and animals following exercise, though their role in reduction of depression is less certain (Dishman et al., 2004). Considering previous findings for exercise intensity and anxiety responses, it is unlikely that endorphins play a solitary role in this effect due to the fact that the greatest endorphin levels are seen with increasing intensities of exercise.

The Endocannabinoid Hypothesis

Other explanations for calming anxiety with moderate- to high-intensity exercise (70% to 80% VO_2 max) are also available. The discovery of endogenous cannabinoid receptors in the brain and in the periphery suggest that they, too, may reduce pain and produce a calming state (Dietrich & McDaniel, 2004). The cannabinoid system has two receptors, CB_1 and CB_2, and two naturally occurring ligands, anandamide and 2-arcachidonylglycerol (2-AG). The endocannabinoid system has been linked to stress-induced analgesia. In addition, Sparling and colleagues (Sparling, Giuffrida, Piomelli, Rosskopf, & Dietrich, 2003) found that male college students undergoing aerobic exercise for 50 min at 70% to 80% of maximum heart rate had higher plasma anandamide levels following exercise than sedentary control subjects. Anandamide can readily cross the blood-brain barrier and it binds to CB_1 receptors, which are located in brain regions associated with the control of motor functions, emotion, and cognition. Though insufficient research currently exists on which to base firm conclusions, this remains a promising explanation for the affective responses seen with exercise that may be clarified with future studies.

The Serotonin Hypothesis

Drugs commonly used in the treatment of depression (Prozac®, Zoloft®, & Paxil®) work by altering the function of neurons that release the neurotransmitter serotonin (i.e., 5-HT) or the catecholamine norepinephrine (NE). Depressed patients typically have chronically low brain levels of 5-HT and NE, and this is associated with feeling listless or extremely lethargic (Jacobs, 1994). Physicians often prescribe selective serotonin-reuptake inhibitors (SSRIs) that are designed to produce acute and chronic adaptations of receptor function and molecular changes in cells that alter neuronal activity so that brain levels of 5-HT and NE can be regulated. These drugs prevent the reuptake of 5-HT by the neuron, and this results in more 5-HT being available to produce heightened nervous system activity. There is some recent evidence that this serotonin increase is produced from an interaction of a protein (p11) and a specific serotonin receptor (1B; Svenningsson et al., 2006). The 1B receptor has been shown in animals to be related to a diverse range of physiological functions and behaviors, including mood, Obsessive-Compulsive Disorder, depression, anxiety, cognition, aggression, drug addiction, and sleep. P11 makes more 5-HT 1B receptors available at the cell surface, thereby increasing the receptor signaling efficiency. Svenningsson et al. have provided convincing evidence that long-term administration of either electroconvulsive therapy or antidepressant drugs increases p11 mRNA in rat brains. They also found that p11 mRNA was markedly reduced in helpless mice (showing behavioral signs of depression) compared to nonhelpless mice, and was also reduced in the anterior cingulated cortex in 10 human patients with unipolar Major Depressive Disorder.

Presently, there are data derived from animal and human studies indicating that central serotonergic systems are modified by physical activity. Studies with cats (Jacobs, 1994) show that when awake, the 5-HT neural discharge rate is about 3 spikes (or pulses) per second. By systematically increasing motor activity while the animal is awake, the discharge rate of 5-HT can increase to 4 or 5 spikes per second. In a review of microdialysis studies with rats (Chaouloff, 1997), exercise was shown to markedly increase 5-HT levels in three out of four studies (overall ES = 1.70). Frequency of 5-HT discharge decreases with drowsiness and sleep onset, but falls completely silent during a particular type of sleep called rapid eye movement (REM). Rapid eye movement sleep is paradoxical because it is a deep sleep, but it is not as restful as slow-wave sleep. Meta-analytic reviews (Kubitz, Landers, Petruzzello, & Han, 1996; Youngstedt, O'Connor, & Dishman, 1997) have shown that both acute and chronic exercise are related to a significant increase in slow-wave sleep and total sleep time, but also to a decrease in sleep onset latency and REM sleep. In other words, exercisers go to sleep more quickly, sleep longer, and have a more restful sleep than untrained subjects or nonexercisers. The increased time that exercisers are in slow-wave sleep relative to REM sleep would, in effect, increase the amount of 5-HT available in their nervous system. Therefore, exercise may help alleviate depression by increasing serotonin levels in the awake state as well as during sleep.

The Norepinephrine Hypothesis

As stated earlier, depression is associated with a lowered synthesis of NE in the brain. Lowered levels of metabolites of NE are found in the urine of depressed patients (Dishman, 1997). Drugs, such as monoamine oxidase inhibitors and tricyclics, prevent the degradation of NE or block its reuptake into the neuron, thus producing adaptations of receptor function and molecular changes in cells that alter NE at the synapse or postsynaptic receptor sites. There is increasing evidence that exercise can cause modifications to the monoaminergic and noradrenergic systems that are associated with effects similar to those of antidepressants (see Dishman et al., 2004). Recent research has also suggested that regulation of dopamine, a precursor for the synthesis of NE, may play an important role in the effects of both certain antidepressants and exercise on depression and mood (Dishman et al., 2004).

Chronic treadmill running and chronic activity wheel running have been found to increase NE or its metabolites in selected brain regions (i.e., pons medulla, frontal cortex, and hippocampus), "brain areas that are activated during integrated behavioral responses to stressors that evoked anxiety and depression" (Dishman, 1997, p. 71). These effects were independent of increases in physical fitness and therefore do not appear to be due to the increased oxidative capacity of skeletal muscle. The early pharmacological methods used to examine concentrations of NE in the brains of rats were basically descriptive (Dishman, 1997), but direct measures (i.e., microdialysis probes) also show that following acute treadmill running there is increased release of NE in the frontal cortex (Pagliari & Peyrin, 1995). Chronic physical activity seems to mitigate NE release during stress (Soares et al., 1999), and up-regulation of galanin in the region of the locus coeruleus could plausibly explain this effect (O'Neal, Van Hoomissen, Holmes, & Dishman, 2001).

An endogenous depression model in the rat involves injecting neonatal pups with clomipramine (CLI), a 5-HT reuptake inhibitor. In adulthood, these CLI pups have characteristics (e.g., decreased REM sleep latency, immobility, and decreased sexual activity) that resemble depressive symptoms in humans. Yoo, Tackett, Crabbe, Bunnell, and Dishman (2000) examined the relative effectiveness of exercise versus antidepressant drugs in increasing NE levels in CLI-altered rats. Norepinephrine levels in rats given 12 weeks of chronic activity wheel running were equal to levels from an antidepressant drug treatment, and the running activity exceeded the drug treatment in increasing male sexual performance. Although exercise was superior to drugs in influencing behavioral measures, measures of sexual arousal (latency of mounting and penetration) were not significantly different between drugs and exercise.

Although the research to date is encouraging, there is much that remains to be determined before the NE hypothesis can be fully supported. For example, no human evidence apparently exists in which measures of peripheral NE levels as a function of chronic exercise training in depressed subjects have been employed (Dishman, 1997). Likewise, questions remain concerning the interaction of various neuromodulators (NE, DA, GABA, and endorphins) in affecting depression and anxiety.

Hypothalamic-Pituitary-Adrenal Axis Hypothesis

Dysregulation of the HPA axis resulting in hypercortisolism has been identified as an underlying mechanism associated with depression (Holsboer, 2000) and with anxiety and other stress-related disorders (Burrows et al., 1998). This may at least be partly due to down-regulation of corticotropin-releasing hormone (CRH) receptors following hypersecretion of CRH or an increased vasopressin response (Purba, Hoogendijk, Hofman, & Swaab, 1996). Chrousos and Gold (1992) have also indicated that the emotional response to stressor exposure may be mediated by responsivity of the HPA axis and the autonomic nervous system. Previous research has suggested that there may be a genetic component to this effect in individuals with affective disorders, as demonstrated by an exacerbated response to stress (Modell et al., 1998). Furthermore, hypersecretion of CRH has been shown to result in increased demonstrations of anxiety-based behaviors in mice (Stenzel-Poore, Heinrichs, Rivest, Koob, & Vale, 1994). The effects of the stress response on emotional regulation may also explain the anxiogenic effects seen in previous studies using high-intensity exercise (Arent, Landers, et al., 2005; Bartholomew & Linder, 1998). This would be consistent with the notion that an "intensity threshold" exists, beyond which exercise may not produce homogeneously beneficial affective responses (Arent, Landers, et al., 2005; Ekkekakis, 2003).

According to Holsboer (2000), one of the more consistent findings in relation to improvement of clinical depression is the necessary rectification of the HPA dysregulation. Without improvement in the regulation of an appropriate stress response, relapse risk is markedly increased. This appears to be a major pathway through which effective antidepressants exert their influence (Holsboer & Barben, 1996). It may also be that an optimal, controlled stimulation of the stress response is one mechanism through which exercise exerts it affective benefits. Acutely, this would be consistent with the model proposed by Chrousos and Gold (1992) suggesting a curvilinear relationship between activation of the stress system and a sense of well-being. Over time, this may help produce HPA regulation or exert a potentially protective effect on the hippocampus (McEwen, Gould, & Sakai, 1992). Both of these effects can result in reduced anxiety and depression as well as provide stress-buffering benefits (Holsboer, 2000). On the other hand, chronic elevations in CRH and cortisol are related to hippocampal atrophy (Lupien et al., 1998) and maladaptive responses to stress-inducing stimuli (Linthorst et al., 1997).

Summary

There has been lack of agreement as to whether reductions in depression and anxiety associated with exercise meet Hill's (1965) criteria for causation (Arent et al., 2001;

Dishman, 1995; Dishman et al., 2004; Mutrie, 2000). The current discussion was extended to include the effects of exercise on both depression and anxiety due to the emerging realization that depression and anxiety disorders are related (Gorman, 2002) and that the same drugs are often used to treat both conditions. For the exercise-depression relationship, Mutrie concluded that the research evidence supported all eight of the criteria for causation (see Table 21.1), whereas Arent et al. found support for some criteria (i.e., strength of association, consistency, temporal sequence, biological plausibility), limited support for experimental evidence and coherence, and weak experimental support for a dose-response gradient. Human experiments now demonstrate more evidence of dose-response effects of exercise for both anxiety (e.g., Arent, Landers, et al., 2005; He, 1998) and depression (e.g., Dunn et al., 2005) reductions. The dose-response criterion for causation now has greater support and shows that moderate levels of exercise reduce levels of anxiety and depression. However, there may be variability in this response (Ekkekakis, 2003), and further research is clearly warranted to examine factors (e.g., subject characteristics, biological thresholds) that may influence dose-response patterns. Finally, coherence is met because the results for exercise as an antidepressant and anxiolytic is consistent with our understanding of the natural history and biology of mental illness. There are now numerous experimental studies in the human and animal literature that are consistent in showing that exercise produces anxiolytic and antidepressant effects. According to the U.S. Surgeon General's Report on Mental Health (U.S. Department of Health and Human Services, 1999), the level of evidence required for psychotherapy to be well established is at least two published experiments with group designs that have demonstrated efficacy. The experimental evidence for exercise as a treatment intervention exceeds this criterion for anxiety and for both minor and major unipolar clinical depression. Two of the RCTs have also examined depression during a follow-up period (Babyak et al., 2000; Singh, Clemens, & Fiatarone Singh, 2001), but no studies examining anxiety disorders during the follow-up period were found. This is needed to establish long-term adherence and efficacy.

EXERCISE AND STRESS REACTIVITY

Chronic stress is associated with affective disorders such as anxiety and depression and is also a risk factor for the development of CHD, hypertension, atherosclerosis, and compromised immune functioning (McEwen & Lasley, 2002). The ability to attenuate physiological reactivity to a stressor has been identified as an important component of overall physical and mental health (Holsboer, 2000). Exercise, itself a stressor, has received considerable attention for its possible role as an intervention or preventive strategy for stress-related disorders and maladaptive responsivity to psychological stressor exposure. It is believed that exercise may contribute to an individual's "hardiness," which is the ability to transform or buffer stressful events into less stressful forms by altering the appraisals of the stressor (Kobasa, 1979), thus leading to better physical and mental health through reduced reactivity. Another possibility is that exercise may directly impact or modify the physiological response to stress both acutely and chronically. The general research paradigm for this area of research is to compare exercisers and nonexercisers in their ability to recover after being subjected to a psychosocial stressor. Stressors, such as frustrating timed cognitive tasks, are given to fit or trained subjects or to subjects following acute exercise to determine the magnitude of their psychological and physiological responses to stressors and the amount of time it takes for them to return to baseline levels.

Overall Findings and Moderating Variables

In their stress-reactivity meta-analysis of 34 studies, Crews and Landers (1987) found that aerobically fit subjects significantly reduced psychosocial stress response when compared to either baseline values or a control group. The reduced physiological response to stress and faster physiological recovery resulted in less overall time spent in stress, perhaps at a lower level of stress. Taylor (2000) conducted a narrative review of the stress-reactivity literature since 1988 and located 14 cross-sectional, 11 chronic exercise, and 14 acute exercise studies completed since the Crews and Landers meta-analysis. Nine of the 14 cross-sectional studies indicated that fit and/or active people demonstrated less reactivity when exposed to psychosocial stressors, whereas the chronic exercise studies were mixed in their conclusions. Ten of the 14 acute exercise studies indicated reduced reactivity to brief, passive, and active stressors. One of the problems with many of these studies, however, was that the number of subjects was relatively small, and therefore the statistical power was likely compromised.

One major disadvantage to both the Crews and Landers (1987) meta-analysis and the narrative review by Taylor (2000) is that moderator variables were not examined. However, Alderman, Rogers, Landers, Arent, and Johnson (2006) recently conducted an updated meta-analytic review of the literature and included analyses of potential moderator variables. Across 608 ESs derived from 102 studies, an overall effect of 0.37 was found. This is consistent with the magnitude of the overall effect from the earlier meta-analysis by Crews and Landers. The effects of exercise on mean arterial pressure (MAP) and vagal activity assessed through heart rate variability were particularly pronounced and better than those for most other stress measures. This may hold particular clinical relevance in light of the established links among stress, hypertension, and cardiovascular disease (McEwen & Lasley, 2002).

Further analysis of moderator variables indicated significant reductions in stress due to exercise regardless of race or gender, though effects were largest for Black participants and for males. Effects were also larger for those classified as "clinical" versus "healthy/nonclinical." For chronic studies, exercising for a longer duration (46 to 120 min) and more than 3 days per week was associated with the largest ESs, regardless of an increase in physical fitness. Finally, both acute and chronic exercise were effective in reducing stress reactivity.

This finding for the effectiveness of acute exercise is consistent with another recent meta-analysis (Hamer, Taylor, & Steptoe, in press). Hamer et al. analyzed 15 RCTs to determine the effects of acute aerobic exercise on BP responses on exposure to a psychosocial stress task and found an overall effect of 0.38 for SBP response and 0.40 for DBP response. Unfortunately, because of the small number of RCTs available, they did not quantitatively evaluate moderator variables. However, a qualitative examination did indicate that the largest effects were derived from studies using higher exercise doses.

Explanations for the Stress-Buffering Effect of Exercise

Along with cognitive functioning and antidepressive effects, BDNF has also been implicated in improving the stress response. Exposure to stress is known to reduce BDNF levels in the hippocampus of laboratory animals. These decreases in BDNF levels following a stressful event (i.e., a forced swim test) have been shown to be counteracted when animals have been given 1 week of exercise or 1 week of an antidepressant (Russo-Neustadt et al., 2001).

Like BDNF, NE levels also markedly decrease when animals are exposed to a severe stress (see Dishman, 1997, for a review). For example, stress associated with chronic, unavoidable foot shocks produces substantially lower levels of NE and a deficit or delay in escaping from this shock when tested on subsequent days. However, these effects can be attenuated by chronic voluntary wheel running and treadmill training (Dishman et al., 1997). Aerobic exercise increases NE levels in the hypothalamus and pons medulla at rest and protects against NE depletion in the locus coeruleus, amygdala, hippocampus, and frontal cortex after foot shock stress ($ES_{range} = 0.64$ to 0.84). Forced treadmill exercise in rats also increases the metabolism of NE in the brain ascending terminal areas for NE ($ES_{range} = 0.57$ to 1.04). Several of these areas modulate hypothalamic regulation of adrenocorticotropic hormone (ACTH) release during stress, and studies have shown that exercise training leads to blunted plasma ACTH response to acute treadmill exercise but a hyperresponsiveness of ACTH after novel immobilization (Dishman, Renner, White-Welkley, Burke, & Bunnell, 2000).

The results of the meta-analyses can be interpreted as exercise either acting as a coping strategy or serving as an "inoculator" to enable people to more effectively respond to psychosocial stress. Exercise may provide a more efficient system for coping with stress by reducing autonomic or HPA recovery time. It may also provide for acute buffering effects due to vagal or parasympathetic rebound following cessation of the exercise stressor (Solomon & Corbit, 1973). As an inoculator, exercise bouts may provide for controlled stimulation of the stress response, thus causing systemic adaptations that may protect against similar perturbations due to future psychosocial stress.

While the concept of the existence of a "cross-stressor" adaptation has been questioned (Dishman & Jackson, 2000), the veracity of this conclusion may depend on the specificity with which we would expect these adaptations to be manifest. Chrousos and Gold (1992) suggest that the adaptive responses of the stress system can either be stressor-specific or more generalized and nonspecific in nature, requiring an overall mobilization of the stress response. It is expected that this general response would be seen when stressor intensity exceeds a threshold for threat to homeostasis of the organism (Chrousos & Gold, 1992). This view is consistent with mechanisms that have been proposed to explain the relationship between stress and various affective responses or disorders (Arent, Landers, et al., 2005; Ekkekakis, 2003; Holsboer, 2000). Furthermore, Singh, Petrides, Gold, Chrousos, and Deuster (1999) found that individuals exhibiting a hyperreactive HPA axis when exposed to the stress of exercise also had a hyperreactive HPA axis (particularly as demonstrated by increased cortisol) when exposed to psychological stress. This suggests a cross-stressor commonality in the stress response. Singh et al. indicate that this commonality may be even more pronounced for the HPA axis than for the sympathoadrenomedullary system because of the responsiveness of cortisol to degree of distress.

The importance of the HPA axis as it relates to exercise and stress reactivity has been questioned due to lack of effects of wheel running on ACTH responses to behavioral stress in rats (Dishman, 1997), but recent studies with humans provide support for a link between fitness, stress, and HPA response. Traustadóttir, Bosch, and Matt (2005) found that aging is associated with greater reactivity to a psychological stressor, but fitness appears to offset these effects, as evidenced by blunted cortisol responses. Similar to the animal studies, there was no effect on ACTH, suggesting that the hormonal marker of HPA activation may be important, possibly due to the different time course of ACTH and cortisol secretion. Additionally, although some studies have found increased HPA reactivity to a stressor following training, this may actually represent a more efficient response and enhanced sensitivity or adrenal capacity (Traustadóttir, Bosch, Cantu, & Matt, 2004). Future research in this area should consider the impact of exercise on HPA and autonomic nervous system responsiveness and *recovery* with stressor exposure, as well as the potential importance of individual characteristics such as hardiness and coping style (Goldstein, 1973). Additionally, the time course of stress attenuation following exercise warrants investigation, with particular attention paid to the interaction with exercise intensity or dose. Systematic manipulation and measurement of these variables may help shed light on the viability of some of the mechanisms proposed to underlie the exercise-stress reactivity relationship.

EXERCISE AND SELF-ESTEEM

The concept of self-esteem has considerable relevance to one's mental health because it has been shown to be a key indicator of emotional stability and adjustment to life demands and one of the strongest predictors of subjective well-being (Fox, 2000). It has also been related to other positive qualities (e.g., life satisfaction, positive social adjustment, resilience to stress) and choice and persistence in a range of achievement and health behaviors (Fox, 2000). Self-esteem differs from self-concept; the latter is a self-description, whereas the former is a self-rating of how the self is doing (Fox, 2000).

Operationalizing the concept of self-esteem for scientific measurement has been fraught with problems. Much of the research literature is based on general or global measures of self-esteem, though advances have been made in the development of measuring instruments that assess self-ratings in different domains (e.g., work, family, and physical activities). Ratings for the physical self hold particular interest for exercise-related research, and multidimensional models, and instruments to test these models, have been developed (see Landers & Arent, 2001). Although these developments are encouraging, they have not as yet assumed a dominant position in the majority of research studies devoted to this topic. We next review investigations and, where possible, make distinctions between findings derived from measures of global self-esteem and those for physical self-esteem.

Overall Effects

Early narrative reviews (Leith, 1994; Sonstroem, 1984) of physical activity and self-esteem generally concluded that approximately half of the experimental, quasi-experimental, and preexperimental studies showed statistically significant improvements in self-esteem following physical activity, with a majority of the studies reviewed having examined global self-esteem. This led to the relatively conservative contention that the results were quite inconsistent (Leith, 1994) or that exercise programs (not exercise per se) were associated with significant increases in participants' self-esteem scores (Sonstroem, 1984). Fortunately, a number of meta-analytic reviews and a recent narrative review of only randomized controlled studies present more objective views of the research literature in this area and provide information on both physical self-concept and global self-esteem.

There are currently five meta-analytic reviews on self-esteem or physical self-concept (Calfas & Taylor, 1994; Ekeland, Heian, Hagen, Abbot, & Nordheim, 2004; Gruber, 1986; McDonald & Hodgdon, 1991; Spence, McGannon, & Poon, 2005). The number of studies in these meta-analyses ranged from 10 (Calfas & Taylor, 1994) to 113 (Spence et al., 2005). In all five of the reviews, physical activity or exercise was determined to bring about small to moderate ($ES = 0.23$ to 0.57) increases in physical self-concept or self-esteem scores.

A narrative review by Fox (2000) examined 36 randomized controlled studies published since 1972. Compared to other health-related topics, there were only a small number of true experimental studies. Fox concluded that 78% of these studies yielded positive changes in some aspects of physical self-esteem or self-concept. This is a robust finding that is less susceptible to behavioral artifacts because the studies were experimental. One of the experimental studies (King, Taylor, & Haskell, 1993) with the largest number of subjects ($N = 357$), and therefore the greatest statistical power, showed that, compared to inactive controls, subjects in exercise conditions had higher ratings of self-perception of change in health, appearance, fitness, and weight. Consistent with previous narrative reviews, only about half of the studies examining global self-esteem demonstrated improvement.

Many of the self-esteem studies do not completely eliminate certain types of behavioral artifacts. Social desirability responding on questionnaires has been ruled out in some studies (Sonstroem & Potts, 1996). However, in other studies (Desharnes, Jobin, Côté, Lévesque, & Godin, 1993), an expectancy-modification procedure accounted for differences in self-esteem scores, thus suggesting that exercise may enhance self-esteem by providing a strong placebo effect. The potential for this overall effect to be influenced by subject expectancies, or other behavioral artifacts, needs to be investigated further.

Moderating Variables

Meta-analyses of self-esteem and physical activity have shown that the effects generalize across gender, various ages (though there are far more studies in children and young adults), and subgroups of the population (Fox, 2000). In comparing self-esteem scores in children, Gruber (1986) found that the effect of physical activity was larger for handicapped children. This is consistent with recent experimental evidence suggesting that exercise participation increases physical self-concept and self-esteem in individuals with brain injury (Driver & O'Connor, 2003). Fox concluded that exercise was particularly effective for children who were initially low in self-esteem. One group that this may hold particular relevance for is overweight and obese adolescents. A significant relationship between obesity and low self-esteem in children has been found to exist (Strauss, 2000). Given the current youth obesity trends, this may be an area that deserves further examination, particularly in light of the other behavioral and mental health risk factors that accompany low self-esteem among overweight adolescents (Strauss, 2000).

Gruber (1986) also reported that aerobic fitness programs produced much larger effects on children's self-esteem scores than other types of physical education class activities (e.g., learning sports skills or perceptual-motor skills). Spence et al. (2005) found that across young, middle-age, and older adults, participation in exercise or lifestyle enrichment programs was related to larger increases in global self-esteem than participation in skills-training activities. Fox (2000) found that for the limited research available with older participants, most of the evidence was in favor of the use of either aerobic exercise or weight training, with weight training showing the greatest short-term benefit. Interestingly, this conclusion is consistent with meta-analytic evidence for the relationship between exercise and improved mood in older adults (Arent et al., 2000). Weight training has the potential to produce positive effects in children as well, but little has been done with this mode of exercise in younger age groups. Studies that have included other activities, such as swimming, flexibility training, martial arts, and expressive dance, have not revealed significant changes in self-esteem scores. These studies are few in number, however. More research is needed before any firm conclusions can be drawn.

The results for the dose-response effects of exercise on self-esteem scores have been mixed (Fox, 2000) and extremely limited due to lack of information or little variability in the existing studies. Spence et al. (2005) found no significant differences in global self-esteem with exercise of different intensities, durations, frequencies, and lengths of the program. They did find that significant changes in physical fitness were related to greater increases in self-esteem.

Explanations for Self-Esteem Changes

Many explanations have been suggested for self-esteem changes due to exercise involvement, but there is very little evidence for any of them. There are some data indicating that self-esteem changes may occur because of a behavioral artifact, such as positive expectancies people associate with exercise (Desharnes et al., 1993). Fox (2000) interprets the inconsistent relationships for global self-esteem as due to an absence of a generic or generalized psychophysiological effect, suggesting that psychosocial mechanisms are more likely. The autonomy and personal control that one may gain from participation in exercise programs and the sense of belonging one may experience from participating in group exercise programs, have been proposed as explanations for increases in self-esteem scores. Recent research (e.g., Wilson & Rodgers, 2002) has provided some initial compelling support for the link between autonomy and physical self-esteem with exercise. It may also be that there is more variability associated with a global self-esteem measure than a measure that is more specific (i.e., physical self-esteem). Given the findings reported by Fox, it is likely that both global and physical self-esteem measures are affected by exercise, but the effects may be larger (and more consistent) for measures of physical self-esteem. If this hypothesis is correct, then a common psychophysiological mechanism(s) could be mediating these self-esteem findings. However, it is unlikely that this would be the only mechanism or even the primary one due to the subjective nature of self-esteem. It is important that future research efforts be directed toward an examination of the proposed explanations and mechanisms underlying the exercise-self-esteem relationship to guide both optimal implementation and theoretical understanding.

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CHAPTER 22

Physical Activity and Three Dimensions of Psychological Functioning in Advanced Age

Cognition, Affect, and Self-Perception

YAEL NETZ

People are increasingly living longer, and the senior population age 65 and older has consistently been rising over the past few decades. Whereas in 1950 there were only 131 million people over the age of 65 worldwide, in 2000 the number had risen to 420 million and is projected to increase to nearly 1 billion by 2030 (Kinsella & Velkoff, 2001). It is now generally accepted that chronic and systematic exercise throughout life, when accompanied by appropriate health habits, increases life expectancy (I. M. Lee, Hsieh, & Paffenbarger, 1995). In recent years, there has also been growing evidence that physical activity is a viable public health intervention for improving or maintaining quality of life in old age (Rejeski & Mihalko, 2001). Although quite a few factors, such as health, physical function, and independence, constitute quality of life in old age, psychological well-being is of particular significance to quality of life as it reflects the desire to maintain productivity, independence, and an active interaction with the environment (Spirduso, Francis, & MacRae, 2004). Two recently published meta-analyses on the effect of fitness on cognitive function (Colcombe & Kramer, 2003) and on the effect of physical activity on psychological well-being (Netz, Wu, Becker, & Tenenbaum, 2005) are representative of the attempt to quantify the almost intuitive psychological benefits of physical activity in old age.

Careful review of the literature presents myriad operational definitions of the term "psychological well-being," and particularly in the aging population it is agreed that it is a multifaceted phenomenon (McAuley & Rudolph, 1995; Netz et al., 2005).

Based on the American College of Sport Medicine (ACSM, 1998) position paper on physical activity in old age, the present review concentrates on three tangible dimensions of psychological well-being: cognition, affect, and self-perception. Cognitive function is dependent on the central nervous system, which undergoes an increasing decline over the adult life span, bringing about a decline in a wide variety of cognitive abilities (Dustman, Emmerson, & Shearer, 1994). Affect and self-perception may be altered across the life span, not necessarily as a function of the aging process per se, but as a function of health or other environmental factors. Affect refers to both positive and negative feelings, such as happiness, vigor, and enthusiasm as well as anxiety, depression, and stress. Self-perception refers to self-efficacy, self-concept, and self-esteem.

The current review includes only nonclinical populations. Clinical populations are highly heterogeneous, and the number of studies targeting clinical populations of one kind is limited. They range from depressed persons and geriatric mental patients to individuals with cardiopulmonary obstructive disorders. The relatively small number of studies examining specific clinical populations does not permit careful examination of each subgroup.

Studies employing acute designs whereby changes in affect are assessed as a function of a single bout of exercise were also excluded from this review. Such studies are scarce in old age, and their outcomes, transient in nature, are equivocal.

Finally, quite a large number of studies were reviewed for this chapter. The review is by no means exhaustive of all studies published on the topics covered here, but the vast majority have indeed been incorporated. Furthermore, some studies refer to different age groups and not necessarily to older adults. However, as those studies demonstrate the unique relationship existing between physical activity or fitness and psychological well-being in older age as opposed to younger age, they were also included. In that sense, this chapter discusses aspects of physical activity or fitness as related to the *aging process,* rather than to a certain age, such as 65+, arbitrarily determined as old age. Taking into account all other factors involved, it is believed that an examination of such a large number of studies may enable us to draw certain conclusions.

Following a short examination of relevant conceptual and methodological definitions, the three dimensions are presented in the following manner: a description of the dimension as a psychological function, a description of the function in relation to the aging process, and the conceptual framework for assessing physical activity and that dimension in advanced age. Following the discussion of each dimension, a review of the research in the area for noninterventional and interventional studies is presented, followed by a description of the mechanisms responsible for the relationship between this function and physical activity.

PHYSICAL ACTIVITY, EXERCISE, AND FITNESS

Research examining the relationship between physical activity and psychological aspects employs various methods for determining levels of activity and fitness. Physical activity, exercise, and fitness are not synonymous terms. Physical activity is a broader term for exercise. It is best defined as "bodily movement involving the skeletal muscles that results in energy expenditure" (Caspersen, Powell, & Christenson, 1985, p. 126) and is generally assessed as a function of kilocalories expended per unit time in work or leisure activity. Exercise, on the other hand, involves planned repetitive and structured activity with the goal of improving fitness and is typically expressed in terms of frequency, duration, and intensity of that physical activity.

Physical fitness is the product of physical activity and/or exercise. It refers to flexibility, strength, coordination, and balance, but for the most part, studies that have examined the relationship between physical fitness and psychological aspects have tended to focus on cardiovascular (aerobic) components of fitness. Aerobic fitness is usually defined as an individual's capacity to perform continuous, repetitive physical work involving the major muscle groups of the body. When directly assessed, the measure of aerobic fitness used is VO_2 max, reported in milliliters (ml) of oxygen consumption per kilogram (kg) of body mass per minute (ACSM, 2006). As assessing maximum oxygen consumption requires maximum effort, which may be dangerous in old age, some researchers employ submaximum measures (Era, Jokela, & Heikkinen, 1986; Shay & Roth, 1992).

Aerobic capacity may be estimated by self-reports, in which subjects are required to recall exercise frequency, intensity, and duration over a specified period of time. The activity information is then calculated into energy expenditure on the basis of standard tables (Ainsworth et al., 2000). Although the accuracy of self-reports is always questionable, their use is both convenient and economical.

Correlation versus Causation

A key methodological issue integral to the study regarding the relationship between physical activity and psychological well-being is correlation versus causation, assessed by cross-sectional or longitudinal noninterventional studies versus interventional studies, respectively. *Cross-sectional and longitudinal noninterventional studies* typically compare individuals who have elected to participate in physical activity on a regular basis for several years with age-matched controls who seldom engage in physical activity. The obvious shortcoming of such designs is the inability to establish causal links between differential levels of physical activity or fitness and psychological responses, given that a multitude of other factors can also covary with the decision to lead a physically active life. The vast majority of investigators conducting cross-sectional studies, and specifically those conducting longitudinal studies, attribute the superior psychological performance achieved by habitual physical activity to fitness. Nevertheless, positive effects of fitness on psychological well-being may reflect a predisposition of physically active individuals toward a healthier psychological well-being rather than a benefit of fitness achieved through physical activity.

Intervention studies, on the other hand, investigate the effects of exercise on psychological well-being. In general, volunteers who have seldom exercised are randomly assigned to exercise and control groups. Fitness levels and psychological measures are then assessed before and after some type of predetermined exercise intervention. The importance of this type of research is that if a causal relationship is established, people who have already reached old age can be encouraged to start an exercise program to improve their psychological well-being, in addition to improvement in physiological functioning. Another difference between the two designs is that, whereas in cross-sectional or longitudinal nonintervention studies the exercise mode is either aerobic or nonspecified (self-report), the exercise mode in intervention studies is more specific and generally includes either aerobic exercise or strength training, or a combination of both. As the conclusions drawn from the two designs are different, they are examined separately for each dimension.

COGNITION

Cognitive functioning is related to the function of the brain and the central nervous system. It is divided into domains according to the regions of the brain supporting them. The main domains are memory, perception, language and verbal ability, attention, abstract reasoning, visual information processing, psychomotor function, and executive functions. Executive functions refer to mental processes such as planning, organization, working memory, monitoring, and cognitive flexibility (Lezak, 1995). The functions of the domains are assessed by the performance of specific tasks. The speed of task performance is assessed in reaction time.

It has been well-documented that increased age is associated with lower performance on various measures of cognitive functions (Salthouse, 1998; Schaie, 2000). Beginning in the 40s and continuing throughout the rest of life, there is a gradual deterioration in the functioning of the brain. It is clear, however, that the variability of age-related functional losses increases with age (Morse, 1993). Some individuals maintain a relatively high level of mental functioning in old age, whereas others experience a dramatic mental decline.

This variability of mental functioning is often explained on the basis of factors extrinsic to the aging process (Kramer & Willis, 2002). One of those factors is physical fitness.

Conceptual Frameworks for Assessing Cognition

Several approaches have been suggested for examining the fitness-cognition relationship. The traditional approach focuses on intelligence. An influential theory developed by Cattell (1963) postulated two general intelligences, which are affected in different ways by different sets of influences. Fluid intelligence is considered to reflect the functioning of neurological structures. It increases until the cessation of neural maturation and declines thereafter (Schaie, 1993) unless some form of intervention takes place. Fluid intelligence is independent of previous experience, knowledge, or education. Crystallized intelligence, including knowledge-based abilities such as verbal knowledge and comprehension, is considered in terms of cultural assimilation and is highly influenced by formal and informal educational factors throughout the life span.

Spirduso and Asplund (1995) describe cognition in terms of three functions: (1) cognitive supports, which are basic to all types of complex cognition, including perceptual processes, information-processing speed, working memory, attention, and psychomotor control; (2) cognitive mechanics, which may be described as fluid intelligence; and (3) cognitive pragmatics, comparable to crystallized intelligence. Later on, Spirduso et al. (2004) described cognitive mechanics as “cognitive functions” and cognitive pragmatics as “global cognition.” Cognitive pragmatics deteriorate very little throughout the life span, but cognitive mechanics and cognitive supports deteriorate substantially.

Tomporowski (1997) differentiates between researchers who focus on measures of elementary units of cognition, usually by using laboratory-based tests, to identify and evaluate the function of basic mental structures and processes such as attention and memory, and those who focus on psychometric tests of intellectual functioning (such as the Wechsler Adult Intelligence Scales).

A number of researchers have proposed paying closer attention to the demand level of the tasks selected for the evaluation of cognitive performance (Chodzko-Zajko & Moore, 1994). They base their proposition on earlier research by Schneider and Shiffrin (1977), who suggested that cognitive functions can be placed on a continuum from automatic to effortful and that aging degrades effortful cognitive function more than automatic functions. Automatic tasks are simple and overlearned, whereas effortful tasks are complex, requiring greater attention demands and cognitive flexibility.

More recently, Colcombe and Kramer (2003) proposed four different categories of cognitive tasks based on four different conceptual frameworks:

1. *Processing speed:* A low-level neurological functioning and cognitive support system, such as finger tapping as rapidly as possible or recognition memory.
2. *Visuospatial processing:* A transformation or recall of visual and spatial information requiring effortful processing, for instance, replicating a picture from memory.
3. *Controlled processing:* Tasks that begin by requiring controlled, effortful processing but through practice can be processed automatically, such as the two-choice reaction time task.
4. *Executive control:* Effortful tasks requiring planning, scheduling, coordination, inhibition, and working memory functions of the brain.

These cognitive categories are similar to the automatic-to-effortful continuum in that they differ in the demand level they require. It is assumed that cognitive tasks from all categories are sensitive to aging, but this sensitivity is more pronounced as the demand increases. Executive control—the highest level of demand—seems particularly sensitive to aging, and neuroimaging indicates that age-related decline appears to be faster in the prefrontal and frontal lobes of the brain (Colcombe et al., 2003), which mediate executive control functions.

Another approach suggested in examining the fitness-cognition relationship is to conduct clinical tests such as the Mini Mental State Exam in longitudinal studies to assess the ability of long-term physical activity and physical fitness to postpone or eliminate cognitive decline. In these studies the rate of cognitive decline in active old individuals is compared to that of inactive individuals (Barnes, Yaffe, Satariano, & Tager, 2003; Lytle, Vander Bilt, Pandav, Dodge, & Ganguli, 2004).

PHYSICAL ACTIVITY AND COGNITION IN ADVANCED AGE: CROSS-SECTIONAL AND LONGITUDINAL NON-INTERVENTION STUDIES

Although cross-sectional studies vary in terms of the cognitive tasks or fitness measured, their findings generally indicate the existence of a link between physical fitness or physical activity and cognitive functioning. Most studies refer to aerobic fitness, measured directly (Barnes et al., 2003; Era et al., 1986; Etnier & Landers, 1997; Shay & Roth, 1992; Van Boxtel et al., 1997) or indirectly by activity tests (Ble et al., 2005) or by self-report measurements translated into energy expenditure (Lytle et al., 2004; Stones & Kozma, 1989; Van Gelder et al., 2004; Weuve et al., 2004). For most cognitive measures, individuals who maintained high levels of fitness performed better than people who exercised infrequently. Furthermore, in studies assessing various age groups, the fitness effect found for elderly subjects was not always found for young subjects (Christensen & Mackinnon, 1993; Emery, Huppert, & Schein, 1995; Etnier & Landers, 1997; Rikli & Busch, 1986; Shay & Roth, 1992; Spirduso, 1975; Stones & Kozma, 1989; Van Boxtel et al., 1997). In contrast, one retrospective study (Dik, Dee, Visser, & Jonker, 2003) suggests that information-processing speed is better among men who were active at young age. This means that although differences between highly fit and unfit individuals at young age are not noticeable, they may emerge as people age.

An additional finding is that a high fitness level is associated with fluid intelligence but not crystallized intelligence (Christensen & Mackinnon, 1993; Clarkson-Smith & Hartley, 1990; Etnier & Landers, 1997; Stones & Kozma, 1989; Van Boxtel et al., 1997). A study assessing memory and abstract thinking found them to be related to education rather than to physical activity (DiPietro, Seeman, Merrill, & Berkman, 1996).

Yet, several studies have found that fitness status is related to effortful rather than automatic processing (Abourezk & Toole, 1995; Chodzko-Zajko, Schuler, Solomon, Heinl, & Ellis, 1992; Van Boxtel et al., 1997). The sensitivity of both age and exercise to controlled processes and, moreover, to executive function, as recently suggested by Colcombe and Kramer (2003), has been indicated by Abourezk and Toole, who found a link between fitness and complex reaction time (controlled processes category) but not simple reaction time (processing speed category), and by Van Boxtel et al., who found a fitness by age interaction on Stroop color *and* word (executive function) and not on Stroop color *or* word (processing speed).

Longitudinal observational studies constitute fairly recent and unique research. Such studies have attempted to assess whether physical fitness may preserve cognitive function and diminish the risk of dementia and cognitive decline. In general, they establish a baseline physical activity or fitness level as well as cognitive functioning, and after a several-years-long follow-up, the same measures are assessed again. Of special interest is the most recent nurses' health study, which examined 18,766 women using data of self-report physical activity (translated into energy expenditure) in 1986 and assessed their cognitive functioning 10 years later (Weuve et al., 2004). Those studies, whether using clinical testing for cognitive impairment (Barnes et al., 2003; Laurin, Verreault, Lindsay, McPherson, & Rockwood, 2001; Lytle et al., 2004; Schuit, Feskens, Launer, & Kromhout, 2001; Van Gelder et al., 2004) or cognitive tasks assessing different cognitive functions, such as attention, memory, executive function, or general cognition (Barnes et al., 2003; Weuve et al., 2004), have clearly indicated a negative association between physical activity and risk of cognitive decline.

Based on the non-intervention studies, it may be concluded that there is a link between physical fitness or physical activity, aerobic in most cases, and cognitive functioning in old age, specifically in complex tasks. Furthermore, physically active individuals are more likely to preserve their cognitive function over the years than are nonactive individuals.

Physical Activity and Cognition in Advanced Age: Intervention Studies

In a meta-analysis conducted on intervention studies assessing the effect size of the four proposed cognitive categories concerning the nature of the process-based specificity of fitness training (Colcombe & Kramer, 2003), it was found that fitness training increased cognitive performance regardless of the type of cognitive task, the training method, or participants' characteristics. Executive control processes showed the largest benefit from improved fitness, but controlled processes, which at least partially overlap with executive processes and visuospatial processes, also showed reliable benefits from fitness training.

On the other hand, although many studies have reported improvements along the years (Dustman et al., 1984; Fabre, Chamari, Mucci, Masse-Biron, & Prefaut, 2002; Hassmen & Koivula, 1997; Hawkins, Kramer, & Capaldi, 1992; Kara, Pinar, Ugur, & Oguz, 2005; Kramer et al., 1999; Moul, Goldman, & Warren, 1995; Rikli & Edwards, 1991), quite a number of studies (Blumenthal et al., 1989, 1991; Emery & Gatz, 1990; Hill, Storandt, & Malley, 1993; Panton, Graves, Pollock, Hagberg, & Chen, 1990) did not find that exercise training had a beneficial effect on cognitive functioning.

In addition, although most studies applied aerobic exercise as an intervention program, two unique studies suggested that strength is the modifier of cognitive functioning. Their results, however, were inconsistent: One found improvement in some memory tasks (Perrig-Chiello, Perrig, Ehrsam, Staehelin, & Krings, 1998), whereas the other did not find any improvement (Tsutsumi, Don, Zaichkowsky, & Delizonn, 1997). Another study applying general physical activity, including strength, aerobic, balance, and stretching (Williams & Lord, 1997), did report improvement in memory.

Why some studies find improvement in performance with enhanced fitness and other studies failed to observe such a relationship is complex. Clearly, there are possible methodological reasons for the mixed pattern of results. For example, the length and intensity of fitness interventions have varied quite widely across studies. Also, the use and nature of control groups have varied, from failure to include any control groups (Kara et al., 2005) to failure to include nonexercise (Fabre et al., 2002) as well as exercise control groups (Kramer et al., 1999). Finally, the types of perceptual and cognitive tasks that have been employed to assess mental function have also been quite varied.

Interestingly, regarding the length of programs, Colcombe and Kramer (2003), in their meta-analysis, concluded that participation in relatively brief training programs provided at least as much benefit as moderate training, but not quite as much as long-term training programs; short bouts of exercise (less than 30 min.) had very little impact on cognitive function.

Although the intervention studies, like the non-intervention studies, have inconsistent findings, they clearly indicate a trend of cognitive improvement as a result of physical activity. However, this trend has been shown mainly in aerobic exercise, where improvement in aerobic fitness is a necessary condition for cognitive improvement. In addition, executive control processes showed the largest benefit from improved fitness.

Mechanisms by Which Physical Activity and Physical Fitness Influence Cognition

It may be that the mechanisms mediating between physical activity and cognition result in some studies finding improvement in cognitive performance with enhanced fitness or physical activity and others failing to do so. Three main theories regarding these mechanisms have been proposed, all of which are based on exercise-induced physiological changes:

1. *Improvement in cerebral blood flow and energy metabolism:* It has been proposed that chronic exercise can postpone cognitive aging by its influence on total cerebral blood flow and regional blood flow (R. L. Rogers, Meyer, & Mortel, 1990). Exercise maintains cerebrovascular integrity also by increasing oxygen transport, which in turn reduces brain hypoxia (lack of oxygen) in active brain regions (McFarland, 1963). It has been shown that exercise-induced increases in cytochrome oxidase, an enzyme necessary for a high-energy production compound, were found in the frontal cortex (McCloskey, Adamo, & Anderso, 2001). As the frontal cortex is associated with executive control functions, this mechanism may explain the findings of Colcombe and Kramer (2003) regarding the largest benefit of fitness to executive control functions.

2. *Alterations in neurotransmitter activity:* Aging is associated with disruptions in neurotransmitter synthesis and degradation (J. Rogers & Blume, 1985). It was found that prolonged activity may be associated with an amelioration of the severity of neural degeneration with advancing age. Several investigators have found that after exercise training, catecholamine neurotransmitters (dopamine, epinephrine, and norepinephrine) in rats were changed in a direction counter to the age-associated changes normally seen (B. S. Brown et al., 1979). It is presently unclear at which age physical activity effects on neurological structure and function are the greatest. Some researchers (Black, Isaacs, & Greenough, 1991) have argued that enriched movement experiences may be most beneficial for young animals to the extent that it enables them to optimize neural development, resulting in a more substantial neural reserve that can be drawn upon in old age. This may explain the consistent relationship between physical activity and cognitive functioning evidenced in studies of lifelong exercise, as reported in the cross-sectional and non-intervention longitudinal studies.

3. *Morphological changes as a result of exercise:* Animal research provides considerable evidence suggesting that morphological brain changes, such as changes in neuronal cell structure, number, and density, are affected by experience, including motor activity. Floeter and Greenough (1979) indicated that primates living in movement-enriched environments such as large cages or other primates with which to interact had enhanced morphological changes above and beyond those of primates that were caged alone or those that had no opportunity to be physically active. Recently, thanks to technologies such as high-resolution magnetic resonance imaging scans, studies on humans have been conducted (Churchill et al., 2002; Colcombe et al., 2003). These studies have shown a link between cardiovascular fitness and brain tissue volume.

Although these mechanisms provide support for the relationship between exercise and cognition, they refer mainly to changes induced as a result of aerobic exercise. Other, indirect mechanisms contributing to this link, which do not focus on a specific mode of exercise, include good health habits and prevention and postponement of disease (Spirduso et al., 2004). For example, exercising enables older adults to eat more calories, which enhances the probability that they will consume at least the minimum dietary components necessary for good health. This effect may result in better cognitive function.

AFFECT

Psychology researchers distinguish between the terms emotion, mood, and affect. Mood represents a transient state, whereas affect represents something more enduring (Lazarus, 1991). Mood is distinct from emotions, which are also brief but tend to be both stronger and more situation-specific (Batson, Shaw, & Oleson, 1992; Morris, 1989). Affect is a more general term that refers to the quality of the subjective experience that characterizes all responses, including emotions and moods, and it requires the least amount of cognitive involvement (Batson et al., 1992).

From a construct perspective, mood can be defined as having specific subcomponents, such as tension, depression, anger, fatigue, vigor, and confusion (McNair, Lorr, & Droppleman, 1992), whereas affect is a more inclusive dimension that refers to the way a person, situation, or event makes one feel. The most prevalent bipolar dimensionality of affect is positive versus negative (Watson & Tellegen, 1985). It should be emphasized that positive and negative affect are viewed as distinct and independent dimensions, not just opposite ends of a continuum (Kunzmann, Little, & Smith, 2000). That is, a person who does not get a high score on a happiness or enthusiasm scale may not necessarily get a high score on an anxiety or anger scale.

Affective functioning depends to a large extent on social adjustment. As people age, they must continuously adjust to decreasing physical ability and health, the loss of loved ones, retirement, reduced income, new social roles, and relocation of physical living arrangements (Kimmel, 1990). However, as in cognitive functioning, the variability in affective functioning in later years is quite high, and it increases with age. In later life, the physical, mental, and social changes that accompany aging bring with them challenges to affective well-being that are above and beyond those routinely experienced by most younger individuals (Spirduso et al., 2004). Not surprisingly, quite a few studies point out the high prevalence of depression in the elderly (Blazer, 1994). Nevertheless, other studies indicate that the majority of older adults live happy, fulfilling lives despite the challenges they must face, a phenomenon referred to as the "paradox of well-being" (Mroczek & Kolarz, 1998). One of the explanations for this paradox stems from personal control theory, which postulates that the driving force in personality is the desire to gain control over the interchange with the environment. As people age they lose control in physical, cognitive, and social domains. However, to optimize the ratio of gains to losses and therefore maintain subjective well-being, people attempt to adjust their goals (Schulz & Heckhousen, 1999). Interestingly, a recent study using a cross-sectional and longitudinal research design assessing the effect of age on positive and negative affect concluded that whereas positive affect declines steadily throughout aging, irrespective of health or other variables, negative affect remains the same or even decreases with age (Kunzmann et al., 2000). These results may indicate that as people age, their ability to control disappointments, anger, and anxiety improves. Yet, other variables, predominantly poor health, may contribute to increased negative affect (Kunzmann et al., 2000).

Despite the various distinctions between mood, affect, and emotion, most researchers use them interchangeably when studying their relationship to physical activity (Arent, Landers, & Etnier, 2000; McAuley & Rudolph, 1995). The argument for this approach contends that a wider focus is more likely to capture the nature of exercise-induced affect (Gauvin & Brawley, 1993). Exercise could conceivably induce changes at all levels of the continuum of emotions, moods, and affect (Ekkekakis & Petruzzello, 1999).

PHYSICAL ACTIVITY AND AFFECT IN ADVANCED AGE: CROSS-SECTIONAL AND LONGITUDINAL NONINTERVENTION STUDIES

Generally, most cross-sectional and longitudinal nonintervention studies reveal a link between physical activity and affect (Camacho, Roberts, Lazarus, Kaplan, & Cohen, 1991; Farmer et al., 1988; Fukukawa et al., 2004; Kritz-Silverstein, Barrett-Connor, & Corbeau, 2001; Lampinen, Heikkinen, & Ruoppila, 2000; C. Lee & Russel, 2003; Ross & Hayes, 1988; Ruuskanen & Ruoppila, 1995; Stephens, 1988; Stewart et al., 2003; Strawbridge, Deleger, Roberts, & Kaplan, 2002). Arent and his colleagues, in their meta-analysis on physical activity and mood, reported an effect size (ES) of 0.46 for correlational studies. Although the majority of the studies they analyzed examined negative affect, a large ES was seen on both positive (ES = 0.42) and negative (ES = 0.47) affect across all forms of physical activity (Arent et al., 2000). Studies that followed (Fukukawa et al., 2004; Kritz-Silverstein et al., 2001; Lampinen, Heikkinen, & Ruoppila, 2000; C. Lee & Russel, 2003; Stewart et al., 2003; Strawbridge et al., 2002) support these findings. Similar to earlier studies (Farmer et al., 1988; Morgan et al., 1991; Ruuskanen & Ruoppila, 1995), the majority of later studies focused on negative affect, predominantly depression.

Similar to studies on cognition, in recent years more relation-type studies in physical activity and affect appear to be longitudinal, collecting information at several points of time over the years rather than studying the association at one point of time (Fukukawa et al., 2004; Kritz-Silverstein et al., 2001; Lampinen et al., 2000; C. Lee & Russel, 2003; Strawbridge et al., 2002). Specifically, these studies are interested in the ability of baseline activity patterns or changes in activity patterns over the years to predict risk of depression. Generally, all of them have revealed a link between inactivity, or reduction in activity, and higher risk of depression.

Interestingly, those who were inactive at baseline and became active later on were less likely to develop depression (Camacho et al., 1991), just as those who were active at baseline and reduced their activity were more likely to develop depression (Lampinen et al., 2000) or other negative emotions (C. Lee & Russel, 2003). A relationship between inactivity and higher prevalence of depression emerges from these studies, rather than a linear relationship whereby depression is reduced when activity increases. Although most studies indicate that exercise has a protective effect against depression in general, one study (Kritz-Silverstein et al., 2001) indicates that the protection is only among those who are clinically depressed at baseline. This means that physical activity is more useful in alleviating depression among those who are depressed but not among the general population. This finding gains support from several intervention studies (Bennett, Carmack, & Gardner, 1982; Means, O'Sullivan, & Rodell, 2003; Williams & Lord, 1997). However, a previous meta-analysis (North, McCullagh, & Tran, 1990) performed on different age groups indicated that the effect size of physical activity on depression was not related to the initial depression level, and that all subjects, both the initially depressed and the nondepressed, decreased depression with exercise. It can therefore be concluded that people who are active over the years are less likely to develop depression.

One limitation of most nonintervention studies assessing the relationship between physical activity and affect is that they use predominantly self-report subjective measures for assessing both physical activity and affect. Their weakness is in the ability of participants to easily understand the purpose of the study and fake answers. It is therefore appreciated that two recent studies informed the relationship between physical activity or fitness and affect based on objective measures: a pedometer for assessing physical activity (Fukukawa et al., 2004) and maximal oxygen uptake and a strength test to assess physical fitness (Stewart et al., 2003).

The studies assessing various age groups are of specific importance (Camacho et al., 1991; Farmer et al., 1988; Fukukawa et al., 2004; Stephens, 1988). Generally, all of them succeed in revealing a link between inactivity, or reduction in activity, and higher risk of depression, especially in older age. This trend is consistent with the findings of cognitive studies.

Physical Activity and Affect in Advanced Age: Intervention Studies

Quite a number of studies have posed the question whether physical activity alters affect. Not unexpectedly, however, those studies differ on all possible variables. A large number of these studies applied aerobic activity and fitness—usually VO_2 max—which were assessed in addition to psychological measurements (Blumenthal et al., 1989, 1991; D. R. Brown et al., 1995; Emery & Gatz, 1990; Gitlin et al., 1992; King, Taylor, & Haskell, 1993; McMurdo & Burnett, 1992; Netz, Tenenbaum, & Sagiv, 1988; Nieman, Warren, Dotson, Butterworth, & Henson, 1993; Shin, 1999; Sidney & Shephard, 1976; Swoap, Norvell, Graves, & Pollock, 1994). These studies assume that the cardiovascular change is the mediating mechanism between activity and the affective component. Only a few, however, were able to report improvement (D. R. Brown et al., 1995; King et al., 1993; Shin, 1999; Sidney & Shephard, 1976). Based on these results, the ability of aerobic exercise to induce affective change is questionable.

Some studies used general, undefined physical activity as an intervention, mostly without assessing changes in fitness. Such studies proved more successful and reported psychological improvement mostly in depression (Annesi, 2004; Bennett et al., 1982; Means et al., 2003; Williams & Lord, 1997). The hypothesis of these studies is that the mediating mechanism between physical activity and psychological well-being stems from sheer participation in the activity, and cardiovascular change is not a necessary component.

More interesting, and relatively more recent, are the intervention studies assessing the effect of strength training on affect. Out of five, four reported improvement in mood (Jette et al., 1996; McLafferty, Wetzstein, & Hunter, 2004; Tsutsumi et al., 1998) or in positive/negative affect (Mihalko & McAuley, 1996); only one (Damush & Damush, 1999) failed to find emotional change. The interpretation of the positive change in affect may rely on a feeling of mastery over the environment and an enhanced feeling of power attributed to the self-efficacy theory (Bandura, 1991).

Both general physical activity studies as well as strength studies question the superiority of aerobic studies in altering psychological functioning, as was indicated in cognition studies. These results gain quantitative support from Arent and colleagues' (2000) meta-analysis, which reported a greater ES on mood in strength training studies than in aerobic studies and questioned the importance of fitness improvement for mood alterations. Furthermore, this meta-analysis indicated that moderate exercise was more beneficial in altering mood than high-intensity exercise. The implications are that any physical activity performed at moderate intensity may produce mood change.

However, the study on physical activity and affect is challenged by several limitations. The main limitation is the lack of studies assessing positive affect and the constant focus on negative affect. This shortcoming is reinforced by the previously mentioned research by Kunzmann and colleagues (2000). This study showed that it is positive affect that declines steadily throughout aging, whereas negative affects remain the same or even decrease with increased aging. It is therefore the positive affect that is more sensitive to the aging process and should thus be investigated more ambitiously. Another limitation is the inability to determine dose-response effect in terms of the length or frequency of the program (Arent et al., 2000). More studies are needed to shed more light on this issue.

MECHANISMS EXPLAINING THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND AFFECT

Two of the proposed physiological mechanisms explaining the exercise-mood relationship are similar to those previously described to link physical activity with cognition. One is the improved cerebral blood flow, hypothesizing that increased blood flow increases the amount of oxygen, which initiates mood changes (Oleson, 1971). The other refers to alterations in neurotransmitters such as dopamine, serotonin, and norepinephrine. For example, there is evidence that exercise enhances the function of these neurotransmitters (DeCastro & Duncan, 1985), and it is known from drug research that antidepressants function by increasing the amount of these neurotransmitters in the central nervous system (Laraia, 1987).

An additional mechanism is the thermogenic hypothesis, proposing that exposure to moderate heating elicits muscular and mental relaxation. It is hypothesized that the increase in body temperature caused by exercise has a tranquilizing effect (deVries, 1987). There are also proposed mechanisms that are not based on any biological change as a mediator between exercise and affect, but rather on psychological processes. One is the distraction hypothesis, suggesting that exercise provides a diversion from the stresses of life (Bahrke & Morgan, 1978), thus reducing anxiety and distress. This mediating mechanism, however, is no different from other activities, which are not necessarily physical, and may equally distract people's mind from stressful stimuli. Another theory is the self-efficacy theory (Bandura, 1977), implying that improvement in physical function as a result of exercise leads to increased feelings of self-efficacy. Recent research has shown that self-efficacy and the view of self moderate people's affective reactions (Marquez, Jerome, McAuley, Snook, & Canaklisova, 2002).

SELF-PERCEPTION

Perception of self typically encompasses the constructs of self-concept, self-esteem, and self-efficacy. Self-concept incorporates all aspects of what one thinks one is, and as such is a central concept in one's conscious life (Campbell, 1990). Generally, the theory of self-concept is studied as a collection of certain facets of the self, such as academic self-concept, social self-concept, and physical self-concept (Shavelson, Hubner, & Stanton, 1976). Self-esteem refers to the evaluation one holds for this personal picture (Rhodewalt & Agustsdottir, 1986). However, because it is difficult to describe oneself without experiencing evaluation, the two terms are often used interchangeably, and empirical attempts to distinguish the two have generally failed (Byrne, 1996). Most of the models describing self-esteem are hierarchical, with more general constructs at the top of the hierarchy and greater specificity down at the lowest, most situation-specific level. It is hypothesized that changes in lower-level constructs influence change in more general constructs (Fleming & Courtney, 1984).

Self-concept and self-esteem are regarded as global concepts, referring to the overall evaluation of the self. Self-efficacy is more specific; thus, it is a lower-level construct. It describes the belief one has in being able to execute a specific task to obtain a certain outcome (Bandura, 1997).

In general, the majority of older adults maintain a positive sense of self in spite of the negative ageist stereotypes and normative age-related declines (Sneed & Whitbourne, 2005). A study assessing attitudes of different age groups toward the concept of "old person" indicated that older adults rated themselves significantly more favorably than did the other age groups (Netz & Ben-Sira, 1993). Human beings, even those very late in their life, seem to retain a coherent sense of self across time (Troll & McKean Skaff, 1997).

However, variations in sense of self in old age may occur with regard to physical movement. As it relates to physical movement and exercise, self-concept is based on self-awareness of physical competence, body consciousness, and self-efficacy with regard to physical function or skill. The hierarchical self-concept is transformed into a hierarchical physical self-concept (Fox, 2000; Sonstroem, 1998). This hierarchical physical self-concept proposes that one of global self-esteem's domains is that of physical self-worth, which in turn may be divided into subdomains of sport competence, physical conditioning, attractive body, and strength. These subdomains may be further broken down into facets and subfacets, and further down to behavior-specific self-efficacy. Although this model was designed for athletes and young adults, it might be modified for older adults (Spirduso et al., 2004). The subdomain of sport competence may be replaced by performance of daily activities, which may be further broken down into specific daily activities such as stair climbing or working in the garden. In this hierarchical model, it is proposed that changes at each level generalize to the level above, so that a change in strength through an exercise program would change feelings of self-efficacy regarding one's physical condition, and this in turn would alter feelings of self-worth, which would finally effect self-esteem (Spirduso et al., 2004).

In the study of physical activity and cognition or affect, the causal link is generally unidirectional, so that physical activity enhances cognition or affect. In self-perception, a reciprocal causation is assumed, particularly in relation to self-efficacy. Self-efficacy is evaluated in Bandura's (1986) social cognitive theory. According to Bandura (1977), self-efficacy greatly influences the decision to produce a behavior, as well as the effort spent and persistence to maintain it during times of adversity and setbacks. Therefore, as better physical competence improves self-efficacy, which in turn enhances self-esteem, high physical self-efficacy stimulates older adults to participate in exercise programs. When contemplating participation in an exercise program, older adults will consider the task attributes, performance conditions, their estimated ability, and the effort required. If they believe that they cannot perform well enough, they will not make the attempt (Spirduso et al., 2004).

PHYSICAL ACTIVITY AND SELF-PERCEPTION IN ADVANCED AGE: CROSS-SECTIONAL STUDIES

All cross-sectional studies focus on the relationship between physical activity and physical self-perceptions. Two studies reported a link between physical activity and perceived self-efficacy. One study included only older adults (Parkatti, Deeg, Bosscher, & Launer, 1998); the other (Miller, Ogletree, & Welshimer, 2002) included a wide range of ages (20 to 73 years old). Interestingly, this latter study indicated that it was the intensity—vigorous activity—that was associated with self-efficacy regardless of age. Nonetheless, appearance and body satisfaction were related to physical activity in older adults more than in younger adults (Loland, 2000). In contrast, an additional study looking into body-shape dissatisfaction and physical activity in older adults (Schuler et al., 2004) failed to find any association between them. Based on these studies, it may be concluded that self-efficacy is related to physical activity not necessarily in relation to age, whereas appearance and body satisfaction are related to physical activity specifically in old age. Perhaps appearance and body satisfaction reflect natural qualities at a young age, whereas in old age they pertain more to the maintenance or upkeep of the body. Self-efficacy, on the other hand, represents a perception of physical capability, which is experienced and examined in physical activity at any age.

Physical Activity and Self-Perception in Advanced Age: Intervention Studies

In the past, intervention studies focused more on general constructs located at the top of the hierarchy of self-perception, such as self-concept and self-esteem (D. R. Brown et al., 1995; Netz et al., 1988; Perri & Templer, 1985; Swoap et al., 1994; Valliant & Asu, 1985). Their findings were inconclusive, however, in terms of showing a consistent trend. Three of them (D. R. Brown et al., 1995; Netz et al., 1988; Swoap et al., 1994) failed to show any change in self-concept or self-esteem as a result of physical activity. However, recent studies focusing more on physical self-perception, mainly self-efficacy rather than general self-concept, were more consistent in indicating alterations in physical self-perception as a result of exercise. Among them are studies conducted by McAuley and his colleagues (McAuley, Blissmer, Katula, Duncan, & Mihalko, 2000; McAuley et al., 1999; McAuley, Marquez, Jerome, Blissmer, & Katula, 2002) and the King and colleagues (2000) study on self-efficacy. Of special interest are the studies by Li and colleagues (Li, Fosher, Harmer, & McAuley, 2005; Li, McAuley, Harmer, Duncan, & Chaumeton, 2001) showing improvement in self-efficacy as a result of participation in a program of tai chi. Two more studies (Means et al., 2003; Taylor & Fox, 2005) showed improvement on self-esteem and self-worth, respectively. Only one study (Jessup, Horne, Vishen, & Wheeler, 2003) did not show any improvement on self-efficacy as a result of exercise. Generally, intervention studies, specifically those published since 1999, have indicated that physical activity, of almost any kind, improves self-perception in general and physical self-perception in particular.

This qualitative observation was recently supported quantitatively by a meta-analysis (Netz et al., 2005). It was demonstrated that in older adults, more than any other aspect of well-being, including mood and life satisfaction, physical self-efficacy and view of self were by and large affected by exercise. This effect was indicated in aerobic as well as strength training. Furthermore, this meta-analysis showed that improvements in strength, and specifically improvement in functional capacity, contributed to the increased self-efficacy and view of self. This finding is significant in light of the finding that rather than intensive exercise, moderate exercise is needed to alter well-being. It is possible that physical fitness, not necessarily cardiovascular but also strength and functional capacity, may be improved by moderate exercise, which in turn moderates well-being, specifically self-efficacy. Nevertheless, consistent with the meta-analysis on mood (Arent et al., 2000), this meta-analysis was unable to determine a dose-response effect in terms of the length or frequency of the program; hence further studies need to be conducted for this purpose.

Mechanisms Mediating between Physical Activity and Self-Perception

Two psychological hypotheses have been proposed as mediators between physical activity and self-perception: the mastery hypothesis and the social reinforcement theory. The mastery hypothesis, derived from social-cognitive theory (Bandura, 1986), suggests that physical activity improves physical function, which leads to increased feelings of mastery. For older adults, whose self-efficacy may be deteriorating along with their functional abilities, physical activity may provide a mastery experience that leads to increased self-efficacy (McAuley & Rudolph, 1995). The social reinforcement theory proposes that family and friends may enhance the self-perception of individuals who engage in exercise by praising and congratulating them for their participation (Ross & Hayes, 1988).

CONCLUSION

The present review examined the relationship between physical activity and three dimensions of psychological functioning in advanced age: cognition, affect, and self-perception. Although all three dimensions constitute psychological well-being, each is distinct in nature, specifically in the context of aging. Whereas cognitive abilities clearly decline over the life span, affect and self-perception may be altered, though not necessarily as a function of biological aging, but as a function of personal adjustment to environmental or health factors. To a large extent, the changes in self-perception and affect are a function of personality and adjustment competence; thus, they do not necessarily represent a uniform unidirectional decline and should not be discussed in terms of functional losses. However, as health and environmental burdens increase in advanced age, affect and self-perception are particularly challenged.

Whether behavioral changes or biological losses are involved, the variability in functioning in all three dimensions increases as age increases. Some individuals maintain a relatively high level of functioning; others experience dramatic changes. The potential of physical activity to ameliorate the negative changes and to stimulate positive changes has been a topic of interest among researchers in the past decades.

In reviewing the link between each dimension and physical activity, two questions were posed:

1. Do physically active older individuals function psychologically better than nonactive individuals?
2. Can a physical activity intervention enhance psychological functioning in advanced age?

The first question does not assume a cause-effect relationship; thus, the answer is examined through association-type studies. Based on a large body of such studies, which greatly differ in design variables such as mode, intensity of physical activity, and psychological measure, the answer to the first question is positive. For most cognitive, affective, or self-perception measures, individuals who maintain an exercise routine perform better than people who do not exercise. Moreover, this difference is further substantiated as age increases.

Previous reviews looked into cross-sectional noninterventional studies in general; the present review is unique in separating the longitudinal nonintervention studies from cross-sectional ones. This subgroup provides data on the association between physical activity and psychological functioning over the span of several years. Its unique contribution to the field is the power to predict future psychological functioning on the basis of past and present physical activity patterns. Whereas cross-sectional reports have been published for many years, longitudinal studies are more typical in recent years. Together with cross-sectional studies, they show a clear association between physical activity and psychological functioning. Furthermore, longitudinal studies generally indicate that active individuals are less likely to deteriorate cognitively or emotionally. More important, like constantly active individuals, sedentary individuals who start a physical activity program have lessened the risk of experiencing psychological deterioration, emotional as well as cognitive, in comparison to those who have remained inactive.

Nevertheless, neither longitudinal observational-type studies nor cross-sectional studies can attribute improved psychological functioning to changes in physical activity patterns. Improvement in psychological functioning may precede the decision to become active. It may reflect that healthier psychological functioning predisposes individuals toward exercise.

Consequently, the second question, assuming that physical activity is the cause of an improved psychological state, is answered by interventional-type studies. Although earlier studies and reviews were unable to draw clear conclusions, the present review shows an increase in the number of studies, specifically in recent years, indicating the positive effect that physical activity or fitness has on psychological functioning. Furthermore, meta-analysis studies performed in recent years on all three dimensions provide quantitative support for this effect.

More specifically, in cognition, it is physical fitness, aerobic fitness in particular, that improves cognition. In addition, executive control processes, more than other cognitive functions, showed the largest benefit from improved aerobic fitness (Colcombe & Kramer, 2003). Yet, both general physical activity studies as well as strength studies proved more successful in altering emotions, mainly depression, than studies applying aerobic exercise. In addition, moderate exercise was more effective than intensive. Yet, the effect of improved fitness on mood alterations remains unclear (Arent et al., 2000). Similar to affect, self-perception, predominantly self-efficacy, was improved by almost any kind of physical activity. This improvement was moderated by enhanced fitness. However, not only better aerobic fitness, but also improved strength and flexibility, and specifically improvement in functional capacity, contributed to increased self-efficacy and view of self (Netz et al., 2005).

Although some meaningful conclusions and trends have been pointed out in the present review, some limitations and inconsistencies were also revealed and deserve further research. One limitation was the inability to determine dose-response effect in terms of the length or frequency of programs. This was specifically indicated in affect and self-perception. More studies are needed to determine the time course of psychological change. Another limitation is the lack of studies assessing positive affect and the constant focus on negative affect. This shortcoming is reinforced in light of the finding that positive affect declines steadily throughout aging, whereas negative affects remain the same or even decrease with increased aging (Kunzmann et al., 2000). It is therefore positive affect that is more sensitive to the aging process and should therefore be investigated further.

The underlying mechanisms influencing the exercise-well-being relationship have been described, yet studies testing them are scarce. An interesting question is in what way affect and cognition are related. For example, alterations in neurotransmitter activity have been proposed as the underlying mechanism of exercise and cognition, as well as exercise and affect. Perhaps one is affecting the other.

Clearly, there remains a need for randomized, controlled trials with close attention paid to the measurements of physical activity and psychological function, the underlying mechanisms influencing the relationship, the time course of psychological change, dose-response issues, and the diversity of populations studied. Such needs present an important future challenge to behavioral, social, and exercise scientists, as well as gerontologists, so that the increasingly aging population can benefit from, rather than fear, the aging process.

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CHAPTER 23

Exercise Adherence

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The global burden on public health of a sedentary lifestyle is substantial (Michaud, Murray, & Bloom, 2001). The direct medical costs associated with physical inactivity in the United States were $29 billion in 1987 and nearly $76.6 billion in 2000 (U.S. Department of Health and Human Services [USDHHS], 2003). Physical inactivity is a primary, independent risk factor for coronary heart disease (Fletcher et al., 1992), and an estimated $5.6 billion in medical costs related to heart disease would be saved if 10% of U.S. adults began a regular walking program (USDHHS, 2003). Physical inactivity also contributes to obesity, and together they are responsible for $90 billion in direct health care cost in the United States (Colditz, 1999). While coronary heart disease mortality rates have been decreasing, obesity rates have increased by more than 60% among adults in the past 10 years and have doubled among children and tripled among adolescents since 1980. Physical activity can be an important tool in countering the obesity epidemic. Weight loss programs are more successful with exercise included, and physical fitness can offset the mortality risk associated with being overweight. The physical activity patterns in the United States have remained virtually unchanged over the past 20 years (Centers for Disease Control and Prevention [CDC], 2005; Dishman, 2001), excepting a modest decrease during the past decade of about 7% in the number of adults who report no leisure time physical activity (Kruger, Ham, & Kohl, 2005). Roughly 50% of people who become active will later return to inactivity without sustained intervention.

The importance of increasing adoption and adherence to regular physical activity is undeniable. Since the last edition of this *Handbook,* practitioners and researchers from the fields of sports medicine, public health, and behavioral medicine/health psychology have been progressively more involved in promoting lifestyle physical activity and in identifying the mediators and moderators of exercise adoption and adherence. The scientific quality of the research also has matured, and the volume of published studies on exercise and physical activity behavior change has grown tremendously. Herein we describe the current state of knowledge in the area of exercise adherence, restricting the literature reviewed to the English language and to those studies and reviews that best represent the state of the science. Our specific purposes are (a) to present the factors that influence leisure physical activity and adherence to supervised exercise programs, (b) to provide an overview of the types of interventions applied to exercise adherence and the strength of the theoretically based research evidence, (c) to summarize key methodology problems that continue to face researchers in this area, and (d) to restate major questions for future research.

BACKGROUND

Adherence is simpler to quantify when the behavioral outcome is regular exercise that has explicit intensity, duration, and frequencies per week. As the field has expanded to integrate a public health perspective, however, the targeted behavior has expanded to "active living" and moderate physical activity. The current level of physical activity for health benefits recommended by the CDC and the American College of Sports Medicine (ACSM) is defined as at least 30 minutes per day, at least 5 days per week of moderate-intensity activities, *or* at least 20 minutes per day, at least 3 days per week of vigorous-intensity activities, *or both* (Pate et al., 1995). These options were offered in part to counter the negative attitudes many sedentary adults have toward exercise and to offer a wide array of ways to meet the recommendation. Defining outcome variables in respect to exercise or level of physical activity is an important distinction because different strategies are likely needed to persuade individuals to adopt and adhere to regular exercise, in contrast to getting people to be more physically active.

According to data from the 2003 Behavioral Risk Factor Surveillance Survey (BRFSS), 45.9% of adults in the United States met the minimum CDC/ACSM recommendation (CDC, 2005). The problem of physical inactivity is global and extends to developing nations (Matsudo et al., 2003). Martinez-Gonzalez et al. (2001) reported prevalence of physical activity in the European Union. Prevalence of participation in any leisure time physical activity ranged from 91.9% (Finland) to 40.7% (Portugal), with an overall average of 73.1%. Data for the United States from the 2005 BRFSS indicate a similar prevalence (76.1%), but this represents the proportion of adults who responded that they participated in any physical activities during the past month. These data likely are more valuable for identifying the truly sedentary than for determining how many Americans are active because someone who was physically active only one time in the past month would contribute to this proportion. Meaningful comparisons of physical activity rates are limited because of incomplete standardization of measurement (Brown, Bauman, Chey, Trost, & Mummery, 2004; Caspersen, Merritt, & Stephens, 1994).

In summary, it appears that physical inactivity is a concern in many developed and developing countries. The extent of the problem is being explored through some advances in measurement and attempts at standardization (e.g., International Physical Activity Questionnaire: Craig et al., 2003). Nevertheless, most of the available data are cross-sectional, and it is necessary to understand the patterns of activity over time. It is possible that some theories and technologies for increasing physical activity will have more or less effectiveness depending on the individuals targeted (e.g., individuals with a lifetime history of inactivity, a history of sporadic activity, or a history of sustained activity, albeit with one or more periods of inactivity). It is becoming increasingly evident that one theory or type of intervention applied in general to all people will not solve the problem of sedentariness. An underlying objective of this chapter is to move us closer to understanding the dimensions of interventions that are most likely to be successful for different target groups and for different behavioral goals, which can be to increase and sustain regular exercise, as well as to promote increases in lifestyle moderate-intensity activity as recommended by the CDC/ACSM and other national health and sport authorities.

To accomplish this objective, the consensus on the factors that influence leisure physical activity and adherence to supervised exercise programs is presented. To complement this empirical evidence for variables that can meditate and/or moderate efforts to increase adherence, brief descriptions of the interventions applied to physical activity and exercise follow. It is hoped that the empirical studies may suggest boundary conditions (i.e., limiting or facilitating circumstances) that clarify the generalizability and usefulness of the theories that have been studied.

CORRELATES OF EXERCISE AND PHYSICAL ACTIVITY

Known correlates of physical activity can be categorized as past and present personal attributes, past and present environments, and physical activity itself. It is believed that correlates may differ for supervised versus free-living settings and for adoption versus maintenance of a physical activity pattern (Dishman, Sallis, & Orenstein, 1985; Sallis, Prochaska, & Taylor, 2000; Trost, Owen, Bauman, Sallis, & Brown, 2002). There are no examples of absolute causal factors that explain 100% of the outcome in the behavioral realm. We work in an area with multiple causal factors for behavioral outcomes that likely change over time.

Correlates, as we are presenting them, include factors that mediate a change in behavior, as well as factors that moderate a relationship between the behavior and other correlates. Correlates can demonstrate reciprocal determinism with the target behavior, as in the case in which someone with greater exercise self-efficacy will be more likely to begin an exercise program, and participation in the program will enhance his or her self-efficacy. These complex bidirectional relationships among variables make it difficult to discriminate mediating pathways (Bauman, Sallis, Dzewaltowski, & Owen, 2002). Attention must be drawn to identification of the actual influence of constructs such as self-efficacy that can be both moderators and mediators of behavior change. For example, self-efficacy was correlated, cross-sectionally, with physical activity in eighth-grade Black and White girls (moderator effects) but was not predictive of naturally occurring change across 1 year (Motl et al., 2005). However, change in self-efficacy resulting from intervention has been observed to explain part of the intervention success in increasing physical activity (mediation; Dishman et al., 2004). We illustrate some of the issues related to mediation when we describe studies that report tests of mediation for key theoretical constructs. In the following section, we present our view of the current understanding of correlates of physical activity. Table 23.1 provides a categorical outline of the most studied correlates of physical activity in adults during the past 20 years and our interpretation of their strengths of association.

Table 23.1 Associations of Correlates with Physical Activity in Adults

Determinant	Associations with Activity in Supervised Programs	Associations with Overall Physical Activity
Demographic and Biological Factors		
Age	0 0	− −
Blue-collar occupation	− −	−
Childless		+
Education	+	+ +
Gender (male)		+ +
Genetic factors	+	+ +
High risk for heart disease	−	−
Income/socioeconomic status		+ +
Injury history		+
Marital status	0	−
Overweight/obesity	0	− −
Race/ethnicity (non-White)		− −
Psychological, Cognitive, and Emotional Factors		
Attitudes	+	0 0
Barriers to exercise	−	− −
Control over exercise		+
Enjoyment of exercise	+	+ +
Expect benefits	+	+ +
Health locus of control	0	0
Intention to exercise	0	+ +
Knowledge of health and exercise	0	0 0
Lack of time	− −	− −
Mood disturbance	−	− − −
Normative beliefs	0	0 0
Perceived health or fitness	+ +	+ +
Personality variables		+
Poor body image		−
Psychological health	0	+
Self-efficacy	+ +	+ +
Self-motivation	+ +	+ +
Self-schemata for exercise		+ +
Stage of change		+ +
Stress	0	0
Susceptibility to illness/seriousness of illness		0 0
Value of exercise outcomes	0	0
Behavioral Attributes and Skills		
Activity history during childhood/youth		0 0
Activity history during adulthood	+ +	+ +
Alcohol use		0
Contemporary exercise program	0	0
Dietary habits (quality)	0 0	+ +
Past exercise program	+ +	+ +
Processes of change	+	+ +
School sports	0	0 0
Skills for coping with barriers		+
Smoking	− −	−
Sports media use		0
Type A behavior pattern	−	+
Decision balance sheet	+	+

(continued)

Table 23.1 (Continued)

Determinant	Associations with Activity in Supervised Programs	Associations with Overall Physical Activity
Social and Cultural Factors		
Class size	+	
Exercise models		0
Group cohesion	+	
Past family influences		0
Physician influence		+ +
Social isolation	0	−
Social support from friends/peers	+	+ +
Social support from spouse/family	+ +	+ +
Social support from staff/instructor	+	
Physical Environment Factors		
Access to facilities: actual	+	+
Access to facilities: perceived	+	+
Climate/season	−	− −
Cost of program	0	0
Disruptions in routine	−	
Home equipment		+
Physical Activity Characteristics		
Intensity	− −	−
Perceived effort	− −	− −

Note: + + = Repeatedly documented positive associations with physical activity; + = Weak or mixed evidence of positive association with physical activity; 0 0 = Repeatedly documented lack of association with physical activity; 0 = Weak or mixed evidence of no association with physical activity; − − = Repeatedly documented negative associations with physical activity; − = Weak or mixed evidence of negative association with physical activity. Blank spaces indicate no data available.

Adapted from "The Determinants of Physical Activity and Exercise," by R. K. Dishman, J. F. Sallis, and D. R. Orenstein, 1985, *Public Health Reports, 100,* pp. 158–171; *Exercise psychology,* by J. Buckworth and R. K. Dishman, 2002, Champaign, IL: Human Kinetics. Adapted with permission.

Characteristics of the Person

Personal attributes include demographic variables, biomedical status, past and present behaviors, activity history, psychological traits and states, knowledge, attitudes, beliefs, and intentions, and intrinsic factors associated with physical activity. Correlates that are descriptive of the individual are important because they can identify personal variables or population segments that may be targets for interventions to increase physical activity or, conversely, may describe impediments or identify people resistive to physical activity interventions.

Demographics

Demographics such as age, female gender, non-White race/ethnicity, and low education and income are consistent correlates of physical inactivity (Trost et al., 2002). There is no experimental evidence that those factors cause inactivity. However, the decrease in level of physical activity with age is particularly disturbing because recent estimates indicate that 26% of girls and 20% of boys age 9 to 13 years do not participate in physical activity during their free time; only 38% participate in organized physical activity (Duke, Huhman, & Heitzler, 2003). Moreover, both leisure time physical activity (Kimm et al., 2002) and school-based physical activity (Grunbaum et al., 2004) decline during adolescence, especially among girls (Caspersen, Pereira, & Curran, 2000; Kimm et al., 2002). The pattern of activity for adults age 30 to 64 years is relatively stable until retirement, when there is some improvement until the final period of life (Caspersen et al., 2000). Older adults are less active than other age groups regardless of race/ethnicity (Crespo, Smit, Andersen, Carter-Pokras, & Ainsworth, 2000).

Females are more likely than males to be physically inactive at most ages. Estimates from the Youth Risk Behavior Surveillance System are that 40% of U.S. girls, compared to 27% of boys, do not regularly engage in sufficient amounts of vigorous and moderate physical activity during the high school years (Grunbaum et al., 2004). Fifty percent of Black girls get an insufficient amount of physical activity compared to 38% of White girls and 43% of Hispanic girls. About 30% of Black and Hispanic boys and 25% of White boys get insufficient activity (Grunbaum et al., 2004). A smaller proportion of college females than males participate in vigorous physical activity (Douglas et al., 1997), and females are less likely than males to engage in leisure time physical activity for age groups 18 to 24, 65 to 74, and over 75 (CDC, 2005).

Most of the studies of physical activity correlates in the United States have been with Whites of European ancestry; we know less about what influences physical activity behavior and adherence in ethnic minorities. This is particularly troublesome because lower rates of physical activity and adherence are found for minority adolescents (Grunbaum et al., 2004; Trost et al., 2002) and in most (Crespo et al., 2000) but not all (e.g., Dowda, Ainsworth, Addy, Saunders, & Riner, 2003) minority adults compared to non-Hispanic Whites.

Education is associated with physical activity. For example, Clark, Patrick, Grembowski, and Durham (1995) found that adults age 70 and older with 8 or fewer years of education were less physically active than those with 9 or more years when controlling for educational differences in income, health, functional status, body mass, and chronic disease. This association may reflect an individual's ability to recognize and act on health recommendations. Berrigan, Dodd, Troiano, Krebs-Smith, and Barbash (2003) analyzed associations among demographic variables and physical activity, tobacco use, alcohol consumption, fruit and vegetable consumption, and dietary fat intake in data from the third National Health and Nutrition Examination Survey (NHANES-III). They found that the proportion of adults who adhered to all five health recommendations was greater in adults with some college (8.0%) compared to respondents with less than a high school education (3.7%).

For different markers of socioeconomic status (e.g., education, income), the prevalence of physical activity in non-Hispanic White adults is greater than for other racial/ethnic groups. However, the relationships may be different as a function of race/ethnicity. Education was positively related to physical activity for young adult women and non-Hispanic White and Hispanic men surveyed in NHANES-II, but not for non-Hispanic Black men (Crespo et al., 2000). In a study of sociodemographically diverse African American adults, exercise and several other risk factors that are usually associated with income and education in White adults were not significantly associated (Resnicow et al., 2001).

Lower rates of leisure time physical activity are typically reported by individuals in blue-collar or hourly wage occupations. This relationship is not limited to the United States. According to data from the 1995 Australian National Health Survey, insufficiently active men and women were more likely to be employed in blue-collar jobs and were also more likely to be older, smokers, obese, and perceive their health as "poor" (Burton & Turrell, 2000).

Biomedical Status

There is evidence for a genetic contribution to resting metabolic rate, but also to sports participation and daily physical activity (Beunen & Thomis, 1999). Several correlational studies have been published describing estimates of the heritability of various characteristics related to exercise behavior (e.g., Maia, Thomis, & Beunen, 2002; Stubbe, Boomsma, & de Geus, 2005). More relevant for adherence is the data from the HERITAGE Family Study that showed a genetic influence in how individuals respond to an exercise training program (Wilmore et al., 1997). Some individuals will adapt quickly and show substantial increases in fitness components. Others will demonstrate little change over time regardless of the exercise prescription. Genetic influences on rate and potential for fitness changes can have implications for adherence, particularly for those "slow" adapters who are not experiencing physiologically based reinforcements from regular physical activity, such as increased endurance.

Health status can also affect physical activity. In reviews of physical activity and older adults, poor health is commonly cited as the most frequent barrier to physical activity and exercise (Schutzer & Graves, 2004). Overweight and obesity are also negatively associated with exercise and leisure time physical activity (Trost et al., 2002) in a variety of populations and age groups (Janssen, Katzmarzyk, Boyce, King, & Pickett, 2004; Kaplan, Huguet, Newsom, McFarland, & Lindsay, 2003; Mack et al., 2004; Martinez-Gonzalez et al., 2001). Overweight and obese individuals are the target of public health campaigns to increase physical activity and reduce caloric intake, although only about half of the participants in the U.S. 1998 National Health Interview Survey who were trying to lose weight reported using exercise (Kruger, Galuska, Serdula, & Kohl, 2005).

Past and Present Behaviors

Socioeconomic status, occupation, smoking, and overweight may represent underlying factors that reinforce sedentary living or create barriers to adopting or maintaining physical activity. Many blue-collar occupations may carry with them the perception of on-the-job activity adequate for health and fitness despite low actual exertion, and the norms characteristic of low socioeconomic groups may reinforce inactivity. Smoking and being overweight could exert direct barriers for high-intensity activities or signal a generalized pattern of low-frequency health behaviors. Many theories of human behavior assume that increasing the occurrence of other behaviors that share common precursors, environments, or outcomes with physical activity will facilitate increases in physical activity. However, early cross-sectional correlational studies showed little association between physical activity and other health-related behaviors in adults (e.g., Blair, Jacobs, & Powell, 1985; Norman, 1986) and modest associations with healthy diets but not other health behaviors in college students (Johnson, Nichols, Sallis, Calfas, & Hovell, 1998).

More recently, Berrigan et al. (2003) examined the associations among physical activity and four other health behaviors measured in NHANES-III. About 41% of the sample reported sufficient physical activity, but only 28% adhered to recommendations for exercise and for fruit and vegetable consumption and/or dietary fat intake. In a similar study of health behavior clustering in Dutch adults, Schuit, van Loon, Tijhuis, and Ocke (2002) found that insufficient physical activity was associated with cigarette smoking and low consumption of fruits and vegetables, but not with excessive alcohol intake, after adjusting for age, gender, and education.

There is a popular assumption that television viewing and computer use in children and youth are partially responsible for the increase in obesity and decrease in physical activity in these age groups. A recent meta-analysis of studies on participants under age 18 and the relationships among television viewing/computer use, physical activity, and obesity suggests caution toward this assumption (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004). The authors concluded that spending time engaged in sedentary behavior is likely prohibitive of physical activity, but the contribution of television viewing and computer use to recent epidemiologic trends of overweight and obesity among children and youth is small. In addition, we cannot assume that all sedentary behaviors have the same relationship with physical activity. Santos, Gomes, and Mota (2005) found a positive correlation between time spent using the computer on weekends and physical activity in adolescents. Buckworth and Nigg (2004) reported a negative correlation between computer use and exercise for male (but not female) university students, and positive relationships between time studying and exercise duration.

Sedentary behaviors are not always inversely associated with level of physical activity (Buckworth & Nigg, 2004; Feldman, Barnett, Shrier, Rossignol, & Abenhaim, 2003), and correlates of sedentary behaviors have also been shown to be different from those of physical activity (Gordon-Larsen, McMurray, & Popkin, 1999; Schmitz et al., 2002). Because of the increased opportunities for sedentary recreation that can compete with physically active recreation, we need to know more about outcome expectations for sedentary behaviors (Williams, Anderson, & Winett, 2005) and factors influencing the choices to engage in sedentary activities (e.g., Raynor, Coleman, & Epstein, 1998).

There is consistent evidence that a personal history of exercise or regular physical activity is positively associated with current level of physical activity and adherence (Trost et al., 2002) and with current and future participation in supervised programs for adult fitness, cardiac rehabilitation, and weight loss (Dishman & Buckworth, 1996a). Given the strong association between previous exercise and adherence, positive experiences with exercise and physical activity in physical education and youth sports can have an important impact on adult physical activity. Persistent physical activity in youth was predictive of adulthood activity over a 21-year tracking period in the Cardiovascular Risk in Young Finns Study (Telama et al., 2005). Correlational (e.g., Alfano, Klesges, Murray, Beech, & McClanahan, 2002) and longitudinal (e.g., Tammelin, Nayha, Hills, & Jarvelin, 2003) studies provide some evidence that participation in youth sport leads to active lifestyles as adults, although not all studies have supported this relationship (e.g., Dishman, 1988). We need to be cautious when we interpret cross-sectional retrospective studies linking youth sport and physical activity history with contemporary adult physical activity, especially considering limitations of long-term recall of attitudes and beliefs. Childhood sport experience can be an agent in socializing to adult roles, but it can also be overridden by other personal and environmental influences that exert an immediate impact in adulthood.

Psychological States and Traits

Psychological constructs can account for variability in behavior within population segments that are demographically homogeneous and across settings that differ in place and time. Although general self-motivation that is conceptualized as a trait and other personality variables, such as extraversion, are less amenable to change with interventions than other psychological variables (e.g., beliefs), information about their relationship with exercise adherence can guide in the tailoring of interventions through their contribution as moderators.

Self-motivation may reflect self-regulatory skills such as effective goal setting, self-monitoring of progress, and self-reinforcement (Dishman, 1982). An initial classification model (Dishman & Ickes, 1981) was most accurate when self-motivation scores were combined with body weight and composition. This was recently demonstrated in a sample of 275 Filipino students, for whom self-motivation together with body weight and percentage of body fat were the best predictors of exercise (Polman, Pieter, Bercades, & Ntoumanis, 2004). Accumulated across published studies, the population estimate of the correlation between self-motivation and physical activity approximates .25, indicating about a 12% clinical benefit when judged as a binomial effect size (R. K. Dishman, personal communication, December 15, 2005). Self-motivation has been associated with better adherence in some (e.g., Annesi, 2002) but not all studies (Wallace, Raglin, & Jastremski, 1995).

Other personality traits that have been studied in conjunction with exercise and physical activity and have shown weak or mixed associations are optimism (Fontaine & Shaw, 1995; Glazer, Emery, Frid, & Banyasz, 2002), health locus of control, and Type A behavior pattern. There is some evidence that extraversion and conscientiousness, measured using the NEO-Five Factor Inventory, are positively associated with exercise, whereas neuroticism is negatively associated (Courneya & Hellsten, 1998; Rhodes, Courneya, & Bobick, 2001). Davis, Fox, Brewer, and Ratusny (1995) speculated that characteristics of extraverts' personality, such as exuberance and optimism, might have a positive influence on their exercise self-efficacy. Other studies, however, have found no relationship between extraversion and exercise adherence (e.g., Potgieter & Venter, 1995). The use of different scales to measure extraversion (i.e., Eysenck Personality Inventory) may contribute to these mixed results, along with other intervening variables, such as motivation and exercise history.

Knowledge, Attitudes, Beliefs, and Intentions

Psychological traits can change, but they are resistant to change over the narrow ranges of time, exposure, and settings characteristic of medical and public health interventions. Social cognitive factors related to knowledge, attitudes, beliefs, and intentions are sensitive to change and have proven more responsive to interventions designed to alter health behaviors. Knowledge, along with attitudes, normative beliefs, and values of exercise outcomes, show poor associations with physical activity in general (Trost et al., 2002). However, knowledge and belief in the health benefits of physical activity may motivate adoption of an exercise program, especially by influencing intentions to be active, although their roles for reinforcing adherence are less clear.

Older adults in the United States and in other countries grew up before the benefits of physical activity were widely promoted, and many are still not well informed about the health benefits of exercise and the role physical activity plays in disease prevention (Schutzer & Graves, 2004). For these older adults, lack of knowledge can be a significant barrier to exercise adoption. However, knowledge, low fitness, or health risk factors alone are insufficient to prompt exercise behavior. Despite the documented benefits of cardiac rehabilitation in enhancing recovery and reducing mortality following a myocardial infarction, only about 33% of patients participate in such programs (Daly et al., 2002), and 50% of patients in these programs drop out within the first 6 months (Burke, Dunbar-Jacob, & Hill, 1997).

Self-efficacy beliefs and intentions have received the most support as correlates of exercise and physical activity, and there is evidence that self-efficacy is both a predictor and outcome of exercise behavior (McAuley & Blissmer, 2000). The lack of prospective population studies and clinical experiments that have controlled for physical activity history limits an interpretation of how much of the observed associations of physical activity with self-efficacy and intentions is causal and how much reflects a selection bias effect. Currently active people or those with a history of activity who are recently inactive but resume activity during a prospective study may report high self-efficacy because of past success. In addition, people with high self-efficacy may overreport actual physical activity, and people with low self-efficacy may underreport actual physical activity. The experimental evidence that an increase in self-efficacy is accompanied by an increase in physical activity has been limited to heart and lung patients in whom a lack of confidence about physical exertion is typical due to medical limitations. Only recently has an experimental increase in self-efficacy been confirmed as a mediator of increased physical activity in other groups (i.e., young adolescent girls; Dishman et al., 2004).

Studies reporting relationships between intentions and physical activity share the same limitations found in the studies of physical activity and self-efficacy, namely, a reliance on correlational rather than experimental designs and the use of unvalidated self-report measures of physical activity. Hence, it is difficult to determine how much of the association between intentions and actual exercise behavior was an artifact of using self-report to estimate both the presumed determinant and the behavior. This concern is highlighted by the observation that in five studies that assessed both past physical activity (i.e., habit) and intentions for future physical activity, the correlation with current physical activity was higher for habit (mean ~ .43) than for intention (mean ~ .38) (Dishman, 1994a). Because habit and intention were also related in these studies (r ~ .50 to .65), a substantial portion of the relationship between intention and exercise adherence observed in cross-sectional studies is reflecting past exercise habits and cannot be viewed as causing contemporary exercise. Recent evidence from a prospective cohort study supports a predictive relationship between intention and physical activity in adolescents (Godin, Anderson, Lambert, & Desharnais, 2005), but other evidence suggests that this relationship declines across time (Chatzisarantis, Hagger, Biddle, & Smith, 2005) and might be explainable by self-efficacy (Hagger, Chatzisarantis, & Biddle, 2002a; Motl et al., 2002).

The mean correlation (weighted for sample size) between self-reports of physical activity and intentions reported in 15 studies before 1994 was .50 (Dishman, 1994a). Expressed as a binomial effect size, this correlation suggests that an intervention that results in high intentions to be active will lead to a 75% rate of exercise adherence, compared with a 25% rate of adherence under control conditions of low intention. The few controlled clinical experiments to increase intentions to exercise, however, have not led to persisting effects. Also, mediated interventions in communities or population-based designs to increase intentions for other behavior changes clearly show that a much smaller increase in physical activity can be expected than the large increase implied by correlations between intentions and physical activity obtained in descriptive studies.

Intrinsic Factors

Factors such as self-schemata and enjoyment are potentially important influences on physical activity but have been understudied. The core traits of an individual's identity (i.e., self-schemata) are socially learned beliefs about the self that are context-specific. Adults who have self-schemata for exercise (i.e., they see themselves as an exerciser) exercise more frequently, do more activities for exercise, are more likely to resume an exercise program after a period of inactivity, are more likely to act on their intentions to exercise, perceive more behavioral control over their physical activity, and are less likely to perceive causes of temporary inactivity as stable (Estabrooks & Courneya, 1997; Kendzierski, 1994; Kendzierski & Sheffield, 2000; Kendzierski & Whitaker, 1997). How self-identity as a physically active person develops in social contexts of physical activity has not been studied, especially during adolescence.

Whereas beliefs and expectations about benefits of physical activity can lead to distal, abstract goals, intrinsic factors such as enjoyment provide a more immediate, intrinsic affective reward for being physically active. Nonetheless, Lewis, Marcus, Pate, and Dunn (2002) concluded that the cumulative evidence did not support enjoyment as a mediator of physical activity behavior change. However, evidence for the construct validity of most measures of enjoyment has been limited (Motl et al., 2001). In a recent study, enjoyment was measured as a potential mediator in our school-based intervention to increase physical activity in adolescent girls (Lifestyle Education for Activity Program; Pate et al., 2005). Structural equation modeling indicated that effects of the intervention on physical activity were partially mediated by factors influencing enjoyment of physical education, enjoyment of physical activity, and self-efficacy (Dishman et al., 2004; Dishman, Motl, Saunders, et al., 2005).

Environmental Factors

The natural or built environment and the human environment (e.g., social support) and their relationship with physical activity are receiving more attention since the last publication of the *Handbook*. The theory of environmental or architectural determinism proposes that the physical environment is an important shaper of behavior (Ewing, 2005). This perspective is in contrast to the psychological models historically applied to exercise behavior that focus on the effects of intra- and interpersonal variables on motivating individuals to seek out an environment that enables them to be active.

Built Environment

The built environment (e.g., metropolitan land use patterns, urban transportation, sprawl index) is important in level of physical activity because it can be related to the choices individuals have for being physically active as part of their daily lives. A number of potential environmental influences on exercise behavior were assessed mainly by self-report through the early 1990s. This was a measurement problem because objective measures (e.g., distance from facilities) can provide results that differ from self-reported accessibility (Sallis et al., 1990). When measured by self-report, perceived access typically has not been related to adoption and maintenance (Dishman, 1994b), but when access to facilities has been measured by objective methods (e.g., distance), access typically has been related to physical activity (Sallis et al., 1990). However, the clearest findings have been limited to use of parks and walking trails (e.g., M. Duncan & Mummery, 2005; Troped et al., 2001). The application of standardized measures, such as geographic information systems to complement self-reports, is needed in this area (Porter, Kirtland, Neet, Williams, & Ainsworth, 2004). Researchers are beginning to use other objective measures, such as the sprawl index (Duncan & Mummery, 2005) and data from existing Geographic Information Systems databases (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003) to determine associations between the actual and perceived environment and physical activity.

Human Environment

The human environment has been mainly studied in terms of life events that can disrupt physical activity habits or otherwise create barriers to physical activity and to selected aspects of social support.

Major Life Events. Personal stress and risk of illness can be considered parts of the human environment that usually disrupt routine, distract from attention to personal health-supporting behaviors, and increase emotional stress, all of which can undermine one's commitment to exercise. Oman and King (2000) examined the effects of potentially stressful routine life events on exercise adoption and maintenance. The 2 years of the study were divided into four 6-month adherence periods. Major life events had a significant negative effect on adherence during the last three adherence periods, but did not have a negative effect on exercise during the adoption phase, regardless of intervention format or exercise intensity. Similarly, Stetson, Rahn, Dubbert, Wilner, and Mercury (1997) found that women who had been exercising regularly for more than 5 years reported lapses in their adherence and lower self-efficacy for meeting exercise goals during weeks with more daily, minor hassles (typically related to time pressures). In the Oman and King study, the effects of life events during adoption may have been buffered by the supportive nature of that intense counseling phase of their intervention. Major life events can impact daily routines regardless of the affective component (e.g., marriage versus death of a loved one), and interventionists should provide cognitive and behavioral skills training to help participants better handle life stress.

Social Support. Several types of social support have been consistent correlates of physical activity (Trost et al., 2002). Support from family, friends, and physicians is positively associated with exercise, whereas social isolation is negatively associated. There is mixed evidence for moderating influences of age and gender. Both family and friend support for exercise was associated with physical activity in elderly men and women in California (Oka, King, & Young, 1995), but social support was related to frequent physical activity only among women in a survey of older Canadian adults (Kaplan, Newsom, McFarland, & Lu, 2001). In a review of correlates of physical activity in children and adolescents, there was no association for parent or peer influences in children age 4 to 12, but positive correlations with physical activity for sibling physical activity and support from significant others in adolescents age 13 to 18 (Sallis et al., 2000).

The relationship between family social support and exercise is less significant for adolescents in general (Kohl & Hobbs, 1998). For adolescents, peer pressure is a stronger social determinant of physical activity level than family support, although in youth (Sallis et al., 1992) and college students (Wallace, Buckworth, Kirby, & Sherman, 2000) family support for exercise is more important for women and peer support is more important for men. Support may have different effects on adherence, though. Adherence data from an intervention study with college students (Project GRAD) showed significant effects on adherence in women for support from peers and not family, and no effects from social support on adherence in men (Sallis, Calfas, Alcaraz, Gehrman, & Johnson, 1999).

Time

As a correlate of exercise and physical activity, time has both environmental and personal (e.g., perception) dynamics. A perceived lack of time is the principal and most prevalent reason given for dropping out of supervised clinical and community exercise programs and for an inactive lifestyle (Dishman & Buckworth, 1997; Trost et al., 2002).

For many, however, reporting lack of time does not represent an environmental barrier to physical activity. It may reflect a lack of interest or commitment to physical activity. Thus, stated lack of time can be associated with physical activity in different ways: as a true environmental correlate for individuals who want to exercise but actually do not have the time to do so, or perceive they do not have time, or as a marker of poor time management skills, the unwillingness to take time from other preferred activities, or a rationalization for lack of motivation to be physically active.

Physical Activity Characteristics

It is likely that activity characteristics predispose or impede participation in specific population segments and settings. In our meta-analysis of exercise interventions, we found the best adherence for lifestyle physical activity, but no differences as a function of mode or duration (Dishman & Buckworth, 1996b). More recent research has been conducted to test the effects of exercise intensity and frequency on adherence, but few studies have examined the effects of exercise mode.

Mode

Walking is the most common type of physical activity in adults and can be a facet of lifestyle physical activity or a mode of regular exercise. According to U.S. data from the 1998 National Health Interview Survey, the greatest proportion of respondents reported walking for exercise (43.2%) compared to gardening or yard work (28.1%) or stretching exercises (27.2%). Researchers and interventionists are examining walking for exercise because of its accessibility and safety. In a review of environmental influences on walking, Owen, Humpel, Leslie, Bauman, and Sallis (2004) found 18 studies that reported on objectively assessed and perceived environmental attributes of walking. Although this research area is not yet extensive, there are implications that environmental factors that influence recreational walking, such as being aesthetically pleasing and coastal locations, are different from walking for transportation, which was associated with sidewalks present and stores in walking distance, among others.

The effect of exercise mode on adherence was examined in a dietary intervention with overweight men (Borg, Kukkonen-Harjula, Fogelholm, & Pasanen, 2002). Adherence was better during the intervention for the walking compared to resistance training group, but during unsupervised follow-up, physical activity decreased for everyone. Walking during this period was similar between groups, and the authors suggested that adherence to walking is better than to resistance exercise in this population. In another study, the effect on adherence from varying the exercise mode was examined in an 8-week intervention with initially sedentary adults (Glaros & Janelle, 2001). Participants were randomly assigned to one of three exercise conditions that varied on level of choice and variety for exercise mode but not on frequency, intensity, and duration. In the variable condition, participants selected a minimum of two and maximum of four different exercise modes that they performed for 2 weeks before switching. In the static condition, participants selected one cardiovascular exercise mode and stayed with that mode the entire 8 weeks. In the preferred mode, participants could choose any cardiovascular mode each time they exercised. No differences were found in fitness increases or in self-efficacy over time. Participants in the variable condition, however, demonstrated the best adherence and reported the greatest enjoyment.

Duration

The CDC/ACSM recommendation offers the flexibility to exercise in several short bouts during the day or in the traditional single longer bout. Researchers have been interested in the effects of prescribing bouts of intermittent exercise (e.g., two 15-minutes bouts per day) on adherence. Snyder, Donnelly, Jacobsen, Hertner, and Jakicic (1997) prescribed three 10-minute bouts of moderate intensity exercise 5 days per week in a 32-week study of overweight adults and found good adherence. Jakicic, Winters, Lang, and Wing (1999) examined the effects of prescriptions for long-bout exercise, multiple short-bout exercises, and multiple short bouts of exercise with home exercise equipment on weight loss over an 18-month intervention. They found the best adherence for the multiple short-bout group with the home equipment. Jacobsen, Donnelly, Snyder-Heelan, and Livingston (2003) found similar adherence for continuous and intermittent prescriptions in overweight females over 72 weeks, but dropout was greater for the continuous group during the first 24 weeks of the intervention.

Intensity

Most early studies of supervised exercise programs in adults did not show an association between dropout rates and exercise intensity or perceived exertion (Pollock, 1988), but results from our meta-analysis (Dishman & Buckworth, 1996b) show best adherence for low-intensity leisure time physical activity. Perri et al. (2002) examined the effects of moderate versus higher intensity crossed with two levels of frequency (3 to 4 versus 5 to 7 days per week) on adherence to a 6-month walking program in initially sedentary adults. There was better adherence for moderate-intensity exercise regardless of frequency, and no difference in adherence between the frequency prescriptions. There was also a higher injury rate in the higher compared to the moderate-intensity conditions (18.7% versus 8.3%).

Higher intensity exercise prescriptions have lower adherence in different populations, including sedentary adults (e.g., Perri et al., 2002) and men in cardiac rehabilitation (e.g., Lee et al., 1996), although not all studies have found consistent effects of training intensity on adherence. For example, differences in assigned training intensity did not affect adherence to a 7-week heavy-resistance weight training program in women (Sidney & Jette, 1992). King, Haskell, Young, Oka, and Stefanick (1995) found better adherence in a high-intensity, home-based program (67.8%) than a low-intensity home-based (49%) or high-intensity supervised group-based (36.4%) program after 2 years. However, the low-intensity prescription involved a greater frequency to equalize the weekly caloric expenditure among programs. The higher frequency could have been a barrier to adherence.

In free-living settings where the energy cost of standard activities may require varying percentages of metabolic capacity, exertional perceptions and preferences may be more important influences on participation. In a study of California adults (Sallis et al., 1986), participants were more likely to adopt regular moderate-intensity activities than high-intensity fitness activities during a year's time. Moderate activities showed a dropout rate (25 to 35%) roughly half that seen for vigorous exercise (50%). Measurement of the rating of perceived exertion is recommended by the ACSM; hence, there is some acknowledgment of the value in addressing the subjective experience of exercise and physical activity. However, the relationships among fitness, physical activity, perceived exertion, and preferred types and levels of exertion have not been systematically studied as determinants of adherence.

Correlates Summary

Defining correlates of different types of physical activity behavior in a variety of populations and age groups can point to potential mediating and moderating variables. Variables consistently unrelated to physical activity in adults, such as normative beliefs from the theory of planned behavior (see Table 23.1), are poor choices to target in behavior change interventions. Bauman et al. (2002) evaluated reviews of correlates of physical activity in adults in terms of associations with overall physical activity and dominant theoretical models, and found 15 variables that were consistently related to physical activity but not associated with a specific theory. Some of these that are potential targets of an intervention are enjoyment, self-motivation, and self-schemata for exercise, as well as exercise intensity and perceived effort. In the following section, we describe interventions that have been applied to physical activity behavior change and highlight the potential mediators and their associated theories, if feasible.

BEHAVIOR CHANGE INTERVENTIONS

Governmental and nonprofit organizations have made significant efforts to promote physical activity. In 1996, we published a meta-analysis of 127 studies and 14 dissertations from 1965 to 1995 describing interventions to increase exercise adherence (Dishman & Buckworth, 1996b). The overall effect size weighted by sample size was 0.75; interventions produced a ¾ standard deviation increase in exercise adherence. We found no difference in effectiveness of interventions as a function of age, gender, or race. The most successful interventions applied behavioral modification strategies to healthy subjects in a group setting using a mediated approach (e.g., print mailings, telephone).

More than 50 articles describing physical activity interventions have been published since 1996. Researchers and practitioners have augmented their approaches, such as using telephone-based and electronic formats (e.g., e-mails, web sites) to deliver interventions. Many are recognizing that individual behavior patterns are not caused exclusively by psychological factors, but are determined over time through the interaction of individual characteristics with the social and physical environment. In the previous edition of this *Handbook,* we described interventions that were based on psychosocial theories of behavior change. Socioecological models and perspectives from urban planning and transportation research are being applied with some success to modify level of physical activity.

Our review of interventions to increase exercise adherence in randomized controlled trials in clinical populations illustrates the range of intervention formats (Buckworth & Sears, 2006). In the 55 studies published from 1981 through 2004, the most common type of intervention was exercise prescription without education or counseling. Other interventions were exercise prescription plus cognitive-behavioral therapy in a group format, behavioral counseling, nurse-led brief interventions, "lifestyle" intensive group programs, home-based programs, motivational interviewing, mailings, and multiple mixed strategies. Level of physical activity remained above baseline in two-thirds of the interventions, most of which had shorter (1-year) follow-up. Generally, adherence decreased over time: The longer the follow-up, the lower the adherence. Dropout tended to be higher in time-limited interventions with no subsequent contact with the participants except for follow-up testing.

Because limited access to facilities and inconvenience have been repeatedly cited as reasons for dropping out of supervised cardiac rehabilitation exercise programs, several studies have implemented home-based interventions. Benefits of a home-based intervention for clinical populations include convenience, flexibility, and the opportunity to identify and resolve barriers to maintaining regular exercise while there are resources available through the intervention. Studies that compared a home-based approach to traditional group or site-based interventions have generally reported better adherence and fewer dropouts for the home-based groups (King et al., 1995; Perri, Martin, Leermakers, Sears, & Notelovitz, 1997; Strijbos, Postma, van Altena, Gimeno, & Koeter, 1996).

Another, more general approach to physical activity behavior change interventions relates to targeted programming. Targeting involves defining groups within a population along some characteristic (e.g., stage of change) and delivering a program suited to this characteristic. Tailoring goes further in refining an intervention through customizing the intervention to each member of a specific stage. Information from the individual is used to create personally relevant messages. Intuitively, a more personalized approach is appealing, but evidence for effectiveness beyond traditional approaches is equivocal.

Health Risk Appraisal and Fitness Testing

Early studies suggested that health risk appraisal and physical fitness testing might increase physical activity, but results were mixed (e.g., Desharnais, Godin, & Jobin, 1987; Driggers et al., 1984; Godin, Desharnais, Jobin, & Cook, 1987). Health risk appraisals and fitness testing are not typically used as stand-alone interventions. More recent interventions have used these assessments to establish baseline levels of health variables and to tailor interventions. For example, older adults who received an exercise prescription based on training heart rate (75% predicted VO_2 max), which was adjusted at 3 and 6 months according to results from new step tests, demonstrated better adherence at 12 months compared to the usual care group (Petrella, Koval, Cunningham, & Paterson, 2003).

Behavior Modification and Cognitive-Behavior Modification

Behavior modification is the planned, systematic application of learning principles to the modification of behavior. Representative approaches include written agreements, behavior contracts and lotteries, stimulus control, and contingencies. Both reinforcement control and stimulus control strategies have been successfully implemented with exercise (Dishman & Buckworth, 1996b; Knapp, 1988; Marcus et al., 2000). Behavior modification had the largest effect size among the intervention types included in our meta-analysis (Dishman & Buckworth, 1996b). Cognitive-behavioral approaches, including self-monitoring, sensory distraction, feedback, decision making, and goal setting, have appeared equally effective when used alone or when combined in intervention packages.

Behavior modification and cognitive-behavior techniques are usually associated with about a 10% to 25% increase in frequency of physical activity when they are compared with a no-treatment control group, but their impact on changes in intensity and duration of activity is less clear. Behavioral modification in general seems to be useful for short-term adherence, but follow-up studies typically show poor maintenance. Conclusions about behavior modification and exercise adherence are limited because of problems with the research, such as application of multiple strategies (which makes it difficult to identify what actually contributes to adherence), inconsistency in defining and measuring adherence, missing reports of frequency, intensity, and duration or fitness gains, and a lack of follow-up data (Leith & Taylor, 1992).

Lifestyle Physical Activity

Lifestyle intervention strategies aim to help people develop multiple behavioral skills necessary to incorporate more physical activity in their daily lives, rather than engage in planned, structured exercise on a regular basis. Intermittent and lifestyle approaches are being recommended for exercise to maximize adherence (Jakicic, 2003). Several studies have implemented lifestyle interventions in different populations, with promising results. For example, in Project Active, 235 initially sedentary adults were randomized to an intensive lifestyle physical activity program or a traditional structured exercise program (Dunn et al., 1999). The intensive intervention lasted 6 months, followed by 18 months of a maintenance intervention. After 24 months, both groups demonstrated significant increases in aerobic capacity and decreases in blood pressure and percentage of body fat. Adherence was comparable in both groups, and most of the subjects were meeting the CDC/ACSM criteria; the lifestyle program, however, was more cost-effective (Sevick et al., 2000).

Several studies have described interventions using strategies to increase lifestyle physical activity through walking, such as promoting walking as transportation (Merom, Miller, Lymer, & Bauman, 2005; Mutrie et al., 2002) and as a way to meet the CDC/ACSM recommendations (Reger et al., 2002). Although the popular 10,000 steps per day goal has its roots in Japanese walking clubs and a pedometer manufacture's slogan from the 1960s, there is evidence that 10K/day can equate to the 30 minutes of moderate activity recommendation (Hultquist, Albright, & Thompson, 2005) and promote health (Tudor-Locke & Bassett, 2004). Providing a step counter with instructions in goal setting and overcoming barriers can be effective to increase physical activity (e.g., Croteau, 2004), but other strategies may be needed to sustain the effects.

Environmental Interventions

More interventions are being implemented at the level of the community and even society. Innovative strategies that entail environmental engineering, community action, and legislation to support active lifestyles are being explored. Matson-Koffman, Brownstein, Neiner, and Greaney (2005) reviewed 129 studies published from 1970 to 2003 that addressed policy or environmental interventions to promote physical activity and/or good nutrition, half of which were published since 1990. They concluded that policy and environmental strategies may promote physical activity and good nutrition. The strongest evidence for influencing physical activity was for prompts to increase stair use, access to places and opportunities for physical activity, school-based physical education, and comprehensive work site approaches.

With exponential increases in the use of technology, the electronic environment should be considered a setting for physical activity interventions. Young adults spend a significant proportion of their discretionary time using computers. Their familiarity with this communication, entertainment, and educational tool may make them more receptive to computer-mediated exercise interventions (Fotheringham, Wonnacott, & Owen, 2000). In fact, an increasing number of universities and high schools recognize this potential and offer some physical education classes online. Web sites, telephones, and e-mail have the potential to deliver physical activity interventions to a large number of participants at a low cost. Researchers and practitioners who develop programs to be implemented electronically must consider issues of engagement and retention, especially with middle-aged and older adults who are not dedicated users of information technology (e.g., Leslie, Marshall, Owen, & Bauman, 2005).

Intervention Summary

Researchers and practitioners have become more methodical in the design and implementation of interventions since the last edition of this *Handbook,* but problems still exist. These include lack of follow-up, undemonstrated fitness or health changes, poor measures of fitness and physical activity, variability in how adherence is defined and measured, and the absence of minimally effective intervention conditions for control comparisons. Comparisons between different types of interventions that have been associated with increased physical activity should be made, and application of a theoretical model in the implementation and analysis would make important contributions to what we know about exercise adherence. In the following section, we review representative studies that have applied theoretical models to exercise or physical activity settings.

RESEARCH EVIDENCE

Baranowski, Anderson, and Carmack (1998) used a mediating framework to assess physical activity intervention and correlational studies and concluded that most studies do not measure mediating variables. They charged the research community to focus on understanding the predictors of physical activity and to design and test interventions to modify purported mediators (Baranowski et al., 1998). One place to start in selecting possible mediators is a thorough review of physical activity and exercise correlates. A better approach is to select a theoretical model of behavior change and apply key constructs. Theories of human behavior should be used to guide the development and implementation of intervention technologies; these can be directed at various stages of planning, adopting, and maintaining regular physical activity. The primary theories that have been applied to public health promotions of physical activity are the theory of reasoned action/planned behavior, social cognitive theory, the transtheoretical model of behavior change, self-determination theory, and the social ecological model. Please see Biddle et al.'s chapter, "Theoretical Frameworks in Exercise Psychology," in this *Handbook* for a constructive review and analysis of theoretical models and frameworks that have been applied to physical activity and exercise.

The vast majority of theories used in exercise behavior change have been at the personal level and have focused on cognitive, affective, and social influences on the choice to be physically active (Dishman, 1994a; King, Stokols, Talen, Brassington, & Killingsworth, 2002). It seems unlikely that psychological models that exclude or minimize considerations about biological aspects of physical activity or environmental factors will be sufficient to explain and predict physical activity. The following are examples of how the major theoretical models have been used in interventions, and how well the models have been able to foster adherence.

Theory of Reasoned Action/Planned Behavior

The theory of reasoned action (TRA) proposes that attitudes can predict behavior through their interaction with social norms. Both influence exercise intention, which is viewed as the direct mediator of behavior. The theory of planned behavior (TPB) is an expanded model that adds the influence of perceived and actual control over behavior. Perceived behavioral control predicts intention, but can also have a more direct effect on behavior. Hausenblas, Carron, and Mack (1997) conducted a meta-analysis of studies that applied the TRA/TPB to exercise. There were large effects for all tested relationships except the moderate effect between social norms and intention and the nonsignificant effect for social norms and exercise. A more recent meta-analysis by Hagger, Chatzisarantis, and Biddle (2002b) also generally supported the major relationships of the TRA/TPB. They concluded that self-efficacy and past behavior are important additions to the model to predict physical activity. Adding self-efficacy to TPB increases its utility, as self-efficacy has effects that are independent of perceived behavioral control.

Elements of the TPB have predicted exercise adherence in diverse samples. Subjective norm was the most important determinant of intention, and intention was the only determinant of exercise program attendance in breast cancer survivors (Courneya, Blanchard, & Laing, 2001). Attitude, perceived behavioral control, and social norm predicted attendance in a cardiac rehabilitation program through effects on intention (Blanchard et al., 2003), and exercise adherence in colorectal cancer survivors was explained by perceived behavioral control (Courneya et al., 2004). Attitude, social norms, and perceived behavioral control predicted intention, which predicted exercise in pregnant women from their second to third trimester (Downs & Hausenblas, 2003). Theory of planned behavior constructs accounted for substantial variance in aerobic (19%) and resistance (40%) exercise over 3 months in a sample of healthy college students (Bryan & Rocheleau, 2002). Because other variables were included in that model (i.e., extraversion and perceived health), we cannot conclude that TPB predicts resistance exercise better than aerobic exercise.

General Conclusions

The addition of perceived behavioral control to the TRA and self-efficacy to the TPB strengthened their explanation and prediction of exercise behavior. The usefulness of the social norm construct has been questioned, but there is evidence that it is predictive for some populations.

Self-Efficacy Theory

According to Bandura's (1991) self-efficacy theory, behavior change and maintenance are a function of expectations about the outcome and belief in one's ability to engage in or execute the behavior (efficacy). Self-efficacy beliefs have been related to the adoption, maintenance, and relapse of physical activity in free-living settings (McAuley & Blissmer, 2000). For example, self-efficacy decreased over 6 months in university students who regressed in their exercise stage of change, but exercise self-efficacy was unchanged for those who maintained regular exercise (Wallace & Buckworth, 2003). In another study of university students, social cognitive theory variables explained 55% of the variance in physical activity over 8 weeks (Rovniak, Anderson, Winett, & Stephens, 2002). Self-efficacy, which was mediated by self-regulation, had the greatest total effect on physical activity. Social support predicted physical activity through its effect on self-efficacy. There were no significant effects, however, for outcome expectations.

Self-efficacy is also related to adherence in exercise interventions. Higher exercise self-efficacy and perceived benefits and barriers were associated with better attendance by African American and Hispanic college women in a 16-week exercise program (D'Alonzo, Stevenson, & Davis, 2004). Increased self-efficacy and fitness outcome realization predicted adherence at 7 and 12 months of an exercise program in initially sedentary older adults, but exercise-related social support was not related to adherence

(Brassington, Atienza, Perczek, DiLorenzo, & King, 2002). Hallam and Petosa (2004) found support for self-efficacy and other constructs of social cognitive theory mediating exercise adherence in a work site intervention. They found theoretically expected increases in self-regulation skills, outcome-expectancy values, and self-efficacy for the treatment group and not the control group, and better adherence across 12 months for the treatment group. Other intervention studies have found that effects of self-efficacy can be mediated by other variables, such as self-management strategies (e.g., Dishman, Motl, Sallis, et al., 2005). Self-efficacy may have different effects during adoption and maintenance and as a function of intervention. Oman and King (1998) found that baseline self-efficacy, independent of past adherence, predicted adherence during the adoption but not maintenance phase of their 2-year randomized trial. Long-term exercise program maintenance was predicted by self-efficacy in the supervised home-based exercise but not the class-based condition.

General Conclusions

Social cognitive theories are frequently applied to physical activity, and self-efficacy has the strongest support as a correlate of exercise and physical activity. There is evidence for its role in exercise adoption, but mixed support for effects on adherence.

Self-Determination Theory

Motivation represents the internal and external forces that produce the initiation, direction, intensity, and persistence of a specific, goal-directed behavior and is one of the critical cognitive variables in exercise adoption and maintenance. The initiation of the behavior can be the result of psychophysiological drives, but the contemporary perspective is that the need for self-improvement or self-actualization provides the "Why?" for behavior. Self-determination theory (SDT) is a theory of human motivation proposing that behavior is sustained when basic needs for affiliation, competency, and autonomy are met; behavior is facilitated when motivation is intrinsic (Deci & Ryan, 1985; Ryan & Deci, 2000). Please see the chapter by Biddle et al. in this *Handbook* for a more comprehensive description of this theory.

Wilson, Rodgers, Fraser, and Murray (2004) conducted a study to gain more insight into the role of SDT constructs on exercise. They measured amotivation, extrinsic regulation (external, introjected, identified) and intrinsic regulation of exercise behavior, exercise behavior, behavioral intentions, and effort and importance associated with exercise participation in 276 university students. Intrinsic regulation predicted effort and importance for men and women, and behavior intentions for women. However, of the extrinsic motivations, identified regulation had the strongest influence on motivational consequences, and introjected regulation contributed to predicting each motivational consequence for women. They concluded that aspects of the regulatory continuum closer to intrinsic regulation (i.e., identified regulation) can predict exercise behavior, intention, and effort and importance attached to exercise, but that there are positive effects on behavior and psychological outcomes from extrinsic motivation in exercise. There is some evidence, however, that the use of extrinsic rewards can undermine intrinsic motivation for sport and exercise activities (e.g., Frederick & Ryan, 1995). Other behavioral researchers have suggested that intrinsically motivated behavior may be more likely to be maintained without external reinforcers (Curry, Wagner, & Grothaus, 1990; Harackiewicz, Sansone, Blair, & Epstein, 1987). Intrinsic motivation may also be associated with psychological well-being. Maltby and Day (2001) compared university students who had been exercising regularly for less than 6 months to those exercising for 6 or more months on exercise motivation and psychological well-being. The number of extrinsic motivations for exercise was significantly related to poorer psychological well-being for those who more recently adopted exercise; conversely, the number of intrinsic motivations was significantly related to better psychological well-being for those exercising regularly for 6 or more months.

We found one published study describing the results of an intervention based on SDT. Levy and Cardinal (2004) implemented a mail-mediated intervention including strategies intended to promote perceptions of autonomy, competence, and relatedness regarding exercise. No clear effects of the intervention on SDT variables were reported, but it cannot be said that SDT is not applicable in exercise interventions because in this study participants were not compliant in completing the intervention tasks designed to target SDT constructs.

General Conclusions

One of the contributions of SDT is the caution not to dichotomize motivation into intrinsic and extrinsic influences, but to conceptualize a motivational continuum. More self-regulated extrinsic motivation may be a goal with exercise adherence because exercise may not be inherently interesting or enjoyable enough for most people to exercise for only intrinsic reasons. Most intervention approaches enhance less self-directed extrinsic motivation to exercise, such as offering social support and setting up rewards and consequences that originate outside the person. Another contribution is the concept of psychological need, which is an energizing state that can enhance well-being when satisfied. It seems that if exercise can satisfy the psychological needs for autonomy, competency, and relatedness, then adherence would be enhanced. Currently, very few studies have been published that describe exercise or physical activity interventions based on SDT, although concepts related to competency are emphasized in respect to the positive effects of, for example, mastery experiences on self-efficacy.

Transtheoretical Model (Stages of Change Model)

The transtheoretical model of behavior change (TTM) was introduced in 1982 by Prochaska and DiClemente as a model of *how* people change health behaviors, specifically cigarette smoking. Behavior change is described as a process in which stages are used to identify the dynamic process through which an individual progresses when intentionally attempting behavioral change (Prochaska & Velicer, 1997). Mediators of stage-specific transition are decisional balance, self-efficacy, and processes of change. Each stage is characterized by a difference in decisional balance, the balance between the benefits (pros) and the costs (cons), and intentions associated with engaging in a behavior (Nigg, 2005). Self-efficacy increases with stage progression, but is thought to be more important in the later stages. According to the theory, the cognitive processes of change are more important during adoption, and the behavioral processes are used more in the later stages. Support for theoretical relationships among TTM constructs and adherence is mixed, and the validity of the TTM as a true stage model has been challenged (see Bandura, 1997; Biddle et al., in this *Handbook;* Weinstein, Rothman, & Sutton, 1998).

Few of the published studies using the TTM applied to exercise behavior have included all the key constructs. According to a recent meta-analysis, only three of the samples from 71 published reports included all the TTM constructs, and most studies were cross-sectional (Marshall & Biddle, 2001). Cross-sectional designs do not serve to examine the dynamic nature of exercise behavior change, only to describe the characteristics of individuals falling into the different stages. We found two longitudinal studies published since 2001 that tested all the TTM constructs. Prapavessis, Maddison, and Brading (2004) found that all TTM constructs predicted stage transition 6 months after initial assessment in a large (1,434 at 6 months) sample of New Zealand adolescents. Plotnikoff, Hotz, Birkett, and Courneya (2001) tested the predictive ability of the TTM in 683 adults 6 and 12 months after an initial assessment and found strongest support for the self-efficacy construct and weakest for experiential processes of change. Results were mixed in that only 45% of their predictions based on the model were supported.

Several interventions have been based on the TTM. Adams and White (2003) found 16 programs described in 26 papers published from 1982 to 2001 that described TTM-based interventions to promote physical activity. Eleven programs demonstrated increases in physical activity in the short term, that is, less than 6 months. However, only 2 of the 7 longer interventions reported sustained activity for more than 6 months. Five studies reported stage progression without a concurrent measure of physical activity. We cannot assume that stage progression is a good proxy of changes in physical activity, although several studies used stage change only as the outcome variable.

General Conclusions

A number of early reviews of the exercise adherence literature acknowledged the appearance of stages of exercise behavior (e.g., Dishman, 1982; Martin & Dubbert, 1985). The TTM, which was initially developed for smoking (Prochaska & DiClemente, 1982), was applied to exercise in the early 1990s (e.g., Marcus, Selby, Niaura, & Rossi, 1992). A potential major contribution of the TTM for increasing exercise and physical activity lies in its consideration of the readiness for change. As well, relapse cannot be understood or controlled without knowledge of the influence of past history on contemporary exercise and physical activity. The status of the TTM as a true stage model has been called into question, and the lack of an interaction between stage and processes reported by Marshall and Biddle (2001) does not support stage-matched interventions. A few intervention studies have tested the stage assumption that people in different stages must face different barriers; these studies compared stage-matched to stage-mismatched interventions, with no or mixed support (Blissmer & McAuley, 2002; Bull, Jamrozik, & Blanksby, 1999; Marcus et al., 1998). Results may also be conflicting because this model was developed to explain the cessation of a frequent, undesired, addictive behavior (smoking) and is being applied to adoption of an infrequent, desired behavior that requires considerable effort, time, and planning. Additionally, the TTM is a behavior *change* model, and this may explain in part the lack of support for the usefulness of this model to support exercise adherence.

Relapse Prevention Model

Even among the habitually active, unexpected disruptions in activity routines or settings can interrupt or end a previously continuous exercise program. Interruptions and life events have less impact as the activity habit becomes more established; their impact may also be diminished if the individual anticipates and plans for their occurrence and develops self-regulatory skills for preventing relapses to inactivity. A popular example of self-regulation is relapse prevention developed by Marlatt and Gordon (1985). The application of relapse prevention to exercise has been described thoroughly by Knapp (1988) and includes identifying situations that put a person at high risk for relapse and expecting and planning for lapses, such as scheduling alternative activities while on vacation or after injury.

Simkin and Gross (1994) tested the relapse prevention model with exercise by measuring coping responses to high-risk situations in a prospective study of women who had started exercising on their own. A lapse, defined as no exercise for one of the 14 weeks of observation, occurred in 66% of the women, and 41% experienced a relapse, defined as at least 3 consecutive weeks of no exercise. Relapse antecedents were boredom, lack of time, laziness, vacation, and illness. Those who did not relapse had higher self-motivation scores and fitness measured at baseline and used more coping skills and behavioral strategies than those who relapsed. Marcus and Stanton (1993) included identifying high-risk situations, developing effective coping responses, and a planned relapse in their application of relapse prevention in an 18-week intervention with women. Adherence was compared among a relapse prevention group, a reinforcement group, and a control group. At week 9, the relapse group had better attendance than the control (89% versus 57%) but not statistically better than the reinforcement group (64%). However, at the end of the intervention, most of the participants had dropped out, regardless of group (attrition 67% to 76%). Marcus and Stanton speculated that planned relapse is not effective for acquisition of new behavior, citing several studies in which relapse prevention without planned relapse was beneficial for exercise adherence.

Other components of relapse prevention, such as identification of and planning for high-risk situations, developing coping skills, and using a decisional balance sheet, are often included as part of interventions but are not typically analyzed as mediators of adherence. Stetson et al. (2005) conducted a more comprehensive test of the relapse prevention model in a community sample of 65 adults who had been exercising regularly for an average of 5 years. They measured current and past exercise, self-efficacy for overcoming obstacles, aspects of the abstinence violation effect (e.g., perceived control and affective response), and cognitive and behavioral coping responses. At baseline, self-identified high-risk situations were also measured. Participants were reassessed at 3 months, and 53.8% slipped in response to a high-risk situation. The most common high-risk situation was bad weather. Being alone was the only high-risk situation associated with a slip, but interestingly, participants who were alone during the high-risk situation were *less* likely to slip. Both men and women who slipped reported more guilt that those who did not, but less perceived control was related to a slip only for men. The only measured variable associated with dropout over the 3 months was use of the cognitive reappraisal coping strategy. Cognitive coping strategies and not behavioral strategies reduced the likelihood of a slip. Other gender differences were reported, which supports the need for additional research on relapse prevention and exercise comparing the effects of high-risk situations and coping responses between men and women.

General Conclusions

Knapp (1988) correctly noted that relapse prevention was designed for reducing high-frequency, undesired, addictive behaviors such as smoking and substance abuse, whereas exercise is a desired but low-frequency behavior for many. In addition, exercise lapse is hard to define and may not be recognized or dealt with before adherence is threatened.

Thus, modification of the relapse prevention model may be required to enhance its effectiveness for increasing exercise adherence. Although behavioral interventions based, in part, on the principles of relapse prevention have resulted in increased exercise frequency, more naturalistic studies of free-living exercise, such as described by Stetson et al. (2005), are needed to describe the parameters of relapse and the predictive validity of the processes of relapse for exercise behavior.

Social Ecological Model

Ecological models acknowledge that behavior can be influenced by the social environment, physical environment, and public policy variables, along with intrapersonal factors. According to the social ecological model, behavior is affected by and affects multiple levels of influence; that is, there is reciprocal causation between the individual and his or her environment. Sallis and Owen (1999) applied this model to physical activity and defined the "behavioral setting" to describe social and physical (constructed and natural) environmental factors that can facilitate or enable the decisions to be more active and the behavior itself.

Using social ecological models, physical activity is targeted through changing the environmental and public policies. There are, however, limited studies that have systematically changed aspects of the physical and/or sociocultural environment and measured effects on physical activity. Effects from environmental manipulations are often difficult to measure and to isolate from other multiple personal and social influences on physical activity and are likely to be necessary but not sufficient for long-term maintenance of active lifestyles. Associations between environmental factors and physical activity have been demonstrated in several studies (e.g., M. Duncan & Mummery, 2005). For example, the relative influence of individual, social environmental, and physical environmental correlates of recreational physical activity was assessed in 1,803 healthy adults in metropolitan Perth, Western Australia (Giles-Corti & Donovan, 2002). Generally, there were some associations between environmental factors and behavior, but individual and social environmental determinants were more important than the physical environment in explaining exercise behavior. A supportive physical environment is necessary but may not be sufficient to enable individuals in a community setting to become sufficiently physically active.

General Conclusions

Theories and models that come from environmental and community psychology can contribute to our understanding of how environments can enable or impede physical activity. Please see King et al. (2002) for a useful summary of six of these theories, and Pikora, Giles-Corti, Bull, Jamrozik, and Donovan (2003) for a framework of potential environmental influences on walking and cycling in community settings. Because access and safety are reported barriers in different populations (e.g., Eyler & Vest, 2002), environmentally focused interventions based on the social ecological model that include efforts to develop safe, accessible facilities for exercise have promise through an impact on perceived accessibility.

Summary of Research Evidence

There is evidence that researchers are applying models to exercise and physical activity in a more systematic way (e.g., TPB: Courneya & McAuley, 1995; TTM: Plotnikoff et al., 2001; social cognitive theory: Rovniak et al., 2002; SDT: Wilson et al., 2004) and are evaluating theoretical constructs for mediation of behavior change in intervention studies. We are also beginning to see reports of process evaluations to test the fidelity of theoretically based interventions (e.g., Hallam & Petosa, 2004; Levy & Cardinal, 2004; Pate et al., 2003). These efforts will advance our understanding of how well different theories actually explain and predict exercise behavior; however, it is unknown if any model or combination of models can explain physical activity behavior adequately for public health purposes of increasing physical activity adoption and adherence. The TTM is the only process model consistently used with exercise, and yet it does not seem as useful with individuals maintaining regular exercise or in identifying someone at risk of relapse as it is with facilitating adoption and early adherence. The lack of progress in increasing adoption and adherence to regular physical activity may also be a consequence of limiting interventions to motivational and educational approaches directed to individuals or small groups.

ISSUES IN RESEARCH

Efforts to apply theoretical models to exercise adherence have contributed to the quality of studies in exercise psychology published since the previous edition of this *Handbook*. Still, there are areas in which improvement is needed. The following sections define these issues and lead to the final section, in which we make recommendations for future research directions.

Measurement of Outcomes

The terms *exercise, physical activity,* and *lifestyle activity* reflect subtle differences in how we conceptualize and measure the target behavior and how adherence is defined and measured. Regardless of how the behavior is defined, it must be measured with reliable and valid methods. The critical aspects of good measures of exercise or physical activity have been elaborated elsewhere (Dishman, 1994b; Dishman, Washburn, & Schoeller, 2001), but many studies continue to rely on unvalidated self-report instruments. There are problems in standardizing results for studies of correlates and adherence that cannot use objective tools to measure physical activity because of the confounding aspects of the cognitive recall process (Durante & Ainsworth, 1996). Questionnaires validated against biological estimates of activity (e.g., metabolic tolerance) are useful in dichotomizing between high-active and sedentary individuals, but they are less accurate in providing valid data for other aspects of behavior, such as distinguishing among levels of activity intensity. Measurement of physical activity by accelerometry has become popular, but accelerometry has practical limitations (Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005). Poor measurement can compound difficulties in evaluating exercise adherence, but consistent and clear measurement of adherence and dropout are not characteristic of the exercise and physical activity literature. In supervised exercise studies, widely varying definitions and variables are used to indicate adherence. This makes it difficult to compare the effectiveness of different interventions.

Along with how it is measured, other elements of adherence necessary to consider are the active voluntary involvement of the participant in an ongoing, dynamic process and, consequently, motivation to continue investing the effort necessary to sustain the target behavior. Thus, the behavior alone is not a complete indicator of adherence, especially when we want to sustain adherence or at least understand what psychosocial and environmental factors facilitate or impede behavioral maintenance. For practical and research purposes, it is desirable to evaluate mediators and moderators, as well as both subjective and objective evidence of exercise behavior over time.

Measurement of Mediators and Moderators

Factors that are hypothesized to influence exercise and physical activity must be measured and tested for mediation according to accepted procedures (e.g., Baron & Kenny, 1986). Personal goal attainment, satisfaction, and enjoyment of activities are theoretically stronger reinforcers of maintenance of physical activity than knowledge and beliefs, but surprisingly, they have been understudied using validated measures. Use of scales to measure correlates and potential mediators of behavior change should include validation if the scale is used for a different population from the one it was developed for, or if the scale has been modified. This is not always the case, and mixed results for some variables may be a fault of the instrument not capturing the level of a construct in the sample or the use of multiple instruments to measure the same construct. The inconsistent evidence for mediation for several psychosocial variables typically associated with physical activity and exercise points to the need for newer conceptualizations and statistical applications of mediator and moderator analyses (e.g., Kraemer, Wilson, Fairburn, & Agras, 2002).

We also need to measure mediators frequently to determine the trajectory of change (King et al., 2002) and to determine if mediators of change operate in a dose-response manner or have a threshold for effects. It is likely that changes in mediators over time are not linear, and there are different influences on adoption, early adherence, and long-term maintenance of sufficient physical activity. More sophisticated statistical analyses, such as structural equation modeling, should be used to reveal the dynamics of change.

Intervention Design

Current models of behavior do not discriminate between lifestyle physical activity and regular exercise. These are distinct behaviors that likely have different psychological and environmental determinants requiring different intervention strategies. Personal-level interventions have traditionally dominated research in the field of physical activity behavior, but more interventions incorporating strategies from social ecology and urban planning are being implemented at the community and environmental levels. Interventions that include choice-enabling as well as choice-persuasive strategies based on a transdisciplinary model (King et al., 2002) can make significant contributions to the literature. Intervention tailoring is being applied in different settings (e.g., medical clinics); Cress et al. (2005) recommended tailored programs as one guideline for best practices for interventions for promoting physical activity in older adults. However, there is mixed evidence for the superiority of tailoring and stage-matched interventions, and these approaches should be tested against standard interventions. Some of the more effective interventions include a tapering of contacts and booster sessions. This makes sense from a behavioral perspective, and we are surprised that more interventions do not include a phase to help the participants make the transition to being regularly active on their own. Additionally, we must have long-term follow-up in which suspected mediators and moderators are measured in addition to behavior and physiological outcomes.

Population

Progress has been made in how much we know about correlates of exercise and physical activity in ethnic minorities, children, older adults, and women, and in populations in Asia and South America. There has been an increase in interventions directed to ethnic minorities, but we need more studies designed to determine the efficacy of culturally appropriate intervention methods and messages (e.g., Beech et al., 2003; Lee et al., 2001; Newton & Perri, 2004).

Increasing rates of physical inactivity and obesity in children and adolescents point to the need for effective behavior change interventions in these populations (Pate et al., 2005). Beliefs about ability and goals (Biddle, Wang, Chatzisarantis, & Spray, 2003), enjoyment (Dishman, Motl, Saunders, et al., 2005), and the role of sedentary behaviors (Santos et al., 2005) may be more powerful influences for children than for adults. Interventions with children need to address the social and environmental barriers to and support of physical activity that are distinctive to children and adolescents, such as control over resources and time and the influence of sedentary recreation on participation in exercise and sport.

The increase in the number of older adults in the United States presents a challenge to physical activity promotion because by age 75, about 33% of men and 50% of women do not engage in any physical activity (USDHHS, 1996). Additionally, the elderly are particularly vulnerable to barriers to physical activity that may not be as influential on younger populations (e.g., perceived poor health, fear of pain or injury, or caring for an ailing family member). Cultural norms can prejudice us to perceive and treat older adults as frail, which can reinforce a personal schema of dependency (Brawley, Rejeski, & King, 2003). Additional barriers, such as misconceptions of older adults that physical activity must be strenuous or uncomfortable to be beneficial must be addressed in interventions (Brawley et al., 2003).

Gender differences in exercise adherence were generally not compared in the reports of clinical trials and exercise adherence we reviewed (Buckworth & Sears, 2006). This is unfortunate considering that females are less active than males. There is ample evidence for gender differences in correlates of physical activity and sedentary behaviors between boys and girls (Brodersen, Steptoe, Williamson, & Wardle, 2005; Godin et al., 2005) and some evidence for difference in predictors of adherence (e.g., Duncan, Duncan, & McAuley, 1993). Intervention effectiveness should be compared between males and females in all age groups.

Application of Theories

The theoretical models that dominated early exercise adherence research were based on the assumption that mediators of exercise behavior change are intraindividual processes, such as attitudes and beliefs. Some included environmental factors (e.g., social cognitive theory) but still emphasized psychosocial forces as determining behavior. The environment has been emphasized in several recent correlational studies based on ecological models. Changes in the environment can act as mediating variables on behavior without necessarily being mediated by psychological variables. That is, environmental interventions may not need conscious mediation to be effective.

Progress has been made in using established theories in intervention research, but many researchers apply incomplete models and combine constructs and strategies from several theories in designing interventions. This is understandable because several theories share common variables and predictive relationships, but interpreting results using two incomplete theories is problematic. Still, there is merit in considering a transdisciplinary paradigm, as proposed by King et al. (2002), as evidence mounts for the role of multiple levels of influence on physical activity behavior.

CONCLUSION

We soon embark on the 5th decade of psychological research on exercise adherence. We are in a better position to form questions and strategies that will effectively advance our ability to increase participation in leisure physical activity and exercise around the world reliably and predictably. We have several recommendations to be addressed for future research:

- Adherence must be reframed to consider patterns of physical activity over the life span. Efforts must be made to study the patterns of physical activity over time and in different populations, considering unique cultural and economic-political differences within and among countries. We still do not know the situations and individual characteristics that influence increases, decreases, or stability in level of physical activity or purposeful exercise. It may be that most people go through phases during their lives when they are more or less physically active, and it is therefore unrealistic to expect lifelong behavioral stability.
- Interventions to increase lifestyle physical activity must be supported by empirical research on the correlates of naturally occurring change in physical activity. We must address differences and similarities between mediators and moderators of lifestyle physical activity and regular exercise, and among exercise modes and prescriptions. We need to understand how perceptions and preferences for types of activities and intensities are formed and if they influence

participation. We must also study how genetic variation influences biological adaptability to exercise and the motivation to be physically active.

• Mediator research should be conducted in different populations, at different points in the adoption-maintenance process. There is likely a range of mediating variables and a cascading sequence of mediating processes that are different throughout behavior change and maintenance. We need to determine the influence of level and change of a mediator and examine the possibility of thresholds for mediators for behavior change. Multivariate analysis should be conducted with multiple mediators, and we should take advantage of the advances in data analysis, such as latent variable structural equation and growth modeling and multilevel analysis. Naturally, this research must be supported by sound measurement of these constructs and behavioral outcomes.

• Intervention research needs to evolve to match what we know about behavior. Programs should routinely have sequenced components focusing on adoption, early adherence, maintenance, and relapse prevention with appropriate strategies. Intervention design should incorporate follow-up sessions to monitor participants after the formal intervention is over. Process evaluation should also be included routinely to evaluate intervention fidelity.

• The application of theories and models from diverse disciplines, such as urban planning and transportation, should be continued. The field is growing beyond a focus on intra- and interpersonal explanations and interventions, and we must continue to study adherence through a broad lens. Social support, self-motivation, and self-regulatory skills and interventions such as relapse prevention seem necessary to maintain or resume regular physical activity, but choice-enabling environments also play an important role from a public health perspective. Key constructs from different theories should be competitively contrasted or remodeled based on path analyses of data from large population-based studies or large sample clinical studies of specific target groups.

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CHAPTER 24

Theoretical Frameworks in Exercise Psychology

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Reference to apparently unhealthy lifestyles in modern society is now common in popular and academic media. Contemporary diseases and conditions most often mentioned as having an association with physical inactivity include obesity, diabetes, heart disease, and some cancers. Indeed, obesity seems to be the health issue most worrying politicians and health professionals, and lack of physical activity is a key element of the energy imbalance that is causing current obesity trends (Bouchard, 2000; Bouchard & Blair, 1999). However, the beneficial effects of physical activity go far beyond healthy weight management. The magic pill of physical activity is powerful, with effects demonstrated on numerous health outcomes, including positive mental health (Dishman, Washburn, & Heath, 2004). Indeed, physical activity research pioneer Professor Jeremy Morris (1994, p. 807) once referred to physical activity as "today's best buy for public health," and we now have strong advocacy documents promoting the importance of regular, moderate-intensity physical activity on most days of the week (Department of Health, 2004; U.S. Department of Health and Human Services & Centers for Disease Control and Prevention, 1996; Pate et al., 1995). In addition, recommendations can be tailored to individual needs, such as those of young people, adults, older adults, and those with certain medical conditions (Department of Health, 2004).

The five-phase behavioral epidemiology framework advocated by Sallis and Owen (1999) is a useful way of viewing various processes in the understanding of physical activity and health. Behavioral epidemiology considers the link between behaviors, health, and disease, such as why some people are physically active and others are not. In relation to physical activity, this framework has five main phases. The first is to establish the link between physical activity and health. The second phase is to develop methods for the accurate assessment of physical activity. The third phase is to identify factors that are associated with different levels of physical activity. Given the evidence supporting the beneficial effects of physical activity on health, it is important to identify factors that might be associated with the adoption and maintenance of the behavior. This area is referred to as the study of correlates or determinants of physical activity. The fourth phase is to evaluate interventions designed to promote physical activity, and the fifth is to translate findings from research into practice.

In this chapter, we focus on theoretical frameworks and perspectives that assist in the understanding of determinants and correlates of physical activity, thus addressing issues in phase 3 of the behavioral epidemiological framework. A theory is "a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomena" (Kerlinger, 1973, p. 9). Physical activity behavior researchers have adopted theories and models from general, social, educational, and health psychology (Sutton, 2004) and tested and applied them in the context of physical activity. Given the emphasis of this book on psychology, we, too, adopt an individual psychological approach to understanding physical activity. However, we recognize the importance of a wider set of influences, including the broader social, environmental, and cultural context of behaviors (Sallis & Owen, 1999).

To assist in the organization of diverse theories, we have placed key theoretical frameworks into a classification

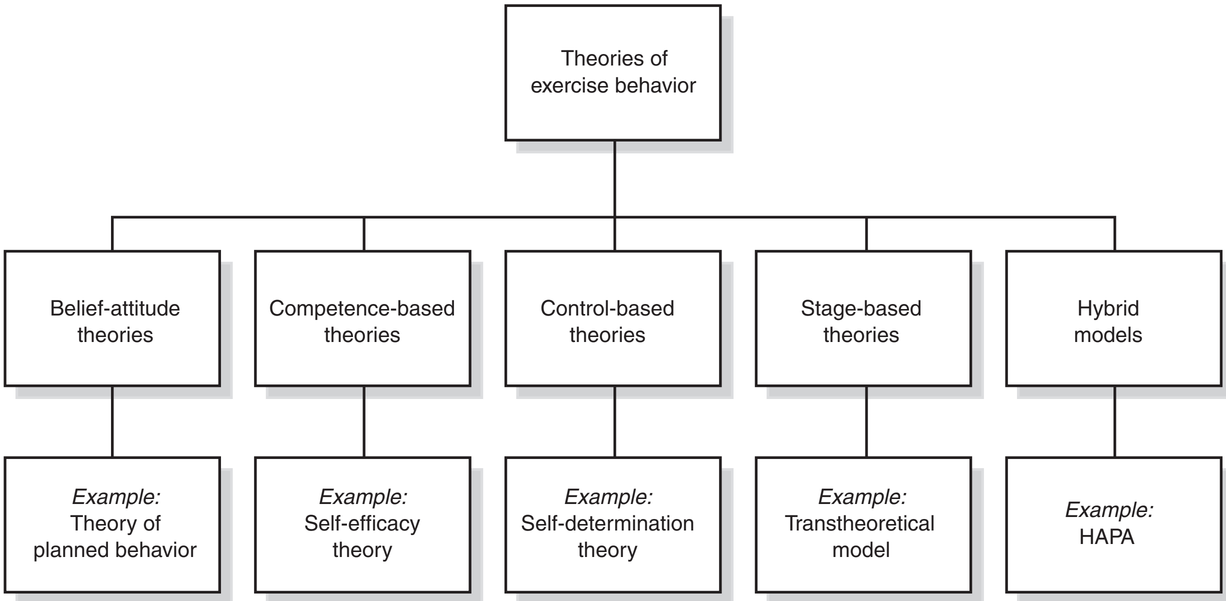

Figure 24.1 A framework for classifying theories of physical activity. Adapted from S. J. H. Biddle and C. R. Nigg, 2000, "Theories of Exercise Behavior," *International Journal of Sport Psychology, 31,* pp. 290–304. Adapted with permission.

system (Biddle & Nigg, 2000), as shown in Figure 24.1. Such a system is a heuristic, and there will be overlap between categories, as we discuss later concerning implementation intentions. Moreover, part of the classification may reflect different types of theories, such as continuous approaches like the theory of planned behavior, and stage models that assume discontinuity between the different stages, at least for some variables. In addition, Armitage and Conner (2000) have made the distinction between motivational and behavioral enaction models. The former, such as the theory of planned behavior, tend to predict behavior from a series of variables. The key variable is intention or motivation that mostly mediates the influences of predictors on behavior. Behavioral enaction models, on the other hand, focus on the translation of intentions into behavior by postintentional variables, such as implementation intentions (discussed later).

Throughout the chapter we refer to physical activity in the context of sport, exercise, and physical activity for health rather than high performance, some of the models and frameworks may be appropriate beyond this context.

BELIEF-ATTITUDE APPROACHES

Attitude has been one of the most influential and enduring constructs in social psychology and has been incorporated into many theoretical approaches adopted for the understanding of physical activity behavior (Hagger, Chatzisarantis, & Biddle, 2002b). The fascination of attitudes in social psychology has been largely due to the premise that attitudes predict behavior (Wicker, 1969). However, studies have often reported a considerable gap in the attitude-behavior relationship (Chatzisarantis, Hagger, Biddle, & Smith, 2005; Sheeran, 2002). Social cognitive theories developed in the past 2 decades or so have done much to resolve this disparity, and contemporary theories incorporate attitude alongside measures of other fundamental belief-based constructs in an attempt to understand the mechanisms underlying social behavior such as physical activity (Hagger & Chatzisarantis, 2005a). A brief overview of attitudes as an important theoretical construct in the context of physical activity is presented in this section, with a focus on the theories of reasoned action and planned behavior (Ajzen, 1985, 1991; Ajzen & Fishbein, 1980) as an example of a popular social cognitive approach that has adopted attitude and belief-based constructs to study physical activity.

Attitude is commonly defined as an individual's favorable or unfavorable evaluation of an attitude object or target behavior (Ajzen, 1991; Eagly & Chaiken, 1993). Attitudes have typically been measured with semantic differential scales using bipolar word adjectives (Ajzen, 2001). These scales have often been validated using exploratory factor-analytic procedures to arrive at multi-item scales that capture the essence of the person's beliefs regarding the target behavior. In the domain of physical activity, the adjectives that have been most frequently used to measure attitudes reflect moral (e.g., good-bad), instrumental (e.g., harmful-beneficial), and affective (e.g., pleasant-unpleasant) beliefs about the target behavior (Ajzen & Driver, 1991). Such measures are known as *direct* measures of attitudes because they focus on attitudes at the global level rather than the beliefs that underpin the construct.

The use of semantic differential attitude scales can be problematic because their use may be susceptible to method and context effects. Method effects describe responses to attitude items that are triggered by similarities in the method used to measure attitudes rather than by the content of the items (Mulaik & Millsap, 2000). Context or order effects refer to biases in responses to attitude items caused by responses to previously presented items (Ajzen, 2002). For example, the presentation of an affective attitude item to which a person responds positively may affect his or her response to an instrumental attitude item presented subsequently. In fact, this often occurs in attitude research in physical activity involving the administration of multi-item attitude inventories.

Problems associated with context and method effects can be overcome by constructing a large set of belief statements that are relevant to physical activity and then asking people to rate these statements on Likert-type scales (Ajzen, 2002). Responses to these belief statements constitute an *indirect* or belief-based measure because attitudes are inferred from the beliefs themselves (Fishbein & Ajzen, 1975). Another popular conceptualization of attitudes that has been used in physical activity studies is the expectancy-value model (Fishbein & Ajzen, 1975; Pender & Pender, 1986; Riddle, 1980). This model also constitutes an indirect measure of attitudes. It posits that a combination or multiplicative function of beliefs that behavior will lead to certain consequences, known as *behavioral beliefs,* and evaluations of these consequences, known as *outcome evaluations,* are indicators of attitudes. Expectancy-value measure of attitudes can be formulated by asking respondents to rate available behavioral beliefs on expectancy scales (e.g., "Engaging in physical activities will make me fitter") and then multiplying each of the likelihood ratings with ratings of the desirability of behavioral beliefs (e.g., "Getting fitter is good/bad"). Such indirect measures of attitude are often used in social cognitive theories to validate the direct measures by correlating the composite expectancy-value items with the direct measures (Hagger, Chatzisarantis, & Biddle, 2001).

The Theory of Reasoned Action

The theory of reasoned action (TRA; Ajzen & Fishbein, 1980) is a popular and widely cited social cognitive model that incorporates attitudes in a belief-based framework aimed at explaining behavioral intentions, the proximal precursor of actual behavior. It preceded the more commonly studied model in contemporary literature, the theory of planned behavior. In the TRA, intention indicates the degree of planning and effort people are willing to invest in their performance of future behavior. It is therefore a construct that is motivational in nature and function. Intention is the most immediate or *proximal* antecedent of behavior and is a function of a set of personal and normative expectations regarding the performance of the behavior, termed attitudes and subjective norms, respectively. Attitudes represent an overall positive or negative evaluation toward the target behavior and have a dominant role in the formation of intentions. Subjective norms are defined as the perceived influences that significant others may exert on the execution of behavior. Generally speaking, the TRA predicts that the more favorable an individual's attitude and subjective norm, the stronger his or her intentions to perform the behavior. Finally, intentions are hypothesized to lead directly to behavioral engagement and are proposed to mediate the effects of attitudes and subjective norms on behavior. This means that intentions *explain* the attitude-behavior and subjective norm-behavior relationships. Intentions are therefore necessary to convert attitudes and subjective norms into behavior.

Expectancy-value models of *behavioral beliefs* and *outcome evaluations,* identical to those outlined previously, are thought to be the antecedents of attitudes (Ajzen & Fishbein, 1980). Similarly, the origins of subjective norms can be traced to belief-based judgments that include *normative beliefs* and *motivation to comply.* Normative beliefs refer to behavioral expectations that important referent individuals (or groups) approve or disapprove of performing the behavior. Motivation to comply is the actor's general tendency to go along with the wishes of the salient referents (Ajzen & Fishbein, 1980). These constitute *indirect* measures of attitude and subjective norms, respectively, and are expected to correlate with the direct measures of these constructs (Hagger, Chatzisarantis, & Biddle, 2001). The TRA is shown in Figure 24.2.

The major hypotheses of the TRA have been supported in numerous studies across a number of different behaviors

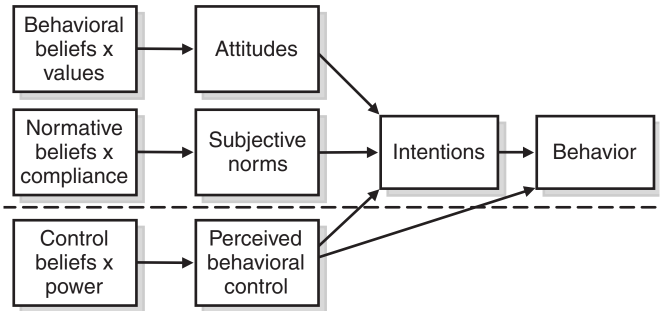

Figure 24.2 The theories of reasoned action and planned behavior. *Note:* Constructs and relationships above the broken line represent the theory of reasoned action, and constructs above and below the broken line taken together represent the theory of planned behavior.

(Sheppard, Hartwick, & Warshaw, 1988), including exercise (Hagger et al., 2002b) and sports training (Theodorakis, Goudas, Bagiatis, & Doganis, 1993). In the exercise domain, tests of the theory have provided strong evidence for the overall predictive value of intentions and have shown that attitudes have a pervasive effect on intentions. A lesser role has been observed for subjective norms (Hagger et al., 2002b). In addition, panel studies have indicated that the strong effects of attitudes on intentions remain stable over time (Chatzisarantis & Hagger, in press; Hagger, Chatzisarantis, Biddle, & Orbell, 2001).

Applications of the theory have also revealed the salient behavioral and normative beliefs related to physical activity. The beliefs are typically elicited from open-ended questionnaires administered to a pilot sample and are used to develop belief-based measures of the attitude and subjective norm constructs (Ajzen & Fishbein, 1980). Behavioral beliefs identified in this research include "good companionship," "weight control," "benefit my overall health," "take too much time," "fun," "get fit," "stay in shape," "improve skills," "get an injury," and "makes you hot and sweaty" (Hagger, Chatzisarantis, Biddle, et al., 2001). Important referents for measures of normative beliefs and motivation to comply tend to be family members, such as parents, grandparents, and siblings, along with friends and schoolteachers (Hagger, Chatzisarantis, Biddle, et al., 2001). However, these beliefs have not been shown to unequivocally account for unique variance in the directly measured attitude and subjective norm constructs, and alternative subsets of beliefs may exist (Hagger, Chatzisarantis, Biddle, et al., 2001).

The TRA has not been without critics. It is a unidirectional model and so fails to offer the possibility that variables in the model can act in a reciprocal manner. In addition, the model relies solely on cognitions and omits other potentially important determinants of action, such as environmental influences, and it usually predicts behavior from measures of behavioral intention taken at one point in time. Moreover, insufficient attention has been paid to the measurement of behavior within the TRA. Without an accurate measure of the behavior, the principle of correspondence cannot be applied. This casts some doubt on several studies, such as when assessment relies on unvalidated self-reports or inappropriate "objective" measures (e.g., use of pedometers for people who are physically active predominantly through cycling or swimming). Finally, the TRA allows the investigation of the interrelationships among attitudes, subjective norms, intentions, and a single behavior. It does not account for alternative behaviors. For example, although many people intend to be more physically active, few see this through to action in a sustained way. This could be due to physical activity being of lower priority than other behaviors, and so just does not get to the top of the list of things to do.

In summary, the TRA has been at the forefront of reestablishing attitude research as a powerful force in social psychology, and both health and exercise psychology have been quick to utilize such an approach. The TRA has proved to be a viable unifying theoretical framework that has been successful in furthering understanding of exercise intentions and behaviors. It has also been instrumental in moving research on physical activity correlates from being largely atheoretical to theoretical.

The Theory of Planned Behavior

Although the TRA has been successful in predicting and explaining participation in physical activities, a major limitation of the theory noted by Ajzen (1985) is that not all behaviors are under volitional control. This led to Ajzen to propose an alternative theory, the theory of planned behavior (TPB), to resolve this limitation. As with the theory of reasoned action, it is proposed in the theory of planned behavior that intention is a central determinant of social behavior and a function of attitudes and subjective norms with corresponding behavioral beliefs and normative beliefs, respectively. However, it is also proposed in the TPB that when perceived control over behavior is problematic, an additional factor, termed perceived behavioral control (PBC), can influence intention and behavior (Ajzen, 1985).

For Ajzen (1991), the PBC construct refers to general perceptions of control (see competence-based approaches in the next section). He overtly compared it with Bandura's (1977) construct of self-efficacy that captures judgments of how well one can execute volitional behaviors required to produce important outcomes. The construct of PBC is also underpinned by a set of control beliefs and the perceived power of these beliefs (Ajzen & Fishbein, 1980). Control beliefs refer to the perceived presence of factors that may facilitate or impede performance of behavior, and perceived power refers to the perceived impact that facilitative or inhibiting factors may have on performance of behavior (Ajzen, 1991). In the same way that an expectancy-value model is used to form indirect antecedents of attitudes and subjective norm, an indirect measure of PBC can be formed from the multiplicative composite of each control belief multiplied by its corresponding perceived power rating (Ajzen, 1991).

The inclusion of perceived behavioral control in the TPB is important because it reveals the personal and environmental factors that affect behavior (Ajzen, 1985). To the extent that PBC influences intentions and behavior, the researcher can evaluate which behaviors are under the volitional control of the individual and the degree to which the behavior is impeded by personal and/or environmental factors. Ajzen (1991) hypothesized that when control over the behavior was problematic, PBC would exert two types of effects. First, it would influence intentions alongside attitudes and subjective norms; this additive effect reflects the *motivational* influence of perceived control on decisions to exercise. Second, PBC may predict behavior directly, especially when perceptions of behavioral control are realistic; this direct effect reflects the effect of actual, real constraints or barriers to doing the behavior. In this case, PBC is a proxy measure of *actual* control over the behavior (Ajzen, 1991). These relationships are shown in Figure 24.2.

A number of studies have shown the TPB to be superior to the TRA in predicting and explaining volitional behavior across many settings (Armitage & Conner, 2001), including physical activity behavior (Dzewaltowski, Noble, & Shaw, 1990; Hagger et al., 2002b). In terms of the relative contribution of the theory constructs, a number of studies have shown that attitude and perceived behavioral control predict intentions equally well (Hagger & Chatzisarantis, 2005a; Hagger, Chatzisarantis, & Biddle, 2002a). A number of control beliefs have also been identified, including barriers and facilitating factors related to exercise, such as "bad weather," "age," "heart pain," "costs," "fatigue," and "no time" (Godin, Valois, Jobin, & Ross, 1991; Hagger, Chatzisarantis, & Biddle, 2001). As with behavioral and normative beliefs, control beliefs have been demonstrated to vary considerably across different populations and behaviors. For example, "age" and "fear of having a heart attack" have been identified among the physical activity control beliefs for older and clinical populations (Godin et al., 1991), but these beliefs do not feature among the control beliefs of younger populations (Hagger, Chatzisarantis, & Biddle, 2001).

We conducted a comprehensive synthesis of the extant TPB research in the physical activity domain (Hagger et al., 2002b). We meta-analyzed 72 studies that allowed calculations of the relationships proposed in either the TRA or TPB. In addition to reporting correlations between variables, we did three things:

1. By using the correlation matrix, we tested the TRA and TPB through path analysis.
2. We tested the additional variance accounted for by adding variables to the TRA. This was done by first adding PBC (hence testing the TPB), then self-efficacy, and finally past behavior.
3. We tested three moderator variables: age, attitude-intention strength, and the time between the assessment of past behavior and (present) behavior.

Results supported the TPB. Intention was the only direct predictor of behavior, intention was predicted more strongly by attitudes than by subjective norms (the latter showing a small contribution), and PBC was associated with behavior through intention. Self-efficacy (which some might argue is a more internal or "personal" aspect of PBC) added to the prediction of both intentions and behavior, and past behavior was associated with all TPB variables. Of most importance was the finding that by adding past behavior to the model, other paths were reduced, suggesting that studies that do not assess past behavior may be obtaining artificially high correlations. Nevertheless, the relationship between attitude and intentions remained even when past behavior was included. We concluded:

> While past behavior had a significant and direct influence on intention, attitude, PBC, and self-efficacy, these cognitions are also necessary for translating past decisions about behavioral involvement into action. This is consistent with the notion that involvement in volitional behaviors such as regular physical activity involves both conscious and automatic influences. (Hagger et al., 2002b, p. 23)

One problem with the TPB, in addition to some of the criticisms given for the TRA, is the lack of consistency in defining and assessing perceived behavioral control. For example, Ajzen (1988) originally said that perceived behavioral control was "closely related to self-efficacy beliefs" (p. 106) and that it "refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles" (p. 132). The similarity with self-efficacy has also been noted by Stroebe and Stroebe (1995). Ajzen (1991), however, defines perceived behavioral control in terms of both perceived resources and opportunities as well as perceived power to overcome obstacles; thus, the construct represents both control beliefs and perceived power.

It is often found in studies incorporating self-efficacy and PBC that they make independent contributions to the prediction of intentions or behavior. For example, Terry and O'Leary (1995) found items reflecting self-efficacy and PBC to be factorially distinct. Moreover, they found that self-efficacy predicted intentions to be physically active, but not activity itself, whereas PBC predicted physical activity but not intention.

Reasons for the success and popularity of the TPB can be attributed to its efficacy in accounting for variance in intention and behavior, its relative parsimony, and its flexibility. Furthermore, the original constructs of the TPB have been shown to mediate the direct effect of other constructs on intentions and behavior, suggesting that the belief systems that underpin the directly measured theory constructs are able to account for the effects of other variables that have previously accounted for unique variance in behavior (Conner & Abraham, 2001). However, researchers have also indicated that the theory does not account for all of the variance in intention and behavior, nor does it mediate the effects of certain "external variables" (Rhodes & Courneya, 2003), personality and belief-based constructs on intentions and behavior (Bagozzi & Kimmel, 1995; Conner & Abraham, 2001; Conner & Armitage, 1998; Rhodes, Courneya, & Jones, 2002). Paradoxically, this weakness has become the theory's greatest strength. Ajzen (1991) states that the theory should be viewed as a flexible framework into which other variables can be incorporated provided they make a meaningful and unique contribution to the prediction of intentions and there is a theoretical precedence for the inclusion of such variables.

As a consequence, the theory has demonstrated considerable flexibility and has been adopted by researchers as a general framework to investigate the effect of a number of additional social cognitive constructs on intention and behavior (Conner & Armitage, 1998). To the extent that such constructs have a unique effect on intention or behavior and are not mediated by the core theory variables of attitude, subjective norm, and PBC, the researcher has evidence to support the inclusion of that construct in the theory. A number of constructs have been found to have a unique effect on intentions and/or behavior in this regard, including anticipated affect and anticipated regret (Sheeran & Orbell, 1999a), self-schemas (Sheeran & Orbell, 2000), self-efficacy (Sparks, Guthrie, & Shepherd, 1997), descriptive norms (Sheeran & Orbell, 1999a), desires (Perugini & Bagozzi, 2001), and self-identity (Hagger & Chatzisarantis, in press; Sparks & Guthrie, 1998).

In addition to the effects of other constructs, the influence of variations in the characteristics and nature of the core theory of planned behavior constructs on intentions, and of intention itself, on behavior have been investigated (Sheeran, 2002). Examples include the stability of intentions (Sheeran, Orbell, & Trafimow, 1999), the accessibility of attitudes (Verplanken, Hofstee, & Janssen, 1998), and hypothetical bias (Ajzen, Brown, & Carvahal, 2004). In the same vein, researchers have also investigated the extent to which individuals are oriented toward or base their intentions on each of the core theory constructs (Sheeran, Norman, & Orbell, 1999; Trafimow & Finlay, 1996). These modifications suggest that the antecedents of volitional behaviors, such as physical activity, may be more complex than originally conceived in the theory (Conner & Armitage, 1998). Notwithstanding these modifications, the theory still performs relatively well in terms of explaining physical activity behavior, and in its most parsimonious form can inform successful interventions to promote physical activity (Chatzisarantis & Hagger, in press; Hagger & Chatzisarantis, 2005a).

Implementation Intentions

One reason the theories of reasoned action and planned behavior do not fully explain the processes by which intentions are translated into action is that people often fail to carry out their intentions (Gollwitzer, 1999; Orbell, 2000; Orbell, Hodgkins, & Sheeran, 1997; Sheeran & Orbell, 1999b). Alternatively, individuals' execution of their intentions may be interrupted because other, competing goal-directed behaviors gain priority over the original intended behavior (Verplanken & Faes, 1999). Social cognitive theories like the theories of reasoned action and planned behavior do not address these difficulties associated with enactment of intentions, and as a result may not fully explain the intention-behavior relationship.

One approach that has been put forward to resolve the inadequacies of the intention-behavior relationship in the TPB is *implementation intentions* (Gollwitzer, 1999). These are self-regulatory strategies that involve the formation of specific plans that specify when, how, and where performance of behavior will take place. Implementation intentions were developed from concerns about the intention-behavior gap.

Experimental paradigms using implementation intention strategies require research participants to specify explicitly *when, where,* and *how* they will engage in an intended behavior to achieve their behavioral goals (Orbell, 2000). According to Gollwitzer (1999), implementation intentions help people move from a motivational phase to a volitional phase, ensuring that intentions are converted into action. Research has indicated that forming implementation intentions decreases the probability of people failing to initiate their goal-directed intentions at the point of initiation (Orbell, 2000; Orbell et al., 1997; Sheeran & Orbell, 1999b). This is because planning when and where to initiate a prospective action strengthens the mental association between representations of situations and representations of actions. Research has also shown that increased accessibility of situational representations in memory increases the probability of action opportunities getting noticed and of action initiation occurring, given that the mere perception of action opportunities can automatically trigger a behavioral response (Orbell et al., 1997; Sheeran & Orbell, 1999b). Of particular importance, implementation intentions increase behavioral engagement through these postdecisional, automatic mechanisms, and not by concomitant increases in motivation or intention (Orbell et al., 1997).

Recent research has evaluated the effectiveness of interventions that combine motivational techniques with volitional techniques, such as implementation intentions, in influencing the performance of social and exercise behavior (Koestner, Lekes, Powers, & Chicoine, 2002; Milne, Orbell, & Sheeran, 2002; Prestwich, Lawton, & Conner, 2003; Sheeran & Silverman, 2003). The rationale behind this combined approach is that motivational strategies focus on increasing intention levels but do not facilitate the enactment of intentions, and volitional strategies, such as implementation intentions, increase the probability that these strong intentions will be converted into action without changing intentions. Research has corroborated the utility of these combined techniques in increasing exercise behavior. For example, Prestwich et al. demonstrated that an intervention that had a combination of a rational decision-making strategy, or decisional balance sheet (weighing up the pros and cons), and implementation intentions was more effective in promoting physical activity behavior than either of the strategies alone. These results support the existence of two distinct phases of motivation: a motivational or predecisional phase, during which people decide whether or not to perform a behavior, and a volitional, postdecisional, or implemental phase, during which people plan when and where they will convert their intentions into behavior (Gollwitzer, 1999). As a consequence, interventions that combine motivational and volitional techniques are likely to be most effective in promoting physical activity behavior.

COMPETENCE-BASED APPROACHES

The social-cognitive perspectives currently favored when studying individual motivation in the exercise psychology literature have drawn extensively on self-efficacy theory. This approach has had a large impact in both exercise (McAuley & Blissmer, 2000; McAuley, Pena, & Jerome, 2001) and health (Stroebe & Stroebe, 1995) research. Other confidence- and competence-related perspectives are achievement motivation (Roberts, 2001) and self-presentation (Leary, 1992). In addition, theories of self-perceptions are relevant and will be discussed in brief later.

Self-Efficacy Theory

Confidence has been identified at the anecdotal and empirical level as an important construct in exercise motivation. Statements associated with self-perceptions of confidence are commonplace in studies on exercise and sport and are likely to be associated, in one way or another, with the initiation and maintenance of physical activity. Bandura (1986, p. 391) defines perceived self-efficacy as

> people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one possesses but rather, with judgments of what one can do with whatever skills one possesses.

Beliefs related to the ability to carry out a particular behavior are self-*efficacy* expectations, whereas beliefs as to whether the behavior will produce a particular result are *outcome* expectations. People are likely to be concerned about both types of expectancy, and both require study in exercise psychology research. For example, it is important to know whether efficacy expectations are influential in the adoption of exercise programs, yet it is also likely that outcome expectations will affect the maintenance of such programs and the reinforcement necessary for continued involvement.

It is thought that people gain or lose self-efficacy in four main ways (Bandura, 1986, 1997):

1. Prior success and performance attainment
2. Imitation and modeling, particularly of people similar to oneself
3. Verbal and social persuasion
4. Judgments of physiological states, such that states of relaxation can be achieved

C. Ewart (1989, p. 684) summarized the application of these in the context of promoting exercise in a rehabilitation setting by saying that

> the most effective way to encourage patients to adopt exercise activities for which they lack self-efficacy is to expose them to the recommended activity in gradually increasing doses [performance], arrange for them to see others similar to themselves performing the activity [modeling], have respected health care providers offer encouragement by providing reassurance and emphasizing the patient's accomplishments [persuasion], and arrange the setting of the activity so as to induce a relaxed but "upbeat" mood [arousal, physiological state].

Research Findings for Self-Efficacy in Exercise

Early work in this area tended to focus on patients, such as those in cardiac rehabilitation. For example, C. E. Ewart, Taylor, Reese, and DeBusk (1983) studied self-efficacy in the context of treadmill running with post-myocardial infarction patients. Before and after treadmill exercise, assessment of self-efficacy to take part in walking, running, stair climbing, sexual intercourse, lifting, and general exertion was made. Results showed that positive changes in self-efficacy took place following treadmill exercise, and that this was greatest for running, suggesting that efficacy effects can generalize but appear to have stronger effects on similar exercise modes. When counseling also took place, it was found that efficacy perceptions for some of the activities significantly increased above the level attained after treadmill running. Studies on medical patients in exercise rehabilitation have suggested that self-efficacy judgments can generalize but will be strongest for activities similar to the activity experienced, that self-efficacy in "dissimilar" activities can be enhanced through counseling, and that self-efficacy better predicts changes in exercise behavior than generalized expectancies of locus of control (Biddle & Mutrie, 2001).

A number of researchers have now investigated nonpatient groups in physical activity. For example, self-efficacy has been shown to predict walking in a large adult sample contacted by mail (Hofstetter et al., 1991), has discriminated adherers from dropouts in an exercise weight loss program (Rodgers & Brawley, 1993), and has predicted positive affect after exercise (Bozoian, Rejeski, & McAuley, 1994).

McAuley's work on exercise self-efficacy has been influential (e.g., McAuley, 1992; McAuley & Courneya, 1993; McAuley & Mihalko, 1998). In particular, McAuley and colleagues have studied self-efficacy responses of older adults, a population previously underrepresented in the exercise psychology literature. Several studies by McAuley and coworkers focus on a group of previously sedentary 45- to 64-year-olds. These studies have shown that for older adults, exercise self-efficacy:

- Can be increased through intervention
- Will predict participation, particularly in the early stages of an exercise program
- Declines after a period of inactivity
- Is associated with positive exercise emotion

In summary, the studies investigating self-efficacy in nonpatient exercise groups show a consistent relationship between efficacy and exercise participation, as well as relationships with other important factors, such as postexercise emotion.

Self-efficacy needs to be assessed in relation to specific behaviors if increased magnitude of behavioral prediction is required. Generalized perceptions of confidence are not the same as perceptions of efficacy. Nevertheless, we need more studies on the generalizability of self-efficacy across different physical activity and exercise settings. Similar to the attitude-behavior correspondence issue discussed earlier, the utility of self-efficacy is likely to be greater when measures correspond closely to the behavior in question, such as walking to work 4 days per week, rather than using a general reference such as "exercise."

Assessing self-efficacy in any meaningful way requires the behavior to be associated with effort, potential barriers, and behavioral self-regulation. "Easy" habitual behaviors, such as tooth brushing, are likely to be unrelated to feelings of efficacy, whereas physical exercise may be highly associated with efficacy beliefs if exercise requires planning, effort, and the overcoming of considerable barriers. This is probably why self-efficacy emerges as one of the most consistent predictors of physical activity behaviors, particularly when physical activity includes elements of vigorous exercise.

Physical Self-Perceptions and Competence

Dominant theories of competence-based motivation often involve constructs related to self-perception, and these have been a central feature in the exercise psychology literature. In contemporary self-esteem theory, it is proposed that global self-esteem (how we view ourselves overall) is underpinned by perceptions of specific domains of our lives, such as social, academic, and physical domains (Shavelson, Hubner, & Stanton, 1976). Based on this approach, Fox (1997; Fox & Corbin, 1989) has developed an operational measure of physical self-perceptions whereby psychometrically sound scales assess the higher-order construct of physical self-worth (PSW) and its self-perception subdomains of sport competence, perceived strength, physical condition, and attractive body. It is proposed that everyday events are likely to affect more specific perceptions of self (e.g., the belief that one can walk to work), which, if reinforced over time, may eventually contribute to enhanced self-perceptions of physical condition or even PSW. As such, self-perceptions can be viewed in terms of being more general in their orientation (i.e., domain-general) when they operate at the level of general self-perceptions of competence and worth, such as PSW. Self-perceptions can also be viewed in more specific terms, such as specific competency perceptions like "Can I finish this bike ride?" and "I have just walked to work for the first time."

At least two perspectives on competence perceptions and motivation can be considered relative to Fox's (1997) model of physical self-worth. The self-enhancement model of self-esteem is where positive self-perceptions play a motivational role in behavior. For example, if I feel competent in physical activity, it is more likely that I will want to demonstrate that competence, and hence be motivated to be active. The reverse could also be true, whereby a lack of motivation through perceptions of incompetence becomes a determinant of sedentary habits. The personal development model views self-esteem or physical self-perceptions as outcomes of physical activity, such that positive outcomes will reinforce competence and boost self-perceptions, and negative outcomes will have the reverse effect (Biddle & Mutrie, 2001).

CONTROL-BASED THEORIES

The research and lay literatures contain numerous references to the fact that changes in physical activity behaviors are thought to be associated with the need for personal control of our lifestyles. The information that many of the modern diseases linked with premature mortality are lifestyle-related has the implicit message that we, as individuals, are at least partly responsible for our health and well-being, thus implying the need for personal control and change. However, it could be argued that a greater emphasis should be placed on social determinants of health. Whatever the outcome of such a debate, it is clear that perceptions of control are important psychological correlates of health-related behavior at the individual level.

Definitions of Control and Autonomy

The construct of control is one of the most popular and oft-cited in the social psychology literature (Skinner, 1995, 1996). Its popularity stems primarily from the fact that many theories of human motivation either make a reference to control or explicitly include a construct of control in their proposed models (Biddle, 1999). Corresponding to the popularity of the construct of control has been the proliferation of terms and confusion of theoretical definitions used to describe this construct. According to Skinner (1995) and Biddle (1999), the construct of control has been used in the literature in three different ways.

First, the term *control* has been used to describe beliefs that one has the capacity to control performance of the means (i.e., behaviors) leading to outcomes. These control beliefs, which are termed "capacity beliefs" (Skinner, 1995), are similar to Bandura's (1997) self-efficacy beliefs. Second, the construct of control has been used to describe beliefs (strategy beliefs) concerning the necessary availability of means to produce the desired outcome. Third, the construct of control has been used to describe beliefs (control beliefs) that an agent (person) has the capacity to produce a desirable outcome. These control beliefs are very similar to White's (1963) and Deci and Ryan's (1985) definition of the need for competence, which refers to the need that one has the capacity to produce outcomes and also understand the instrumentalities leading to these outcomes. In fact, because Skinner's and White's definitions of control beliefs and of the need for competence are very similar, some researchers suggested that the perceptions related to control are energized by the need for competence (Hagger, Chatzisarantis, & Biddle, 2001; Hagger et al., 2002a).

There has also been some confusion about the construct of autonomy. Autonomy and control are not the same (Deci & Ryan, 1987). Autonomy describes the extent to which performance of behavior is volitional and is endorsed with a sense of choice and willingness. Autonomy does not mean being able to control outcomes or have the capacity to perform behaviors leading to outcomes. The two constructs are conceptually and empirically distinct: One can be compelled to engage in behaviors over which one has complete control, and one can try to self-initiate a behavior over which one has little control (i.e., people self-initiate challenging tasks; Deci & Ryan, 1985; Hagger et al., 2002a). Applications of self-determination theory (SDT) are reviewed in this section of the chapter because this is one of the few theories in social psychology that explicitly recognizes the importance of the distinction between control and autonomy in understanding social phenomena such as physical activity.

Self-Determination Theory

Self-determination theory is a popular theory proposing that human motivation and psychological well-being can be explained on the basis of psychological needs for competence, self-determination (autonomy), and relatedness (Deci & Ryan, 1985). Self-determination refers to the need for experiencing oneself as an initiator and regulator of one's actions. Competence refers to the need for producing behavioral outcomes and understanding the production of these behavioral outcomes. Relatedness refers to the need for experiencing satisfactory relationships with others and with the social order in general (Deci & Ryan, 1991).

Psychological Needs and the Energization of Behavior

The concept of psychological needs differs from the more common usage that equates a need with any personal desire or goal that people may try to achieve. According to Ryan (1995), psychological needs are *necessary* for human development and growth. For example, it has been suggested that as human beings require water and food to survive, in the psychological domain human motivation requires experiences of autonomy, competence, and relatedness to sustain and grow (Sheldon, Elliot, Kim, & Kasser, 2001). Individuals do not necessarily need, for example, fancy cars and private jets to grow psychologically. These other needs are not essential but substitute needs that are not universal but learned through social processes (Deci & Ryan, 1980).

The concept of psychological needs is also important because it makes motivation a dynamic concept (Ryan, 1995). By definition, a psychological need is an energizing state that, if satisfied, enhances health and psychological well-being; if not satisfied, then "ill-being" will result (Ryan & Deci, 2000). Several studies in social and sport/exercise psychology have consistently supported this hypothesis (Gagne, Ryan, & Bargman, 2003; Hagger, Chatzisarantis, & Harris, in press; Ntoumanis, 2001; Sarrazin, Vallerand, Guillet, Pelletier, & Cury, 2002; Wilson, Rodgers, Blanchard, & Gessell, 2003). For example, in a study of young gymnasts, Gagne et al. documented that need satisfaction experienced during practice explained changes in daily well-being. In addition, we have recently documented that need satisfaction was associated with positive physical activity attitudes, strong intentions to exercise, and physical activity participation (Hagger et al., in press).

Interpersonal Context and the Fostering of Human Motivation and Psychological Well-Being

In addition to addressing issues related to the energizing of human motivation, SDT places importance on the environment and interpersonal contexts within which motivation occurs. According to Ryan (1995), psychological needs and the inputs that those psychological needs generate are necessary but not sufficient for human development and growth. For intrinsic motivational tendencies to sustain and grow, psychological needs must be supported because otherwise individuals will be alienated from these needs (Deci & Ryan, 1980). It is evident, therefore, that SDT is a *dialectic* theory that assigns to the environment the role of a nurturer that actually does or makes efficient motivation occur (Aristotle, 1993). The conceptual analogue of the role of environment, as viewed by SDT, is that of a seed that grows into a tree only if the greater environment (i.e., climatic conditions, soil) is conducive to its growth.

Self-determination theory differentiates among three types of interpersonal contexts that either support or frustrate psychological needs. The general ambience of interpersonal context is said to be chaotic when the greater environment is unstructured and significant others do not provide feedback at all (Deci & Ryan, 1991). Chaotic environments undermine competence and promote amotivation, as demonstrated in physical education by Ntoumanis and colleagues (Ntoumanis, Pensgaard, Martin, & Pipe, 2004). The interpersonal context is said to be supportive of psychological needs (autonomy-supportive contexts) when significant others encourage choice and participation in decision making, provide a meaningful rationale, use neutral language (e.g., "may," "could" rather than "should," "must") during interpersonal communication, and acknowledge people's feelings and perspectives (Deci, Koestner, & Ryan, 1999). For example, an instructor who uses neutral language in conducting an exercise class and explains reasons behind different exercise tasks is likely to contribute to the development of an autonomy-supportive climate. The interpersonal context is said to frustrate psychological needs (controlling contexts) when significant others do not explain why performance of certain behaviors may be important, use pressuring language during interpersonal communication (e.g., use of "should" and "must"), or do not acknowledge difficulties associated with performance of a behavior. An exercise instructor who makes people think, feel, or behave in particular ways is likely to contribute to the development of a controlling interpersonal context.

The importance of adopting autonomous-supportive versus controlling interpersonal styles has been examined in numerous studies and across different life domains. Autonomy-supportive health care providers, parents, coaches, physical educators, and peers have been found to develop a better quality of motivation (Goudas, Biddle, & Underwood, 1995; Hagger & Chatzisarantis, 2005b; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2003; Standage, Duda, & Ntoumanis, in press; G. C. Williams, Gagné, Ryan, & Deci, 2002), promote adherence to sport and physical activity (Chatzisarantis, Hagger, Smith, & Sage, in press), and promote enhanced levels of satisfaction of psychological needs and psychological well-being (Gagne et al., 2003; Levesque, Zuehlke, Stanek, & Ryan, 2004; Sarrazin et al., 2002). In contrast, young people and adults develop less persistent forms of motivation (Goudas, Biddle, & Fox, 1994; Goudas et al., 1995; Hagger & Chatzisarantis, 2005b, in press; Vansteenkiste & Deci, 2003), tend to drop out from physical activity and sport (Sarrazin et al., 2002; G. C. Williams & Deci, 1998), and are left unsatisfied (Gagne et al., 2003) when significant others pressure them or make them think, feel, and behave in particular ways.

Forms and Quality of Human Motivation

Self-determination theory distinguishes not only between autonomous and controlling interpersonal contexts but also between autonomous and controlling motivational styles. The conceptual analogue of motivational form is that of the shape of materials and describes the structure by which motivation is identified (Aristotle, 1993). Cognitive evaluation theory (a subtheory of SDT) initially distinguished between two general forms of motivation. *Intrinsic motivation* refers to the doing of an activity for its inherent satisfactions rather than for some separable outcomes. *Extrinsic motivation* refers to the doing of an activity for outcomes that are separable from the activity itself (Ryan & Deci, 2000). However, subsequent studies have shown that extrinsic motivation can be further differentiated into external regulation, introjection, identification, and integration.

External regulation refers to a behavior that is performed to obtain a reward or approval from a significant other (Ryan & Connell, 1989). For example, people who exercise because their spouse pressures them to do so are externally regulated. Introjection lies next to external regulation; it refers to a behavior that is performed to avoid a pressuring emotion of guilt or shame. A person who exercises for reasons of weight management and feels guilty when missing some exercise sessions is said to be introjected. External regulation and introjection describe controlling forms of motivation because they describe behaviors that are performed under some form of internal (e.g., introjection) or external (e.g., external regulation) pressure. A less controlling and more self-determined form of motivation is identification. This refers to a behavior that is performed because the individual values it. During identification, individuals accept and endorse the value of physical activity, and for this reason, identified behavior represents a more self-determined form of motivation. The most autonomous and least controlling form of behavior is integrated regulation. This refers to identifications that are brought into congruence with other behaviors and roles that are enacted in life. This definition presupposes that identification is a less autonomous form of behavioral regulation than integration because regulation through identification may conflict with preexisting values and behaviors.

In the domain of sport and physical activity, many instruments measure the motivational styles proposed by SDT. The Sport Motivation Scale, developed by Pelletier and colleagues (1995), assesses amotivation, external regulation, introjection, identification, and three types of intrinsic motivation: intrinsic motivation to know (e.g., "for the pleasure it gives me to know more about the sport that I practice"), to accomplish (e.g., "because I feel lot of personal satisfaction while mastering certain difficult movements"), and to experience stimulation (e.g., "for the intense emotions").

In the context of physical activity, there is the Behavioral Regulation in Exercise Questionnaire (Markland & Tobin, 2004; Mullan, Markland, & Ingledew, 1997) and the Exercise Motivation Scale (EMS; Li, 1999). Both of these instruments measure amotivation, external regulation, introjection, identification, and intrinsic motivation. However, the EMS measures integrated regulation as well. Finally, Goudas et al. (1994) adapted Ryan and Connell's (1989) self-regulation questionnaire and Vallerand et al.'s (1992) academic motivation scale in the physical education context. Goudas et al.'s scale measures external regulation, introjection, identification, and intrinsic motivation but not integrated regulation.

The importance of adopting an autonomy-supportive versus controlling motivational style has been examined in numerous studies across different domains. Supporting assumptions underling SDT, we have documented that motivational styles form a motivational continuum (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). In this continuum, which is often described as a *developmental continuum of self-determination* (Deci & Ryan, 1991), external regulation and intrinsic motivation are located at the opposite ends, and introjection and identification lie in between external regulation and intrinsic motivation. In addition, several prospective studies have shown that autonomous motivational styles are more strongly associated with intentions to exercise, prolonged participation in sport, adherence to physical activity, and psychological well-being than controlling motivational styles (Chatzisarantis & Biddle, 1998; Chatzisarantis, Biddle, & Meek, 1997; Chatzisarantis, Hagger, Biddle, & Karageorghis, 2002; Gagne et al., 2003; Hagger et al., 2002a; Matsumoto & Takenaka, 2004; Vansteenkiste & Deci, 2003). In addition, empirical evidence supports relationships between autonomy-supportive interpersonal contexts and autonomous motivational styles on the one hand (identification and intrinsic motivation), and between controlling interpersonal contexts and controlling motivational styles on the other (Hagger & Chatzisarantis, 2005b, in press; Hagger et al., 2003; Ntoumanis, 2001; Standage et al., 2003, in press).

Research in sport and physical activity has also examined relationships between motivational styles and other psychological variables not necessarily included in SDT. For example, in the context of physical education, Goudas et al. (1994) found relationships between motivational styles and task and ego achievement goal orientations, perceived competence, and intentions. Wilson, Rodgers, Blanchard, et al. (2003) documented that motivational styles are related to different imagery techniques used by exercisers. Appearance imagery was associated with introjection, and identification and intrinsic motivation were associated with imagery techniques reflecting technique and energy.

In summary, SDT has emerged as an important theoretical approach in exercise psychology (Biddle, Chatzisarantis, & Hagger, 2001; Chatzisarantis et al., 2003). Building on prior work concerning intrinsic and extrinsic motivation, SDT now embraces a wider view of human motivation, including differentiated types of extrinsic motivation, and the role of need satisfaction (Deci & Ryan, 2002). The challenge for practitioners remains how to create an autonomy-supportive climate whereby self-determined forms of motivation dominate in the physical activity context.

STAGE-BASED MODELS

The theoretical approaches discussed so far tend to be continuous models; that is, constructs are reflected as continuous variables rather than discrete stages. The most well-known stage conceptualization is that of the transtheoretical model (TTM), developed by Prochaska and DiClemente (1984, 1986; Prochaska, Norcross, & DiClemente, 1994; Prochaska & Velicer, 1997). The TTM emerged from an analysis of change systems used in psychotherapy to treat addictive behaviors such as smoking and drug use. More recently, it has been offered as a coherent framework to help understand readiness to begin physical activity. Literature on the TTM in physical activity is now diverse, including descriptive studies (Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Mullan & Markland, 1997), interventions (Mutrie et al., 2002), narrative overviews (Prochaska & Marcus, 1994), a meta-analysis (Marshall & Biddle, 2001), and practical guidelines (Marcus & Forsyth, 2003). The TTM treats behavior change as a dynamic process rather than an all-or-nothing phenomenon. Evidence suggests that individuals attempting to change their physical activity behavior move through a series of stages. The stages are characterized by a temporal dimension of readiness to change. Five stages have been proposed that differ according to an individual's intention and behavior, the latter being defined in relation to a criterion level. Whether people move into a more advanced stage will partly be determined by how the level of the behavioral criterion is defined. The stages have been labeled precontemplation, contemplation, preparation, action, and maintenance (see Table 24.1).

Original formulations of the model proposed that individuals moved through the stages in a linear fashion. It is now recognized that stage progression is more likely to follow a cyclical pattern whereby individuals progress and regress through the stages in an effort to create lasting change. This is analogous to the board game "Snakes and Ladders," where you make progress up the ladders but sometimes regress down the snakes before climbing another ladder.

Four factors are hypothesized to mediate the change process: (1) an individual's self-efficacy for change, (2) the weighing up of perceived advantages (pros) and (3) disadvantages (cons) of change (decisional balance), and (4) the strategies and techniques individuals use to modify their thoughts, feelings, and behavior (referred to as the processes of change). As such, it is possible to identify *how* people change through the stages and *why* people change through the mediators. Changes in the mediators should result in behavior change.

The importance of self-efficacy for initiating and maintaining a pattern of regular physical activity derives from social cognitive theories of behavior (Bandura, 1986) and was discussed earlier in the chapter. Numerous studies have revealed a consistent positive relationship between exercise self-efficacy and stage of change (Marcus, Eaton, Rossi, & Harlow, 1994). Narrative reviews of the literature are unequivocal that higher efficacy is associated with advancing stage, with many concluding the relationship to be linear (Prochaska & Marcus, 1994). Self-efficacy also appears to successfully differentiate between individuals at most stages, as shown in our meta-analysis (Marshall & Biddle, 2001).

Behavior change is assumed to involve a systematic evaluation of the potential gains (pros) and losses (cons) associated with adopting the new behavior. Our meta-analysis showed that pros increase for every forward stage transition, with the largest change being from precontemplation to contemplation, whereas the change from contemplation to preparation was virtually zero. All other stage transitions had small effects. For the cons of behavior change, we showed that these generally decreased across stages, as predicted, and that the largest change was from precontemplation to contemplation, whereas the smallest was from action to maintenance (Marshall & Biddle, 2001). Our results, therefore, suggest that interventions might usefully focus on increasing pros and reducing cons, particularly at the important transition from precontemplation to contemplation. For example, a decisional balance exercise could be adopted in self-help change leaflets for community-level interventions or could be used in individual exercise counseling (Biddle, 2004; Breckon, 2002; Loughlan & Mutrie, 1997).

Ten basic processes of change have been proposed that describe the techniques and strategies individuals use to modify their thoughts, feelings, and behavior (Prochaska & DiClemente, 1983). These processes have been organized into two higher-order constructs: cognitive processes (thinking or experiential processes) and behavioral (doing) processes (Prochaska, Velicer, DiClemente, & Fava, 1988). Narrative reviews in the physical activity domain have also concluded that a two-factor model is appropriate, and stage-specific trends exist for these higher-order constructs (Prochaska & Marcus, 1994). The general consensus is that cognitive processes are more important during the early stages, with behavioral processes important at later stages, but our meta-analysis was not able to support this (Marshall & Biddle, 2001). Indeed, the majority of conclusions in previous reviews are based on a single primary study that found the correlation between cognitive and behavioral processes to be .91 (Marcus et al., 1992), a finding that actually argues against a two-factor model.

Few studies are available that make process-specific predictions at each stage of change. It has been suggested that consciousness raising is particularly important when

Table 24.1 Defining Stages of the Transtheoretical Model

Stage	Meeting Criterion Level of Physical Activity?	Current Behavior	Intention to Meet Criterion Level of Physical Activity?
Precontemplation	No	Little or no physical activity	No
Contemplation	No	Little or no physical activity	Yes
Preparation	No	Small changes in physical activity	Yes
Action	Yes	Physically active for less than 6 months	Yes
Maintenance	Yes	Physically active for more than 6 months	Yes

moving from precontemplation to contemplation (Reed, 1999), and the findings from our meta-analysis were in support of this. However, the greatest effect size from precontemplation to contemplation was for self-liberation. This is the belief that change is possible and that responsibility for change lies within the individual. Items measuring self-liberation appear theoretically consistent with concepts of autonomy, as discussed earlier in the section on self-determination theory, and this has predicted interest in and adherence to physical activity. Based on our meta-analysis, we believe that processes of change for physical activity require further investigation before definitive statements about their use can be made for interventions.

The vast majority of studies investigating the TTM in physical activity (Marshall & Biddle, 2001) and other health behavior contexts (Sutton, 2000) are cross-sectional. This presents difficulties in establishing causal relationships between constructs and stages. Moreover, many studies using such a design provide support for what Weinstein and colleagues (Weinstein, Rothman, & Sutton, 1998) have called "pseudo-stage" models, where there is a linear pattern of change (actually "difference" in a cross-sectional design) between variables rather than having an a priori assumption of discontinuity whereby a variable is predicted to act differently at different stages (Sutton, 2000). Data from our meta-analysis are more supportive of a pseudo-stage model, as shown in Figures 24.3 and 24.4.

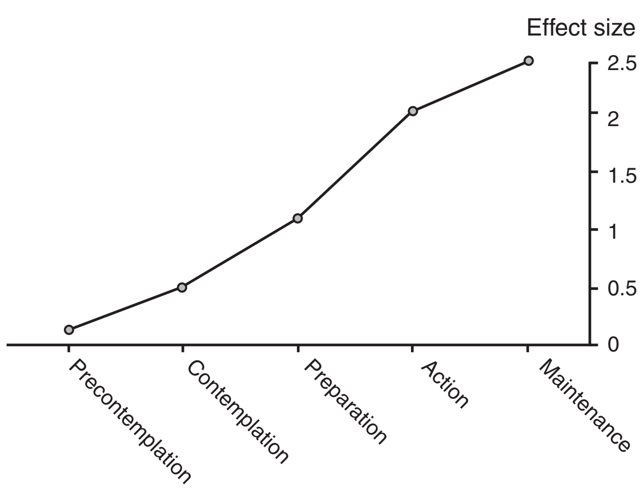

Figure 24.3 Differences in effect sizes in physical activity across stages for physical activity studies. *Source:* "The Transtheoretical Model of Behavior Change: A Meta-Analysis of Applications to Physical Activity and Exercise," by S. J. Marshall and S. J. H. Biddle, 2001, *Annals of Behavioral Medicine, 23,* pp. 229–246. Reprinted with permission.

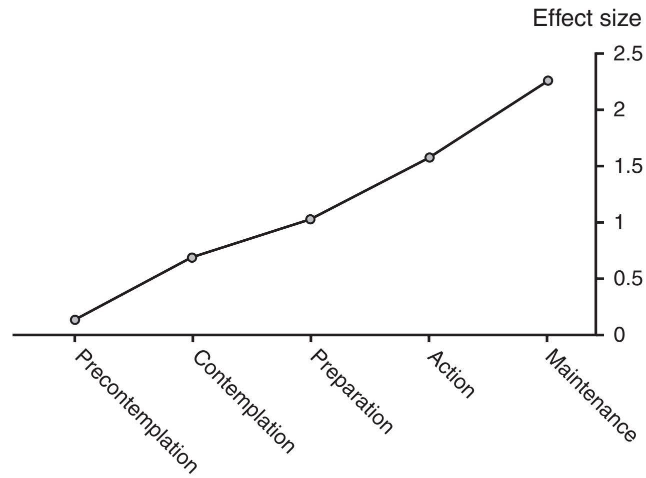

Figure 24.4 Differences in effect sizes in self-efficacy across stages for physical activity studies. *Source:* "The Transtheoretical Model of Behavior Change: A Meta-Analysis of Applications to Physical Activity and Exercise," by S. J. Marshall and S. J. H. Biddle, 2001, *Annals of Behavioral Medicine, 23,* pp. 229–246. Reprinted with permission.

In Figure 24.3, physical activity differences between stages follow essentially a linear pattern, with only a hint of discontinuity through a flat S-shaped curve. In Figure 24.4, self-efficacy is largely linear across the stages. Similarly, in a study we conducted on the extent and determinants of promoting physical activity for patients by mental health professionals (Faulkner & Biddle, 2001), we assessed mean score differences in variables from the theory of planned behavior among three stages: no promotion of physical activity, irregular promotion, and regular promotion. Again, results supported a pseudo-stage model rather than a true stage model because the differences across the three groups for each variable were essentially linear (see Figure 24.5). Future studies on the TTM and physical activity need to test for the discontinuity of variables across stages and establish whether the variable is an antecedent or consequence of stage transition (Sutton, 2000).

THEORETICAL INTEGRATION

Recent investigations have combined stage models with linear, continuous models. One approach is to investigate the means in variables derived from continuous theories, such as the TPB, across the different stage groups. Another strategy might be to test the architecture of a linear model within each stage group separately.

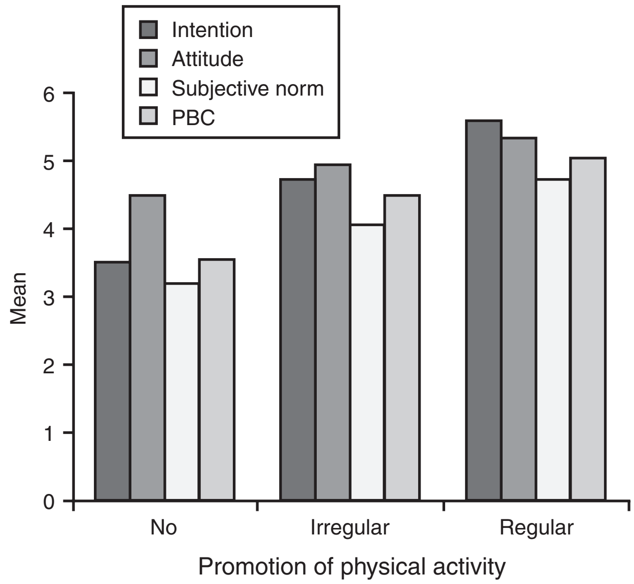

Figure 24.5 Mean scores for variables from the theory of planned behavior across three stage groups based on the extent of physical activity promotion by mental health professionals. *Note:* PBC = Perceived behavioral control. *Source:* "Predicting Physical Activity Promotion in Health Care Settings," by G. Faulkner and S. Biddle, 2001, *American Journal of Health Promotion, 16*(2), pp. 98–106. Reprinted with permission.

Cross-Sectional Patterns

As described previously, the TPB variables often show linear patterns (Faulkner & Biddle, 2001). However, for variables that might operate in a more stage-specific way, we have found nonlinear patterns and support for stage assumptions (Lippke & Plotnikoff, 2005). Strongest support for discontinuity patterns were revealed for perceptions of vulnerability (subjective chances of contracting a disease if one is not physically active). Individuals in the precontemplation stage felt least vulnerable, those in contemplation and action reported the highest vulnerability, and individuals in preparation and maintenance had reduced vulnerability. The higher level of vulnerability in the contemplation stage, in comparison to precontemplation, is in accordance with the stage definition. Individuals in precontemplation are either unaware of the risk behavior (such as not being physically active enough) or subjectively reduce their vulnerability due to an incorrect optimistic mind-set. In contemplation, persons become aware of their risk. However, if they plan to start performing the behavior in question in the near future, or if they are already performing some behavior, their vulnerability estimation becomes relevant and they may express feelings of vulnerability. Individuals in action are more realistic, and those in maintenance are actually reducing their vulnerability because of their behavior. However, such a pattern is not expected in variables such as self-efficacy due to its core importance in all stages (Bandura, 1986, 1997). Therefore, it is important to employ the appropriate test variables for investigating discontinuity patterns (Lippke & Plotnikoff, 2005; Lippke, Sniehotta, & Luszczynska, 2005).

Longitudinal Patterns

Another strategy is to combine a linear model with a stage model. In some studies, the stage membership has been predicted additionally or alternatively to intention and behavior in these linear estimations, as, for example, in the TPB (Courneya, Nigg, & Estabrooks, 1998). Because stage is conceptualized as analogous to intention and behavior probability, the advantage of including the stage variable alongside intention and behavior additionally or alternatively is rather small. In contrast, to investigate stage as a moderator and to examine stage-dependent processes has been shown to be fruitful (Lippke, Nigg, & Maddock, 2004). These processes are analogous to the assumption of most social cognitive models, intention formation, action planning, and behavior change. With this strategy one might also test discontinuity patterns by testing whether, depending on the stage, different social cognitive variables are more or less influential (Weinstein et al., 1998).

By testing the TPB over 1 year, we found that attitude and intention were highly associated in all stages. Perceived behavioral control, subjective norm, and intention were significantly and positively related. In all other stage groups, the subjective norm and intention relations were not significant. Perceived behavioral control was not related to intention or behavior except in the maintenance stage. If individuals who performed physical activity over a longer period of time perceived more control, they also had a higher intention and performed more behavior. Intention and physical activity were correlated in precontemplation, preparation, action, and maintenance, but not in contemplation (Lippke, Nigg, et al., 2004).

A Hybrid Model: The Health Action Process Approach

The health action process approach (HAPA; Schwarzer, 1992, 2001) is a model that explicitly integrates continuous and stage assumptions and is thereby a *hybrid model.* At the same time, the HAPA integrates motivational (prediction of intention) and behavior-enabling models (inclusion of postdecisional facets such as implementation intentions).

The HAPA makes a distinction between a motivation phase and a volition/postdecision phase of health behavior change. The basic idea is that individuals experience a shift of mind-set when moving from the first phase (motivational) to the second (volitional). The moment people commit themselves to an intention to exercise, for example, they enter the volitional phase. In this phase, a division into two subphases appears to be meaningful, wherein people can be labeled as either intenders or actors. First, they intend to act but they remain inactive. Second, they initiate the intended action. Thus, three phases or stages can be distinguished, as shown in Figure 24.6. In the (a) *nonintentional stage,* a behavioral intention is being developed, which is similar to the contemplation stage in the TTM. Afterward, individuals enter (b) the *intentional stage,* where they have already formed an intention but still remain inactive (or at least not active at the recommended level), while the exercise behavior is being planned and prepared. If these plans are translated into action, individuals reside in (c) the *action stage.* They are then physically active at the recommended goal behavior level.

In the *nonintentional stage,* an intention has to be developed. In this phase, risk perception is a distal antecedent within the motivational phase. Risk perception is sufficient to enable the undecided person to form an intention. Furthermore, it is a prerequisite for a contemplation process

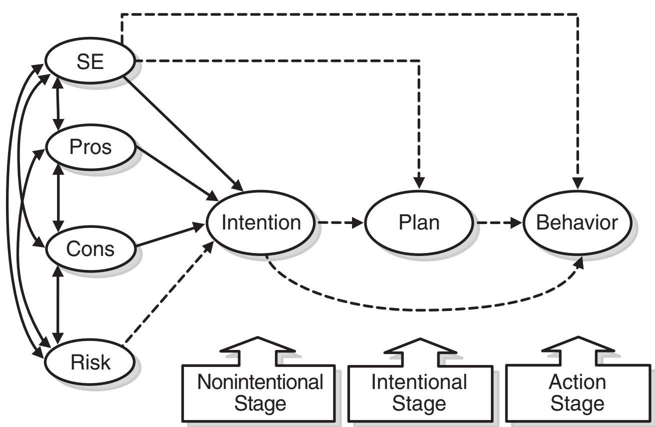

Figure 24.6 The health action process approach, with its architecture and stages adapted from Lippke, Ziegelmann, and Schwarzer (2005). *Note:* SE = Self-efficacy; Risk = Risk perception. Dashed arrows indicate stage-specific effects and mechanisms; solid arrows show generic effects. *Source:* "Self-Efficacy in the Adoption and Maintenance of Health Behaviors: Theoretical Approaches and a New Model" (pp. 217–243), by R. Schwarzer, in R. Schwarzer (Ed.), *Self-Efficacy: Thought Control of Action,* 1992, Bristol, PA: Taylor & Francis. Reprinted with permission.

and further elaboration of thoughts about consequences and capacities. Risk perception operates at a stage-specific level, and therefore its effect on intention is represented by a dashed line in Figure 24.6; in the intentional stage, risk perception has no effect (Lippke, Ziegelmann, & Schwarzer, 2005). The belief in one's capabilities to perform a desired action (self-efficacy) is necessary for goal pursuit. That is, perceived self-efficacy promotes intention formation and behavior implementation in all stage groups (Lippke, Ziegelmann, et al., 2005); the arrow is therefore drawn as a solid line, not dashed, in Figure 24.6.

After a decision has been made, the *intentional stage* is entered: The individual has a high intention but is not performing the behavior. The intention has to be transformed into detailed plans on how to perform the behavior. Instructions on the goal pursuit may contain assisting intentions and precise implementation intentions or plans. These plans involve when, where, and how the goal behavior will be initiated (Lippke, Ziegelmann, & Schwarzer, 2004) whereby cognitive links between concrete opportunities and the intended behavior will be built. Social cognitive variables change in dominance and interplay. Risk perception has no further influence, but outcome expectancies remain important. Self-efficacy is also important in the planning and initiation process, especially if barriers occur or no enabling situation arises. Self-efficacy keeps the intention high and the plans flexible to compensate for setbacks and stay on track to initiation.

If the goal behavior has been initiated, the individual enters the *action stage.* The behavior has to be controlled by cognitions in order to be maintained. Self-regulatory skills are substantial for the maintenance process. Effort has to be invested, useful situations for implementation of the new behavior have to be detected, and distractions have to be resisted. The behavior will mainly be directed by self-efficacy (Schwarzer, 2001) because it regulates how effort is invested and persistence is managed if barriers and setbacks occur. The performed behavior has to be maintained, and relapses have to be managed by action control strategies.

Due to individuals having to first set a goal that then may be translated into plans and behavior, this process is stage-specific; only persons in intentional and action stages are more likely to make plans and subsequently perform the goal behavior (dashed lines in Figure 24.6; Lippke, Ziegelmann, et al., 2005). Also, the influence of self-efficacy on postdecisional processes, such as planning and behavior performance, depends on whether one has decided to change (here it is crucial to believe in one's own competencies) or not (here only intention formation can be supported by self-efficacy). The HAPA also includes aspects such as situational barriers and resources (Schwarzer, 1992, 2001), but not much work has been done on these to date.

CONCLUSION

In this chapter, we have summarized the most popular theories in exercise psychology. One objective was to provide a framework or heuristic to differentiate the various theories. This is challenging due to the multiple overlaps of different theories and constructs (Armitage & Conner, 2000). The correspondence of the TRA and the TPB is obvious. However, there also are similarities in other theories, as, for example, the TPB and self-efficacy theory due to relationships between perceived behavior control and self-efficacy (Bandura, 2004). Perceived behavioral control and control variables might not be clearly separable (Schwarzer, 2001). Another example of overlap is attitudes in the TPB, outcome expectancies in self-efficacy theory, and the decisional balance (pros and cons) in the TTM (D. M. Williams, Anderson, & Winett, 2005). In the future, investigators need to state which theory is the most appropriate for a particular research question or intervention strategy. With the current overlap in constructs, however, it might be difficult to compare the theories because one might not easily test the discriminant validity of the constructs. One solution would be to assume that the constructs match each other and thus can be used for comparing the theories, as Garcia and Mann (2003) have done. They identified the HAPA as being superior to other models, such as the TPB, by investigating explained variances. With this method, we can compare how well the different theories explain the variation in behavior and which theoretical constructs might be most valuable. Other methods to assess the appropriateness of a theory could be to evaluate (a) whether the theory provides statistically significant outcomes (e.g., tested in an experimental design); (b) its effect size and whether it is clinical meaningful; (c) the public health impact if the theory is tested in a public health intervention; and (d) how generalizable the theory is to different populations, cultural subgroups, and circumstances (Nigg & Jordan, 2005).

One other approach in the future is not necessarily comparing and separating the theories but, instead, combining them to explain more variance. However, researchers and pragmatists have to avoid overloading theories and intervention plans. Theories have to be complete but also parsimonious—in other words, clear and simple (Michie et al., 2005). One model that aims to achieve this end is the HAPA due to its integration of motivational and volitional stages and generic factors of self-efficacy and stage-specific features, such as translating intentions into behavior via implementation intentions. With this model, we have learned, depending on the stage of the target group, that different mechanisms are important. For example, for those described as "intentional individuals," implementation intentions or plans are most crucial to translate their intentions into successful behavior.

Most of the theories in this chapter focus on the individual, but environmental factors are also important (Biddle & Mutrie, 2001). Some theories include external factors such as the TPB with subjective norms and SDT with its external forms of motivation. In these models, external factors are included as a *subjective representation* in the individual. However, numerous studies have also shown that objective features of the environment can explain why individuals are likely to be physically active or not. For instance, if there are more parks and pavement and sidewalks in the neighborhood, people walk more (Suminski, Poston, Petosa, Stevens, & Katzenmoyer, 2005). In the future, individual approaches should be tested under different environmental circumstances. This could test, for example, whether more variance is accounted for using TPB in a positive physical activity environment (e.g., where people perceive that they just have to change their own behavior to be active) than in unattractive environments (where individuals feel they cannot change their behavior just by individual decisions and become subject to learned helplessness in terms of their exercise behavior). These thoughts require further testing.

Empirically supported models are useful for creating interventions by identifying and altering particular factors (e.g., derived from continuous social cognitive models) that help people move from one stage to the next. Stage models offer the possibility of designing programs and treatments that will be more effective and efficient than one-size-fits-all interventions (Weinstein et al., 1998). Therefore, translating research into practice is important, and theory-based interventions are imperative for successful exercise and health-enhancing physical activity promotion.

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CHAPTER 25

A Social-Cognitive Perspective of Perceived and Sustained Effort

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> Most of the physiological processes that are associated with the perception of effort occur more or less unconsciously, including heart-rate, oxygen consumption, blood pressure, and even lactate production. As exercise intensity grows, so does the possibility that sensation will receive more conscious attention, especially those readily available to consciousness, such as pulmonary ventilation and regionalized pain. (Noble & Robertson, 1996, p. 207)

Perceived exertion* has been defined as one's subjective rating of the intensity of work being performed (Morgan, 1973), and later as the act of detecting and interpreting sensations arising from the body during physical exercise (Noble & Robertson, 1996). Perceived effort represents an important complement to behavioral and physiological measurements of physical performance and work capacity. Ratings of perceived exertion (RPE) scales are widely used in an array of situations, including monitoring individuals during graded exercise testing and prescribing and monitoring exercise intensity. Less attention has been given to effort tolerance (i.e., the ability to sustain and cope with feelings of effort for a period of time).

Interest in perceived effort was initiated with the work of Gunnar Borg during the early 1960s. In 1962, Borg viewed "perceived force" as one's perception of effort in short-time exercise and "perceived fatigue/exertion" as representing exertion during aerobic activities (Noble & Robertson, 1996). In the 1950s and 1960s, perceived exertion was studied using a psychophysiological perspective (i.e., how sensations of effort are perceived as a function of gradual physiological increase). At the same time, various RPE scales were developed for various tasks (see Noble & Noble, 1998). Perhaps the most frequently used measure of perceived effort is Borg's 15 graded category scale (Borg, 1971). This scale was designed so that it directly paralleled the heart rate (HR) range of a normal, healthy male. According to the theory, if the scale ratings were multiplied by 10, HR could be calculated: HR = RPE × 10 (Borg, 1961). Borg's RPE scale has been well validated, represents a reliable measure of perceptual intensity, and has proved robust in its usefulness (Noble & Noble, 1998). However, a number of researchers have questioned the efficacy of a single-item measure of effort (e.g., Hardy & Rejeski, 1989; Hutchinson & Tenenbaum, in press-a; McAuley & Courneya, 1994; Parfitt, Markland, & Holmes, 1994; Tenenbaum, 2005). It is our belief that a single-item measure of effort, such as Borg's RPE scale, is insufficient to capture the whole range of perceptual sensations that people experience when exercising or being physically active. We concur with Noble and Noble that "emphasis should be placed on understanding perception, not on studying the results of the Borg scale. Until that is done, the study of perceptual response during physical activity will reflect only what the Borg scale measures" (p. 356).

As early as 1973 it was suggested that physiological responses account for approximately two-thirds of the variance in perceived exertion, and that different psychological factors might explain the remaining one-third of the variance (Morgan, 1973; Noble, Metz, Pandolf, & Cafarelli, 1973). Despite this early insight, scant research attention has been paid to the effect of psychological factors on per-

* We prefer the term *perceived effort* to define the concept. However, where researchers have used the term *exertion* in other publications, we use this term to maintain the original terminology.

ceptions of effort. According to Noble and Robertson (1996), of the 450 published articles on perceived exertion, only 39 (8.6%) examined psychological factors. The main areas of research were descriptive studies on how perceived effort related to physiological factors and conditions, clinical applications, methodological issues, exercise and perception, and environmental factors. The main purpose of this chapter is to describe the psychological variables that affect perceived effort and effort tolerance, from both theoretical and scientific perspectives.

A GUIDING CONCEPTUAL MODEL

Perceived effort and effort tolerance are two psychological states that are determined by the interaction of several variables. Perceived effort and effort tolerance can be regarded as complex phenomena in which the performer makes attempts to adapt to the social and physical demands imposed on him or her while engaged in exercise. Perceptions of effort are determined by individual disposition, demographic characteristics, the task (whether aerobic, anaerobic, or both), the intensity level, the conditions under which the task is performed (e.g., temperature, humidity, time of day), and the coping strategies used when experiencing these feelings (see Figure 25.1). The conceptual framework displayed in Figure 25.1 assumes a mutual relationship between perceived effort and effort tolerance. More specifically, when perceived effort is reported to be low, under any task and environmental condition, the exerciser can adhere to and

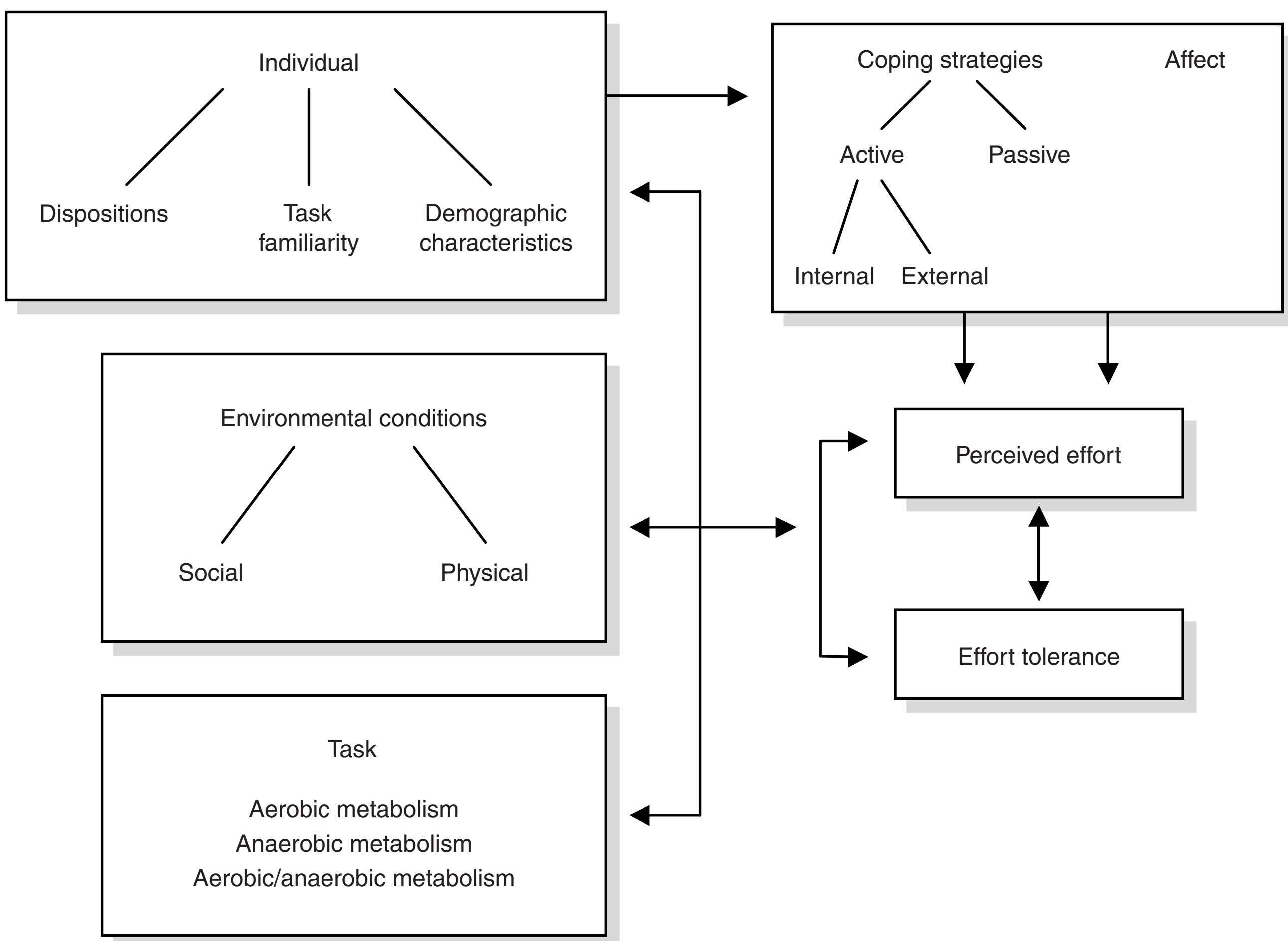

Figure 25.1 A model that postulates the effect of an individual's characteristics, environmental conditions, task characteristics, and coping strategies on both perceived effort and effort tolerance. Perceived effort and effort tolerance are believed to be independent variables, though strongly linked.

cope with effort longer than when perceived effort is reported to be high.

Dispositional Characteristics

Noble and Robertson (1996) summarized the limited research linking personal dispositions to perceived effort. They found that (a) the more people desire to impress others, the lower they tend to report their perceived exertion (Boutcher, Fleischer-Curtian, & Gines, 1988); (b) augmenters (i.e., people who exaggerate the importance of events in their life) report greater perceived exertion than do reducers (i.e., people who underestimate the importance of events in their life; Robertson, Gillespie, Hiatt, & Rose, 1977); (c) internal and external locus of control fails to determine perceived exertion (Kohl & Shea, 1988); (d) feminine sex-typed women report greater perceived exertion than do masculine or androgynous women (Hochstetler, Rejeski, & Best, 1985); (e) extraverts suppress painful stimuli and rate their perceived exertion lower than introverts (Morgan, 1973); and (f) self-efficacy is negatively related to perceived exertion (McAuley & Courneya, 1992). A clear relationship between Type A/B personality and perceived exertion has not been established (De Meersman, 1988; Hardy, McMurray, & Roberts, 1989; Rejeski, Morley, & Miller, 1983).

Recent research by Hall, Ekkekakis, and Petrozzello (2005) indicates that relationship of RPE to dispositional psychological factors may be intensity-dependent. Hall et al. found that extraversion and behavioral activation showed significant negative correlations with RPE at lower but not higher intensities, whereas neuroticism was unrelated to RPE, and behavioral inhibition was positively related across all three levels of intensity.

In general, the relationships between dispositional variables and perceived effort are limited. The association found between the desire to impress others, the over/underestimation of life events, femininity/masculinity type, extraversion/introversion, and perceived effort can be regarded as the effect of social desirability on reported effort. The failure to find any consistent link between locus of control and Type A/B personality with perceived effort appears to be a consequence of a lack of sound theory and measurement problems. For example, the most frequently employed measure of Type A and B personality styles, the Jenkins Activity Survey (Jenkins, Zyzanski, & Rosenman, 1979), is known to be no better than chance in its ability to discriminate Type A from Type B personalities (Noble & Robertson, 1996). The result has been a limited selection of psychological constructs with an appropriate methodological plan aimed at verification or modification of these relations. More specifically, the link between motivational components that are responsible for energizing and inhibiting human actions and effort components has not been sufficiently postulated and, therefore, not studied. An exception is McAuley and Courneya's (1992) study that linked perceived effort to task-specific self-efficacy. In line with this study, possible links between motivational variables such as goal orientation, self-efficacy, task-specific commitment and determination, effort tolerance, effort investment with perceived effort, and maintaining an exertive state are discussed in this chapter.

Task Familiarity

The importance of previous athletic experience was attested to by Rejeski (1981, p. 313), who wrote, "RPE for a given task is, at least in part, a function of past experience." Previous data on arm and leg training (Burkhardt, Wilkinson, Butts, Kirkendall, & Seery, 1982) and running and cycling training (Hassmén, 1990) suggest that RPE scores during a given mode of exercise will be lower for individuals for whom it is the primary mode of training. In addition, Hassmén showed that active individuals reported lower RPE scores than sedentary subjects at the same absolute power outputs.

Janot, Steffen, Maher, Zedaker, and Porcari (1998) reported that novice sport climbers experienced higher perceptions of effort than more experienced climbers during two indoor climbing bouts. However, novice climbers also experienced higher heart rates during the climbs, so it is difficult to conclude with any certainty that the differences in RPE were not simply attributable to more efficient climbing technique in the experienced climbers. Lagally, McCaw, Young, Medema, and Thomas (2004) found no difference in RPE between novice and recreationally trained lifters during resistance exercise.

In a study designed to explicitly examine the influence of athletic experience on perceived effort and effort tolerance, Tenenbaum et al. (2001) compared the perceived and sustained effort of individual-sport athletes (swimmers, cyclists, triathletes, and long-distance runners), team sport athletes (basketball, hockey, and soccer players), and untrained participants on two fatiguing tasks: an isometric handgrip task and a treadmill running task. Results indicated that individual-sport athletes rated perceived effort consistently lower than did their team sport and untrained counterparts throughout both tasks. The three groups were also significantly different on effort tolerance. On average, individual-sport, team sport, and untrained participants tolerated effort for 161, 150, and 74 s, respectively, during the handgrip task, and for 475, 313, and 279 s, respectively, during the running task. Given that individual-event athletes must cope with effort and physical discomfort on a regular basis during training, Tenenbaum et al. proposed that they were relatively accustomed to it, would be motivated to endure it, and would likely have developed the appropriate strategies to deal with it. In contrast, team sport athletes would not be as familiar with prolonged effort and discomfort given that they generally perform relatively brief bouts of intense physical activity yet rarely must endure intense effort for sustained periods. Interestingly, greater differences existed between individual-sport and team sport participants on the running task than the handgrip task—a clear indication that coping with and sustaining effort is task-specific.

Techniques for Coping with Stress

Strategies for coping with physical effort can take two forms: active and passive (Morgan & Pollack, 1977). As illustrated in Figure 25.1, active strategies are classified as either internal or external to the performer. External (dissociative) strategies are those in which the performer shifts attention to external events to reduce perceptions of neural exertion signals coming from the muscles and joints and the cardiopulmonary systems. Internal (associative) strategies are aimed at coping directly with feelings of overuse and effort through "fighting" against them or other negative events. A passive form of coping with effort is considered when people do not attempt to do anything that will enable them to better tolerate the sensory signals of fatigue, discomfort, exertion, and pain.

Morgan and Pollock (1977) studied the strategies used by elite marathoners and recreational long-distance runners in coping with perceptions of exertion. Marathon runners reported using an association strategy whereby attention was given to internal sensory cues. In comparison, recreational runners used a dissociation strategy in which they deflected internal bodily signals with various forms of distractive thinking. This finding was expanded by Schomer (1986), who claimed that increases in task intensity resulted in a shift from dissociative to associative thinking.

A number of studies have been concerned with the effect of coping strategies on perceived effort. For example, Pennebaker and Lightner (1980) manipulated external attentional focus by activating external street sounds; internal attentional focus was manipulated by asking participants to attend to their own breathing while walking on a treadmill. Greater fatigue was experienced when attending to one's own breathing compared to attending to street sounds. Fillingham and Fine (1986) asked participants while running to either count the word "dog" (external attention) or to focus on their breathing and heartbeat (internal attention). Fewer exercise symptoms were reported under the external attention compared to the internal attention condition. This finding has been supported by a number of subsequent studies using a variety of distraction methods, such as solving math problems (Johnson & Siegel, 1987) and attending to music (Potteiger, Schroder, & Goff, 2000), and across a variety of exercise modes, such as stationary cycling (Potteiger et al., 2000), treadmill running (Stones, 1980), repetitive leg-lift tasks (Gill & Strom, 1985), and isometric leg-extension tasks (Weinberg, 1985).

Boutcher and Trenske (1990) compared a sensory-deprivation (internal focus) condition to a music (external focus) condition and a control condition at three different levels of intensity using untrained subjects on a cycle ergometer. Ratings of perceived exertion responses in the music condition were significantly lower than responses in the deprivation condition at low (60% HR max) exercise intensity, but no differences in RPE were found at moderate (75% HR max) or high (85% HR max) exercise intensities. These findings led the authors to conclude that the influence of music on RPE was "load-dependent."

In addition to perceptions of effort, the effect of different attentional strategies on effort tolerance has been examined. Morgan, Horstman, Cymerman, and Stokes (1983), for example, found that a dissociative cognitive strategy resulted in 32% longer endurance on a treadmill compared to a control condition. In a subsequent study, Weinberg, Smith, and Jackson (1984) compared associative, dissociative, and positive self-talk strategies in the performance of an endurance task. Participants were asked to employ one of these strategies throughout the duration of a leg-extension endurance task. Results indicated that the dissociation and positive self-talk conditions produced significantly greater tolerance than the association or control conditions. Rejeski and Kenney (1987) varied the complexity of a dissociative coping task to verify if this affected effort tolerance. The time that a participant could maintain an isometric contraction of 40% on a handgrip dynamometer was used as a dependent variable. No differences were found between the simple and complex dissociation groups, with both tolerating fatigue better than controls.

Another common technique for coping with aversive stimuli is imagery. Explanations for the effectiveness of imagery in coping with exertive stimuli are based on the premise that a close link exists among emotions, images, and sensations. In the same way that emotions are accompanied by physical sensations, images may evoke emotions. Visualization is believed to affect feelings and physical sensations by altering images.

Various relaxation techniques, such as meditation, exercising, rhythmic breathing, and attending to music, are often used to decrease stress symptoms. Progressive relaxation, which consists of active contraction and passive relaxation of gross muscle groups, is a technique frequently used with guided imagery (Edgar & Smith-Hanrahan, 1992). Guided imagery involves the development of mental representations of reality or fantasy. Guided imagery is aimed at reducing the pain and autonomic reactivity. The principle is to hold the image (e.g., a peaceful, pain-free scene) during a painful experience (James, 1992; Taylor, 1995). Imagery can also help to transform pain into numbness or an irrelevant sensation. It may divert attention from internal and external events. In addition, pain can be controlled through somatization (i.e., the focus of attention on the painful area but in a detached manner; Melzack & Wall, 1989).

Images used to cope with aversive stimuli vary. Murphy, Woolfolk, and Budney (1988) manipulated emotive images by instructing participants to develop imagery-arousing specific feelings while performing a strength task with a handgrip dynamometer. Participants were instructed to imagine a scene in which they felt either angry, afraid, or relaxed. They were then asked to visualize the scene until the feeling was evoked. When feeling fully involved in the scene, they were asked to squeeze the dynamometer as hard as possible. It was found that anger and fear images increased arousal level, but not strength. Relaxation images resulted in decreased strength. Relaxation imagery is more frequently used than emotive imagery in controlling pain and uncomfortable feelings (Taylor, 1995). Both techniques induce a mood state (relaxation or excitement) that may aid in tolerating pain or discomfort. Whereas relaxation imagery improves pain tolerance through physiologically calming the body, emotive imagery increases mental arousal and enhances the body's coping mechanisms to better tolerate exertive experiences. For example, motivational general-mastery imagery incorporates images of coping in difficult conditions, staying focused throughout a workout, maintaining effort even when tired, and being confident or mentally tough (Giacobbi, Hausenblas, Fallon, & Hall, 2003).

Coote and Tenenbaum (1998) randomly divided 48 female university students into 3 groups. Two groups were taught relaxation or aggressive imagery techniques, and the third (control) group spent an equivalent amount of time discussing various irrelevant topics. Participants completed two sessions involving a 50% max handgrip squeeze to fatigue: one prior to learning the imagery techniques, and the other after learning the imagery techniques. Ratings of perceived exertion were measured at regular (15 s) intervals during both tasks. Analyses indicated that from the first to second trial, control group performance declined by 3.7%. In contrast, the aggressive imagery group tolerated effort at the second trial 30.5% longer than the first attempt, and the relaxation imagery group improved by 28%. The three groups were similar in RPE throughout the entire exertive experience.

Environmental Conditions

The physical aspects of the environment that can affect RPE include altitude, ambient temperature, music and noise, and air conditions such as wind velocity, humidity, and airborne pollutants (Borg, 1998). In addition, the social context in which exercise is performed may significantly influence RPE. According to Hardy, Hall, and Prestholdt (1986), perceived effort and effort tolerance are directly influenced by the salience of social cues present in the environment. For example, Hardy et al. had participants cycle alone, and in the presence of a coactor performing at the same exercise intensities (25%, 50%, and 75% of VO_2 max). They found that participants reported lower RPE when cycling at 25% and 50%, but not 75% of VO_2 max in the presence of a coactor. Perceived effort was also lower when instructors were of the opposite sex, but this was less salient for highly trained athletes (Sylva, Boyd, & Magnum, 1990).

The main environmental factors that evoke feelings of effort are the intensity and duration of a task. "Perceptual responses are an expression of the sensory link between external stimuli arising from physical work and internal responses reflecting physiological function" (Noble, 1977, as cited in Noble & Robertson, 1996, p. 93). Kinsman and Weiser (1976), Weiser and Stamper (1977), and Pandolf (1982) developed a model that describes the relationship between physiological symptoms occurring during exercise and how they are perceived by the exerciser. There are four levels of subjective reporting of sensory experiences during an ongoing physical exercise, each associated with physiological processes that induce fatigue. The first level, discrete symptoms, is associated with symptoms such as sweating, perspiring, panting, heart pounding, leg aches and cramps, muscle tremors, leg twitching, heavy and shaky legs, tiredness, drive, vigorous mood, and determination. The second level, the subordinate, is associated with cardiopulmonary, leg, and general fatigue. The third level, ordinate, is linked to task aversion and the motivation to adhere in the task. The fourth level, superordinate, is associated with extreme fatigue and/or physical exhaustion. At this stage, one cannot identify specific sensations (i.e., muscle aches, breathing, leg cramps), but only extreme general fatigue and exhaustion (see Noble & Robertson, 1996, chap. 4, for a detailed description).

As discussed earlier, the subjective-objective link to effort is strongly related to the attentional mode of the exerciser. Noble and Robertson (1996) concluded that exertion feelings intensify with an increase in physical load, and consequently attention shifts from an external-dissociative mode to an internal-associative mode. Under low effort conditions, perceived effort can be manipulated by attending to external cues such as music (passive) or problem solving (active). However, diverting attention is much harder to implement when the exerciser is in the superordinate level. At this stage, an exerciser needs a high level of determination and effort tolerance to persist in the task. The subjective-objective link with respect to attentional mode and perceived effort manipulation is illustrated in Figure 25.2.

Several recent studies provide validation for the model presented in Figure 25.2. Tenenbaum et al. (2004) conducted three studies that examined the effect of music on sensations and thoughts experienced by runners under high physical load. In the first two studies, 15 male participants who were not regular runners participated in a 90% VO_2 max treadmill run to fatigue under four conditions: silence, rock music, inspirational music, and dance music. The order of the four running conditions was counterbalanced to mask any order effect. Ratings of perceived exertion (Borg, 1982) and HR were monitored every 30 seconds during the run. At the termination of each run, participants completed the Running Discomfort Scale. (Tenenbaum et al., 1999) and answered open-ended interview questions on motivation, perception, and attention focus they experienced during the run. The third study was a field study in which 25 male physical education students ran a hilly 2.2 km course as fast as possible under different conditions (same music conditions as in the previous two studies). The same questionnaire and open interview administered in the two laboratory studies were used in the field study, with the instructions adjusted to the context of a field run. The overall findings of these three studies were that music failed to influence HR, sensations of exertion (RPE), or effort tolerance, although about 30% of the participants indicated that the music helped them at the beginning of the run. Tenenbaum et al. (2004) concluded that the exertive symptoms experienced by the participants at the 90% VO_2 max level were beyond the distraction capabilities of the external stimulus (music). The practical application of this is that when one is engaged in strenuous running and attends to one's preferred music, it may result in better feelings at the beginning of the run but not during the latter stages, when the physical effort is very high.

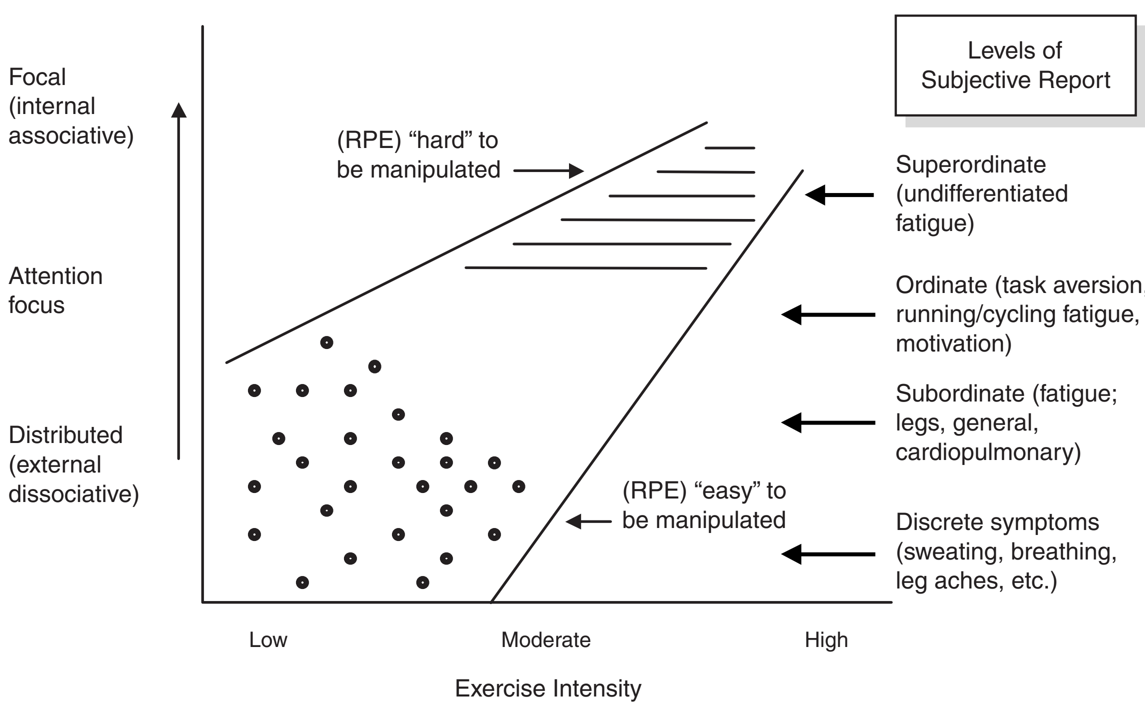

Figure 25.2 Perceived effort as a function of exercise intensity and the physiological substrata.

Hutchinson and Tenenbaum (in press-a) carried out two studies to examine individuals' attentional strategies during engagement in two enduring physical tasks and the effect of workload on attention focus. In the first study, 35 moderately active male and female participants completed a sustained handgrip-squeezing task at 25% max grip strength to fatigue. In the second study, 13 moderately active male and female participants completed a stationary cycling task for 5 minutes at 50% VO_2 max, for a further 5 minutes at 70% VO_2 max, and then to volitional fatigue at 90% VO_2 max. During both tasks participants were instructed to vocally express their current thoughts—in sentences, phrases, or words—continuously during the testing procedure. Participants' statements were written down by the examiner and later classified according to Schomer's (1986) thought classification system to reveal patterns of associative and dissociative attention focus. Results revealed that the frequency counts of classified thoughts differed significantly across the beginning, middle, and end time phases of both exertive tasks. In the handgrip task, frequency of associative thoughts was significantly greater during the middle and end stages of exercise, accounting for 64% and 94% of total reported thoughts, respectively, during these stages. In contrast, dissociative thoughts were more prevalent at the beginning of the task, accounting for 71% of total reported thoughts at this stage. Figure 25.3 displays the observed relationship between attention focus and task intensity during the handgrip task.

The same pattern was evident in the cycle task, where associative thoughts accounted for 91% of all thoughts reported during the final exercise stage and 61% of all thoughts reported during the middle exercise stage. Dissociative thoughts were more prevalent at the beginning of the task, accounting for 78% of total reported thoughts at this time. Figure 25.4 displays the observed relationship between attention focus and task intensity during the cycle task.

The results of these studies indicate that attention focus during sustained effort is largely dependent on stimulus intensity. Specifically, with increasing task intensity and feelings of great effort, attention shifts from an external-dissociative mode to an internal-associative mode. Thus, dissociative coping strategies can be influential on perceived effort and effort tolerance at low to moderate levels of workload, but they are not likely to be effective at higher levels of exercise intensity, when attention is focused on overwhelming physiological sensations that dominate focal awareness.

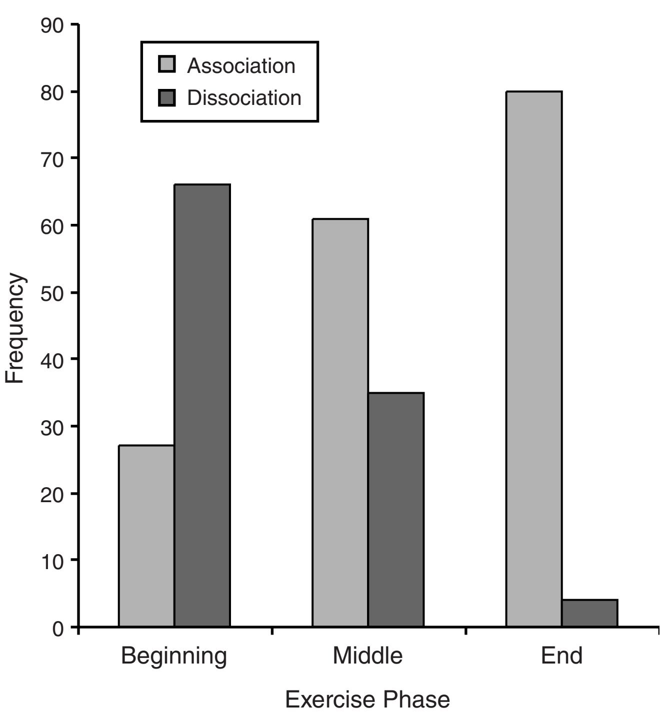

Figure 25.3 Categories of thoughts for beginning, middle, and end time phases of the handgrip task. *Source:* "Attention Focus during Physical Effort: The Mediating Role of Task Intensity," by J. C. Hutchinson and G. Tenenbaum, in press-a, *Psychology in Sport and Exercise.* Reprinted with permission.

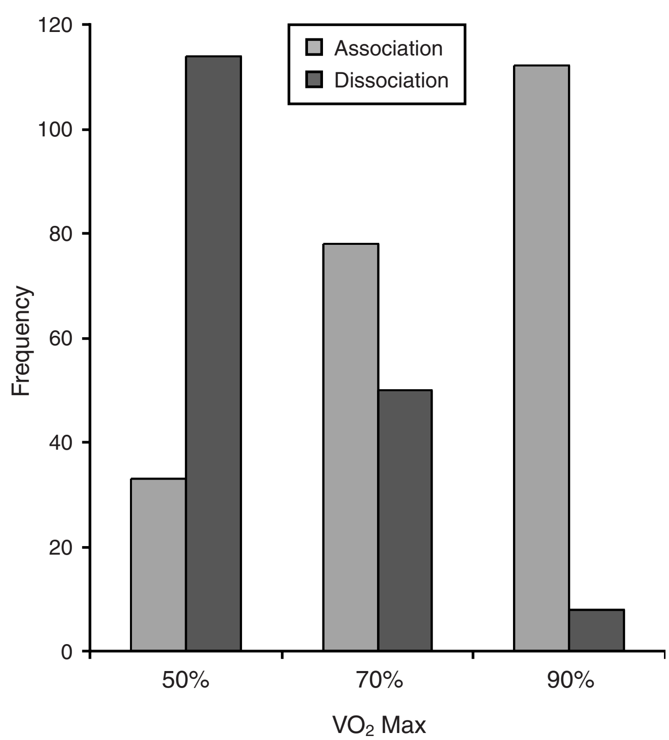

Figure 25.4 Categories of thoughts for beginning (50% VO_2 max), middle (70% VO_2 max), and end (90% VO_2 max) time phases of exercise. *Source:* "Attention Focus during Physical Effort: The Mediating Role of Task Intensity," by J. C. Hutchinson and G. Tenenbaum, in press-a, *Psychology in Sport and Exercise.* Reprinted with permission.

THE SOCIAL-COGNITIVE PERSPECTIVE

In this section, the primary variables studied using the social-cognitive approach in psychology are reviewed. The social-cognitive approach, in particular, self-efficacy theory (Bandura, 1977, 1982, 1986, 1997), when applied to exercise behavior, emphasizes the role that task-specific states have on perceiving and coping with exercise stimuli (e.g., physical effort).

Goal Orientation

Goal orientations reflect individual differences in assigning subjective meaning to outcomes (Ames, 1984; Maehr & Braskamp, 1986). The subjective meaning given to success and failure is linked to either a differentiated or an undifferentiated concept of ability. A differentiated concept of ability is determined by comparing one's performance and outcome to others'. Ability can be evidenced by performing better than others, by surpassing normative-based standards, or by achieving success with little effort (Covington, 1984). This goal orientation is termed *ego orientation.* An undifferentiated concept of ability is utilized when subjective achievements are compared to self-referenced standards. This orientation is termed *task orientation* and is evoked by the need to meet and improve personal standards (Nicholls, 1984, 1989). Task goal orientation is associated with behaviors such as skill improvement, task mastery, working hard, and persistence. In contrast, ego goal orientation is associated with maladaptive or inhibitive behaviors when social comparisons are avoided; as a consequence, effort and confidence decrease (Jagacinski & Nicholls, 1990).

Task and ego goal orientations are independent of each other and important determinants of motivation (see Duda & Hall, 2001, for a review). It is assumed that

> the choice to invest in any activity, the amount of effort expended on a task, the level of persistence shown toward a challenge, and the cognitive and affective responses associated with the resulting behaviors emanate from the meaning that is attached to one's achievement striving. (p. 417)

To date, few studies have examined the effects of goal orientations on perceived effort and effort tolerance. Duda, Sedlock, Noble, Cohen, and Chi (1990) examined the effects of goals on RPE and affective responses while performing a cycle ergometer task at 70% VO_2 max. They found that a combination of high task and low ego orientation led to lower perceptions of effort and more positive affect associated with exercise than a combination of high ego and low task orientation. Stephens, Janz, and Mahoney (2000) examined the relationship between adolescents' goal orientation in sport and RPE during a graded exercise test and concluded that a task orientation was negatively related to RPE in girls, but not in boys.

Tenenbaum et al. (2001) sought to extend the work of Duda et al. (1990) and Stephens et al. (2000) by examining the predictive capabilities of goal orientations in both a local muscular endurance task and a treadmill running task. In two separate studies, participant's goal orientations were assessed using the Task and Ego Orientation in Sport Questionnaire (Duda & Nicholls, 1992). Participants in the first study were then asked to tolerate a sustained handgrip squeeze at 50% of their maximum capacity for as long as they could maintain it. Sustained effort (determined as time elapsed from reporting RPE "hard" until ceasing the task) was used as the dependent variable. Participants in the second study completed a submaximal (90% VO_2 max) running task on a treadmill. Again, sustained effort was used as the dependent variable. Tenenbaum et al. reported that task and ego goal orientations accounted for 21% of the variance of sustained effort in a muscular endurance task and 20% of accounted variance in a treadmill running task. Though both ego and task orientation accounted for substantial variance in the prediction of effort, each of them separately did not correlate with the amount of time participants spent in sustained effort.

Goal orientation describes an individual's disposition to be ego- or task-oriented, and *goal involvement* describes situationally emphasized goal perspectives, or different motivation states. According to Nicholls (1989), task and ego goals are determined by both dispositional and situational factors. However, research has mainly addressed goal orientations, and goal involvement states have received little direct attention (Gernigon, d'Arripe-Longueville, Delignières, & Ninot, 2004). Furthermore, research to date has primarily examined dispositional goal orientations and goal involvement states as separate constructs. An interactionist approach that looks to integrate dispositions and the motivational climate promises a more complete understanding of achievement behaviors in sport and exercise (Roberts, 2001). This is especially important for a measurement standpoint. Tenenbaum et al. (2001, p. 1620) concluded:

> If the meaning of achievement is a psychological state (Maehr & Braskamp, 1986), then it is necessary to examine the meaning of achievement in the specific context of interest. . . . One

cannot simply assume that by measuring participants' goal orientations in sport, they will be reflective of the meaning of achievement on a contrived motor task.

Perceived Competence and Self-Efficacy

Competence is a multidimensional construct that is produced by mastery attempts in various tasks, and consequently leads to the development of behaviors and perceptions of control (S. E. Harter, 1978). People with similar goal orientations differ from each other in various tasks performed under similar conditions due to their different levels of self-perceived competence. In educational settings, learners with low perceived competence or ability, accompanied by ego goal orientation, were found to reduce their learning effort (Jagacinski & Nicholls, 1990). In football, players with high ego goal orientation and low perceived competence exhibited higher competitive anxiety before competitions than did players with greater perceived competence (Boyd, Callaghan, & Yin, 1991). Conversely, Ommundsen and Pedersen (1999) reported that high task goal orientation and high perceived competence predicted a reduced tendency to report cognitive anxiety during competition in young tennis players. Thus, the greater an individual's perceived competence in a specific task or activity, the better the ability to cope with its physical demands.

Perceived self-efficacy "refers to beliefs in one's power to produce a given level of attainment" (Bandura, 1997, p. 382). It is a cognitive state that has a direct impact on how well actions are performed. Beliefs of self-efficacy constitute the key factor of human agency. People who lack self-efficacy believe they also lack the power to perform the task. Bandura states that a sense of personal efficacy is represented by prepositional beliefs embedded in a network of functional relationships. An example is coping with aversive experiences in which exertion and discomfort are present.

Self-efficacy expectations differ on three dimensions: magnitude, generality, and strength. The magnitude of self-efficacy refers to the level of task difficulty that a person believes he or she is capable of executing. Generality refers to efficacy expectations that may be specific to a task, or a more generalizable sense of efficacy (i.e., related to several tasks). Finally, the strength of expectations refers to the degree to which one exhibits perseverance when facing aversive or frustrating situations that evoke physical exertion and discomfort.

Bandura, O'Leary, Barr Taylor, Gauthier, and Gossard (1987) maintained that judgments of self-efficacy determine the effort people invest while performing a task and their perseverance in the face of either aversive experiences or taxing environmental demands. Stemming from the area of pain research, there is considerable evidence to support the notion that efficacy cognitions play an important role in influencing an individual's ability to sustain and cope with symptoms of discomfort. It is reasonable to assume that such cognitions might also play a role in the ability to cope with exertive discomforts associated with exercise.

Turk, Michenbaum, and Genest (1983) studied participants who utilized self-efficacy boosting strategies to tolerate a noxious stimulus (e.g., cold pressure task). They found that participants who could apply efficient coping strategies tolerated the task longer than did those who were unable to apply efficient coping strategies. Litt (1988) investigated discomfort tolerance caused by a cold pressure task and found that self-efficacy predicted persistence in the task, and efficacy expectations strongly determined performance duration. Participants with higher degrees of both self-efficacy and perceived control were able to tolerate the cold pressure task longer. Discomfort tolerance was longest when both of these factors were high. Similarly, Baker and Kirsch (1991) found self-efficacy to be a strong predictor of discomfort tolerance in a cold water task. In this study, participants who used strategies to boost self-efficacy while immersing their hand in cold water for as long as possible showed increased discomfort tolerance, but did not report a decrease in perceived discomfort.

The effects of both self-efficacy and drugs on tolerating the discomfort of a cold pressure task were investigated by Bandura et al. (1987). Participants were given either self-efficacy-related cognitive methods to cope with discomfort tolerance, a placebo, or no intervention control. To test whether changes in discomfort tolerance were mediated by activation of the endorphin system, half the participants in each condition received 10 mg of naloxone, a drug that inhibits the effect of opiates and, therefore, increases the sensation of pain. The other half received 10 mg of a saline solution. Results suggested that those who received cognitive training strengthened their self-efficacy to withstand and reduce pain. The cognitive training and naloxone group, when compared to the group receiving cognitive training and saline, was less able to tolerate discomfort. However, the cognitive group that received the naloxone was still able to increase discomfort tolerance to some degree. This suggests a nonopioid component in cognitive pain control (Bandura et al., 1987).

In conclusion, self-efficacy can be altered, but its effectiveness is accurately assessed only under task-specific conditions.

Given the wealth of studies pertaining to the effect of self-efficacy on pain tolerance, it is surprising to observe the lack of studies examining self-efficacy and effort tolerance. In his extensive literature review, Bandura (1997) failed to locate any studies that examined perceived self-efficacy and beliefs of control with effort tolerance. However, he described the role of cognitive activities in displacing sensations from consciousness and altering their aversiveness:

> If aversive sensations are supplanted in consciousness or are construed benignly . . . they become less noticeable and less distressingly intrusive. Research . . . shows that belief that pain is controllable to some extent makes it easier to manage. . . . The ameliorative effects of such pain control techniques operate partly through changes in self-efficacy. . . . The stronger the instated perceived coping efficacy, the higher the pain tolerance and the less dysfunction pain produces. (pp. 393–394)

In a study designed to test this hypothesis, Tenenbaum et al. (2001) confirmed that perceived dispositional and task-specific self-efficacy can determine how long one can tolerate effort and discomfort on both a running and a strength-endurance task (see Tenenbaum, 2001, for details). This finding was supported in an unpublished study by Tenenbaum and Hutchinson (2004), who observed that task-specific self-efficacy and task-specific perceived ability accounted for a substantial variance of effort tolerance in a handgrip task, and that physical self-efficacy contributed significantly to variance of effort tolerance in a cycle task. Further research examining this effect is warranted.

Research pertaining to self-efficacy and perceived effort has been more forthcoming. McAuley and Courneya (1992) took 88 middle-aged sedentary participants and measured perceptions of their ability to ride a cycle ergometer at 70% of age-predicted HR max for gradually increasing periods of time. Results indicated that a strong sense of self-efficacy resulted in participants perceiving themselves to have exerted less effort than those subjects with lower sense of self-efficacy. After controlling for fitness, body fat, age, gender, and affect, preexercise self-efficacy accounted for 3.1% ($p < .05$) of the variance in RPE at the conclusion of the protocol. Rudolph and McAuley (1996) reported similar findings in a sample of 50 young men who ran on a treadmill at 60% VO_2 max for 30 min. After controlling for VO_2 max, preexercise self-efficacy accounted for 14% ($p < .001$) of RPE in the final minute of the protocol. This finding was recently replicated with teenage girls by Pender, Bar-Or, Wilk, and Mitchell (2002), who reported that preexercise self-efficacy accounted for 14% of the variance in average RPE collected at 4-min intervals during a 20-min bout of cycle ergometry at 60% VO_2 peak.

Recent research by Hall et al. (2005) indicates that the relationship between RPE and self-efficacy may be intensity-dependent. Self-efficacy was measured on a 100-point scale at regular intervals during three 15-min treadmill runs, one 20% below, one at, and one 10% above the ventilatory threshold (VT). Results indicated that self-efficacy produced consistently negative correlations with RPE below and at the VT, but no significant correlations were observed at intensities above the VT.

Future research ought to focus on *how* self-efficacy influences perceived effort and effort tolerance. Several explanations have been put forward. Bandura et al. (1987) reported that an actual decrease in the appraisal of aversive stimuli might be responsible for lower perceptions of effort and increased effort tolerance. According to Bandura (1995, p. 359), “Self-percepts foster actions that generate information as well as serve as a filtering mechanism for self-referent information in the self-maintaining process.” Studies reporting a negative relationship between self-efficacy and RPE (Hall et al., 2005; Pender et al., 2002; Rudolph & McAuley, 1996) support this contention. An alternative explanation offered by Hardy and Rejeski (1989) is that efficacy cognitions determine affective reactions to tasks that challenge personal skills or capabilities. For example, engaging in exercise produces demands on the system that can result in considerable in-task affect, which, if positive, might lead to continued participation and, if negative, to ultimate disengagement from the activity. This assumption was confirmed by McAuley and Blissmer (2000), who successfully manipulated self-efficacy via false performance feedback in a group of young, low active women and concluded that the self-efficacy manipulation differentially influenced feeling state responses. Specifically, high-efficacy participants reported significantly greater positive well-being and less psychological distress and fatigue than low-efficacy participants exercising at the same intensity. Finally, S. Harter (1990) suggested that self-efficacy plays an influential role in moderating effort tolerance because it represents a critical aspect of self-worth. Therefore, self-judgments about one’s competence on meaningful tasks moderate the motivational effects of aversive feedback or physical exertion on persistence and performance. Future investigations are called for that attempt to elucidate the mechanisms by which self-efficacy positively impacts effort tolerance.

Task-Specific Commitment, Determination, and Effort

Task-specific commitment/determination and the effort one is ready to invest in and tolerate while exercising may affect coping and persisting behaviors. The concept of commitment has been conceptualized as a psychological state related to extended engagement in activity over a given period of time that leads to persistence in the face of difficulties or setbacks (Scanlan, Carpenter, Schmidt, Simons, & Keeler, 1993). Commitment is related to the determination, dedication, and effort needed to persist in a particular activity. Scanlan and Simons (1992) further conceptualized commitment as a multidimensional concept, consisting of five main components: enjoyment, personal investment, social constraints, involvement alternatives, and involvement opportunities. Of these five dimensions, personal investment (i.e., how much effort one is ready to invest in the activity) is most clearly relevant to effort tolerance. Commitment can be considered a causing variable rather than an outcome behavior. In other words, a person with more commitment and determination coupled with readiness to invest effort and tolerate exertion will adhere longer to aversive stimuli.

Tenenbaum et al. (2001) reported that task-specific determination, commitment, and effort investment accounted for 32% of sustained effort variance in a handgrip task. Similarly, the same constructs added 11% to the accounted sustained effort variance in a running task (see Tenenbaum, 2001, for details). These results can be viewed as strong evidence for the role that task-specific variables play in effort tolerance.

NEW DIRECTIONS: MULTIDIMENSIONALITY OF EFFORT PERCEPTIONS

Recent research has supported the conceptualization of perceived effort as a multidimensional construct. Borg's concept of perceived exertion was introduced in the 1950s as a holistic concept that incorporated perceived exertion, local fatigue, and breathlessness. Currently, Borg (1998) conceptualizes exertion within a gestalt framework, that is, a configuration of sensations such as strain, aches, and fatigue that stem from the peripheral muscles, pulmonary system, somatosensory receptors, cardiovascular system, and other sensory organs and cues. In the gestalt conceptualization of perceived exertion, motivation and emotions are psychological variants that are viewed as an integral part of the experience of exertion. In this respect, Borg views exertion as a latent variable that incorporates many other symptoms and yet uses measures to estimate exertion level that fail to account for the many symptoms that constitute perceived exertion.

Recently, it has been proposed that differentiated exertional signals provide a more precise definition of the physiological and psychological processes that shape the perceptual context during exercise (Noble & Robertson, 1996). Differentiated ratings of perceived exertion have been used to examine in greater detail the central and local factors contributing to an individual's RPE (Demura & Nagasawa, 2003; Gearhart et al., 2001, 2002; Lagally et al., 2002; Marsh & Martin, 1998; Pincivero & Gear, 2000; Pincivero, Gear, Moyna, & Robertson, 1999; Robertson et al., 2000). In these studies, RPE scores were assigned to central (cardiopulmonary) and peripheral (muscles and/or joint) sources, alone or in conjunction with an overall RPE score (Marsh & Martin, 1998). The intensity of the various differentiated perceptual signals usually differs from that of the undifferentiated signal at a given time point during submaximal exercise (Noble & Robertson, 1996).

Certain types of exertional symptoms are not specifically related to physiological processes (Noble & Robertson, 1996). These nonspecific symptoms reflect psychological factors and represent distinct inputs in the perceptual report. Thus, conceptually, exercise-related effort must take into account the different psychological components that reflect signals of motivation and affect, in addition to physical components (Hardy & Rejeski, 1989; Parfitt, Markland, & Holmes, 1994). A series of studies incorporating aerobic and anaerobic tasks are presented that shed light on physiological and psychological factors in perceived effort.

Hutchinson and Tenenbaum (in press-b) studied the effort perceptions of volunteer male and female participants who were exposed to the sensation of physical effort via two exhaustive tasks: a handgrip squeezing task and a stationary cycling task. The handgrip task involved a sustained isometric contraction at 25% maximum grip strength to fatigue using a calibrated handgrip dynamometer. The cycle task involved pedaling on a stationary cycle ergometer at 50%, 70%, and 90% of previously established VO_2 max to fatigue. Three dimensions of perceived effort (sensory-discriminative, motivational-affective, and cognitive-evaluative sensations) were measured, via self-report, at regular intervals for the duration of the two tasks. Participants were asked to rate their current perceptions of each sensation on a 0 to 10 scale. The sensory-discriminative dimension comprised muscle aches, pain, and fatigue; the motivational-affective dimension comprised concentration, determination, and mental toughness; and the cognitive-evaluative dimension comprised effort, exertion, and task aversion. Results indicated that the three dimensions were perceived distinctly and operated differently in the duration of the two physical tasks.

In the handgrip task, analysis revealed significant effects for effort sensation, task endurance, and an effort sensation-by-task endurance interaction effect. On average, motivational-affective sensations were rated 17% higher than sensory-discriminative sensations (effect size [ES] = 0.78) and 11% higher than cognitive-evaluative sensations (ES = 0.30). Cognitive-evaluative sensations were rated 7% higher than sensory-discriminative sensations (ES = 0.43). Over the time course of the task both sensory-discriminative and cognitive-evaluative sensations increased by 68% and 53%, respectively. The cognitive-evaluative sensations were rated higher during the initial 60 seconds of the task, but the two sensations were rated similarly during the last 60 seconds. In contrast, motivational affect remained more stable over time, showing a slight increase of 27% from the outset. A graphic representation of this effect is shown in Figure 25.5.

In the cycle task, findings revealed significant effects for effort sensation, task endurance, and an effort sensation-by-task endurance interaction effect. On average, motivational-

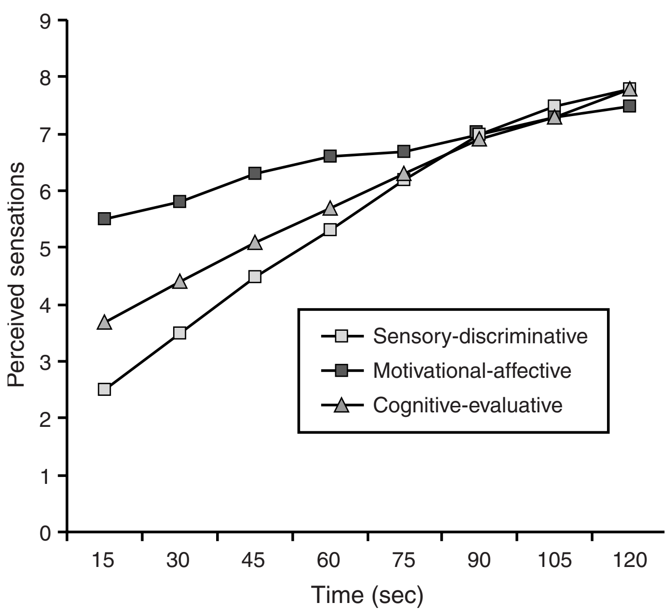

Figure 25.5 Mean ratings for each dimension within 15 sec intervals during 120 sec duration for the handgrip task. *Source:* "Attention Focus during Physical Effort: The Mediating Role of Task Intensity," by J. C. Hutchinson and G. Tenenbaum, in press-a, *Psychology in Sport and Exercise.* Reprinted with permission.

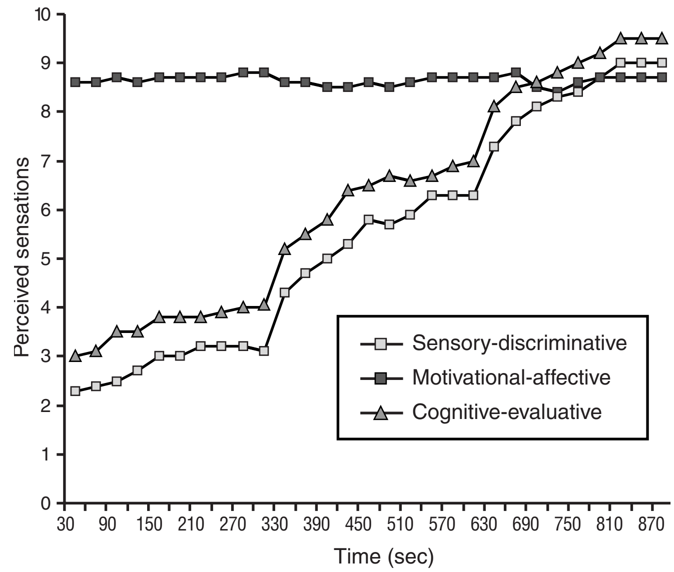

Figure 25.6 Mean ratings for each sensation dimension in 30 sec intervals during 900 sec of the cycle task. *Source:* "Attention Focus during Physical Effort: The Mediating Role of Task Intensity," by J. C. Hutchinson and G. Tenenbaum, in press-a, *Psychology in Sport and Exercise.* Reprinted with permission.

affective sensations were rated 37% higher than sensory-discriminative sensations (ES = 0.64) and 29% higher than cognitive-evaluative sensations (ES = 0.82). Cognitive-evaluative sensations were rated 11% higher than physical sensations (ES = 0.08). Similarly to the handgrip task, the three sensations were rated differently each from the other.

The effort sensation-by-task endurance effect is represented in Figure 25.6. The graphic presentation indicates that the three effort sensations resulted in different patterns over the time course. Both the sensory-discriminative and cognitive-evaluative sensations increased monotonically over time, by 76% and 68%, respectively. Cognitive-evaluative sensations were rated higher than the sensory-discriminative sensations throughout the task. Motivational-affective sensations, in contrast, remained relatively stable over time, with a slight (3%) average decrease at the end of the task.

Similar findings have been reported by Ekkekakis, Hall, and Petruzzello (2004). Perceived activation and perceived exertion rose continuously over the duration of an exertive task, whereas perceived affect (pleasure-displeasure) did not. Ekkekakis et al. subjected two groups of young, healthy volunteers to incremental treadmill tests until volitional exhaustion. During testing, perceived exertion was assessed via Borg's (1998) RPE scale, perceived activation was assessed by the Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985), and affect was assessed by the Feeling

Scale (FS; Hardy & Rejeski, 1989). Participants gave self-ratings on the RPE scale, FS, and FAS (in that order) every minute from the beginning of the incremental phase of exercise to the point of volitional exhaustion. Results demonstrated a significant main effect of task endurance for all variables. Trend analyses showed that linear trends were significant for all variables, but quadratic trends were significant for only FS. Specifically, affective valance showed a pattern of quadratic decline, initiated once the ventilatory threshold was exceeded.

Evidence for a differentiated postexercise affective response comes from the recent work of Arent and colleagues. Arent, Landers, Matt, and Etnier (2004) examined the dose-response gradient of exercise-induced affective change using a resistance training protocol. Male and female participants completed three resistance training protocols (40%, 70%, and 100% of 10-repetition max) and a no-treatment control condition. Affective responses were assessed immediately before and at 0 to 5, 15, 30, 45, and 60 minutes postexercise. Salivary cortisol and heart rate responses were also assessed during each condition. Ratings of perceived exertion were assessed using Borg's (1998) scale, and affective variables encompassing state anxiety, arousal/activation, and positive and negative affect were assessed using the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), the Activation-Deactivation Adjective Check List (Thayer, 1989), and the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), respectively. Results revealed a significant linear relationship between exercise intensity and RPE. Significant curvilinear trends for intensity were found for all affective variables. Moderate-intensity strength training was found to produce the greatest improvements in postexercise anxiety, positive affect (PA), negative affect (NA), and arousal. High-intensity training resulted in increased anxiety, NA, and tense arousal. Low-intensity exercise was generally ineffective in producing beneficial changes in affect and typically was no different from the control condition. These findings led the authors to conclude that "affective change following resistance training occurs at a dimensional level (i.e., the dimension of PA and NA) and categorical level (i.e., anxiety) level" (Arent et al., 2004, p. 104). In addition, Arent et al. concluded that HR and cortisol responses were significant predictors of changes in negative affective states but did not predict changes in positive affective states. This suggests that changes in negative affect are more heavily influenced by interoceptive cues associated with the physiological demands of exercise, whereas changes in positive affect are brought about by cognitive appraisals based on exteroceptive cues associated with the exercise bout (Arent et al., 2004).

Together these studies demonstrate that perceived effort comprises several distinct inputs that are perceived differently across the duration of a demanding physical task. This conclusion lends support to the assertion that exertion is only one of many sensations that are felt during exercise engagement (Hardy & Rejeski, 1989; McAuley & Courneya, 1994; Parfitt et al., 1994; Tenenbaum, 2005) and questions the efficacy of a one-item measure of effort via the term *exertion.*

CONCLUSION

In this chapter, psychological components that affect and mediate perceived effort and effort tolerance have been examined. The literature offers evidence for several conclusions. First, effort develops in stages with load increase. It starts with discrete symptoms such as sweating, breathing, and leg aches, and ends with an undifferentiated extreme. Second, attention to the exertive symptoms narrows with increase in physical load (i.e., from a distributed mode to a symptom-focused mode). Third, perceptions of effort are influenced by both physical and social environmental conditions. And finally, exercise participants who are relatively accustomed to enduring feelings of physical discomfort appear more motivated to tolerate and sustain effort, although this effect appears to be task-specific. The dispositional characteristics associated with perceived effort and effort tolerance were found to be inconsistent, partially because of measurement problems and lack of sound theory to support such relationships.

Strategies for coping with physical effort can take two forms: active and passive. Active coping strategies classified as internal (associative) or external (dissociative) to the performer were reviewed. The available research suggests that dissociative strategies of coping with effort are more salient under low physical load. In contrast, under heavy and continuous loads, associative strategies are more common and perhaps even unavoidable. Another technique often used for coping with aversive stimuli is guided imagery. Explanations for the effectiveness of imagery in coping with exertive stimuli are based on the premise that a close link exists among emotions, images, and sensations. Visualization is believed to affect feelings and physical sensations by altering images. Research evidence supports the contention that both relaxation and aggressive imagery may aid in tolerating pain or discomfort.

Social-cognitive theory seems to have much potential in accounting for perceived effort and effort tolerance. Recent studies indicate that task-specific variables such as commitment/determination and the effort one is ready to invest in and tolerate while experiencing exertion account for substantial amounts of the variance in effort tolerance. Physical self-efficacy and perceived competence in tolerating effort and discomfort appear to be strong predictors of discomfort tolerance. However, no intervention studies have yet been conducted to examine this contention in an exercise setting. The relationship between self-efficacy and perceived effort and the impact of these perceptions on task persistence is a fruitful avenue for future research. Studies that go beyond the correlational nature of the efficacy-perceived effort relationship and directly manipulate self-efficacy are warranted. Such studies will advance our knowledge of how we might structure interventions to maximize efficacy, and in turn influence both psychosocial and behavioral outcomes associated with exercise (McAuley & Blissmer, 2000).

As stated previously, few studies have attempted to examine the effects of goal orientations on perceived effort and effort tolerance. Findings from the limited number of studies available to date indicate that task orientation is associated with a superior level of coping with exertive experiences compared to ego goal orientation. However, further research is needed to confirm this assertion.

New research directions pertaining to the influence of psychological factors in determining perceived effort and effort tolerance have adopted a multidimensional approach. Recently, Hutchinson and Tenenbaum (in press-b), and Ekkekakis et al. (2004) have demonstrated that different dimensions of effort are perceived distinctly during exercise and operate differently in the duration of an exertive task. Arent et al. (2004) observed similar trends postexercise.

Together, these findings imply that feelings of effort are a consequence of several physiological and psychological determinants. To study the dependence of perceived effort on one physiological index is an oversimplification of the psychophysiological construct. Accordingly, a single-item measure of effort, such as Borg's (1998) RPE scale, is insufficient to capture the whole range of sensations that people experience when exercising or when being physically active (Hutchinson & Tenenbaum, in press-b). An adequate theory of effort perception ought to sufficiently account for the distinct inputs that shape the perceptual milieu during sustained physical activity. Future studies of perceived effort and effort tolerance using multidimensional measures will provide additional insights into the various psychophysiological determinants of perceived effort.

The social-cognitive theory introduced in this chapter in relation to perceived effort and effort tolerance reveals new horizons in the study of the psychological states and mechanisms that affect the complex psychophysiological construct of effort. Innovative methodological designs and paradigms should be initiated to shed new light on this interesting area of study.

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CHAPTER 26

Exercise and Psychosocial Issues for Cancer Survivors

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The primary focus of our chapter is the application of exercise psychology principles to cancer survivors. By cancer survivor, we mean any individual diagnosed with cancer, from the time of discovery and for the balance of life. Interestingly, exercise research in cancer survivors is relatively new compared to research in persons with other chronic diseases (e.g., cardiac disease, diabetes, chronic obstructive pulmonary disease). As the reader will learn, however, exercise may play an important role in enhancing the recovery of cancer survivors, including psychosocial issues. Nevertheless, there is still much to learn about the contribution of exercise psychology to this emerging field of inquiry.

We begin our chapter by providing an overview of the disease itself, including its pathophysiology, epidemiology, and common medical treatments. We then review the psychosocial side effects of cancer and its treatments as well as some of the currently accepted psychosocial interventions that are offered to cancer survivors. The crux of our chapter, however, is a review and summary of the research on the effects of exercise on psychosocial outcomes in cancer survivors. After that, we review and summarize the important corollary research on exercise motivation and behavior change in cancer survivors. Finally, we discuss the many opportunities for future research in this field.

PATHOPHYSIOLOGY OF CANCER

Cancer occurs when normal cells undergo a series of genetic mutations that spur them to grow and divide indefinitely (Gribbon & Loescher, 2000). These cancer cells can accumulate and develop into a mass called a "tumor" or "neoplasm" (i.e., new growth). Benign tumors grow and enlarge only at the site where they began and, therefore, are not usually considered life-threatening. Conversely, malignant or cancerous tumors have the potential to invade and destroy normal healthy tissue anywhere in the body. These cancerous tumors do this through a process called "metastasis," whereby they spread throughout the body via the bloodstream or lymph system. If the cancer continues to spread, it will ultimately destroy life-sustaining organs such as the brain, lung, and liver. The term "cancer" actually includes more than 100 diseases that occur in virtually any tissue or organ in the body. Most cancers, however, fall into four major classifications based on cell type. Carcinomas are cancers that develop from the epithelial cells that line the surfaces of the body, glands, and organs. They are the most common form of cancer, comprising approximately 80% to 90% of all cancers, and include prostate, colon, lung, cervical, and breast cancers. Cancerous cells can also arise from the blood (i.e., leukemias), immune system (i.e., lymphomas), and connective tissues such as bones, tendons, cartilage, fat, and muscle (i.e., sarcomas).

EPIDEMIOLOGY OF CANCER

Cancer is a major public health burden worldwide (Parkin, Bray, Ferlay, & Pisani, 2001). In the United States alone, almost 1.4 million new cases of cancer were confirmed in 2005 (American Cancer Society, 2005). The lifetime probability of being diagnosed with cancer in the United States is about 42%. This means that approximately 2 out of every 5 Americans will be diagnosed with cancer at some point in their lifetime. Moreover, cancer is the second leading cause of death in the United States after heart disease, with more than 570,000 deaths from cancer confirmed in 2005. The

Table 26.1 Estimated New Cancer Cases and Deaths for the Most Common Cancers in the United States by Sex

Cancer	Estimated New Cases			Estimated New Deaths		
	Total	Male	Female	Total	Male	Female
All cancers	1,372,910	710,040	662,870	570,280	295,280	275,000
Prostate	232,090	232,090	—	30,350	30,350	—
Breast	212,930	1,690	211,240	40,870	460	40,410
Lung	172,570	93,010	79,560	163,510	90,490	73,020
Colorectal	145,290	71,820	73,470	56,290	28,540	27,750
Urinary bladder	63,210	47,010	16,200	13,180	8,970	4,210
Melanoma	59,580	33,580	26,000	7,770	4,910	2,860
Non-Hodgkin's lymphoma	56,390	29,070	27,320	19,200	10,150	9,050
Uterine corpus	40,880	—	40,880	7,310	—	7,310
Ovaries	22,220	—	22,220	16,210	—	16,210

Note: Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.

Adapted from *Cancer Facts & Figures 2005,* by the American Cancer Society, 2005, Atlanta, GA: Author.

four most common cancers—prostate, breast, colorectal, and lung—account for over 55% of all new cancer cases and over 50% of all new cancer deaths each year (Table 26.1). In terms of disease burden, men are slightly more likely to develop and die from cancer than women, and older adults are significantly more likely to develop cancer and die from cancer than children or younger adults (Table 26.2). More specifically, about 80% of all cancers are diagnosed in persons age 60 and older.

Despite the high death rates, survival rates have increased significantly over the past few decades due to earlier detection and better treatments. The current estimate of the 5-year relative survival rate across all cancers and disease stages is 64% (American Cancer Society, 2005). Table 26.3 demonstrates that this figure varies dramatically by cancer type and disease stage. For example, if detected early, the 5-year relative survival rate is over 90% for prostate and breast cancers. The high incidence and good survival rates have resulted in almost 10 million cancer survivors currently living in the United States. Consequently, there is a growing population of cancer survivors who will look to exercise as a way of coping with, and recovering from, their treatments as well as reducing their risk of recurrence and other chronic diseases.

MEDICAL TREATMENTS FOR CANCER

Although many cancers can be cured or controlled for long periods of time, the medical interventions that must be endured are demanding, to say the least. The most common

Table 26.2 Percentage of the U.S. Population Developing the Most Common Invasive Cancers over Selected Age Intervals by Sex

Cancer	Sex	Birth to 39	40–59	60–79	Birth to Death
All cancers	Male	1.41	8.52	34.63	45.59
	Female	1.97	9.10	22.51	38.18
Prostate	Male	0.01	2.58	14.76	17.81
Breast	Female	0.48	4.18	7.49	13.39
Lung	Male	0.03	1.06	5.75	7.63
	Female	0.03	0.81	3.91	5.71
Colorectal	Male	0.07	0.90	3.96	5.90
	Female	0.06	0.69	3.04	5.54
Urinary bladder	Male	0.02	0.41	2.42	3.56
	Female	0.01	0.12	0.65	1.13
Melanoma	Male	0.13	0.51	1.08	1.89
	Female	0.21	0.40	0.53	1.28
Non-Hodgkin's lymphoma	Male	0.14	0.46	1.32	2.18
	Female	0.09	0.31	1.00	1.80
Uterine corpus	Female	0.06	0.72	1.57	2.62

Note: Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.

Adapted from *Cancer Facts & Figures 2005,* by the American Cancer Society, 2005, Atlanta, GA: Author.

Table 26.3 Five-Year Relative Survival Rates for the Most Common Cancers in the United States by Stage at Diagnosis

Cancer	All Stages (%)	Local (%)	Regional (%)	Distant (%)
Prostate	99.3	100	—	33.5
Breast	87.7	97.5	80.4	25.5
Colorectal	63.4	89.9	67.3	9.6
Lung	15.2	49.4	16.1	2.1
Urinary bladder	81.7	94.1	48.8	5.5
Melanoma	90.5	97.6	60.3	16.2
Uterine corpus	84.4	95.8	67.0	25.6
Ovarian	44.0	93.5	68.8	28.5

Note: Rates are adjusted for normal life expectancy and are based on cases diagnosed from 1995 to 2000 followed through 2001. Adapted from *Cancer Facts & Figures 2005,* by the American Cancer Society, 2005, Atlanta, GA: Author.

treatment modalities for cancer are surgery, radiation therapy, and systemic therapy (i.e., drugs). These medical interventions have been shown to improve survival rates, but they also come with a cost to quality of life and an increased risk for other chronic diseases. Surgery is the primary treatment for most solid tumors and often results in a cure all by itself (Frogge & Cunning, 2000). That is, some cancer survivors will not require any additional (i.e., adjuvant) therapy after their surgery because their tumors are considered to have been removed entirely by the procedure. However, surgery is successful only if the cancer is limited to a small area. Like any surgery, there are risks and morbidities depending on the location and extent of the operation (e.g., wound-healing complications, infections, loss of function, reduced range of motion, diarrhea, dyspnea, pain, neuropathy, lymphedema, fatigue, anxiety). With more than 100 different types of cancer—and multiple surgical procedures even for the same cancer (e.g., breast, colorectal, lung)—it is easy to see that there are potentially dozens of different operations that cancer survivors may face.

Approximately 60% of cancer survivors will receive radiation therapy at some point during their treatments (Maher, 2000). Radiation therapy can cure some cancers if they are localized, and it can also provide palliative relief if the cancer is causing pain or discomfort. External beam radiation therapy is the most common method of delivering radiation. It is typically delivered in repeated small doses (i.e., fractions) over a 5- to 8-week period to maximize the killing of cancer cells and minimize the damage to normal cells. Nevertheless, side effects do occur that are dependent on the dose and site that receives the radiation (Maher, 2000). Radiation therapy can cause acute and late-appearing side effects such as pain, blistering, reduced elasticity, decreased range of motion, nausea, fatigue, dry mouth, diarrhea, lung fibrosis, and cardiomyopathy (Maher, 2000).

Unfortunately, many cancer survivors already have metastatic disease at the time of their diagnosis (Frogge & Cunning, 2000). That is, the disease has already escaped the original tumor and has spread to other places in their body. Consequently, systemic therapies are needed to track down and destroy the cancer cells wherever they may be. The three major types of systemic therapy are chemotherapy, hormone therapy, and biologic therapy.

Chemotherapy is usually administered intravenously or orally and is given in repeated courses or cycles 2 to 4 weeks apart over a 3- to 6-month period or even longer. It often involves a combination of 2 to 4 active drugs to treat a given cancer. Because chemotherapy is designed to kill rapidly proliferating cells, it often results in significant side effects, such as fatigue, anorexia, nausea, anemia, neutropenia, thrombocytopenia, peripheral neuropathies, ataxia, alopecia, and cardiotoxicity (Camp-Sorrell, 2000). The incidence and severity of these side effects can vary widely depending on the type of drug (more than 80 different drugs are used to treat the different cancers), mechanism of action, drug dosage, administration schedule, presence of comorbidities, and the use of supportive care interventions (Camp-Sorrell, 2000). The side effects from chemotherapy can appear at any time, from almost immediately to within a few days or weeks, to even months or years after treatment has been completed (i.e., late effects). Fortunately, most side effects that occur with treatments dissipate fairly quickly after treatments are completed. Some side effects, however, can linger long after treatments.

Hormone therapy is used to reduce sex hormones such as estrogen and testosterone that can facilitate the growth of some cancers. These drugs can be administered orally (continuously or intermittently) for many years. These treatments can also have significant side effects, such as weight gain, muscle loss, proximal muscle weakness, osteoporosis, fatigue, hot flashes, and an increase in cardiovascular risk factors and cardiac dysfunction. Biologic therapies attempt to influence the body's own defense mechanisms to act against cancer cells or potentiate the effects of other drugs (Battiato & Wheeler, 2000). These treatments tend to be better tolerated than chemotherapy but can still produce significant side effects similar to chemotherapy, including a greater risk of cardiovascular complications.

The most common protocols for cancer treatment actually include a combination of modalities (i.e., surgery, radiotherapy, and systemic therapy). The timing and sequence of the treatments vary depending on the cancer and its stage. Sometimes treatments are given sequentially and sometimes concurrently. This multimodal treatment protocol means that many cancer survivors are treated on multiple occasions with multiple modalities over many months or years. Consequently, it is easy to see that such prolonged and intensive medical treatments may take a heavy toll on cancer survivors, both physically and emotionally.

Given the focus of this chapter on psychosocial aspects of cancer, we restrict our review to the psychosocial effects of the disease and the potential role of exercise in reducing these challenges. Suffice it to say, however, there are many physical, biological, and functional issues faced by cancer survivors that may be of interest to exercise researchers in other disciplines (e.g., physiology, biochemistry, biomechanics). In this sense, exercise oncology is a multidisciplinary field that is best addressed by a multidisciplinary team working in an integrated manner.

PSYCHOSOCIAL ISSUES IN CANCER SURVIVORS

The diagnosis and treatment of cancer may result in considerable psychological distress. Distress is defined by the U.S. National Comprehensive Cancer Network (2003) as

> a multifactorial unpleasant emotional experience of a psychological (cognitive, behavioral, emotional), social, and/or spiritual nature that may interfere with the ability to cope effectively with cancer, its physical symptoms and its treatment. Distress extends along a continuum, ranging from common normal feelings of vulnerability, sadness, and fear, to problems that can become disabling, such as depression, anxiety, panic, social isolation, and spiritual crisis.

Almost all cancer survivors experience at least some distress following diagnosis or during treatment (White & Macleod, 2002), but for most this does not differ from levels of psychological distress reported in normal populations (van't Spijker, Trijsburg, & Duivenvoorden, 1997). However, a significant minority of cancer survivors are affected by moderate to high levels of psychiatric morbidity.

In one of the first studies to quantify the frequency of psychiatric problems among cancer survivors, a random sample of 215 newly diagnosed survivors from three U.S. cancer centers underwent a psychiatric interview and psychological testing (Derogatis et al., 1983). Based on *Diagnostic and Statistical Manual of Mental Disorders* (third edition) criteria, 47% had a psychiatric diagnosis. Over 66% had an Adjustment Disorder with depressed or anxious mood, 13% had Major Depression, and 4% had an Anxiety Disorder. The majority of problems were observed to be directly attributable to the disease or treatment. Subsequent studies have consistently indicated that approximately 33% of cancer survivors experience levels of psychological distress suggestive of psychiatric illness (Allgar, Neal, & Pascoe, 2003; Carlson et al., 2004; Fallowfield, Ratcliffe, Jenkins, & Saul, 2001; Parker, Baile, de Moor, & Cohen, 2003; Zabora et al., 2001).

Unfortunately, much of the psychological morbidity experienced by cancer survivors goes unrecognized and therefore untreated. A survey of 504 Australian cancer survivors found that 75% experiencing significant anxiety or depression had not received any psychological treatment or counseling (Pascoe, Edelman, & Kidman, 2000). Similarly, in a U.K. study involving 33 women who were receiving inpatient chemotherapy, nurses identified only 20% of survivors' concerns because they tended to focus on physical symptoms and treatment-related issues and failed to recognize the women's psychological and social concerns (Farrell, Heaven, Beaver, & Maguire, 2005). Another study examined the ability of 143 doctors to assess the psychological status of their cancer survivors. Only 29% of survivors who scored high on a measure of psychological morbidity were correctly identified by their doctors as having probable psychiatric problems (Fallowfield et al., 2001).

Identifying cancer survivors who may be at risk of psychiatric illness is difficult for health care professionals because factors that increase the likelihood of distress for cancer survivors have not been reliably determined. No clear relationship exists between specific cancer sites and levels of distress (Fallowfield et al., 2001; Herschbach et al., 2004; Zabora et al., 2001). In general, risk factors relate to the individual survivor rather than disease- or treatment-related variables (Burgess et al., 2005; Kiss & Meryn, 2001). However, there is some evidence that distress is greatest in younger survivors (Burgess et al., 2005; Fallowfield et al., 2001; Herschbach et al., 2004; Kau, 2005; Norton et al., 2004; van't Spijker et al., 1997; Wright, Kiely, Lynch, Cull, & Selby, 2002) and in those with more advanced or recurrent disease (Burgess et al., 2005; Fallowfield et al., 2001; Herschbach et al., 2004; Massie, 2004; Norton et al., 2004; Wright et al., 2002).

Psychological distress tends to be greater in recently diagnosed survivors and diminishes over time. A longitudinal study of 170 breast cancer survivors found that 50% had clinically important depression, anxiety, or both in the year following diagnosis, with the figure falling to 25% after 2 years, and 15% at 5-year follow-up (Burgess et al., 2005). Another observational study of 227 breast cancer survivors reported that although the majority of survivors experienced substantial disruption to psychosocial aspects of quality of life postoperatively, most had normalized 1 year later, with only 8% showing a decline (Shimozuma, Ganz, Petersen, & Hirji, 1999). A study of 143 women with ovarian cancer also reported the highest levels of distress for those most recently diagnosed (Norton et al., 2004). For some survivors, however, the adverse psychological effects of cancer can last for many years after treatment completion. A prospective study of 52 cancer survivors found the prevalence of psychiatric disorders to be 47% at diagnosis and still as high as 37% at 6-year follow-up, although psychological adjustment did improve during that time (Grassi & Rosti, 1996).

Depression occurs in response to perceived loss, and anxiety is a response to perceived threat. Cancer survivors face the shock of diagnosis, the burden of treatment, the loss of good health, uncertainty about the future, and the threat of dying. Adjustment disorders can develop if survivors' coping responses are insufficient to overcome the challenges of living with cancer. Body image can be affected in survivors for whom surgery or other treatments have caused scarring, weight loss, weight gain, alopecia, or loss of a body part or function. Self-esteem may be impaired in survivors who feel that they have lost independence and control over their health and life. For some survivors psychological distress can be an indirect result of physical symptoms such as insomnia, fatigue, nausea, and pain (Deimling, Kahana, Bowman, & Schaefer, 2002; White & Macleod, 2002).

In addition to physical symptoms and emotional distress, cancer survivors are also faced with a number of social problems that impact negatively on quality of life. A qualitative study of 96 adult cancer survivors revealed eight categories of social problems relating to managing in the home, health and welfare services, finances, employment, legal matters, relationships, sexuality and body image, and recreation. The most commonly identified problems concerned personal relationships (Wright et al., 2002). The importance of financial (R. Schulz et al., 1995) and employment (Bradley & Bednarek, 2002; Spelten, Sprangers, & Verbeek, 2002) issues for cancer survivors has also been demonstrated in other studies.

In summary, the psychosocial impact of cancer differs from one individual survivor to another. Only a minority develop psychiatric illness, but most survivors experience some emotional distress initially and encounter various psychological and social problems at different stages during the treatment and recovery process, which can negatively impact their quality of life. Many psychosocial problems are not adequately addressed during routine cancer care.

CURRENT PSYCHOSOCIAL INTERVENTIONS IN CANCER SURVIVORS

The physical and psychosocial challenges associated with a cancer diagnosis have prompted research into strategies to enhance psychological functioning both during and after treatments. In attempting to delineate the potential role of exercise in this regard, it is important that exercise researchers are aware of other psychosocial interventions that are currently offered to cancer survivors. This knowledge will allow exercise researchers to address the issue of how exercise might complement existing interventions. Here, we provide a brief overview of some of the currently accepted psychosocial interventions for cancer survivors.

Psychosocial interventions for cancer survivors include various cognitive-behavioral therapies (e.g., relaxation training, meditation), informational and educational strategies (e.g., procedural, medical), counseling or psychotherapy (e.g., psychodynamic, existential), support groups, and newer alternative treatments (e.g., music therapy, art therapy). The first meta-analysis on this topic summarized 45 randomized controlled trials (Meyer & Mark, 1995). The results showed that these psychosocial interventions had small (*d*s = .19 to .28) but significant effects on emotional well-being, functional well-being, symptoms, and global quality of life. A more recent meta-analysis applied a different analytical strategy and inclusion criteria for 37 randomized controlled trials (Rehse & Pukrop, 2003). This meta-analysis found an overall moderate to large effect (d = .65) of these interventions. The researchers also reported that the effects were larger for men, informational/educational interventions, longer interventions, self-report measures, functional versus emotional adjustment, and better quality studies. In a multivariate analysis, however, only intervention length was predictive of a larger effect.

The only specific psychosocial intervention that has been subjected to a meta-analysis is relaxation training.

Luebbert, Dahme, and Hasenbring (2001) conducted a meta-analysis of 15 randomized controlled trials focusing exclusively on relaxation training in cancer survivors. Their analysis showed significant moderate effects (*d*s = .34 to .55) on blood pressure, pulse rate, nausea, pain, depression, tension, anxiety, mood, and hostility, but not fatigue, confusion, or vigor. Finally, a qualitative review focusing exclusively on group psychotherapy interventions concluded that there is compelling evidence that this intervention improves the emotional and social well-being of cancer survivors (Blake-Mortimer, Gore-Felton, Kimerling, Turner-Cobb, & Spiegel, 1999). In summary, there are clearly good data to support the utility of psychosocial interventions in enhancing psychosocial functioning in cancer survivors. Not surprisingly, in many cancer centers psychosocial interventions are offered to cancer survivors as part of standard care. More recently, researchers have begun to examine the utility of exercise in optimizing psychosocial functioning in this population.

EXERCISE AND PSYCHOSOCIAL OUTCOMES IN CANCER SURVIVORS

A growing number of trials have assessed the effects of participation in structured exercise programs for cancer survivors. The body of literature consists of at least 12 single-armed (uncontrolled) studies and a further 26 controlled clinical trials that have measured psychosocial outcomes. The majority of the uncontrolled trials involved group interventions that combined aerobic activities, resistance training, and flexibility exercises with social interaction and support. These studies are summarized in Table 26.4. An

Table 26.4 Uncontrolled Trials of Exercise Interventions for Cancer Survivors

Study	Sample	Intervention	Results for Psychosocial Outcomes
Turner et al. (2004)	10 breast cancer survivors	Group aerobic, aquatic, and resistive exercises 1 d/w for 8 w	Trend toward improved quality of life
Christopher and Morrow (2004)	21 survivors with breast (*n* = 19), lung (*n* = 1), or colon (*n* = 1) cancer	Group aerobic, toning, flexibility, and relaxation exercises 2 d/w for 12 w	Some aspects of quality of life and distress improved in some survivors
Young-McCaughan et al. (2003)	42 survivors with various cancers	Group walking, stair climbing, and arm exercises 2 d/w plus 3–5 d/w at home for 12 w	Improved quality of life
Adamsen et al. (2003)	23 survivors with various cancers receiving adjuvant therapy	Group high-intensity (cycle ergometer and resistance training) or low-intensity (relaxation, massage, and body-awareness training) 3–4 d/w for 6 w	Improved quality of life observed in approximately half the sample
Kolden et al. (2002)	40 breast cancer survivors receiving adjuvant therapy	Group aerobic, strength, and flexibility training 3 d/w for 16 w	Improved quality of life and mood/distress
Durak et al. (1999)	25 survivors with prostate cancer (*n* = 12) or leukemia/carcinoma (*n* = 13)	Group aerobic, strength, and flexibility training 2 d/w for 20 w	Improved quality of life reported for leukemia or carcinoma survivors but not prostate
Durak and Lilly (1998)	20 survivors with various cancers	Group aerobic, strength, and flexibility training 2 d/w for 10 w	Improved quality of life
Goodwin et al. (1998)	55 breast cancer survivors receiving adjuvant therapy	Group exercise (aerobic, strength, and flexibility training) and nutrition and psychological support 1 d/w for 10 w then 1 d/mo for 10 mo	Improved quality of life, mood, and psychosocial adjustment; no change in coping style or emotional expression
Schulz et al. (1998)	28 nonmetastatic breast cancer survivors	Group sport and gymnastic activities 2 d/w for 10 w	Increased quality of life and reduced depression and anxiety
Seifert et al. (1992)	7 head and neck cancer survivors	Group sport and gymnastic activities 1 d/w for 6–12 mo	All survivors reported improved perception of quality of life
Gaskin et al. (1989)	96 breast cancer survivors (± 2 y postoperative)	Group mobility, stability, and relaxation exercises 1 d/w for 8 w	65% reported positive psychological changes, including self-esteem, coping, relaxation

Note: d = Day(s); w = Week(s); mo = Month(s); y = Year(s).

additional single-armed trial involved individualized home-based exercise for advanced cancer survivors receiving palliative care (Porock, Kristjanson, Tinnelly, Duke, & Blight, 2000). All of these trials reported either significant positive changes or trends toward improvements in measures of quality of life and some other psychological outcomes following structured exercise programs.

These results are generally encouraging with regard to exercise having psychosocial benefits for cancer survivors. However, because they are derived from pre- and poststudies without appropriate control groups, it is difficult to determine whether the improvements observed were attributable to the exercise intervention rather than to natural recovery over time or other factors. Therefore, the data from controlled trials provide a clearer indication of the specific effects of exercise on psychosocial outcomes.

The body of controlled clinical trials includes 22 randomized trials and 4 nonrandomized trials. The 4 nonrandomized trials are summarized in Table 26.5 and indicate some potential benefits of the interventions. However, as with the uncontrolled trials, the nonrandomized studies do not provide definitive information about the therapeutic effects of exercise (Sibbald & Roland, 1998).

Randomized controlled clinical trials are the established means of evaluating the effectiveness of interventions because they attempt to minimize sources of bias that exist in uncontrolled and nonrandomized studies. The 22 randomized trials assessing the psychosocial effects of exercise interventions in cancer survivors are summarized and discussed here. Nine trials involved samples of women with breast cancer, two included men with prostate cancer, and there was one trial each of colorectal cancer, lung cancer, head and neck cancer, and multiple myeloma. The remaining seven trials involved samples of survivors with various cancers.

Six trials investigated the effects of exercising on psychosocial variables in breast cancer survivors while they underwent treatment. These studies are summarized in Table 26.6. Enhanced quality of life was demonstrated from a group intervention involving a range of aerobic and resistive exercises (Campbell, Mutrie, White, McGuire, & Kearney, 2005). An individual walking program reduced anxiety and body dissatisfaction, but not depression, in survivors undergoing radiation therapy (Mock et al., 1997). A similar walking intervention in a small study of women receiving chemotherapy indicated less depression midtreatment compared with survivors receiving standard care, although there were no differences between groups by the end of treatment in depression or other psychosocial outcomes (Mock et al., 1994). A sample of survivors with advanced cancer showed a smaller decline in quality of life

Table 26.5 Nonrandomized Controlled Trials of Exercise Interventions for Cancer Survivors

Study	Sample	Intervention (I) and Control (C) Arms	Psychosocial Outcome Measures	Results for Psychosocial Outcomes
Hayes et al. (2004)	12 cancer survivors receiving high-dose chemotherapy and autologous peripheral blood stem cell transplantation	(I) Aerobic and resistive gym-based training 3 d/w for 12 w (C) Stretching	Quality of life (CARES)	Exercise group improved more on quality of life
Dimeo et al. (1999)	59 cancer survivors (mostly breast) receiving high-dose chemotherapy and autologous peripheral blood stem cell transplantation	(I) Supervised bed ergometer cycling daily during hospitalization (C) Usual care	Psychologic status (POMS, SCL-90-R)	Exercise group reduced global psychologic distress; control group did not change, but no group differences analyzed
Segar et al. (1998)	24 breast cancer survivors (± 3.5 y postsurgery)	(I) Unsupervised gym- or home-based aerobic activity 4 d/w for 10 w (C) No intervention	Depression (BDI); anxiety (SSTAI); self-esteem (RSEI)	Exercise group had lower depression and anxiety than control group; no change in self-esteem
Berglund et al. (1993)	60 cancer survivors (mostly breast) <2 months of treatment	(I) Supervised group physical training 1 d/w for 4 w and information and coping skills for 7 w (C) Usual care	Quality of life (2 items); depression (HAD); anxiety (HAD)	Exercise group increased social activities more than control group; no difference on any other psychosocial outcomes

Note: d = Day(s); w = Week(s); mo = Month(s); y = Year(s); BDI = Beck Depression Inventory; CARES = Cancer Rehabilitation Evaluation System; HAD = Hospital Anxiety and Depression Scale; POMS = Profile of Mood States; RSEI = Rosenberg Self-Esteem Inventory; SCL-9-R = Derogatis Symptom Check List-90—Revised; SSTAI = Spielberger State Trait Anxiety Inventory.

Table 26.6 Randomized Controlled Trials of Exercise for Breast Cancer Survivors Receiving Treatment

Study	Sample	Intervention (I) and Control (C) Arms	Psychosocial Outcome Measures	Results for Psychosocial Outcomes
Campbell et al. (2005)	19 breast cancer survivors receiving adjuvant therapy	(I) Supervised group aerobic and resistance exercise 2 d/w for 12 w (C) Usual care	Quality of life (FACT-B); satisfaction with life (SWL)	Exercise group improved general quality of life more than control group; no significant difference in other outcomes, but results favored exercise
Headley et al. (2004)	32 advanced breast cancer survivors receiving chemotherapy	(I) Unsupervised seated exercises 3 d/w for 12 w (C) Usual care	Quality of life (FACIT-F)	Exercise group declined less in quality of life and physical well-being than control group
Segal et al. (2001)	123 breast cancer survivors (Stage V) receiving adjuvant therapy	(I) Supervised gym-based walking 5 d/w for 26 w (I) Unsupervised home-based walking (C) Usual care	Quality of life (SF-36, FACT-B)	No difference between groups for any psychosocial outcomes
Mock et al. (2001)	50 breast cancer survivors (Stage I or II) receiving adjuvant therapy	(I) Unsupervised home-based walking 5–6 d/w for 2–6 mo (C) Usual care	Quality of life (SF-36); emotional distress (POMS)	No difference between groups due to high exercise levels in control group. Those walking >90 min/w scored higher on quality of life and lower on emotional distress than those walking <90 min/w
Mock et al. (1997)	46 breast cancer survivors (Stage I or II) receiving radiation therapy	(I) Unsupervised home-based walking 4–5 d/w for 6 w (C) Usual care	Depression, anxiety, and body dissatisfaction (SAS)	Exercise group improved more on anxiety and body dissatisfaction than control group
Mock et al. (1994)	14 breast cancer survivors (mostly Stage II) receiving chemotherapy	(I) Unsupervised home-based walking 4–5 d/w for 4–6 mo (and weekly support group) (C) Usual care	Psychosocial adjustment (PAIS, BSI); body image (VAS, TSCS); depression and anxiety (SAS)	Exercise group had lower depression midtreatment than control group but not posttreatment; no significant changes in other outcomes

Note: min = Minute(s); d = Day(s); w = Week(s); mo = Month(s); y = Year(s); BSI = Brief Symptom Inventory; FACIT-F = Functional Assessment of Chronic Illness Therapy—Fatigue; FACT-B = Functional Assessment of Cancer Therapy—Breast; PAIS = Psychosocial Adjustment to Illness Scale; POMS = Profile of Mood States; SAS = Symptom Assessment Scale; SF-36 = Medical Outcomes Survey—Short Form 36; SWL = Satisfaction With Life Scale; TSCS = Tennessee Self-Concept Scale; VAS = Visual Analogue Scale.

following a seated exercise program than those receiving usual care (Headley, Ownby, & John, 2004).

The results of most of these studies provide promising evidence of the beneficial effects of exercise on quality of life. In contrast, the largest trial of breast cancer survivors on adjuvant therapy did not produce positive findings on quality of life outcomes (R. Segal et al., 2001). In this study, 123 participants were randomized to one of three groups for 26 weeks: Group 1 participated in supervised group exercise 3 days per week and were expected to exercise 2 more days at home; group 2 undertook self-directed exercise 5 days per week; group 3 received usual care, which included general advice from the oncologist about the benefits of exercise and a suggestion to exercise if feeling sufficiently well. The prescribed exercise intervention involved a progressive walking program at 50% to 60% of participants' predicted maximal oxygen uptake. The primary outcome for this study was physical functioning measured by the Medical Outcomes Survey Short Form 36. Secondary outcomes included generic health-related quality of life and cancer site-specific quality of life. Results were analyzed on an intention-to-treat basis and revealed no differences between groups in global measures of quality of life or any subdimensions. These results may have been limited by a large dropout rate (20%) and the use of intention-to-treat analysis (which assumes no change in the dropouts), a modest adherence rate (71% in both exercise arms), and low to moderate exercise intensity (50% to 60% of predicted maximal oxygen uptake).

Results of the three studies that involved women who had completed treatment for breast cancer indicated beneficial psychosocial effects. These trials are summarized in Table 26.7. Quality of life, happiness, and self-esteem were all improved after an aerobic exercise intervention using ergometer cycling (Courneya, Mackey, et al., 2003). Self-esteem was also improved more with tai chi than psychological support (Mustian et al., 2004); another small study of tai chi reported similar improvements in quality of life as derived from a walking program (Galantino et al., 2003).

Table 26.8 summarizes trials involving other site-specific cancers. A large and rigorously designed trial examined the effects of a 12-week progressive resistance exercise program on quality of life of prostate cancer survivors who were receiving androgen deprivation therapy (R. J. Segal et al., 2003). One hundred and fifty-five men were randomized to a supervised program of resistance exercise training 3 days per week, performing two sets of 8 to 12 repetitions on each of nine strength-training exercises, or a control group. Results were analyzed on an intention-to-treat basis and showed a significant difference between the groups, with a 2-point increase in quality of life scores in the exercise group and a 3-point decrease in the control group. Exploratory analyses showed that the advantage of exercise over usual care for improving quality of life existed after controlling for intention of treatment (curative versus palliative) and for duration of androgen deprivation therapy (less than 1 year versus 1 year or more).

Evidence of psychosocial benefits of exercise was not provided as clearly by the other studies of specific cancers (Table 26.9). A small trial of survivors with multiple myeloma (Coleman, Coon, et al., 2003; Coleman, Hall-Barrow, Coon, & Stewart, 2003) and another of head and neck cancer survivors (McNeely et al., 2004) did not demonstrate any effects of exercise on mood or quality of life, respectively. Results of a trial in colorectal survivors were contaminated by high exercise levels in the control group, masking any specific effects of the intervention (Courneya, Mackey, et al., 2003). A post hoc analysis showed that those participants who increased their fitness during the intervention scored higher for quality of life than those whose fitness decreased. A study of preoperative lung cancer survivors examined the effects of a program of walking, stair climbing, and leg, arm, and breathing exercises performed daily for the week prior to surgery (Wall, 2000). Power, defined as the capacity to knowingly participate in change, was enhanced in the exercise group and declined in the usual care group. Hope was high in all survivors and did not differ between groups.

The seven trials involving samples of survivors with various cancers did not generally demonstrate psychosocial benefits from exercise interventions. A small study reported greater quality of life with aerobic training compared with usual care and trends toward improvements in other variables (Burnham & Wilcox, 2002). However, three larger trials found no difference between exercise and control

Table 26.7 Randomized Controlled Trials of Exercise for Breast Cancer Survivors Posttreatment

Study	Sample	Intervention (I) and Control (C) Arms	Psychosocial Outcome Measures	Results for Psychosocial Outcomes
Mustian et al. (2004)	21 breast cancer survivors <3 y posttreatment)	(I) Tai chi chuan classes 3 d/w for 12 w (C) Psychological support classes	Quality of life (FACIT-F); self-esteem (RSEI)	Tai chi group increased self-esteem compared with psychological support group; no significant difference in quality of life but results favored exercise
Courneya, Mackey, et al. (2003)	52 postmenopausal breast cancer survivors (±14 mo posttreatment)	(I) Supervised ergometer cycling 3 d/w for 15 w (C) No intervention	Quality of life (FACT-B); happiness (HM); self-esteem (RSE)	Exercise group improved more on quality of life, happiness, and self-esteem than control group
Galantino et al. (2003)	11 breast cancer survivors (<1 y posttreatment)	(I) Tai chi classes and home video 3 d/w for 6 w (C) Walking classes and home booklet/video	Quality of life (FACT-B)	No difference between groups in quality of life scores

Note: d = Day(s) = w: Week(s); mo = Month(s); y = Year(s); FACIT-F = Functional Assessment of Chronic Illness Therapy—Fatigue; FACT-B = Functional Assessment of Cancer Therapy—Breast; HM = Happiness Measure; RSEI = Rosenberg Self-Esteem Inventory.

Table 26.8 Randomized Controlled Trials of Exercise for Survivors with Other Site-Specific Cancers

Study	Sample	Intervention (I) and Control (C) Arms	Psychosocial Outcome Measures	Results for Psychosocial Outcomes
McNeely et al. (2004)	17 head and neck cancer survivors with postsurgical shoulder dysfunction	(I) Supervised progressive resistance training 3 d/w for 12 w (C) Usual care	Quality of life (FACT-H&N)	No difference between groups in psychosocial outcomes
Courneya, Friedenreich, Quinney, et al. (2003)	93 postsurgical colorectal cancer survivors (2/3 receiving adjuvant therapy)	(I) Unsupervised home-based aerobic exercise (e.g., walking) 3–5 d/w for 16 w (C) Usual care	Quality of life (FACT-C); life satisfaction (SWL); depression (CESD); anxiety (SSTAI)	No difference between groups due to high exercise levels in control group. Survivors who increased fitness during trial improved more on quality of life and anxiety than those who lost fitness.
Segal et al. (2003)	155 prostate cancer survivors receiving androgen deprivation therapy	(I) Supervised progressive resistance training 3 d/w for 12 w (C) Usual care	Quality of life (FACT-P)	Exercise group increased quality of life scores compared with control group
Coleman, Coon, et al. (2003)	17 multiple myeloma survivors receiving high-dose chemotherapy and autologous stem cell transplantation	(I) Unsupervised home-based aerobic and resistive training 5 d/w for 12 w pre- and posttransplant (C) Usual care (including advice to walk for 20 min 3 d/w)	Mood (POMS)	No difference between groups in improvement in mood scores
Wall (2000)	97 lung cancer survivors about to undergo surgery	(I) Unsupervised home-based preoperative aerobic, resistive, and breathing exercises daily for 1 w (C) No intervention	Hope (HHI); power (PKPCT-VII)	Exercise group increased power at time of surgery and 6 d follow-up compared with control group; no difference in hope

Note: d = Day(s); w = Week(s); mo = Month(s); y = Year(s); CESD = Centres for Epidemiological Studies Depression Scale; FACT-C = Functional Assessment of Cancer Therapy—Colorectal; FACT-H&N = Functional Assessment of Cancer Therapy—Head & Neck; FACT-P = Functional Assessment of Cancer Therapy—Prostate; HHI = Herth Hope Index; PKPCT-VII = Power as Knowing Participation in Change Test—Version II; POMS = Profile of Mood States; SSTAI = Spielberger State Trait Anxiety Inventory; SWL = Satisfaction With Life Scale.

groups in quality of life and psychological distress (Dimeo, Thomas, Raabe-Menssen, Pröpper, & Mathias, 2004; Petersson et al., 2002; Thorsen et al., 2005). An increase in fighting spirit was reported in a group intervention trial that combined exercise with information and coping skills training (Berglund, Bolund, Gustavsson, & Sjödén, 1994b). The advantage over the usual care group was maintained at 1-year follow-up (Berglund, Bolund, Gustavsson, & Sjödén, 1994a), but no differences were reported for any other outcomes. Another trial compared a home-based exercise program plus group psychotherapy to group psychotherapy alone (Courneya, Friedenreich, Sela, et al., 2003). Most outcomes favored the exercise group, but the only psychosocial outcome to differ significantly between groups was the functional well-being dimension of quality of life.

In summary, the recent increase in numbers of randomized controlled trials has improved the overall methodological rigor of the body of evidence relating to exercise interventions in cancer survivors. Furthermore, some of the studies are well designed and include appropriate comparison groups and validated outcomes measures for investigating the relative value of exercise programs. Increasingly, trials are adopting theoretical frameworks on which to base interventions and monitoring adherence in exercise groups and tracking exercise behavior in control groups to check for intervention contamination. Longer durations of interventions and longer-term follow-ups are also becoming more common.

The most frequent methodological weaknesses among existing trials relate to the use of small convenience samples, lack of intention-to-treat analysis, and multiple outcome measurement. Convenience samples weaken the generalizability of findings, and small numbers increase the risk of both false-positive (Moore, Gavaghan, Tramer, Collins, & McQuay, 1998) and false-negative (Altman, 1991) findings. By not using intention-to-treat analysis, the

Table 26.9 Randomized Controlled Trials of Exercise for Survivors with Various Cancers

Study	Sample	Intervention (I) and Control (C) Arms	Psychosocial Outcomes Measures	Results for Psychosocial Outcomes
Thorsen et al. (2005)	101 lymphoma, breast, testicular, and gynecologic cancer survivors 1 mo after chemotherapy	(I) Unsupervised home-based aerobic and strength activities 2 d/w for 14 w (C) Usual care	Quality of life (EORTC QLQ-C30); mental distress (HAD)	No difference between groups on psychosocial outcomes
Dimeo et al. (2004)	72 postsurgical lung and gastrointestinal cancer survivors	(I) Supervised ergometer cycling 5 d/w for 3 w (C) Progressive relaxation 3 d/w	Quality of life (EORTC QLQ-C30)	No difference between groups on quality of life outcomes
Courneya, Friedenreich, Sela, et al. (2003)	96 cancer survivors (41% breast, 9% colon), with 44% still receiving treatment	(I) Unsupervised home-based walking 3–5 d/w for 10 w (and group psychotherapy 1 d/w) (C) Group psychotherapy 1 d/w	Quality of life (FACT-G); life satisfaction (SWL); depression (CEDS); anxiety (SSTAI)	No difference between groups in psychosocial outcomes except functional dimension of quality of life, but all results favored exercise
Burnham and Wilcox (2002)	18 breast, colon, and lung cancer survivors ≥2 mo posttreatment	(I) Supervised gym-based low- and moderate-intensity aerobic training 2 d/w for 10 w (C) Usual care	Quality of life (QLICP, LASA)	Exercise group increased quality of life and energy more than control group; no difference between groups in other psychosocial outcomes, but results favored exercise
Petersson et al. (2002)	325 breast, prostate, and gastrointestinal cancer survivors ≤3 mo of diagnosis	(I) Supervised group physical training 1 d/w for 8 w (and information and cognitive-behavioral therapy) (I) Individual support (I) Combination of 2 interventions above (C) Usual care	Depression (HAD); anxiety (HAD); subjective distress (IES)	No difference between exercise and nonexercise groups on any outcomes
Berglund et al. (1994a, 1994b)	176 cancer survivors (mainly breast) ≤2 mo posttreatment	(I) Supervised group physical training 1 d/w for 4 w (and information and coping skills for 7 w) (C) Usual care	Quality of life (2 items); depression (HAD); anxiety (HAD); mental adjustment (MAC)	Exercise group increased fighting spirit compared with control group and maintained 12 mo later; no difference in other psychosocial outcomes
Buettner and Gavon (1981)	17 cancer survivors ≤5 y of diagnosis	(I) Supervised group aerobic/strength training 3 d/w for 8 w (C) No intervention	Personality (C16PFQ)	Exercise group improved on cyclothemia, surgency, and self-sufficiency, but group differences not analyzed

Note: d = Day(s); w = Week(s); mo = Month(s); y = Year(s); C16PFQ = Cattell's Sixteen Personality Factor Questionnaire; CESD = Centres for Epidemiological Studies Depression Scale; EORTC QLQ-C30 = European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire Core Module; FACT-G = Functional Assessment of Cancer Therapy—General; HAD = Hospital Anxiety and Depression Scale; IES = Impact of Event Scale; LASA = Linear Analog Self-Assessment; MAC = Mental Adjustment to Cancer Scale; QLICP = Quality of Life Index for Cancer Patients; SSTAI = Spielberger State Trait Anxiety Inventory; SWL = Satisfaction With Life Scale.

advantages of randomization are lost and estimates of efficacy possibly inflated (Hollis & Campbell, 1999). Similarly, measuring a large number of outcomes and carrying out multiple subgroup analyses raise the possibility that significant results reported for single outcomes among a host of others within an individual study are due to chance (Bland & Altman, 1995; Smith, Clemens, Crede, Harvey, & Gracely, 1987).

Although the evidence for beneficial effects of exercise on psychosocial outcomes in cancer survivors is generally less consistent than it is for physical and functional outcomes (e.g., aerobic fitness, muscular strength, fatigue), it is nonetheless very promising. Improvements in quality of life following exercise programs have been demonstrated for several cancer populations, both during and after treatment. There is also encouraging evidence of enhanced body image and self-esteem through exercise interventions in breast cancer survivors.

MECHANISMS OF ENHANCED QUALITY OF LIFE FROM EXERCISE IN CANCER SURVIVORS

Several biopsychosocial mechanisms may explain the psychosocial improvements in cancer survivors that result from exercise training. Courneya (2001) has proposed a simple model that addresses this issue. First, exercise may improve one of the many mechanisms thought to underlie improved coping and adjustment to cancer, such as physical fitness, self-efficacy, or social interaction. These factors may, in turn, reduce many of the common symptoms and side effects associated with cancer and its treatments (e.g., fatigue, insomnia, pain, anorexia) that may impact the ability to perform activities of daily living, leisure activities, and interactions with others. These enhanced physical and social activities may improve psychological distress/well-being (e.g., anxiety, depression) and, ultimately, quality of life.

Only two studies, however, have examined possible mechanisms of change that may explain the effects of exercise on quality of life in cancer survivors. Schwartz (1999) examined exercise, fatigue, and quality of life in 27 breast cancer survivors who participated in an 8-week home-based exercise program during their chemotherapy treatments. Exercise behavior, however, was measured by a functional fitness test (i.e., the 12-minute walk test). In any case, to examine mediation, quality of life was regressed on exercise (i.e., fitness) and fatigue using a stepwise regression analysis. Results showed that only fatigue entered the regression equation, suggesting that the effects of exercise/fitness on quality of life may be mediated by fatigue. Unfortunately, this analytical technique is not consistent with the recommendations for testing mediation by Baron and Kenny (1986), and a functional fitness test is not an ideal exercise measure. Moreover, the small sample and observational design preclude any definitive conclusions from being drawn.

More recently, Courneya, Mackey, et al. (2003) conducted a randomized controlled trial to determine the effects of 15 weeks of exercise on cardiovascular fitness and quality of life in 53 postmenopausal breast cancer survivors who had completed adjuvant therapy. They reported significant effects of the intervention on various indices of aerobic fitness and psychosocial well-being. Multiple regression analyses were used to provide a statistical test of the possible mediating role of fitness following the guidelines of Baron and Kenny (1986). Results showed some evidence that changes in fitness mediated the changes in quality of life (especially physical and functional well-being) and fatigue, but not self-esteem. Results for other psychosocial outcomes were inconclusive. These data suggest that fitness changes may be important for improvements in fatigue and quality of life in cancer survivors. The self-esteem changes, however, appeared to be independent of fitness changes and, therefore, may have resulted from other aspects of the exercise program such as increased social interaction. Taken together, the studies by Schwartz (1999) and Courneya, Mackey, et al. (2003) provide support for the assertion that exercise may enhance quality of life in cancer survivors by increasing fitness and reducing fatigue.

EXERCISE MOTIVATION AND BEHAVIOR CHANGE IN CANCER SURVIVORS

Exercise motivation and behavior change is a major challenge in any population but especially in chronic disease populations. Moreover, the particularly aggressive medical treatments for cancer mean that exercise adherence is going to be even more difficult for cancer survivors, especially during treatments. Given the preliminary positive findings concerning the benefits of exercise in cancer survivors, researchers have begun to examine the prevalence of exercise, the determinants of exercise, and possible behavior change strategies for exercise in this population.

Exercise Prevalence in Cancer Survivors

In one of the most comprehensive prevalence studies to date, Coups and Ostroff (2005) reported that middle-aged (i.e., age 40 to 64) cancer survivors are less active than individuals never having received a cancer diagnosis. They indicated that approximately 25% of cancer survivors were physically active, compared to 31% of noncancer controls. Although the relatively low rate of physical activity was consistent across cancer types, breast and colorectal cancer survivors had the lowest rate of physical activity, at approximately 20%. Given their less aggressive and invasive treatment-related procedures, prostate cancer and melanoma survivors, not surprisingly, had the highest rates of physical activity (i.e., 29% and 31%, respectively).

A more detailed analysis of the physical activity prevalence evidence suggests that physical activity behaviors substantially decrease as an individual moves through the cancer trajectory (i.e., prediagnosis—during treatment—posttreatment). Recently, researchers have begun to study physical activity prevalence in cancer survivors using public health physical activity guidelines (i.e., 150 minutes a week of moderate to vigorous activity; Pate et al., 1995) as a benchmark. These studies indicate that few survivors are meeting public health exercise guidelines, either while receiving treatments or when treatments are completed. Although physical activity behavior improves after treatment, survivors often struggle to regain their prediagnosis physical activity behavior. For example, research by Courneya and colleagues (Courneya & Friedenreich, 1997b; Courneya, Karvinen, et al., 2005; Jones, Courneya, Vallance, et al., 2004; Vallance, Courneya, Jones, & Reiman, 2005) across a range of cancer sites (e.g., non-Hodgkin's lymphoma, breast cancer, multiple myeloma, endometrial cancer) has provided strong evidence of the distinct physical activity pattern experienced by many cancer survivors. These studies suggest that approximately 30%, 6%, and 25% of cancer survivors meet public health exercise guidelines prediagnosis, during treatment, and off/posttreatment, respectively. These fluctuations in physical activity behavior appear to be stable across various cancer types.

There is also evidence to suggest that these fluctuations in physical activity may be a function of various demographic and treatment-related factors. For example, in a recent study, Irwin et al. (2003) found that breast cancer survivors who received a combination of surgery, chemotherapy, and radiation had more substantial decreases in physical activity than surgery-only survivors and surgery-combined-with-radiation survivors. Courneya and colleagues (Courneya, Karvinen, et al., 2005) found similar results in that endometrial cancer survivors receiving adjuvant therapy were less likely to meet physical activity guidelines. To quantify the amount of physical activity loss, Irwin and colleagues estimated that the time spent engaging in physical activity decreases on average 2 hours per week from prediagnosis to off-treatment time points. In a follow-up study, Irwin et al. (2004) further reported that only 32% of breast cancer survivors achieved the recommended levels of physical activity. Irwin and colleagues (2004) also reported that older age and higher body mass index were associated with less time spent being physically active. These consistent trends in declining physical activity behavior provide a strong rationale to encourage and facilitate physical activity among cancer survivors.

Determinants of Exercise in Cancer Survivors

The theory of planned behavior (TPB; Ajzen, 1991) has been a popular model to examine the determinants of physical activity. In the cancer domain, the TPB is the most widely tested behavioral model, with 10 studies now published (Table 26.10). Of the 10 studies that have used the TPB to explain physical activity behavior, 2 studies each examined colorectal cancer survivors (Courneya & Friedenreich, 1997a; Courneya, Friedenreich, Arthur, & Bobick, 1999) and breast cancer survivors (Courneya, Blanchard, & Laing, 2001; Courneya & Friedenreich, 1999) and a combined sample of breast and prostate cancer survivors (Blanchard, Courneya, Rodgers, & Murnaghan, 2002; Rhodes & Courneya, 2003). Single studies have examined non-Hodgkin's lymphoma survivors (Courneya, Vallance, Jones, & Reiman, 2005), endometrial cancer survivors (Karvinen et al., 2005), multiple myeloma survivors (Jones et al., 2006), and mixed cancer survivors receiving bone marrow transplantation (Courneya, Keats, & Turner, 2000). In these studies it is reported that intention and perceived behavioral control predict between 14% and 37% of the variance in physical activity behavior (see Table 26.10). Further analyses consistently demonstrate that attitude, subjective norm, and perceived behavioral control explain between 23% and 68% of the variance in intention to exercise (Table 26.10). These studies confirm that the TPB is a useful model for examining the cognitive antecedents of exercise in cancer survivors. Evidence supporting the use of other behavioral theories in predicting physical activity behavior across the cancer trajectory is now starting to emerge (e.g., Rogers et al., 2004).

Behavior Change Interventions in Cancer Survivors

Given the evidence of decline in physical activity across the cancer experience, researchers have suggested that motivation and adherence are important issues when implementing physical activity programs for cancer survivors (Courneya et al., 1999; Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002). At present, only one published study has examined the effect of promoting physical activity in cancer survivors. Jones and colleagues (Jones, Courneya, Fairey, & Mackey, 2004) examined the effects of two oncologist-centered interventions on self-reported physical activity behavior in breast cancer survivors beginning treatment. During their initial treatment consultation,

Table 26.10 Summary of Studies Examining the Utility of the Theory of Planned Behavior in Predicting Exercise Behavior and Intentions in Cancer Survivors

			Exercise Behavior			Exercise Intention			
Study	Sample	Design	INT	PBC	*R*[b]	Attitude	SN	PBC	*R*[b]
Courneya and Friedenreich (1997a)	110 colorectal cancer survivors receiving treatment	Retrospective	.29	.28	.22	.45	.15	.00	.31
Courneya and Friedenreich (1999)	164 breast cancer survivors receiving treatment	Retrospective	.26	.22	.14	.29	.30	−.04	.23
Courneya et al. (1999)	66 colorectal cancer survivors, with 73% receiving treatment	Prospective	.45	.21	.30	.43	N/S	N/S	.23
Courneya et al. (2000)	37 mixed cancer survivors receiving high-dose treatment	Prospective	.29	.11	.14	.49	.05	.42	.68
Courneya et al. (2001)	24 breast cancer survivors who were posttreatment	Prospective	.64	−.10	.35	−.33	.58	.33	.49
Blanchard et al. (2002)	83 breast cancer survivors who were posttreatment	Cross-sectional	.47	.15	.32	.27	.20	.36	.45
	46 prostate cancer survivors who were posttreatment	Cross-sectional	.50	.15	.37	−.05	.08	.59	.36
Rhodes and Courneya (2003)	272 mixed cancer survivors who were posttreatment	Cross-sectional	.49	.15	.34	.25[a]	.13	.48	.46
Courneya, Vallance, et al. (2005)	399 non-Hodgkin's lymphoma survivors who were posttreatment	Cross-sectional	N/A	N/A	N/A	.23[a] .04[b]	.15	.47	.55
Jones et al. (2006)	70 multiple myeloma survivors who were posttreatment	Cross-sectional	N/A	N/A	N/A	.06[a]	.42[b] .07	.23	.43
Karvinen et al. (2005)	354 endometrial cancer survivors who were posttreatment	Cross-sectional	.34	.14 −.10[c]	.24	.30[a] .06[b]	.02	−.02 .36[c]	.38

Note: N/A = Not applicable (no attempt to predict behavior); N/S = Nonsignificant (exact beta not reported); $p < .05$ = Significant contribution; AT = Attitude; INT = Intention; PBC = Perceived behavioral control; SN = Subjective norm.

[a] Affective attitude.

[b] Instrumental attitude.

[c] Self-efficacy.

participants were randomized to receive either (a) an oncologist's recommendation to physical activity, (b) an oncologist's recommendation to physical activity plus a referral to a kinesiologist, or (c) usual care (i.e., no recommendation). Participants receiving one of the activity recommendations reported total activity amounts that were significantly higher than those receiving usual care. However, given the amount of information dispensed during an initial treatment consultation, not to mention the distress an individual might experience during consultation, it is unclear whether that is an opportune time to recommend physical activity. As the authors indicated, participants may have been concerned only with critical information regarding prognosis and treatment. This contention is supported by the fact that only 59% of individuals correctly recalled their group assignment. Nonetheless, this trial suggests that advocating physical activity behavior via an oncologist's recommendation may be an easy and efficient form of promoting activity in cancer survivors.

FUTURE RESEARCH DIRECTIONS

The application of exercise psychology to cancer survivors is an important field of inquiry that promises to make a significant contribution to the health and psychosocial functioning of this population. Preliminary research suggests that exercise may improve psychological outcomes in cancer survivors, particularly breast cancer survivors. Moreover, the beneficial effects of exercise may extend beyond those provided by group psychotherapy alone (Courneya, Friedenreich, Sela, et al., 2003). The studies are few in number, however, and of modest quality. Encouragingly, the research in this field is increasing rapidly, both in terms of quantity and quality.

There is no doubt that one of the key factors in moving this field forward is the application of rigorous randomized controlled trial methodology. Well-designed and properly executed randomized controlled trials provide the best evidence of the effectiveness of a medical intervention including exercise interventions. Some of the key features of this methodology are an appropriately powered sample size selected from a defined population, proper randomization, blinding of assessors, balanced groups at baseline, an appropriate comparison group, fidelity to the intervention protocols, low attrition, and intention-to-treat analysis. If well-conducted, large-scale, multicenter trials demonstrate the effectiveness of exercise interventions in cancer survivors, then there is a strong possibility that exercise will become a standard intervention for this population, similar to other psychosocial interventions.

Beyond improving the quality of clinical trials, there are many other important future research directions for this field. First, research should be extended beyond breast cancer survivors to the many other cancer groups who may benefit from exercise (e.g., prostate, colon, lung, non-Hodgkin's lymphoma, bladder, ovarian, endometrial, head and neck). For breast cancer survivors, there is sufficient evidence to warrant second-generation studies focusing on more specific questions, such as the optimal timing, type, volume, progression, and context for exercise. Second, research should also be extended beyond high-dose chemotherapy with stem cell support to the many other therapies that cancer survivors endure (e.g., chemotherapy, radiation therapy, hormone therapy, biologic therapy). Third, studies are needed to further elucidate the mechanisms of change in psychosocial functioning in cancer survivors with exercise (e.g., functional, physiological, psychological, social). Fourth, it is very important to compare and integrate exercise with other currently accepted psychosocial interventions to determine if exercise is complementary to these interventions or redundant with them. Only integrated research can determine if exercise should be included as part of a broader psychosocial and behavioral package offered to cancer survivors.

In terms of exercise motivation and behavior change, there are also many important future research directions. First, it is necessary to document the exercise participation rates in various cancer survivor groups across the entire cancer control continuum, including before treatments, during various adjuvant therapies, after treatments, and among long-term survivors (Courneya & Friedenreich, 2001). Second, we need much more research on the determinants of exercise in cancer survivors, including the broad range of determinants outlined in social ecological frameworks. These determinants may include demographic factors, disease factors (e.g., stage), medical factors (e.g., treatments, side effects), the physical and social environment, system factors (e.g., cancer care delivery), personality, and social cognitive variables. In terms of social cognitive variables, there is good evidence that the theory of planned behavior may be a useful framework for understanding exercise in cancer survivors, but there are other validated theories that should also be tested (e.g., social cognitive theory, the transtheoretical model, self-determination theory). Finally, there is a strong need to develop behavior change interventions that can motivate and facilitate exercise participation in various cancer survivor groups at all phases of the cancer experience, including in clinical settings (e.g., during intensive outpatient treatments) and population-based or public health settings (e.g., long-term survivors, rural survivors). Of course, the nature and content of these behavior change interventions may vary based on all the factors mentioned earlier that are contained within ecological frameworks.

CONCLUSION

Cancer is a common disease that affects 2 out every 5 Americans. Better detection techniques and more effective medical treatments have resulted in improved survival rates for this population. Nevertheless, a cancer diagnosis followed by invasive medical interventions can cause significant psychological distress and threats to emotional well-being in some cancer survivors. Preliminary evidence suggests that exercise may ameliorate some of these psychosocial challenges, but the research has been primarily restricted to breast cancer survivors and the quality of the evidence is modest. Moreover, preliminary research has also suggested that exercise participation rates decline in cancer survivors during adjuvant therapies and often do not return to prediagnosis levels even after treatments are completed. Theoretical models, such as the theory of planned behavior, have proven useful in understanding this decline and failure to readopt exercise, but further research is necessary. Overall, it is clear that the field of exercise psychology has an important contribution to make toward understanding exercise in cancer survivors. These contributions may include, but are not limited to, determining the psychological effects of acute and chronic exercise, identifying exercise behavior patterns and motivation difficulties, and developing effective behavior change interventions. Together with contributions from other disciplines, exercise psychology promises to have a significant impact on the psychological well-being, quality of life, and long-term health of cancer survivors.

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CHAPTER 27

Physical Activity and Quality of Life
Key Considerations

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Physical activity is associated with diverse physical and psychological benefits that influence quality of life. *Physical activity* is an umbrella term that includes all forms of human movement, such as exercise and sport, involving skeletal muscle contraction and large increases in energy expenditure. *Exercise* refers to all types of planned, structured, and repetitive large muscle activity, especially to physical activity that has a fitness or recreational focus. In contrast to exercise, *sport* refers to organized physical activity that is characterized by a formal structure, focus on competition and winning, and elite levels of performance (American College of Sports Medicine, 2006; Berger, Pargman, & Weinberg, 2007).

Quality of life is important to all members of the population and is a key component of positive or hedonic psychology and the study of happiness, human strengths, and flourishing (e.g., Aspinwall & Staudinger, 2003; Keyes & Haidt, 2003; Seligman, 2002). As noted by Seligman (2003, p. xii), positive emotion, which can be influenced by physical activity, is one of three pillars of positive psychology:

> Since September 11, 2001, I have pondered the role of positive psychology in a time of trouble (Seligman, 2002). Positive psychology has three pillars: First is the study of positive emotion. Second is the study of positive traits, foremost among them the strengths and virtues but also the "abilities" such as intelligence and athleticism. Third is the study of positive institutions, such as democracy, strong families, and free inquiry that support the virtues, which in turn support the positive emotions.

The current focus in psychology on hedonic psychology, which emphasizes the positive rather than the negative aspects of life, is consistent with the health-enhancement model of physical activity (Gable & Haidt, 2005; Seligman, Steen, Park, & Peterson, 2005). The health enhancement model of physical activity posits that exercise and sport participation can enhance participants' quality of life as well as decrease the onset of disease and delay its progression (Kesaniemi et al., 2001; U.S. Department of Health and Human Services, 1996).

Another factor contributing to increased attention on quality of life is the growing aging population as the average life expectancy in the United States and in many parts of the world has progressively increased (U.S. Department of Health and Human Services, 2000; World Health Organization [WHO], 2003). With people living longer today, health-promoting organizations are highlighting the emerging research supporting the importance of physical activity and its multiple roles in improving quality of life (e.g., American College of Sports Medicine, 2006; Spirduso & Cronin, 2001).

QUALITY OF LIFE

Quality of life is an important issue for all individuals and is a multidimensional construct (Ware, 2000; World Health Organization QOL Group, 1995). Quality of life reflects the harmonious satisfaction of personal goals and desires (Diener, 1994). It also emphasizes subjective experiences, perceptions, and needs of the spirit, rather than objective conditions of life and affluence (Bowling & Windsor, 2001; Diener, 1994). Quality of life has been considered synonymous with subjective well-being, happiness, and life satisfaction. These terms tend to represent important aspects of psychological health. Quality of life also reflects the perceived degree to which individuals are able to perform physical tasks. From a practical standpoint, quality of life refers to behavioral functioning, or the ability to "do stuff," and to live long enough to do it (Kaplan, 1994, p. 451). "Doing stuff," according to the Ziggy theorem, reflects the actual meaning of life, because the capability to perform activities is a central element in quality of life. Clearly, there is a broad range of components that may be considered in a person's assessment of quality of life.

Given the various definitions of quality of life used in the literature, many measures have been developed to assess it (Coons, Rao, Keininger, & Hays, 2000). The Delighted-Terrible Scale measures quality of life with a single question: "How do you feel about your life as a whole?" (Andrews & Withey, 1976). Similar measures have been used in large-scale studies, such as the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System (Brown et al., 2004), but the reliability of such measures is a concern (Andresen, Catlin, Wyrwich, & Jackson-Thomson, 2003). Multiple-item measures such as the Satisfaction With Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) and the Profile of Mood States (POMS; McNair & Heuchert, 2003/2005) may be used to measure the cognitive and affective components of quality of life, respectively. The SF-36 Health Survey (Ware, 2000; Ware, Kosinski, & Gandek, 1993/2000) and the World Health Organization's (1995, 1998) Quality of Life measure are two measures that have been developed in consideration of the multidimensionality of quality of life. That is, both measures assess various domains in a person's life that may influence quality of life.

In this chapter, *quality of life* is defined by the conceptual framework proposed by the World Health Organization (WHOQOL Group, 1995, p. 1405). Quality of life refers to:

- An individual's perception of his or her position in life.
  —In the context of the culture and value systems in which the individual lives, and
  —In relation to his or her expectations, goals, standards, and concerns.
- A broad construct based on the complex way individuals appraise key components of their lives:
  —Physical health,
  —Psychological state,
  —Level of independence,
  —Social relationships,
  —Personal beliefs, and
  —Their relationships to salient features of the environment.

QUALITY OF LIFE AND PHYSICAL ACTIVITY

Physical activity has much to contribute to the quality of life of most individuals. Depending on the type of physical activity and the associated training parameters, physical activity can be associated with a wide variety of benefits that are related to the quality of life. Physical activity-related contributions to quality of life as highlighted in this chapter include the following: (a) enhanced physical functioning, (b) subjective well-being, (c) stress management and eustress, (d) peak moments, (e) exercise enjoyment, and (f) diverse personal meanings. See reviews by the American College of Sports Medicine (2006), Berger et al. (2007), and Jackson and Eklund (2004). A balanced perspective of physical activity is needed because physical activity can influence the quality of life, in both desirable and undesirable ways. Ultimately, however, the perception of quality of life and the role of physical activity in enhancing it reside with the individual.

PHYSICAL FUNCTIONING

Most conceptualizations of quality of life include physical functioning. Because quality of life is a psychological construct, consideration of perceived physical functioning is important (Rejeski & Milhalko, 2001). *Perceived physical functioning* generally refers to an individual's perception of his or her ability to perform various physical activities and may be considered in the context of health limitations. *Actual physical functioning* also is important, and the following section reviews the relationship between physical activity and physical functioning (actual and perceived).

Physical Activity and Actual Physical Functioning

Regular physical activity is associated with many desirable physiological and psychological outcomes, which in turn are associated with better physical functioning (Kesaniemi et al., 2001; U.S. Department of Health and Human Services, 1996). Because physical activity and actual physical functioning (e.g., muscle strength, walking speed) tend to decline with age, much research on physical activity and actual physical functioning has focused on older populations (e.g., Hunter, McCarthy, & Bamman, 2004; Westerterp & Meijer, 2001). Cross-sectional and experimental studies have reported a positive relationship between increased physical activity and better physical functioning (Brach, Simonsick, Kritchevsky, Yaffe, & Newman, 2004; He & Baker, 2004; Riebe et al., 2005; Teoman, Özcan, & Acar, 2004). However, improvements in actual physical functioning do not necessarily correspond with improved perceived physical functioning, and vice versa (King et al., 2000; Lindholm, Brevinge, Bergh, Körner, & Lundholm, 2003). That is, the relationship between actual and perceived physical functioning is not always clear, and it is important to measure both because they influence quality of life (Rejeski & Milhalko, 2001).

Physical Activity and Perceived Physical Functioning

Positive relationships between physical activity and perceived physical functioning have been found in cross-sectional studies. For example, a large-scale, national survey of the U.S. population found that the prevalence of fair or poor health increased as age increased. However, fewer individuals in the more physically active groups reported fair or poor health or unhealthy days compared to those in a less physically active group (Brown et al., 2003). The association between unhealthy days and physical activity was similar for men and women, but it was stronger for the two older age groups compared to the younger group. Similar findings have been reported in other cross-sectional studies in the United States (Laforge et al., 1999), Japan (Kimura, Ogushi, Takahashi, Munakata, & Ishii, 2004), and Australia (Lim & Taylor, 2005).

Qualitative studies offer another perspective for understanding the relationship between physical activity and perceived physical functioning. For example, Stathi, Fox, and McKenna (2002) found that physical activity was related to improved developmental, physical, mental, and social aspects of quality of life in older community-dwelling men and women. Qualitative comments related to perceived physical functioning included increased perceptions of the ability to do things; independence, freedom, and control over one's life; being fit, nimble, flexible, and mobile; and strength, stamina, and being healthy. Consistent with the narratives in Stathi et al., postmenopausal Taiwanese women commented feeling that their mind and body were filled with continuous power following exercise adoption and maintenance for 6 months (Jeng, Yang, Chang, & Tsao, 2004).

The limitations of cross-sectional research are well-known, and it is possible that people with lower perceived physical functioning will be less likely to engage in physical activity. One way to examine the timing sequence of the relationship between variables is through longitudinal research. For example, in one study, adults who reported being physically active at recommended levels at baseline reported significantly better perceived physical functioning at follow-up 9 years later compared to sedentary adults (Hillsdon, Brunner, Guralnik, & Marmot, 2005). Another longitudinal investigation found that reported changes in physical activity at 5-year follow-up were positively associated with improvements in various domains of quality of life but not perceived physical functioning (Wendel-Vos, Schuit, Tijhuis, & Kromhout, 2004). The lack of an association between physical activity and perceived physical functioning may be explained, in part, by characteristics of the sample. The sample was fairly active, and the changes in physical activity may not have been enough to influence perceived physical functioning. Moreover, the effects of changes in physical activity on perceived physical functioning may be more pronounced in older people, especially those over the age of 65 (Brach, VanSwearingen, FitzGerald, Storti, & Kriska, 2004).

Intervention studies can provide evidence about the potential causal relationship between physical activity and physical functioning for diverse age groups (Atlantis, Chow, Kirby, & Singh, 2004; Norris, Carroll, & Cochrane, 1990). For example, adults randomly assigned to a 24-week multimodal exercise intervention reported significant improvements in perceived physical functioning, vitality, general health, bodily pain, and other measures of quality of life compared to a wait-list control group (Atlantis et al., 2004). However, results from this investigation must be viewed with caution due to a high dropout rate for both groups (~ 40%) and the potential for the Hawthorne effect (i.e., greater attention to the exercise group). It is important to note that the Hawthorne effect is a potential problem for all the intervention studies discussed in this section.

Most intervention studies have examined the effect of an exercise program on quality of life in middle-aged and older individuals (Rejeski & Mihalko, 2001; Spirduso & Cronin, 2001). For example, a study with middle-aged women reported significant improvements for perceived physical functioning and other domains of quality of life following a 6-week multimodal exercise group (Teoman et al., 2004). In a study of older adults, participants who were randomly assigned to 4 months of aerobic exercise or yoga reported significant improvements in measures of quality of life, including perceived physical functioning, in comparison to a wait-list control group (Emery & Blumenthal, 1990). Moreover, the quality of life remained higher in those who continued participation in the exercise program up to 14 months later compared to those who did not. These positive effects of exercise programs on perceived physical functioning and quality of life have been supported in other investigations (e.g., Helbostad, Sletvold, & Moe-Nilssen, 2004; Li et al., 2001).

PHYSICAL ACTIVITY AND SUBJECTIVE WELL-BEING

Subjective well-being reflects the multidimensional evaluation of a person's life and includes cognitive judgments of life satisfaction and affective evaluations of moods and emotions. It is a major contributor to quality of life and can be conceptualized as a momentary state or as a relatively stable trait, depending on the time frame of the assessment period (Eid & Diener, 2004). Theorized to be composed of three major constructs, subjective well-being reflects (1) the presence of positive affect, (2) the absence of negative affect, and (3) high levels of life satisfaction (Diener, 1994). Happiness is considered synonymous with subjective well-being. We primarily review the relationship between physical activity and the (a) enhancement of positive affect and mood and (b) decrease of negative affect and mood, as there are relatively few studies of physical activity and life satisfaction.

The relationship between physical activity and subjective well-being is complex. One contributor to this complexity is that there are many types, forms, and modes of physical activity. For example, exercise, a type of physical activity, may refer to acute and chronic exercise, aerobic and anaerobic activities, competitive and noncompetitive recreational physical activities, and group and solitary activities. Even within a single exercise mode, many factors vary. These include practice or training characteristics, the exercise environment, psychological characteristics and backgrounds of the participants, fitness and skill levels of participants, and the instructors' characteristics and approaches to exercise. A second contributor to the complexity of the relationship between exercise and subjective well-being is that the type and extent of the psychological benefits (and decrements) of exercise may differ for specific groups of participants. Participants may vary in age from preschoolers to the elderly and include normal and psychiatric populations. Despite such complex issues, there is a strong consensus that many types of exercise are associated with enhanced subjective well-being, vigor or vitality, and a sense of "feeling better" (e.g., Berger, 2004; Berger & Owen, 1988, 1992, 1998; Carels, Berger, & Darby, 2006; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000; Lane, Jackson, & Terry, 2005; Netz & Lidor, 2003; Osei-Tutu & Campagna, 2005; Rocheleau, Webster, Bryan, & Frazier, 2004).

Acute Exercise and Mood

When exercisers report how they feel *right now at this very moment* both before and after acute exercise, that is, a single exercise session, they tend to report desirable mood changes after the exercise. Desirable mood changes reflect both decreases in negative affect and increases in positive affect, two of the three components of subjective well-being. More specifically, exercisers often report short-term decreases in anxiety, depression, anger, and fatigue and increases in vigor (e.g., Bartholomew, Morrison, & Ciccolo, 2005; Berger & Owen, 1992, 1998; Lane et al., 2005; Motl, Berger, & Leuschen, 2000; Netz & Lidor, 2003). These measurable changes reflect exercisers' perceptions that immediately after physical activity, they tend to "feel better" than they did before. These changes, especially those in vigor and vitality (Ryan & Deci, 2000; Ryan & Frederick, 1997) and calm energy (Thayer, 2001), seem to reflect a high level of life satisfaction characterized by feeling fully functioning and self-realized (Peterson & Seligman, 2004). After exercising, many participants report the desirable mood constellation referred to as the *iceberg profile* that was identified by Morgan (1980) more than 25 years ago. See Figure 27.1 for typical postexercise iceberg profiles as measured on the POMS and represented by elevated vigor and lower scores in the undesirable mood states of tension, depression, anger, fatigue, and confusion.

For members of nonclinical populations, the acute changes in mood appear to last from 2 to 4 hours after exercising (Raglin & Morgan, 1987; Thayer, Peters, Takahashi, Birkhead-Flight, 1993). This may seem a short length of time. However, a variety of events may occur while experiencing more positive mood states for the period, which may have a desirable influence on exercisers' quality of life. For example, an increase in vigor or vitality provides a dynamic sense of well-being marked by the subjective experience of energy, aliveness, and also mental and physical vigor (Peterson & Seligman, 2004; Ryan & Frederick, 1997). Because people with vigor and vitality exhibit "enthusiasm which they direct toward whatever activities they choose to engage" in (Peterson & Seligman, 2004, p. 274), a potential ripple effect may occur for these benefits.

Chronic Exercise and Mood

In addition to short-term changes in mood, chronic exercise may be associated with longer lasting benefits, which would tend to improve participants' quality of life, especially life satisfaction. The effects of chronic exercise are reflected by scores obtained at the beginning and end of an

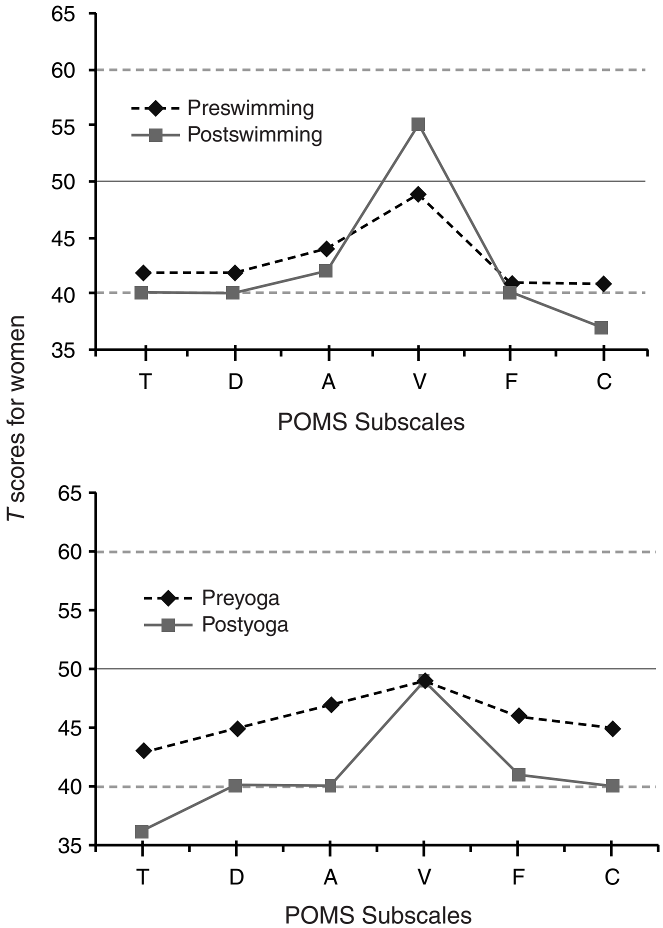

Figure 27.1 POMS scores of women before and after hatha yoga and swimming sessions. *Source:* "Mood Alteration with Yoga and Swimming: Aerobic Exercise May Not Be Necessary," by B. G. Berger and D. R. Owen, 1992, *Perceptual and Motor Skills, 75,* pp. 1331–1343. Reprinted with permission.

extended program of exercise, rather than before and after an acute exercise session. Chronic exercise programs investigated in the studies may last for a few weeks, months, or even years.

Long-term changes in affect and mood may be particularly evident in people who are clinically anxious or depressed (e.g., Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Singh, Clements, & Fiatarone, 1997). They also can be evident in members of a nonclinical population (e.g., Berger, Friedmann, & Eaton, 1988; O'Connor and Puetz, 2005). Such changes are difficult to interpret because they may be due to the chronic exercise program or to a host of other seasonal and life-related influences (Berger et al., 1988). As a result, it is difficult to attribute the changes in mood and affect to the program itself. Reports of mood benefits in members of the general population seem most creditable when they are restricted to short-term changes measured before and after an acute exercise session to control for extraneous variables.

Long-term changes in the mood states of energy and fatigue as measured by the POMS (McNair & Heuchert, 2003/2005) and the Vitality scale of the SF-36 Health Survey (Ware et al., 1993/2000) have direct implications for quality of life. Energy and fatigue would seem to affect one's ability and interest in "doing stuff." People who are high in energy and vitality and low in fatigue can pursue both more difficult and a wider variety of activities in their daily lives than those who are low in energy (Peterson & Seligman, 2004, pp. 273–289). As described by Peterson and Seligman vitality is conceptualized as being fully functioning and self-realized, having a positive feeling of aliveness, and having energy available (p. 276).

Examining the relationships between chronic exercise programs and long-term changes in the mood states of energy and fatigue reported in more than 100 studies, O'Connor and Puetz (2005) concluded that specific populations differed in their reports of exercise-related increases in energy and decreases in fatigue. The exercise programs ranged from 10 to 20 weeks in length. Results of approximately half of the 15 experimental studies reviewed indicated long-term increases in energy with chronic exercise. Other studies reported no meaningful changes in either energy or fatigue with chronic exercise programs (O'Connor & Puetz, 2005). The lack of consistent findings is not surprising as exercise intensity and duration would seem to influence participants' feelings of energy and fatigue. Moderate- (and possibly light-) intensity exercise programs would seem to lead to increased vigor and energy and decreased fatigue (e.g., Bartholomew et al., 2005; Berger & Owen, 1998; Thayer et al., 1993). Chronic high-intensity programs on a long-term basis may have the opposite effects on affect and needs further investigation (Tobar, 2005).

USE OF EXERCISE TO MODERATE DAILY STRESS RESPONSES

Another way regular exercise is related to quality of life is by serving as a stress management technique. Both too little stress (i.e., boredom) as well as too much stress result in *distress* and can have detrimental influences on quality of life (e.g., Nelson & Burke, 2002). In common usage, distress is shortened to the word *stress.* Distress or stress is "a relationship with the environment that the person appraises as significant for his or her well-being and in which the demands tax or exceed available coping resources" (Lazarus & Folkman, 1986, p. 63). Although individuals vary in their optimal or preferred levels of stress, a continual or chronic state of distress tends to be associated with physical and psychological symptoms: illness, high blood pressure, anxiety, depression, hostility, and personal unhappiness (e.g., Nelson & Burke, 2002).

Emphasizing the desirability of optimal levels of stress in daily life, Selye (1975, p. 83) has referred to stress as the "spice of life." Stress provides zest, excitement, and memorable times. The word *eustress* refers to a highly desirable type of stress that is exhilarating, exciting, and a contributor to quality of life (Berger, 1994, 1996). The thrill of eustress is associated with participating in high-risk physical activities such as rock climbing and downhill skiing. It also occurs in competitive types of physical activity, especially when competition is intense. Because too much stress detracts from subjective well-being, it is important to learn to regulate stress levels along a continuum that progresses from too little at one extreme, to optimal, to too much at the other extreme.

Exercise as a Stress Management Technique

Exercise is one of the few stress management techniques that can assist in both raising and lowering stress levels. More specifically, exercise enables participants to establish a personally optimal level of stress. Physical activity serves as a technique for increasing stress levels when participating in competitive sport and in high-risk physical activities such as downhill skiing and scuba diving, even if they do not produce the desirable state of eustress for a participant. Due to the relatively high levels of stress in competitive sport, participants need to develop stress management skills to cope with sport-related stressors (e.g., Nicholls, Holt, Polman, & James, 2005). Exercise also is one of many techniques for reducing stress levels, particularly when participating in noncompetitive, rhythmical types of physical activity that promote abdominal breathing (e.g., Berger, 1994; Iwasaki, MacKay, & Mactavish, 2005; Plante, Coscarelli, & Ford, 2001). Exercisers in these types of activities, especially those that are noncompetitive (Plante et al., 2001), have time out from a busy day, a time to think and problem-solve, and an opportunity to experience their bodies in motion (e.g., Berger et al., 2007; Rocheleau et al., 2004).

Exercise plays a key role in moderating both psychological and physical stress symptoms. Psychological changes associated with regular exercise include decreases of state and trait anxiety, depression, and feelings of stress or being overwhelmed, and increases in positive mood states, energy, cognitive functioning, self-esteem, and feelings of attractiveness (e.g., Berger, 1994; Tomporowski et al., 2005). Stress-related physiological changes associated with acute exercise include changes in electrocortical activity, such as those in the alpha, beta, delta, and theta frequency bands (Crabbe & Dishman, 2004). Increased activity in the alpha frequency band of brain waves, which often have been associated with reports of relaxation and decreased anxiety, has been observed both during and immediately after exercise (Crabbe & Dishman, 2004).

It is important to note, however, that not all exercise may be equally effective in reducing stress symptoms. For example, college students randomly assigned to exercising alone, exercising with another person but engaging in no talking, and exercising with another person and talking all reported acute postexercise increases in energy and calmness and decreases in tiredness. However, students who were exercising alone and thus avoiding interpersonal competition reported lower postexercise scores on tiredness when measured immediately after exercise and later in the evening (Plante et al., 2001). Illustrating the differential stress-reducing effects of exercise, the two groups exercising in the presence of others reported higher scores on calmness immediately after exercising and later in the evening. These changes in affect associated with exercise illustrate the complexity of the exercise-stress reduction relationship and the need for additional research. Physical activity seems to provide participants with greater psychological resources for coping with stressful situations, but the type(s) of exercise, the exercise environment, and the influence of exercise intensities need further investigation.

It seems that individuals who are fit or who exercise regularly have reduced stress responses and symptoms. This is true in both normal and clinical populations (e.g., Hong, Farag, Nelesen, Ziegler, & Mills, 2004; Petruzzello, Landers, Hatfield, Kubitz, & Salizar, 1991; Rostad & Long, 1996). Additional research is needed to determine the role of expectancy, the effectiveness of particular types of exercise, and the effectiveness of exercise as a stress management technique for individuals who are not particularly stressed. Despite these remaining questions, considerable research supports the effectiveness of exercise in reducing stress levels and increasing the effectiveness of executive processing (Long & van Stavel, 1995; Rostad & Long, 1996; Tomporowski et al., 2005).

Effectiveness of Exercise Compared to Other Approaches for Stress Management

Exercise seems to be as effective as more traditional mood alteration and stress management approaches, such as reading, Benson's relaxation response, quiet rest, and eating a sugar snack in reducing anxiety, tension, depression, and anger (Berger et al., 1988; Long & van Stavel, 1995; Petruzzelo et al., 1991; Thayer, 2001). Comparability of effectiveness of stress management techniques, however, differs according to how the specific techniques are conducted. For example, in a recent study, progressive muscle relaxation (PMR) was reported to be more effective than yoga stretching, which the researchers failed to describe (Ghoncheh & Smith, 2004). However, adult participants randomly assigned to yoga stretching or PMR reported similar states of feeling energized and aware (Ghoncheh & Smith, 2004).

In conclusion, the relative effectiveness of exercise for stress management is impressive, because the participants in some of the studies were randomly assigned to treatment. Thus, exercise can reduce stress and enhance mood even in individuals who are not self-selected exercisers. Observations that the benefits of exercise are comparable but are not superior to other mood and stress management techniques emphasize the need for realistic claims regarding the benefits of exercise. A particularly appealing aspect of exercise is that it can enhance subjective well-being while providing a wide variety of additional benefits. These include health enhancement and improved physical appearance by increasing muscle definition and reducing the percentage of body fat (American College of Sports Medicine, 2006; U.S. Department of Health and Human Services, 1996, 2000).

PEAK MOMENTS IN PHYSICAL ACTIVITY AND THE QUALITY OF LIFE: PEAK PERFORMANCE, PEAK EXPERIENCE, FLOW, AND EXERCISE HIGH

Another way that exercise can add to the quality of life is by offering opportunities to experience peak moments (Berger, 1996; Csikszentmihalyi, 1991, 1997). Peak moments provide a base for vivid, fulfilling, often-reviewed memories that help define individuals' lives and give them meaning. They include a broad spectrum of sporadic but highly valued states (Berger, 1996; McInman & Grove, 1991; Privette & Bundrick, 1991, 1997). When exercisers describe peak moments such as flow, peak performance, peak experiences, and the exercise high, they report many similarities in experiential, psychological, and performance states. Although peak moments are quite similar to one another, there are subtle differences between them.

The *feeling and performance model* of peak moments includes two orthogonal dimensions: feeling and performance (Privette & Bundrick, 1987, 1991, 1997). As depicted in Figure 27.2, the *feeling dimension* ranges from one extreme of misery to the opposite extreme of ecstasy. The *performance dimension* ranges from an extreme of total failure to personal best. The center of the figure is neutral and typifies many everyday experiences consisting of average performance and neutral feelings. The entire top right quadrant of the feeling and performance model depicted in Figure 27.2 contains diverse yet somewhat similar peak moments that tend to occur in physical activity.

Peak Performance

A peak performance is spontaneous, represents superior functioning, reflects a high standard of accomplishment, and can result from a wide variety of activities. Interestingly, participation with others, as occurs in team games, may hinder the likelihood of experiencing a peak performance. Being with others may disrupt the exerciser's concentration (Privette & Landsman, 1983). Examples of exercise- and sport-related peak performances are a hole in one in golf, a perfect serve in tennis, and an effortless 10-mile jog for a runner who usually is exhausted after jogging 5 miles. A peak performance promotes strong perceptions of competence, excellence, mastery, and self-efficacy that can enhance quality of life. Such perceptions tend to promote feelings of satisfaction and well-being that are crucial to quality of life (Berger et al., 2007).

Peak Experience

A peak experience reflects a psychological state that includes intense joy and happiness. It can be any experience that evokes strong, positive affective states such as peace, great joy, illumination, loss of self, or ecstasy (Privette & Bundrick, 1987). Peak experiences are memorable, fulfilling, and personally meaningful moments that affect the quality of life (Maslow, 1968). An example of a peak experience in the realm of exercise for one individual might be jogging on a deserted beach, experiencing intense joy while watching a beautiful sunset, and hearing the seagulls calling to one another overhead (e.g., Battista, 2004, pp. 23–28; Berger et al., 2007, p. 44). Peak experiences have been reported by exercisers who swam the English Channel; reflecting on the personal meaning of finishing the swim, they reported

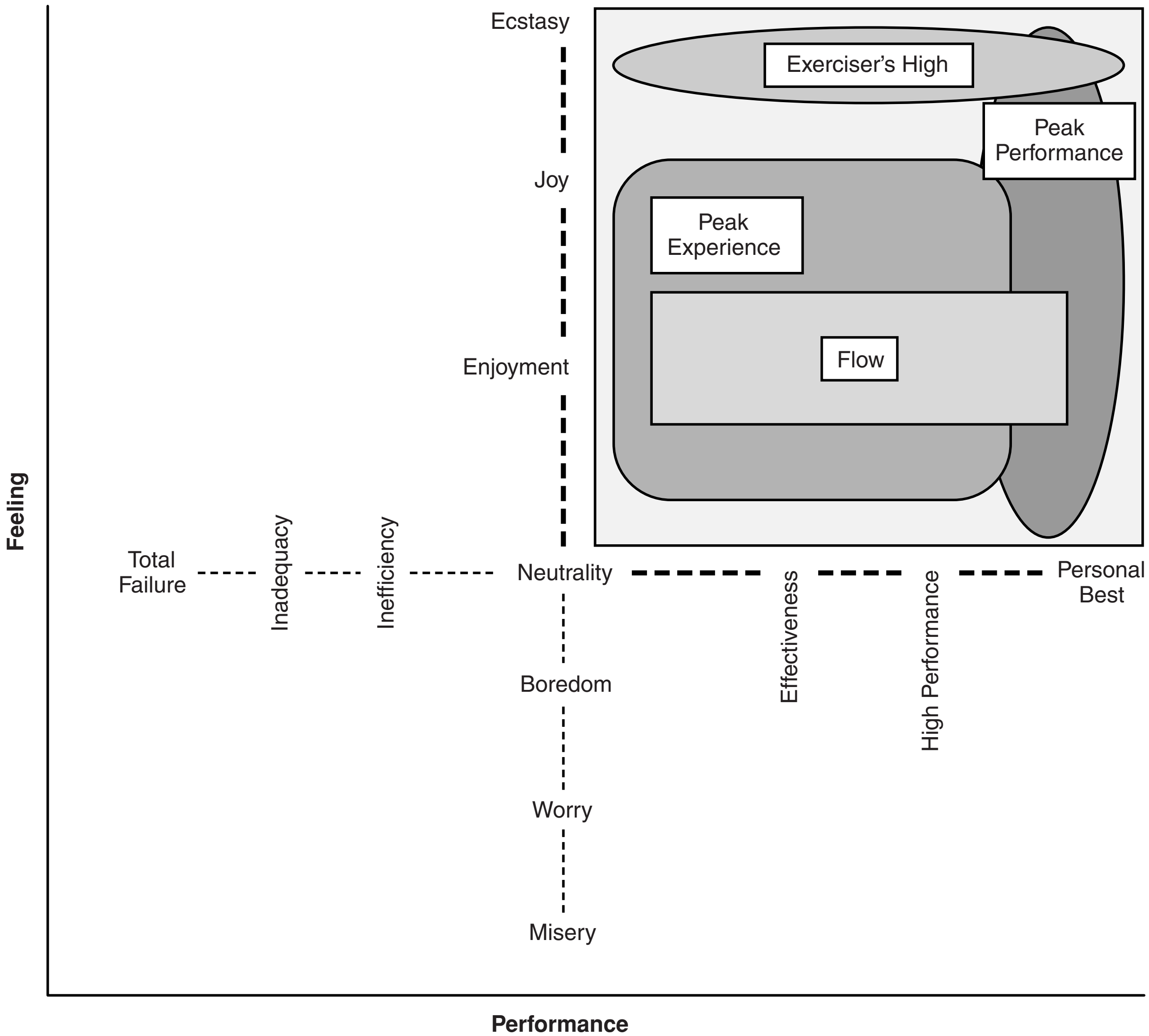

Figure 27.2 Peak moments quadrant of the feeling and performance model. Adapted and expanded from "Measurement of Experience: Construct and Content Validity of the Experience Questionnaire," by G. Privette and C. M. Bundrick, 1987, *Perceptual and Motor Skills, 65,* p. 318. Copyright 1987 by C. H. Ammons and R. B. Ammons. Adapted with permission.

increased self-confidence, awareness of unlimited potential, transcendence of daily life, and increased effectiveness at work (Hollander & Acevedo, 2000).

One problem with researching peak experiences is that they cannot be planned; thus, they are difficult to capture in laboratory settings. The percentage of people who report peak experiences in general, and specifically in exercise, also is not clear. In one study of university students, only 3 of the 214 students tested did not report having a peak experience (Allen, Haupt, & Jones, 1964). Results of this study suggest that peak experiences are rather common. In contrast, Keutzer (1978, p. 77) reported that 61% of a national sample had *not* reported an experience that made them feel as though they "were very close to a powerful, spiritual force that seemed to lift them out of themselves." Part of the discrepancy in the reported frequency of peak experiences may reflect differences of interpretation.

Flow

Csikszentmihalyi (1975) proposed the concept of flow, described as a positive psychological state and contributor to quality of life. The model describes flow as a delicate balance between personal skill and task demands (Csikszentmihalyi, 1991, 1997). If exercise ability exceeds the demands of the task, the task is too easy, and boredom may occur. If an individual's exercise ability is inadequate for the task, the task is too difficult and is associated with anxiety. Apathy results if both perceived challenge and skill level are low. Flow results when the demands of the task require intense concentration and when there is a match between personal ability or skill and the demands of the task (Csikszentmihalyi, 1991; Jackson & Marsh, 1996; Jackson, Thomas, Marsh, & Smethurst, 2001). Because it is characterized by enjoyment and freedom from self-consciousness, flow contributes to quality of life.

Flow is so intrinsically enjoyable that exercisers seek it out (Csikszentmihalyi, 1997). The subscales of the Flow-State Scale reflect key flow dimensions of (a) autotelic, or intrinsically rewarding experience; (b) balance between situational challenge and participant's skills; (c) clear goals; (d) concentration on the task at hand; (e) loss of self-consciousness; (f) merging of action and awareness; (g) perceived control; (h) transformation of time; and (i) unambiguous feedback. For more details, see Csikszentmihalyi (1991, 1997), Jackson and Eklund (2004), Jackson and Csikszentmihalyi (1999), and Marsh and Jackson (1999).

Not all activities are equally conducive to flow. When interviewing university students ($N = 123$) between 20 and 50 years of age, Privette and Bundrick (1987, 1991) reported that sport was a major source of flow experiences. Both within-individual factors and exercise/sport mode factors may affect the flow experience (Jackson et al., 2001). Physical activities that are structured and continuous or endurance-based (rather than start-stop) in nature may facilitate flow. Competition may either facilitate or decrease the likelihood of the flow occurrence (Jackson et al., 2001). Csikszentmihalyi (1991) and Jackson and colleagues (e.g., Jackson & Csikszentmihalyi, 1999; Jackson et al., 2001) have reinforced the possibility of experiencing flow more often when participating in specific types of physical activity.

The Exerciser's or Runner's High

The exerciser's high is a specific type of peak experience characterized by euphoria, a heightened sense of well-being, unusual perceptions of strength and power, a glimpse of perfection, and even spirituality (Berger, 1996, p. 346). Runners, in particular, tend to report occasionally experiencing peak moments and a euphoric state while exercising, as poetically described by multiple contributors to a collection of essays (Battista, 2004). Thus, the term *runner's high* has developed. This experience extends to other activities and can be broadened to *exerciser's high.* The percentages of runners in various studies who report experiencing an exercise high vary greatly. Sachs (1997) estimated that somewhere between 9% and 78% of runners have experienced a runner's high. Among runners who have experienced an exercise high, the frequency of such an experience varies from rarely (i.e., only several times during their running careers) to an average of 29.4% of daily runs. Because of its ability to enhance the quality of life, researchers need to further investigate the exerciser's high as well as provide information about factors that trigger this type of peak moment.

ENJOYMENT OF PHYSICAL ACTIVITY AND QUALITY OF LIFE

Physical activity also contributes to quality of life by providing opportunities for enjoyment. As emphasized by the burgeoning hedonic focus in psychology, enjoyable activities enhance our quality of life by providing interesting, rewarding, and truly memorable experiences (Kahneman, Diener, & Schwarz, 1999). As suggested by Csikszentmihalyi (1991, p. 46), "When people ponder further about what makes their lives rewarding, they tend to move beyond pleasant memories and begin to remember other events, other experiences that overlap with pleasurable ones but fall into a category that deserves a separate name: *enjoyment*" (italics added).

Enjoyment: A Positive Affective State

Enjoyment can be defined as "an optimal psychological state (i.e., flow) that leads to performing an activity for its own sake and is associated with positive feeling states" (Kimiecik & Harris, 1996, p. 256). Enjoyment often occurs in autotelic, or intrinsically rewarding activities. The optimal experience of enjoyment seems to result in desirable affective states such as happiness, vigor, pleasure, and relaxation (Motl, Berger, & Leuschen, 2000). Enjoyment of physical activity also may produce feelings of accomplishment, euphoria, and happiness (Kendzierski & DeCarlo, 1991), which, in turn, may add meaning and "zip" to daily routines. It adds zest and feelings of contentment and appreciation to life. The descriptions of enjoyment highlight its importance for improving life quality, especially positive feelings and perceptions of satisfaction.

Benefits of Exercise Enjoyment: Increased Participation and Program Adherence

As Singer (1996, p. 249) observed, "There's got to be a way to associate regular involvement in vigorous physical activity as something we look forward to and are dedicated to—something we miss when we don't do it." One way to make physical activity enticing and desirable is to increase exercisers' enjoyment of the activity (Dishman et al., 2005). In fact, enjoyment is a commonly cited reason for participating in exercise (Carpenter & Coleman, 1998; Wankel, 1993). Using cross-sectional designs, researchers have investigated enjoyment in relation to physical activity, physical education classes, and sport commitment in youth and adults (e.g., Paxton, Browning, & O'Connell, 1997; Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). Sallis and colleagues reported that enjoyment of physical education was significantly related to physical activity levels in five of six subgroups of participants separated according to gender and grade (grades 4 to 6, grades 7 to 9, and grades 10 to 12). It was concluded that enhancing young people's enjoyment of physical education classes should be considered a health-related goal by society and particularly by physical education teachers. The enhancement of exercise enjoyment would appear to be particularly important: Prochaska, Sallis, Slymen, and McKenzie (2003) recently documented in a 3-year prospective study a consistent decline in enjoyment of physical education classes for children as they moved from the fourth to the sixth grade.

Enjoyment and commitment to involvement in physical activity in adults and youth also have been examined in longitudinal and intervention research designs (e.g., Dishman et al., 2005; Sallis, Calfas, Alcaraz, Gehrman, & Johnson, 1999; Sallis, Prochaska, et al., 1999). For example, Sallis, Calfas, and colleagues reported that enjoyment of physical activity predicted physical activity levels across a 16-week course in college-age male students who were randomly assigned to an intervention. This relationship between exercise enjoyment and subsequent participation was supported by results of a year-long intervention study designed to increase ninth-grade girls' ($N = 2{,}087$) enjoyment of physical activity and self-efficacy beliefs about participating in physical activity (Dishman et al., 2005). The randomized controlled trial linked increased enjoyment of physical activity with increased physical activity among Black and White adolescent girls. Despite participants' multiple exercise goals, it is increasingly evident that enjoyment of physical activity leads to increased participation and thus to a myriad of benefits associated with habitual participation. As emphasized by Kimiecik (2002), enjoyment of physical activity is key to becoming an "intrinsic exerciser."

Benefits of Exercise Enjoyment: Enhancement of Mood Changes

In addition to being a major reason for participating in physical activity, enjoyment may be linked to the psychological benefits associated with it, especially with mood enhancement. Enjoyment of a specific physical activity has been linked to desirable changes in mood states in a study of rock climbers and a control group of students participating in a health education class (Motl et al., 2000). Results suggested that participating in an enjoyable activity promoted short-term changes in mood, rather than a particular mood state influencing perceptions of enjoyment. Recently, Miller and colleagues (Miller, Bartholomew, & Springer, 2005) tested the influence of exercise enjoyment on the relationship between exercise and mood alteration as hypothesized by Berger and Motl (2000; Motl et al., 2000). College students participated in high- and low-preference exercise modes that were aerobic and rhythmical and employed aerobic training equipment common in exercise clubs. Results indicated that participants' exercise enjoyment ratings of the exercise mode mediated desirable changes in both positive and negative affect. In addition to the results for enjoyment, participants exercising in their most preferred exercise mode reported greater improvements in positive affect. It seems that exercise preference is one of many factors that contribute to exercise enjoyment and that additional work is needed to broaden understanding of how enjoyment contributes to the psychological response to exercise (Miller et al., 2005).

An absence of enjoyment may detract from the often reported desirable mood changes associated with exercise. For example, there was a lack of mood change as measured by the POMS during a summer swim class, and the lack of change seemed to result from uncomfortably warm water and air temperatures (Berger & Owen, 1986). In the fall, college students who enrolled in swimming classes reported short-term improvements on a variety of subscales on the POMS. Koltyn, Shake, and Morgan (1993) found a similar effect of unpleasant exercise conditions on acute changes in state anxiety in their examination of the interactive effects of water temperature and protective apparel in adult male swimmers. Participants reported decreased state anxiety after swimming in cold water wearing a wet suit. However state anxiety was elevated after swimming in cold water without a wet suit, and in warm water with a wet suit. Thus, it seems that unpleasant environmental conditions may detract from perceptions of enjoyment and desirable changes in affect.

Interrelationships between exercisers' personality characteristics and the actual exercise environment may influence perceptions of enjoyment. For example, exercisers who have high levels of concern about their physical appearance or have social physique anxiety may not enjoy exercising in public facilities or in class settings. Public exercise environments often present a strong physique-evaluative component that could produce anxiety rather than enjoyment (Focht & Hausenblas, 2004). To enjoy their exercise sessions, exercisers who have a high level of social physique anxiety may need to participate in physical activity environments that contain less of an evaluative component. Ultimately, lack of enjoyment detracts from reaping the benefits of exercise because it decreases the likelihood of program adherence (e.g., Salmon, Owen, Crawford, Bauman, & Sallis, 2003).

UNDESIRABLE EFFECTS ASSOCIATED WITH EXCESSIVE PHYSICAL ACTIVITY

There are many potential benefits of physical activity for improving quality of life, but there is a dark side to physical activity. Too much physical activity, as reflected by long duration and high intensity and frequency, can have an undesirable effect on mood. Two examples of the deleterious effects associated with excessive physical activity are situations when overtraining is employed and when individuals become dependent on exercise.

Overtraining and Staleness

Overtraining is "a process involving progressively increased training to a high absolute level that is in excess of more routine training undertaken to maintain performance" (Raglin, 1993, p. 841). The purpose of overtraining is to enhance physical performance, and it may be incorporated into the training process. Research on overtraining has been conducted primarily with athletes, but the findings from these investigations may generalize to individuals who exercise at extreme levels (Hendrickson & Verde, 1994). For both athletes and exercisers who overtrain, knowing the optimal amount of training or exercise is often difficult but crucial for their level of performance and for quality of life. Too much training can detract from the quality of life (Brown et al., 2004; Wrisberg & Johnson, 2002). Although various moderating factors may influence a person's response to overtraining (Kenttä & Hassmén, 1998; Tenenbaum, Jones, Kitsantas, Sacks, & Berwick, 2003), psychological distress (e.g., mood disturbance) usually occurs when there is an imbalance between training and recovery.

Psychological Responses to Overtraining

During periods of light training, athletes and exercisers tend to report the desirable iceberg profile (Berger, Grove, Prapavessis, & Butki, 1997; Morgan, 1980; Raglin, 2001). However, research examining mood state responses to long-duration overtraining (e.g., several months) in swimmers have found that progressive increases in training volume were associated with greater mood disturbance, and decreases in training volume were associated with an improvement in mood (Morgan, Brown, Raglin, O'Connor, & Ellickson, 1987; O'Connor, Morgan, Raglin, Barksdale, & Kalin, 1989; Raglin, Koceja, Stager, & Harms, 1996). The dose-response relationship between mood states and changes in training levels has been reported with shorter periods of overtraining (e.g., 6 weeks or less) and in other sport settings with different overtraining regimens (e.g., Berger et al., 1999; Kellmann, Altenburg, Lormes, & Steinacker, 2001; Morgan, Costill, Flynn, Raglin, & O'Connor, 1988; Murphy, Fleck, Dudley, & Callister, 1990; O'Connor, Morgan, & Raglin, 1991; Raglin, Eksten, & Garl, 1995; Tobar & Morgan, 2002, 2003).

If the imbalance between training and recovery persists for a lengthy period of time, staleness may occur. Staleness is a severe negative response to overtraining characterized by long-term decrement in performance capacity and dysregulation of psychological and physiological states (Kellmann, 2002; Kenttä & Hassmén, 1998; Tobar, 2005). Individuals suffering from staleness have a decreased quality of life and may also be clinically depressed (Armstrong & VanHeest, 2002; Morgan, Brown, et al., 1987; O'Connor et al., 1991). The only proven treatment for staleness is rest. No uniform terminology has been recognized, and the terms overtraining and staleness may differ from the terminology used by other investigators (Kellmann, 2002; Tobar, 2005).

Prevalence and Incidence of Staleness

Approximately 60% to 64% of elite and 33% of subelite distance runners have reported experiencing staleness at least once in their career (Morgan, O'Connor, Ellickson, & Bradley, 1988; Morgan, O'Connor, Sparling, & Pate, 1987). In adolescent elite athletes, the prevalence of experiencing staleness has ranged from 21% to 45% in various countries (Kenttä, Hassmén, & Raglin, 2001; Raglin, Sawamura, Alexiou, Hassmén, & Kenttä, 2000); the incidence of staleness has ranged from 5% to 21% in college and elite swimmers (Hooper, Mackinnon, & Hanrahan, 1997; Morgan, Brown, et al., 1987; O'Connor et al., 1989). There is preliminary evidence that prior history of staleness may increase susceptibility with future overtraining (Raglin, 1993). Given the negative effects of staleness on physical and psychological health, a significant number of exercisers and athletes who overtrain may experience decreased quality of life at various times.

Exercise Dependence

There may be a link between staleness and exercise dependence, and some exercisers and athletes who overtrain may be exercise-dependent (Adams & Kirkby, 2001). As noted by Morgan (1979, p. 58), excessive physical activity may be indicative of a pathological condition:

> I would like to suggest that running should be viewed as a wonder drug analogous to penicillin, morphine, and the tricyclics. It has profound potential in preventing mental and physical disease and in rehabilitation after various illnesses have occurred. However, just like other wonder drugs, running has the potential for abuse, and the runner who appears in the physician's office on crutches or in a wheelchair as a result of the crippling effects of excessive running can be compared to the hard-core drug addict who overdoses. Running is a form of negative addiction in the case of the hard-core exercise addict.

Although current conceptualizations of exercise dependence suggest that the condition is an addiction (Adams & Kirkby, 2002), we use the term *exercise dependence* in place of *exercise addiction* to be consistent with terminology used in the *Diagnostic and Statistical Manual of Mental Disorders*. Based on criteria established for substance dependence, De Coverley Veale (1987), Hausenblas and Symons Downs (2002), and Adams, Miller, and Kraus (2003) have recommended that the criteria for diagnosing exercise dependence include three or more of the following symptoms within the same 12-month period: (a) *tolerance:* need of increasing exercise dosages for the same desired effect; (b) *withdrawal:* psychophysiological disturbance when deprived of exercise; (c) *intention effects:* engage in more exercise than was intended; (d) *loss of control:* unable to minimize or control exercise behavior; (e) *time:* more time devoted to exercise-related activities; (f) *conflict:* exercise takes precedent over other life situations (i.e., social, occupational, recreational); and (g) *continuance:* continued exercise despite knowledge of having exercise-related physical or psychological problems.

The differentiation between primary and secondary exercise dependence also may be considered in the proposed diagnostic criteria (De Coverley Veale, 1987; Hausenblas & Symons Downs, 2002; Zmijewski & Howard, 2003). Primary exercise dependence is diagnosed when the exercise is an end in itself. This condition *may* include altered eating behaviors for the purpose of enhancing performance. Secondary exercise dependence is diagnosed when the exercise is a symptom of another primary pathological condition (e.g., Eating Disorder). On the other hand, some researchers have proposed that such a differentiation is premature (Bamber, Cockerill, & Carroll, 2000; Blaydon, Linder, & Kerr, 2004).

Prevalence of Exercise Dependence

With the lack of consistent terminology and diagnostic criteria, prevalence estimates of exercise dependence are difficult to interpret. However, estimates of individuals experiencing symptoms of exercise dependence emphasize that this condition may be a problem for some exercisers. For example, about 26% of men and 25% of women runners ranging in age from 15 to 71 reported elevated scores on a measure of exercise dependence (Slay, Hayaki, Napolitano, & Brownell, 1998). Similar estimates for men and women also have been reported in exercisers varying in age and skill (Carmack & Martens, 1979; Garman, Hayduk, Crider, & Hodel, 2004). Although overall prevalence may not differ between men and women, certain withdrawal symptoms and exercising to avoid experiencing withdrawal symptoms were higher among women (Zmijewski & Howard, 2003). Despite widely varying operational definitions of exercise dependence, prevalence estimates for experiencing symptoms of exercise dependence consistently ranged from 22% to 34% of regular exercisers.

Exercise Deprivation Studies

Exercise deprivation may be associated with psychological distress and lower quality of life. For example, Carmack and Martens (1979) found that 74% of runners reported experiencing discomfort when a run was missed. Runners also have reported less desirable psychological states (e.g., mood disturbance) on days when they did not run versus days when they ran (Szabo, Frenkl, Janek, Kalman, & Laszay, 1998). In experimental studies, mood disturbance has been reported in habitual runners deprived of 3 days of exercise (Mondin et al., 1996) and in competitive runners deprived of 1 day of scheduled training (Aidman & Woollard, 2003).

Few studies have examined the psychological effects of exercise deprivation lasting more than a week; this may be due to the extreme difficulty of recruiting exercise-dependent individuals for exercise deprivation studies (Szabo, 1998). In one of the first studies examining prolonged exercise deprivation, Baekeland (1970) reported that participants experienced sleep disturbances and psychological distress during 1 month of exercise deprivation. Mood states, self-esteem, and body image were negatively affected in habitual runners who were prevented from running for at least 2 weeks due to an injury compared to runners who were able to run without interruption (Chan & Grossman, 1988). However, injury and exercise deprivation are confounded in this study, which limits the interpretation of the results. Another investigation found that 2 weeks of exercise deprivation in male runners was associated with increased psychological distress, insomnia, and social dysfunction (Morris, Steinberg, Sykes, & Salmon, 1990). However, demand characteristics cannot be ruled out as participants were asked several questions preceding the study about their perceived ability to stop exercising, how exercise deprivation might affect their life, and perceived addiction to running. Thus, this area is ripe for future investigation.

Qualitative Studies

Qualitative approaches (e.g., case studies) offer a different perspective on exercise dependence and its affect on quality of life. For example, the effect of exercise deprivation on mood is clearly evident in the following quotation: "I do still get the same feelings of distress if I can't go because the exercise is such a major part of my life. . . . I get very very depressed" (Cox & Orford, 2004, p. 183). In fact, exercise-dependent individuals will continue exercising despite being injured and risking further damage; this may be to avoid the withdrawal symptoms from not exercising. "I had two weeks off and it was horrible. I wouldn't want to spend 30 years feeling like that" (Cox & Orford, 2004, p. 183). Dependence on exercise may even put a financial strain on the individual. Griffiths (1997, p. 166) reported a woman claiming "she resorted to (unspecified) socially unacceptable means in order to get money to fund herself" to attend jujitsu competitions across the country. Personal relationships with significant others may begin to suffer due to the excessive time devoted to exercise. The need to exercise also may affect how the person functions at work:

> I simply cannot exist any longer without a midday run. The problem is that I am expected to counsel students throughout the day—that's my job. . . . Part of my noon run consists of my lunch period, but I always exceed that by 30 minutes or so. . . . I know it's wrong though—especially with the students waiting to see me—I don't know what I'm going to do. (quoted in Morgan, 1979, p. 69)

A TAXONOMY TO MAXIMIZE THE BENEFITS

To better understand the relationship between different types of exercise and mood alteration, Berger and her colleagues (e.g., Berger, 2004; Berger & Motl, 2000; Berger & Owen, 1988, 1992, 1998) are beginning to develop a taxonomy to help participants maximize the likelihood of psychological benefits being associated with exercise sessions. Although originally conceived for mood alteration, the taxonomy may be applied to quality of life. See Figure 27.3 for elements in the taxonomy that are extended here to quality of life. Based on the research literature and anecdotal reports, Berger and colleagues suggest that exercise sessions that include a greater number of the taxonomy guidelines are more conducive to mood alteration and quality of life than are sessions that include fewer of the guidelines. As evidenced in the figure, the taxonomy contains three primary requirements: exercise enjoyment, specific mode guidelines, and key training guidelines. Both exercise mode and training considerations have subcategories that may be related to enhancing quality of life.

Because the exercise mode and training guidelines for enhancing the psychological benefits of exercise may differ from those recommended for sport performance, fitness, and physical health (e.g., American College of Sports Medicine, 2006), it is important to clarify partici pants' possibly conflicting goals. For example, exercise guidelines for stress reduction may differ from the training guidelines for physical fitness. The taxonomy is presented as a working model to clarify some of the components of exercise that

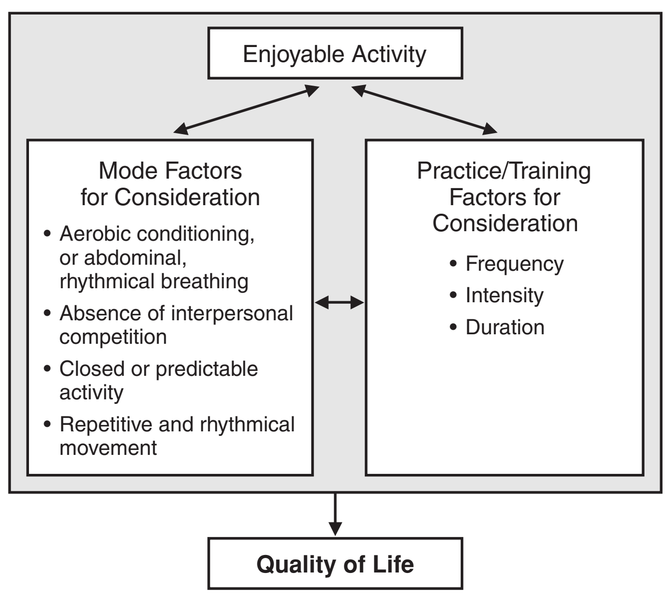

Figure 27.3 Physical activity taxonomy for enhancing quality of life. Adapted from *Foundations of Exercise Psychology,* by B. G. Berger, D. Pargman, and R. S. Weinberg, 2007, Morgantown, WV: Fitness Information Technology. Copyright 2006 by the authors. Adapted with permission.

may be related to the quality of life and as a guide for future investigations, as illustrated in a recent study by Lane and colleagues (2005).

Possible Need for Exercise Enjoyment

Including the enjoyment factor in the taxonomy encourages exercise specialists to consider individual differences and preferences when designing a specific exercise program that is conducive to enhancing quality of life. Activities that are enjoyable seem to be conducive to exercise participation (Dishman et al., 2005) and may serve to increase exercise adherence as the individual returns to the activity for another enjoyable session and to have time for oneself in a hectic day (Kimiecik, 2002). Enjoyable physical activity also seems more likely to be associated with desirable changes in mood than are activities that are not (Motl et al., 2000). Miller and colleagues (2005) recently tested the influence of exercise enjoyment on the relationship between exercise and mood alteration; they concluded that college students' enjoyment of a particular exercise mode mediated mood change. In further support of the importance of exercise enjoyment, Lane and colleagues (2005) concluded that if enjoyment can be operationalized as preference for a particular exercise modality, their experimental results were supportive of enjoyment facilitating the mood-enhancing benefits of exercise. Preferred mode and training parameters (i.e., intensity, duration, and frequency) are related to quality of life and also may be related to enjoyment of physical activity, as illustrated by the bidirectional arrows in Figure 27.3.

Mode Type of Physical Activity

Some types of physical activity may be more likely than others to be associated with quality of life for most participants. Although there are a multitude of factors that distinguish among exercise modes, the basic mode guidelines in the taxonomy are the four primary characteristics in Figure 27.3. The characteristics are presented here as a working model to clarify select exercise mode and practice training considerations that may be related to mood alteration.

Abdominal, Rhythmical Breathing

This exercise mode guideline is a common component of many stress management techniques. Abdominal, rhythmical breathing occurs automatically and regularly when participating in aerobic activities such as swimming and jogging, both of which are associated with mood alteration (e.g., Berger & Motl, 2000; Berger & Owen, 1988; Netz & Lidor, 2003; Rocheleau et al., 2004). Abdominal, rhythmical breathing also occurs in other exercise modes, such as hatha yoga and weight training, as participants coordinate mindful inhalation and exhalation with specific components of their movements (Battista, 2004, pp. 79–83). Yoga, Feldenkrais, and weight training also have been associated with mood enhancement (e.g., Berger & Motl, 2000; Berger & Owen, 1988, 1992; Netz & Lidor, 2003; Rocheleau et al., 2004). Reflecting the findings of these individual studies, a meta-analysis did not support significant differences among various types of exercise (Petruzzello et al., 1991).

Absence of Interpersonal Competition

Absence, or relative absence, of interpersonal competition is another exercise mode guideline. A relative absence of interpersonal competition helps exercisers avoid comparisons with others and the often accompanying mood states of anxiety, envy, or discouragement. An absence of interpersonal competition also enables exercisers to avoid the stress of competition and undesirable mood states that may be associated with losing, overtraining, and exhausting exercise sessions.

A Closed and Predictable Environment

In closed environments, there are few unanticipated events, and the sequence of movements is predictable. In closed, predictable environments such as swimming and jogging, participants do *not* need to attend closely to their exercise environments. As a result, exercisers have the opportunity to let their attention and thoughts wander. They also can engage in self-reflection and stream-of-consciousness thinking and/or have an absence of thought and enjoy a sense of solitude as they feel their bodies in motion (Berger et al., 2007).

Repetitive and Rhythmical Movement

This exercise mode guideline is closely associated with predictable environments and again occurs in activities such as jogging, swimming, aerobic dance, yoga, Feldenkrais, and weight training (e.g., Berger & Owen, 1988, 1992; Netz & Lidor, 2003). Repetitive and rhythmical movements seem to enhance opportunities for thinking in general and for self-reflection, and at other times for a complete absence of thought.

Training Factors

In addition to specific types of exercise, training factors (e.g., exercise frequency, intensity, duration) and various personal characteristics of the participants (e.g., fitness levels) may be related to the direction and scope of mood changes (Berger & Motl, 2000; Berger & Owen, 1998; Dunn et al., 2005; Ekkekakis et al., 2000; Lane et al., 2005; Osei-Tutu & Campagna, 2005; Tobar, 2005). Despite such individual differences, exercise frequency, intensity, and duration have implications for the influence of physical activity on the quality of life (e.g., Kesaniemi et al., 2001).

Frequency

A minimal exercise frequency of 2 to 3 times a week enables participants to establish a basic level of fitness. This reduces the physical discomfort and enhances exercise enjoyment that can occur while exercising. In one of the few investigations of exercise frequency and psychological well-being, Dunn and colleagues (2005) compared the effectiveness of different cycling frequencies (3 or 5 days/week) and caloric expenditures (a low dose [7 kcal/kg/week] and a public health dose [17.5 kcal/kg/week]) in reducing depressive symptoms. Regardless of whether participants exercised 3 or 5 days a week, exercisers in the public health dose reported significantly greater decreases in depression than those in the light dose and in the placebo stretching group. However, studies similar to this one are needed to examine the relationship between various exercise frequencies and psychological well-being in the general population. In addition, regular exercise sessions are necessary to reestablish the mood benefits that tend to last for the previously reported 2- to 4-hour period (Raglin & Morgan, 1987; Thayer et al., 1993).

Intensity

Exercise intensity is a second training factor and generally is indicated by participants' heart rate or VO_2 max (American College of Sports Medicine, 2006). Presently, it seems that exercise intensity should be moderate to avoid the undesirable mood changes that have been associated with high-intensity exercise (e.g., Murphy et al., 1990; Raglin et al., 1995; Tobar, 2005) and the physical discomfort or pain often associated with high-intensity exercise. Because relatively little is known about mood changes associated with low-intensity exercise, additional information about the intensity component is needed prior to recommending low-intensity physical activity (e.g., Berger & Owen, 1992, 1998; Daubenmier, 2005). Complicating the exercise intensity-mood relationship are personal differences in the form of intensity preferences that may influence the relationship (Lane et al., 2005). The relationship between exercise intensity and mood alteration may differ for various exercise modes (Rocheleau et al., 2004).

Duration

Recommended duration of an exercise session for mood alteration has been a minimum of 20 to 30 minutes (e.g., Berger, 1996). Desirable mood changes tend to occur during this length of time, and this duration of exercise is less conducive than longer duration to overuse injuries. Evidence suggests that as little as 10 to 15 minutes of walking may be conducive to calmness and relaxation (Ekkekakis et al., 2000) and to decreases in total mood disturbance (Osei-Tutu & Campagna, 2005). However, in this later investigation, walking in 30-minute sessions during an 8-week program was associated with a greater variety of mood benefits than was walking in 3 separate 10-minute sessions a day (Osei-Tutu & Campagna, 2005). Thus, exercising in short- and moderate-duration sessions may be differentially effective for mood alteration. Exercise duration and other taxonomy components need further investigation (e.g., Rocheleau et al., 2004).

MEANING OF PHYSICAL ACTIVITY AND IMPLICATIONS FOR QUALITY OF LIFE

The meaning of physical activity is closely related to exercise enjoyment and has implications for exercise initiation and adherence and thus to the overall quality of life. There is a relative lack of information, however, within the exercise psychology literature about what exercise means to the participant. This lack is surprising because personal meaning reflects the heart of the exercise experience. Personal meaning and its implications for quality of life and flourishing (e.g., Nakamura & Csikszentmihalyi, 2003) encourage researchers to avoid the common emphases in physical activity on accomplishment and an outward focus, and to look within the participant.

Emphasis on Utilitarian Accomplishment and an Outward Focus

Modern Western society tends to be utilitarian and heavily focused on technology. Thus, endorsement of the biomedical model of health with its focus on disease may preclude a focus on meaning. As a result, researchers tend to value the tangible outcomes of exercise such as heart rate, percentage of body fat, and distance run that are assumed to represent reality, a reality that is out there in the world (Stelter, 1998). Many researchers give little attention to inward, subjective experiences that occur during physical activity. With the focus on *the parts* of physical activity such as skill development, enhanced physical fitness, mood enhancement, and increased self-esteem, . . . *the whole* of the relationship between physical activity and quality of life tends to remain compartmentalized. As aptly noted by Ken Wilber (1996), individuals can take a watch apart to better understand its components; however, the individual parts will not tell the time. The whole (e.g., exercise) often is more than the sum of its parts. Thus, the personal meaning of exercise is much more than improving mood states and decreasing body fat.

Quantitative and Qualitative Research Approaches: Looking Within

Personal meaning is a subjective experience that is difficult to measure. To gain knowledge about the multiple and unique personal meanings and interpretations of physical activity experiences, reflective, *qualitative research* methods are needed, as well as the more traditional quantitative research methods. As emphasized by Brustad (2002), the positivist experimental model of research, which accentuates objectivity and reductionism, is limited if it is the only model employed to investigate the dynamic psychosocial-physical world of exercise. Qualitative research permits the capturing of reality from the perspective of an individual who exercises, emphasizes diversity of expression, and is a useful methodology for describing the many exercise events and interactions that influence the meaning of physical activity.

Commonly Expressed Meanings in Exercise

For many participants, exercise provides a concrete activity, namely, movement, for taking care of personal needs such as health, fitness, physical appearance, and psychological well-being and, in a broader sense, for taking care of themselves. In addition to specific benefits, exercise provides opportunity for each participant to personally construct meanings of exercise. Commonly expressed meanings of exercise include the following:

- Something to be avoided
- Fun, enjoyment, and an opportunity to be lighthearted and joyful while moving
- An avenue for self-reflection and increased exploration and awareness of oneself
- Freedom as exercisers learn to examine, set, and change their personal goals
- Time for oneself: time alone, self-care, and relishing the experience
- Empowerment and self-responsibility
- Communication with nature and feeling close to the earth
- Defying death and delaying the aging process
- Movement for the sake of moving
- More esoteric meanings of exercise: search for spirituality and a feeling of body-mind-heart-and-spirit integration (Battista, 2004; Berger et al., 2007; Kimiecik, 2002)

Paradoxical Meanings of Physical Activity

It is important to recognize and acknowledge that there are diverse meanings, both positive and negative, of physical activity. As observed by Wankel and Berger (1990, p. 167) in their examination of the psychological and social benefits of sport, "Sport, like most activities, is not 'a priori' good or bad but has the potential for producing both positive and negative outcomes." The same is true for exercise. Exercise can liberate or oppress, encourage or alienate, inspire or disillusion; it can also be a source of satisfaction and achievement or a source of disappointment and failure (Tinning, 1997). In addition, exercise can enslave or free the participant, prevent or encourage psychological development, and be a source of body-mind integration or disassociation (Fahlberg & Fahlberg, 1990). These paradoxical meanings of physical activity reflect a diversity of movement forms and movement capabilities, as well as participants' age and gender, and these meanings can affect quality of life (Nakamura & Csikszentmihalyi, 2003).

CONCLUSION

Quality of life denotes an individual's perception of his or her position in life and is a broad construct based on the way individuals appraise key components of their lives (WHO, 1995). Quality of life emphasizes an enhanced sense of physical and psychological well-being. Although the study of physical activity and the quality of life still is in its infancy, accumulating research evidence supports the likelihood that regular physical activity influences quality of life in many ways. Multiple interacting factors challenge researchers who are investigating somatopsychic and psychosomatic relationships, especially as they are related to quality of life. More rigorous intervention studies are needed to minimize the influence of extraneous variables and to elucidate the role of mediating and moderating variables (e.g., self-efficacy) on the relationship between physical activity and quality of life from a theoretical perspective. Most studies have focused on middle-aged and older adults; the effectiveness of physical activity interventions for improving quality of life in younger adults warrants further investigation.

Physical activity can be associated with a myriad of factors that influence quality of life. In addition to improving actual and perceived physical functioning, physical activity influences quality of life by enhancing subjective well-being, moderating daily stress responses, and providing opportunities for peak moments and personal enjoyment. As noted in the section on undesirable changes, excessive physical activity and exercise dependence may detract from the quality of life. A physical activity taxonomy is proposed as a working model designed to emphasize the role of exercise enjoyment, to clarify selected components of exercise mode and training considerations that are associated with enhanced quality of life, and to provide a guide for future investigation.

Physical activity has broad implications for an individual's quality of life throughout the life span. Researchers have just begun to touch the surface of identifying influencing factors and exploring the benefits of physical activity for the life well-lived.

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CHAPTER 28

Athlete Burnout

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Athlete burnout has become a matter of disquiet in both colloquial and sport science commentaries around the world. Concern has been sufficiently elevated that major sporting organizations have been increasingly spurred into action. The International Tennis Federation, for example, sought to alleviate the problem through the development of educational recommendations and rule changes (Hume, 1985). Other sporting bodies have funded major programs of research to gain a better understanding of the problem, including the United States Tennis Association Sport Science Division (e.g., Gould, Udry, Tuffey, & Loehr, 1996), the New Zealand Rugby Football Union (e.g., Cresswell & Eklund, 2005c), and the English Rugby Football Union (e.g., Cain, 2005). Despite these widespread concerns and the variety of important efforts to understand issues surrounding athlete burnout, the construct and its causes and consequences continue to enjoy more notoriety than substantive conceptual clarity and understanding. This chapter is intended to assist in bringing focus to some important issues in the area.

To this end we start this chapter by commenting briefly on the emergence of burnout as a psychological construct and the nature of syndromes to provide a foundation for our observations on the athlete burnout syndrome. Although we do not dwell extensively on alternative conceptualizations of burnout, we do contrast other conceptualizations evident in the extant literature with the more common burnout syndrome conceptualization of this enduring negative experiential state. We subsequently discuss measurement of the syndrome and the scant evidence concerning the extent and prevalence of athlete burnout before focusing our attention on theoretical explanations of the occurrence of burnout. Finally, we outline potential research directions on athlete burnout to bring the chapter to a conclusion. The issues addressed in the chapter are all interrelated, but this progression in the discussion of matters should be illuminating.

As a final introductory note, it is important to understand that we have chosen to focus on *athlete* burnout in this review. Certainly, interesting research has been conducted on the occurrence of burnout in other sporting populations (e.g., coaches, officials, administrators), but discussion of those efforts would be tangential to our intended purpose for this chapter. Moreover, we focus this review on athletes involved in serious organized sporting competition requiring a regular regimen of formalized training. We do not comment on, nor see the issue as particularly relevant for, recreational sport participants.

FROM THE BEGINNING

Burnout emerged as a psychosocial construct in the mid-1970s in Freudenberger's (1975) efforts to describe and explain a process of physical and mental deterioration and workplace ineffectiveness that he observed among some health care professionals. He termed the phenomenon "burnout" and characterized it as exhaustion due to excessive demands on energy, strength, or resources. Maslach (1982) observed the same phenomenon while studying human service workers. The development of a measurement instrument, the Maslach Burnout Inventory (MBI; Maslach & Jackson, 1981, 1986), to study the phenomenon effectively formalized the burnout syndrome: sustained feelings of emotional exhaustion, depersonalization (negative attitudes and feelings toward the recipients of the service), and inadequate personal accomplishment (a sense of low accomplishment and professional inadequacy). This syndrome has been extensively examined in a variety of workplace settings and is associated with negative consequences such as decreased performance, low motivation, impaired health, personal dysfunction, insomnia, increased use of alcohol and drugs, and marital and family problems (Maslach & Goldberg, 1998; Maslach, Jackson, & Leiter, 1996).

From the beginning, Freudenberger (1975) did not believe that this sustained negative experiential state was necessarily limited to professionals working in health care environments. In fact, he specifically implicated sport as an environment with burnout-inducing potential. The notion that negative, amotivated, and exhausted states sometimes described by athletes might be a sport-related manifestation of burnout garnered interest among sport scientists and practitioners in reasonably short order (e.g., Cohn, 1990; Feigley, 1984; Gould, 1993; Henschen, 1990; Rowland, 1986; Schmidt & Stein, 1991; Smith, 1986; Yukelson, 1990). During the past decade, the interest in and concern about athlete burnout among sporting bodies and sport scientists has fueled a noticeable surge in sport psychology research (e.g., Cresswell & Eklund, 2004, 2005a, 2005b, 2005c; Gould, Tuffey, Udry, & Loehr, 1996, 1997; Gould, Udry, Tuffey, & Loehr, 1996; Lemyre, Treasure, & Roberts, 2006; Lonsdale, Hodge, & Rose, 2006; Raedeke, 1997; Raedeke, Granzyk, & Warren, 2000; Raedeke, Lunney, & Venables, 2002; Raedeke & Smith, 2001, 2004; Tenenbaum, Jones, Kistantas, Sacks, & Berwick, 2003a, 2003b).

THE NATURE OF A SYNDROME

A key aspect of Maslach and Jackson's (1981, 1986) landmark work on burnout was the identification of a *syndrome.* In broad terms, a syndrome is a constellation of symptoms that present defining features for a condition of some epidemiological significance. Examples of other syndromes salient in the public consciousness include AIDS (Acquired Immune Deficiency Syndrome) and Chronic Fatigue Syndrome. Identification of defining manifestations or symptoms of the chronic maladaptive state, however, is not quite the same as understanding its precise nature or its underlying causes, but it is a crucial initial step. Syndrome identification provides the foundation for the scientific community to pursue greater understanding of puzzling and problematic health conditions. Refinements to characterizations of syndromes can occur as evidence emerges on what is core (or spurious) to its underlying nature. In some instances, the identification of the underlying nature and causes of a syndrome can result in the syndrome itself ceasing to be the central issue of interest. Perhaps the most high-profile instance of this progression occurred in the study of AIDS once the human immunodeficiency virus (HIV) had been identified (U.S. Department of Health and Human Services, 2005). At that point, the primary focus of research narrowed from the constellation of symptoms, opportunistic infections, and cancers composing AIDS to developing an understanding of processes relating to HIV infection.

Although the general notion of burnout has held appeal to sport scientists, there has been some skepticism about the relevance and applicability of the burnout syndrome as described by Maslach and Jackson (1981, 1986) to the experiences of sport participants (e.g., Feigley, 1984; Garden, 1987). As Smith (1986, p. 44) noted in his seminal paper on sport burnout, it is logical to question "the extent to which the nature, causes and consequences are unique and to what extent they are shared by those who suffer burnout in other domains of activity." The challenges faced by athletes do differ significantly from those of human service professionals. For example, the emotional demands of dealing with difficult, suffering, or unmotivated clients (e.g., social workers dealing with clients facing relatively intractable circumstances) do not correspond to those faced by athletes in the sporting environment. There is merit to the arguments of these skeptics, but too often they have focused on burnout antecedents in making their arguments rather than the experiential syndrome itself.

It is indeed reasonable to expect that the antecedents of the burnout syndrome would vary across settings. The ongoing demands of the sporting environment differ in important ways from the chronic stressors of other settings in which burnout has been studied. This variation, however, does not inherently signify that the experiential consequences of exposure to chronic situational stress must also differ in nature. In fact, research across a variety of work situations featuring chronic exposure to psychosocial stress supports the notion that a common burnout syndrome does exist even though the specific stressful antecedents vary (Schaufeli & Enzmann, 1998). Interview data from athletes indicate that this negative experiential syndrome also has relevance in demanding competitive sport environments (Cresswell & Eklund, in press; Gould, Tuffey, et al., 1996).

THE ATHLETE BURNOUT SYNDROME

At the present time, the most widely employed conceptualization of the athlete burnout syndrome has been forwarded by Raedeke (1997; Raedeke & Smith, 2001). In his conceptualization, the burnout syndrome among athletes is characterized by an enduring experience of (a) emotional and physical exhaustion, (b) sport devaluation, and (c) reduced accomplishment. This sport-specific conceptualization of the syndrome is fundamentally grounded in Maslach and Jackson's (1981, 1986) seminal work, albeit modified to be of particular relevance to sport. The general notion of a sense of reduced personal accomplishment being symptomatic of athlete burnout mapped over unproblematically in Raedeke's conceptualization, but the other syndrome facets identified in Maslach and Jackson's early work were subject to some modification.

Specifically, Raedeke (1997; Raedeke & Smith, 2001) broadened Maslach and Jackson's (1981, 1986) construct of emotional exhaustion to include the chronic experience of physical exhaustion. This decision has intuitive appeal given the centrality of the athlete's physicality in sport, and it is consistent with the broader exhaustion construct assessed in the General Survey version of the MBI introduced in the third edition of the MBI manual (Maslach et al., 1996). Raedeke also argued that the notion of depersonalization had little relevance to athlete burnout given that athletes were not involved in the provision of client services per se. Instead, he argued that "sport devaluation," a diminished and cynical assessment of the benefits of sport involvement, more appropriately characterized the experiential manifestation of burnout among athletes. Again, this decision was consistent with a reconceptualization of depersonalization as a manifestation of the broader issue of cynicism that had occurred in the general workplace literature on burnout (e.g., Maslach et al., 1996; Maslach, Schaufeli, & Leiter, 2001).

ALTERNATIVE CONCEPTUALIZATIONS OF ATHLETE BURNOUT

Not all athlete burnout research has been grounded in conceptualizations of burnout as a psychosocial syndrome. In fact, some conceptualizations and operationalizations in the extant sport science literature differ substantially from Maslach and Jackson's (1981, 1986) seminal conceptualization of burnout as a psychosocial syndrome (cf. Coakley, 1992; Silva, 1990). Diversity in scholarly opinion on substantive issues like athlete burnout is healthy. Diversity in the conceptualization of the construct, however, makes meaningful communication challenging, if only because it requires that people ensure that they are talking about the same thing. The difficulties surrounding the definition of burnout are exacerbated by the colloquial, idiomatic, and widespread use of the term in sport (Raedeke et al., 2002). This is not a matter confined to the sport setting. Burnout has been a problematic term on this account since it was initially coined (Maslach et al., 2001). Nonetheless, the "Everybody knows what it is" problem (Marsh, 1998, p. xvi) is certainly salient when it comes to athlete burnout. Most of the usages and conceptualizations in sport are interrelated in important ways, but they can also differ in important, albeit too often ignored ways. The consequence is that interpretation of the extant literature is a more difficult feat than might appear on the surface because it requires sensitivity to the particular meaning intended when the burnout construct is invoked in each instance. Parenthetically, the existence of this problem highlights the need for sport psychology researchers to ensure that they are entirely explicit about their operational definitions.

The clearest example of an alternative burnout conceptualization in the extant literature that differs substantially from the psychosocial syndrome previously outlined has been forwarded by Coakley (1992). In his view, burnout is a particular type of sport termination that is sometimes observed in highly competitive youth sport. This conceptualization might best be understood in terms of the colloquial "shooting star" metaphor, that is, athletic burnout as an unwarranted withdrawal from sport after intense involvement and substantial accomplishment. Coakley postulated that the social organization and constraints of intense sport involvement disempower young athletes and restrict their opportunities for identity development beyond the athletic role. In his view, athletes burn out of sport (i.e., terminate their involvement) to exercise personal autonomy and explore new dimensions of themselves rather than remain in circumstances they regard to be aversive.

In sum, Coakley's (1992) conceptualization of burnout amounts to nothing more than a particular type of sport dropout. This sort of colloquial understanding does seem to underlie, at least in part, the interest in funding some programs of research on the matter (e.g., Gould, Tuffey, et al., 1996). Nonetheless, Coakley's conceptualization contrasts noticeably with other extant conceptualizations (e.g., Raedeke, 1997; Silva, 1990; Smith, 1986) where dropout is instead viewed as one potential, but not requisite, consequence of burnout—but certainly not as burnout itself. Indeed, athletes suffering from the burnout syndrome do not always withdraw from sport (Raedeke, 1997; Smith, 1986). It would be unfortunate if these athletes were ignored in burnout research in favor of focusing solely on "shooting stars." Even so, Coakley's assertions regarding possible causes of sport withdrawal may have utility for developing a greater understanding of the causes of athlete burnout syndrome. Indeed, the potential role of the social and organizational environment in producing chronic aversive experiential states is central to extant health psychology explanations of the underlying causes of the burnout syndrome (Maslach et al., 2001). His sport-specific postulations on this account, therefore, likely offer important clues for understanding processes involved in producing the athlete burnout syndrome.

Silva (1990) also forwarded an alternative conceptualization of athlete burnout that is commonly alluded to in commentaries on athlete burnout (e.g., Gould, Udry, et al., 1996; Raedeke, 1997). In advocating his "training stress syndrome," he posited burnout as the most extreme of three maladaptive phases in a regressive *psychophysiological* process (see Figure 28.1). This extreme maladaptive phase was characterized by a variety of psychological and physiological symptoms, some of which are reminiscent of more traditional psychosocial burnout syndrome characterizations. (Parenthetically, as per our earlier definitional comments on syndromes, Silva's proposal essentially amounts to conceptualizing burnout as a syndrome within his wider training stress syndrome.) In Silva's view, the progression toward burnout is initiated when the athlete experiences a training-induced performance plateau. The more severe second (and penultimate) phase occurs when continued exposure to training stress stimuli results in "detectable psychophysiological malfunctions, and is characterized by easily observable changes in mental orientation and physical performance" (p. 10). In the ultimate and burnout phase

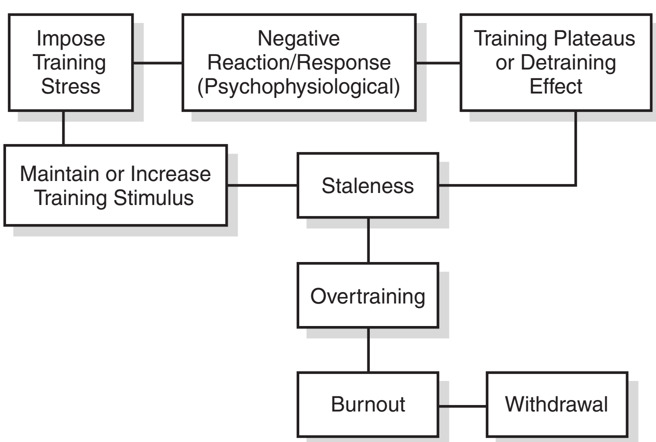

Figure 28.1 The training stress syndrome negative adaptation to training. *Source:* "An Analysis of the Training Stress Syndrome in Competitive Athletics," by J. M. Silva, 1990, *Applied Sport Psychology, 2,* pp. 5–20. Reprinted with permission.

of Silva's training stress syndrome, "the organism's ability to deal with the psychophysiological imposition of stress is depleted, and the response system is exhausted" (p. 11).

Various aspects of Silva's (1990) conceptualization are not entirely at odds with contentions forwarded in psychosocial syndrome accounts of burnout (e.g., Maslach, 1982; Raedeke, 1997; Raedeke & Smith, 2001). Certainly it is not as strikingly distinct from conventional psychosocial conceptualization as Coakley's (1992) dropout construct. Nonetheless, Silva's conceptualization also differs substantively. At some level, Silva essentially blurred together two established, albeit yet to be fully delineated or well-understood syndromes (i.e., burnout syndrome, overtraining syndrome)* and associated terms in his effort to characterize a training stress syndrome. It is nontrivial, however, that burnout in his conceptualization is the ultimate "by-product of an ongoing regressive process" (p. 11) rather than an aversive experiential state associated with negative consequences during the course of its developmental progression (cf. Maslach & Jackson, 1981, 1986; Maslach et al., 1996). For example, the idea that performance plateau and detectable performance malfunction are precursors in the progression toward burnout is strikingly different from conceptualizations wherein an aversive experiential state, also termed "burnout," can be progressively associated with a variety of functional impairments both on and off the playing field (e.g., Cresswell & Eklund, in press; Gould, Tuffey, et al., 1996; Maslach, 1982; Maslach et al., 1996, 2001).

It is also nontrivial that excessive and chronic exposure to training stimuli is requisite to the development of the maladaptive state that Silva (1990) terms "burnout" when a plethora of evidence from outside of sport indicates that training stress is not at all requisite to the attainment of maladaptive levels of the burnout syndrome (e.g., Maslach, 1982; Maslach et al., 2001). Athlete interview data indicate that this negative experiential state can also occur in sport settings without exposure to excessive regimens of sport training (Cresswell & Eklund, in press; Gould, Tuffey, et al., 1996; Gould et al., 1997; Tenenbaum et al., 2003a, 2003b). Nonetheless, the idea that overtrained (or staleness) states and burnout might be linked was evident in the literature (e.g., Henschen, 1990; Rowland, 1986) before Silva advanced his training stress syndrome. Indeed, as noted by Raglin and Wilson (2000), some researchers have

* Also termed the "staleness syndrome" (Raglin & Wilson, 2000) and the "unexplained underperformance syndrome" (Budgett et al., 2000).

indiscriminately used the terms "burnout" and "staleness" interchangeably. It may be, however, that Silva's attempt to integrate extant syndromes (i.e., burnout syndrome, overtraining syndrome) associated with these constructs was prescient in some way. At some point in the future there may be a synthesizing breakthrough explaining both the appealing commonalities and the striking divergences of the syndromes that is analogous to the identification of HIV in the study of AIDS. At this moment, however, Raglin's (1993) observation that they should be regarded as separate conditions requiring distinct interventions should remain salient. As such, caution is warranted when considering, interpreting, and writing about the extant commentary on athlete burnout, and particularly when those commentaries entangle or embed the term "burnout" within the overtraining (or staleness) syndrome.

Although not fundamentally a conceptualization of burnout, comment on the construct of depression is also warranted in this section because the question of whether the distinction between burnout and depression is merited, either conceptually or empirically, arises with some regularity (Maslach et al., 2001). Indeed, Freudenberger (1975) took considerable pains in his work to argue that burnout differed from depression in that, for example, burnout was accompanied by anger and frustration, whereas depression was accompanied by guilt. Without putting too fine a point on the matter, however, the fact remains that there are striking similarities in their symptomatologies (Glass & McKnight, 1996). It is reasonable to believe that the experiences of burnout and depression are not substantially different. Nonetheless, burnout and depression have long enjoyed different conceptual identities.

The crucial conceptual distinction that tends to be highlighted in response to questions about the substantive differences between the constructs relates to experiential generality. Specifically, a diagnosis of depression requires pervasive symptomatology that influences "nearly all activities" (American Psychiatric Association, 1994, p. 320; Leiter & Durup, 1994). Evidence indicates that, although depression-prone individuals have been found to be more vulnerable to burnout, burnout tends to be situation-specific at least in early syndrome stages (Maslach, Jackson, & Leiter, 1997). Moreover, measures of burnout have demonstrated discriminant validity when evaluated against measures of depression in workplace samples (e.g., Firth, McIntee, McKeown, & Britton, 1986; Glass, McKnight, & Valdimarsdottir, 1993; Leiter & Durup, 1994; Schaufeli, Enzmann, & Girault, 1993). Recently, multitrait-multimethod analyses of data collected from New Zealand rugby players also provided evidence that measures of sport-specific athlete burnout could be adequately discriminated from a measure of general depression (Cresswell & Eklund, 2006a). Future research is needed, however, to assess the potential for athlete burnout and depression to be developmentally related. Specifically, the extent to which there is a risk for depressive generalization across life settings among athletes who experience substantial sport-related burnout warrants further investigation.

MEASUREMENT OF THE ATHLETE BURNOUT SYNDROME

For the sake of efficiency, brevity, and focus of presentation, we limit our discussion in this section to measurement of syndrome-based conceptualizations of athlete burnout and sidestep discussion of the interplay among theory, construct conceptualization, construct operationalization, and construct measurement requisite to good research. We acknowledge the importance of these linkages. Nonetheless, measurement limitations have been a central difficulty in efforts to gain a greater understanding of the burnout syndrome among athletes (Raedeke & Smith, 2001), and so we choose to dwell on syndrome measurement.

Not surprisingly, given its status as the seminal and gold standard measure of burnout, incarnations of the MBI (Maslach & Jackson, 1981, 1986; Maslach et al., 1996) have been widely regarded as the instrument of choice in workplace research on burnout (Maslach et al., 2001). They also have been featured, in modified or unmodified forms, in a variety of published investigations on burnout in sport settings. Most of these reports, however, have involved not athletes but coaches (e.g., B. C. Kelley, Eklund, & Ritter-Taylor, 1999), athletic directors (e.g., Martin, Kelley, & Eklund, 1999), and athletic trainers (e.g., Hendrix, Acevedo, & Hebert, 2000). It was probably not incidental to the successful use of the MBI in these investigations that the involved sport personnel occupied roles paralleling those for which versions of the MBI had been developed (i.e., human service personnel, educators). Similar success did not result from early modifications of the MBI for use with athletes, although unpublished attempts can be identified (e.g., Fender, 1988).

The athletic role is not the same as the direct service relationship roles that educator and human service versions of the MBI were grounded in, and so the difficulties encountered in modifying the MBI for use with athletes are perhaps not too surprising. Indeed, problems in modifying the original versions of the MBI for use with personnel in a variety of nonservice roles have also been broadly encountered (Maslach et al., 2001; Schutte, Toppinen, Kalimo, & Schaufeli, 2000). Ultimately, the MBI—General Survey (MBI-GS) was developed to afford burnout syndrome measurement among potential sufferers facing demands that were not substantially service relationship occupations (Schutte et al., 2000). With minor word substitution (e.g., changing "work" to "rugby" and "organization" to "team"), the MBI-GS has recently demonstrated potential utility with rugby players (Cresswell & Eklund, 2006a).

Not all early attempts to measure athlete burnout relied on modified versions of the MBI. The Eades Athletic Burnout Inventory (EABI; Eades, 1990), for example, has enjoyed some celebrity as a key measure in published research on athlete burnout (e.g., Gould, Udry, et al., 1996; Vealey, Armstrong, Comar, & Greenleaf, 1998). This instrument emanated from Eades's unpublished master's thesis. Eades generated EABI items by eclectically drawing on the extant burnout literature, the MBI, and anecdotes from athletes who were deemed to have experienced burnout. The use of exploratory factor-analytic procedures resulted in a 36-item instrument with 6 subscales (i.e., Emotional and Physical Exhaustion, Psychological Withdrawal, Devaluation by Coach and Teammates, Negative Self-Concept of Athletic Ability, Congruent Athlete-Coach Expectations, Personal and Athletic Accomplishment). Despite being greeted with initial enthusiasm, the EABI is an instrument with evident difficulties. For example, its subscales represent a mix of burnout syndrome facets and burnout antecedents (Raedeke & Smith, 2001). Certainly, the atheoretical, idiosyncratic nature of the instrument renders interpretation of EABI data difficult. Moreover, the meager psychometric evidence available is not at all reassuring. As examples, Vealey et al. reported an unsatisfactory fit of the hypothesized factor model to EABI data in confirmatory analyses even after removal of five of the most troubled items. Gould, Udry, et al.'s reporting of unsatisfactory internal consistency for the Congruent Athlete-Coach Expectations and Personal and Athletic Accomplishment subscales (i.e., observed alphas of .51 and .55, respectively) has not been atypical in EABI data collections. Overall, there seems to be little, if any, reason for this instrument to be employed in future research.

Stimulated by EABI inadequacies and an interest in studying athlete burnout, Raedeke (1997; Raedeke & Smith, 2001) developed the Athlete Burnout Questionnaire (ABQ). The ABQ provides an instrument to quantify Raedeke's athlete-specific conceptualization of the burnout syndrome with subscales measuring emotional and physical exhaustion, reduced accomplishment, and sport devaluation. As indicated previously, this athlete-specific conceptualization is grounded in Maslach and Jackson's (1981, 1986) work and is consistent with more recent conceptual developments relative to cynicism and exhaustion (e.g., Maslach et al., 2001; Schutte et al., 2000).

The ABQ is a 15-item instrument designed to quantify Raedeke's (1997; Raedeke & Smith, 2001) conceptualization of the athlete burnout syndrome. The stem for each item is *How often do you feel this way?* Athletes respond to each item on a 5-point Likert scale anchored by "almost never" (1), "rarely" (2), "sometimes" (3), "frequently" (4), and "almost always"* (5). As examples, items designed to measure the key syndrome symptoms include (a) reduced sense of accomplishment (e.g., *It seems that no matter what I do, I don't perform as well as I should*), (b) sport devaluation (e.g., *I have negative feelings toward sport*), and (c) emotional/physical exhaustion (e.g., *I am exhausted by the mental and physical demands of my sport*). Raedeke and Smith presented construct validation evidence and reported acceptable internal consistency for all subscales (i.e., alpha coefficients ranging from .71 to .87) and test-retest reliability (i.e., intraclass correlations ranging from .86 to .92). Recent evidence indicates that Internet-based collection of ABQ data is also viable and psychometrically equivalent to data obtained in the traditional paper-and-pencil format (Lonsdale et al., 2006). As with the long-standing practice with the MBI, a minor word substitution strategy (e.g., replacing "sport" with "swimming") to make the instrument more specific for a particular sample is advocated by Raedeke and Smith. Other researchers have also found this tactic to be useful in their acquisition of ABQ data. For example, Cresswell and Eklund (2005b) changed "sport" to "rugby" in their study of burnout among amateur New Zealand Rugby Football Union players.

The initial validation evidence presented by Raedeke and Smith (2001) from data collected from age-group swimmers and U.S. collegiate athletes was promising. However, construct validation is not an accomplishment but an ongoing process (Marsh, 1998). Recent evidence from multitrait-multimethod (MTMM) analyses presented by Cresswell and Eklund (2006a) suggests that the ABQ also holds up well when employed with elite amateur sporting populations outside of North America. More specifically,

* "Most of the time" was used by Raedeke and Smith (2001) in their initial version of the ABQ and has subsequently been used elsewhere (e.g., Cresswell & Eklund, in press).

the MTMM analyses were conducted with data obtained with two measures of athlete burnout (i.e., the ABQ and a version of the MBI-GS modified for athletes), as well as general measures of depression and anxiety from the Depression Anxiety Stress Scale (DASS; S. H. Lovibond & Lovibond, 1995).

The MBI-GS contains 16 items that measure burnout on 3 subscales that parallel original versions of the MBI: Professional Efficacy (6 items; e.g., *I have accomplished many worthwhile things in this job*), Cynicism (5 items; e.g., *I have become less enthusiastic about my work*), and Exhaustion (5 items; e.g., *I feel emotionally drained from my work*). Items are measured on a 7-point response format with anchors of "never" to "everyday." The MBI-GS has been reported to have acceptable reliability (Cronbach's alpha coefficient range: .75 to .86), and factorial validity has been demonstrated across a range of samples (Schutte et al., 2000). As with the ABQ, the MBI-GS was adapted for use with rugby players by simple word substitution. Specifically, permission for alteration was obtained from the copyright holders to change "work" to "rugby" and "organization" to "team(s)."

The DASS Depression and Anxiety subscales were employed in these analyses to evaluate the extent to which measurements of athlete burnout appropriately converged with these measures of related constructs, while also demonstrating appropriate discriminant validity. The DASS Anxiety subscale is composed of 7 items (e.g., *I was worried about situations in which I might panic and make a fool of myself*), as is the Depression subscale (e.g., *I was unable to become enthusiastic about anything*). Participants responded to items relative to the time frame of "over the last season" on a 4-point measurement format ranging from 0 (i.e., "Did not apply to me at all"), to 3 (i.e., "Applied to me very much, or most of the time"). The DASS is a well-established measure. Alpha coefficients of .96 and .89 have been reported for, respectively, the Depression and Anxiety subscales when used with clinical and nonclinical samples (Brown, Chorpita, Korotitsch, & Barlow, 1997; P. F. Lovibond & Lovibond, 1995; S. H. Lovibond & Lovibond, 1995).

In sum, the ABQ and the MBI-GS displayed acceptable convergent validity with matching subscales highly correlated and satisfactory internal discriminant validity with lower correlations between nonmatching subscales. Of particular importance, both scales also indicated an adequate discrimination between depression and burnout constructs. These findings support previous research in nonsport populations that depression and burnout are, in measurement terms, quantifiably different constructs. This research also provides tentative evidence suggesting that the MBI-GS may also be modified for use among athletes, although the ABQ did perform more adequately in the MTMM analyses on several accounts. Based on the psychometric results, construct validity analysis, and practical considerations, the results support the use of the ABQ to assess athlete burnout.

THE EXTENT AND PREVALENCE OF ATHLETE BURNOUT

At this time there are no published epidemiological reports on athlete burnout. Concerns about the occurrence and prevalence of burnout have been grounded more in anecdotal evidence and speculation than inferences based on population-based surveys. Of course, the previously described conceptual and measurement difficulties have contributed to the lack of clarity on the extent of the problem—not that any instance is unproblematic for a suffering athlete. The athlete burnout data presently available have been obtained largely from nonrepresentative samples of participants thought to be at risk of experiencing elevated levels of burnout. As a result, it cannot be argued that these data are representative of the overall population of athletes involved in serious competition, or even a given subpopulation of competitive athletes (e.g., rugby players). Nonetheless, these data do make it reasonable to believe that some athletes suffer from a level of burnout that may be nontrivial for performance and well-being. We have summarized descriptive statistics from selected studies employing the ABQ in Table 28.1.

Across the studies listed in Table 28.1, there is some consistency in the mean levels of reported physical and emotional exhaustion, reduced accomplishment, and sport devaluation. Regardless of sample, substantive differences are largely not evident in the mean item-average ratings for each subscale or the variability associated with the means. The highest means tend to be relative to the Exhaustion subscale, but indicating a frequency that falls only in the "rarely" to "sometimes" range. Reduced accomplishment means were somewhat (not greatly) lower. Sport devaluation was the lowest endorsed syndrome characteristic, indicating that, on average, these cognitions were "rarely" salient to the athletes in these sample cohorts.

The pattern of modest increases in burnout across a 12-week rugby tournament reported by Cresswell and Eklund (2005a) is interesting, as it may be indicative of some sort of progressive or cumulative effect of competition involvement (see Table 28.1). Some of the highest subscale means across studies in Table 28.1 were observed in data obtained

Table 28.1 Athlete Burnout Questionnaire Descriptive Statistics Available in the Extant Literature

Past Research	*n*	Age Range (Years)	Level and Sport	Physical/ Emotional Exhaustion *M* (*SD*)	Sport Devaluation *M* (*SD*)	Reduced Accomplishment *M* (*SD*)
Raedeke (1997)	236	13–18	U.S. age group, swimming	2.47 (0.83)	2.02 (0.84)	2.32 (0.74)
Raedeke and Smith (2001) Study 3	244	17–23	U.S. collegiate, various	2.62 (0.86)	2.02 (0.88)	2.32 (0.76)
Cresswell and Eklund (2005b)	392	18–42	NZ Amateur Rugby Union	2.67 (0.57)	2.00 (0.67)	2.31 (0.55)
Cresswell and Eklund (2005c)	199	19–33	NZ Professional Rugby Union	2.32 (0.72)	2.16 (0.76)	2.43 (0.68)
Cresswell and Eklund (2005a)	102	19–32	NZ Professional Rugby Union			
Pretournament				2.39 (0.57)	1.65 (0.53)	2.04 (0.44)
Midtournament				2.36 (0.63)	1.82 (0.67)	2.23 (0.52)
End-tournament				2.43 (0.58)	1.90 (0.67)	2.50 (1.17)
Lemyre et al. (2006) (Season end)	44	18–24	U.S. collegiate, swimming	2.88 (0.92)	1.92 (0.82)	2.50 (0.92)
Lonsdale et al. (2006)		18–57	NZAS "high-performance athletes," various			
Online data collection	117			3.00 (0.69)	2.29 (0.73)	2.21 (0.65)
Postal data collection	97			3.32 (0.67)	2.23 (0.74)	2.05 (0.69)

Note: NZ = New Zealand; NZAS = New Zealand Academy of Sport. The ABQ 5-point Likert scale response format is anchored by the terms "almost never" (1), "rarely" (2), "sometimes" (3), "frequently" (4), and "most of the time" or "almost always" (5).

at season or tournament end points (i.e., Cresswell & Eklund, 2005a; Lemyre et al., 2006). This observation seems to substantiate the intuitively reasonable belief that variables such as time of season need to be considered when evaluating burnout levels among athletes involved in serious competition. Variations in burnout also likely correspond reliably with other variables, such as phase of training periodization for the given sport, traveling demands and schedules for a given team, and other demands or cycles of demand that particular athletes might be facing. It should not be assumed, therefore, that peak burnout will manifest at the end of the competitive season. This is a matter awaiting further empirical study.

Interpretation of the extent to which the mean values presented in Table 28.1 are indicative of meaningful levels of burnout would be tenuous at best at this point. It does seem unreasonable to believe that athletes experiencing symptoms in the range of "rarely" to "sometimes" should be considered to be suffering from high levels of burnout. Nonetheless, the variability around the reported means does indicate that some athletes in each sample are experiencing symptoms at a frequency that is very likely to be undesirable. Research in general workplaces and in health and human services indicates that high levels of burnout are associated with a variety of undesirable outcomes, such as decreased performance, low motivation, impaired health, personal dysfunction, insomnia, increased use of alcohol and drugs, and marital and family problems (Maslach & Goldberg, 1998; Maslach et al., 1996). Interview data have been obtained from professional rugby players describing high levels of a persistent negative experiential state reminiscent of burnout (Cresswell & Eklund, in press). Their descriptions make concerns about the emergence of difficulties and undesirable outcomes in sport environments seem reasonable.

Because large-scale epidemiological survey data on athlete burnout are not presently available, normative cutoff values providing signposts for the relative placement of any given observed ABQ score are not yet available to facilitate measurement interpretation. Moreover, presently there is no empirical basis for conclusions that an athlete might be at risk for the emergence of negative burnout-associated consequences regardless of the level of an observed ABQ score. Even the venerable MBI with its well-established norms does not provide this sort of interpretive guidance. As suggested in the MBI (Maslach et al., 1996, p. 9) manual:

> The coding itself is intended primarily as feedback for individual respondents. It enables each respondent to compare him[self] or herself to the overall norm, and to obtain a rough assessment of the degree of his or her experience with the various aspects of burnout. However, neither the coding, nor the original numerical scores should be used for diagnosis purposes; there is insufficient research on the pattern(s) of scores as indicators of individual dysfunction or the need for intervention.

Nonetheless, the availability of MBI normative data does provide important clues for relative interpretation of observed scores. For example, MBI-GS item-average responses indicative of normatively high levels of burnout (in the upper third of normative scores for the Exhaustion and Cynicism subscales, and the bottom third of normative scores for the Professional Efficacy subscale)* have been identified. Scores falling above the midpoint of its 0 (never) to 6 (every day) response format for Exhaustion (i.e., greater than 3.20), above 2.20 on the Cynicism subscales, and below 4.00 for the experience of Professional Efficacy are indicative of normatively high levels of burnout (Maslach et al., 1996). These values indicate that item-average scores well short of being extreme in absolute terms can be indicative of normatively high levels of exhaustion, cynicism, and inefficaciousness. Even midpoint responses (perhaps roughly corresponding to "sometimes" in the ABQ response format) can indicate that an individual is scoring normatively high on that burnout syndrome facet.

Although solid ABQ normative data are presently not available, some tentative efforts have been made to give meaning to levels of ABQ observed scores. For example, one striking subgroup was identified in Raedeke's (1997) cluster analysis of data provided by 236 age-group swimmers on a preliminary version of the ABQ. This cluster of 26 athletes reported significantly higher burnout scores relative to their peers and scored at the response midpoint (i.e., sometimes) or higher on all three ABQ subscales (Exhaustion $M = 3.35$, $SD = 0.83$; Reduced Accomplishment $M = 2.97$, $SD = 0.64$; Sport Devaluation $M = 3.40$, $SD = 0.81$). This group (approximately 11% of his sample of swimmers) was regarded by Raedeke as having experienced a high level of burnout. This interpretation seems reasonable by reference to the well-established distribution of MBI-GS normative scores previously described.

Raedeke's (1997) interpretation also seems reasonable by reference to data that we have collected in our work with New Zealand rugby players. A frequency distribution of ABQ scores from one of our studies involving 392 amateur New Zealand rugby players (i.e., Cresswell & Eklund, 2005b) is presented in Table 28.2 and is illustrative on this account. This frequency distribution affords consideration of the dispersion of ABQ scores in this data collection and, in the absence of good epidemiological data for solid interpretation, contemplation of the number of athletes potentially at risk within this dispersion. Some context is warranted for interpreting these scores. These data were collected at an early stage of the competitive year in New Zealand rugby. The athletes providing these data were participating at the highest level of New Zealand amateur rugby, and rugby is the highest status game in New Zealand society. As a result, they are involved in serious competition, and the vast majority of players at this level aspire to obtain professional contracts. These premier division amateur rugby players were sampled because they are exposed to demands similar to those highlighted in past burnout research (Gould, Tuffey, et al., 1996), including competing time demands (e.g., balancing full-time careers with rugby participation), high rates of injury (e.g., Quarrie et al., 2001), and media scrutiny asserting that burnout was having a negative impact on talented rugby players (e.g., Belfield, 2002; Hinton, 2002). Furthermore, the New Zealand Rugby Football Union had provided grant support for this research out of concern about burnout among the players.

It is evident in Table 28.2 that an overwhelming majority of these amateur rugby athletes infrequently experienced burnout symptoms at this early stage of the season (i.e., subscale item-average scores less than 3, or in the "almost never" to "sometimes" range). Nonetheless, 19% to 25% of the amateur rugby players surveyed reported experiencing individual symptoms at levels Raedeke (1997) characterized as high (i.e., subscale item-average scores at 3 or above, or in the "sometimes" to "most of the time" range), a characterization in keeping with our earlier observations about scores indicative of normatively high levels of burnout on the MBI (Maslach et al., 1996). Very few of these athletes (~1%), however, exhibited item-average scores higher than 4 on any given subscale. It is interesting to consider whether this pattern corresponds with frequency distributions observed in the other investigations. Based on the means and standard deviations from other investigations

* Lower MBI-GS Professional Efficacy subscale scores are indicative of higher burnout, unlike the MBI Exhaustion and Cynicism subscales, where higher scores are indicative of higher burnout. By contrast, higher scores on all ABQ subscales are indicative of higher burnout.

Table 28.2 Frequency Distribution for the Athlete Burnout Questionnaire

Descriptive Statement	Score	Physical and Emotional Exhaustion		Sport Devaluation		Reduced Accomplishment	
		n	%	*n*	%	*n*	%
"Almost never" to "Rarely" Scores less than 2	<2	130	26.3	156	39.8	84	21.4
"Rarely" to "Sometimes" Scores greater than or equal to 2, but less than 3	2–3	203	51.8	162	41.3	210	53.6
"Sometimes" to "Frequently" Scores greater than or equal to 3, but less than 4	3–4	81	20.7	70	17.9	96	24.5
"Frequently" to "Most of the time" Scores greater than or equal to 4	≥4	5	1.3	4	1.0	2	00.5

Source: Data from Cresswell and Eklund's (2005b) study of 392 amateur rugby players age 18 to 42 years.

presented in Table 28.1, it appears unlikely that widely different patterns would have been observed. Certainly, however, the percentage of athletes exceeding a score of 3 on any given subscale (particularly the Exhaustion subscale) in some Table 28.1 data collections would be substantially higher than what is presented in Table 28.2. Exhaustion alone, however, is not a sufficient criterion to indicate burnout even if it is a core characteristic of the syndrome (Maslach et al., 2001).

Nonetheless, and despite the substantial numbers of amateur rugby players scoring above 3 (18.9% to 25%) on any given burnout symptom in the Cresswell and Eklund (2005b) investigation, only 6.4% ($n = 25$) of these athletes reported item-average scores above 3 on *all* three ABQ subscales. It is not possible to know from the descriptive statistics in Table 28.1 just how many athletes in other studies reported scores above the response scale midpoint on all facets of the burnout syndrome. Based on Raedeke's (1997) cluster analysis and the Table 28.2 frequency distribution of Cresswell and Eklund's data, however, it does seem reasonable to speculate that around 6% to 11% of those athletes may fall into Raedeke's categorization of high burnout.

The cohorts of athletes involved in the studies listed in Table 28.1 are certainly not representative of all sport participants. There is some diversity in terms of a range of elite, subelite, and professional athletes from contact and noncontact sports, as well as team and individual sports, but there may well be important differences in the incidence of the syndrome across other subgroups of sport participants. Indeed, many of the Table 28.1 studies were supported by organizations' concerns about burnout among athletes under their purview (e.g., rugby, swimming, New Zealand academy athletes). Other sporting populations may not exhibit burnout to the same extent or with similar prevalence. It is also possible that individual difference variables such as gender, ethnicity, and maturation (or interactions among these variables) may impact the level of burnout observed in athlete populations. Information on the characteristics of athletes reporting high burnout scores could also be useful. Although evidence to date suggests that the percentage of players reporting burnout characteristics at a high frequency is small, the makeup of this group is yet to be determined. For example, are players in this high burnout group more experienced or successful than their counterparts that report lower scores? Preliminary evidence suggests that a positive relationship may exist between experience and burnout in terms of sport devaluation and exhaustion, and between success (in terms of wins) and burnout-related exhaustion (Cresswell & Eklund, 2005a). If more successful and more experienced athletes are more likely to report higher levels of burnout, the relatively low numbers in this group may be of little comfort to athletes, coaches, and administrators concerned with gaining and maintaining success at the top of their sport.

Overall, a relatively consistent picture of the level of burnout in athlete populations is beginning to emerge. Burnout does not appear to be a substantial concern for most athletes. A relatively small proportion of athletes surveyed to date have reported experiencing all facets of the burnout syndrome at a frequency described by Raedeke (1997) as indicative of a high level of burnout. Nonetheless, this relatively small proportion of athletes is a concern on at least two accounts. First, individuals suffering from burnout do not take comfort from being told that they are among a small proportion of afflicted athletes. Second, the small proportion is potentially indicative of a large-magnitude problem in terms of numbers given the extent of participation in serious competitive sport around the world. Better evidence regarding the variety of potential negative consequences associated with high levels of burnout is required, and it may be important for this research to involve efforts to control for time-of-season effects. On the whole, there is a need for a good epidemiological evaluation of incidence and patterns of occurrence of athlete burnout and associated problems to provide credible answers to questions in this area.

THEORETICALLY GROUNDED EXPLANATIONS OF ATHLETE BURNOUT

Initial conceptualizations of burnout in health and human services were not deductively grounded in extant psychosocial theory but were based on induction from grassroots observation of people's experiences in workplace settings (Maslach et al., 2001). This persistent negative experiential state was posited to be the consequence of chronic exposure to worksite-related emotional and interpersonal stressors. The first formal sport-specific model, Smith's (1986) cognitive-affective model of athlete burnout, was grounded in these early observations about workplace burnout and informed by his earlier conceptualization of the stress process in sport (i.e., Smith, 1980) as well as social exchange theory (SET; Thibaut & Kelley, 1959). His sport-specific model (see Figure 28.2) has tended to be the most frequently cited in the extant sport burnout literature because of its conceptual clarity and substantial grounding in Maslach and Jackson's (1981) landmark conceptualization. There has been a reasonably long-standing interest in motivation as it relates to athlete burnout (Gould, 1996), and researchers have progressively considered a broader set of motivational explanations to understand the phenomenon. Self-determination theory (SDT; Deci & Ryan, 1985) and commitment perspectives (Schmidt & Stein, 1991) have received the most attention in recent years. In this section we comment briefly on each of these perspectives and describe examples of relevant extant research.

Stress and Athlete Burnout

Smith (1986, p. 37) described the most notable feature of athletic burnout as a "psychological, emotional, and at times a physical withdrawal from a formerly pursued and enjoyable activity." His explanation of the genesis of this state of withdrawal was grounded in SET and evidence implicating chronic psychosocial stress as the causal agent producing the experiential syndrome afflicting health care

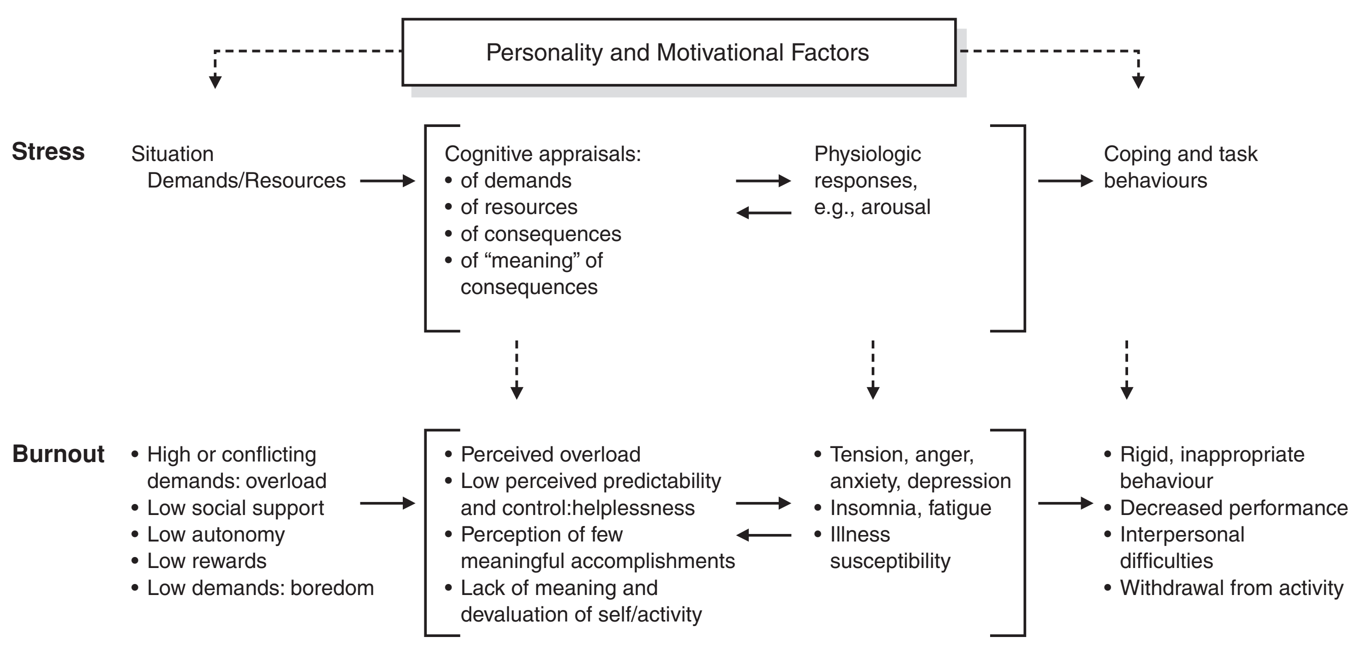

Figure 28.2 A conceptual model showing the parallel relationships assumed to exist among situational, cognitive, physiological, and behavioral components of stress and burnout. *Source:* "Toward a Cognitive-Affective Model of Athletic Burnout," by R. E. Smith, 1986, *Journal of Sport Psychology, 8,* pp. 36–50. Reprinted with permission.

professionals and general work populations (i.e., Maslach, 1982). Smith's model of athletic burnout (see Figure 28.2) was an elaboration on his earlier developed stress process model (i.e., Smith, 1980).

In his conceptual model, Smith (1986) outlines four components with parallel relationships for stress and burnout processes that are influenced by personality and motivational factors. The first component relates to the situational basis for perceptions of stress and burnout: the relative imbalance between situational demands and personal and environmental resources. In the second component of the model, consistent with Lazarus and Folkman's (1984) theorizing on the stress process, Smith specifies cognitive appraisal as the crucial process mediator of behavior. Smith proposed that in the burnout process, salient appraisals include chronic perceptions of overload (or, in some instances, underload), a lack of control, a relative absence of meaningful accomplishment, and devaluation of the self and/or the activity.

In Smith's (1986) model, the nature and intensity of an athlete's physiological response (i.e., component 3) is posited to be determined by and interacts with appraisal of demands, resources available, potential consequences, and the meaning of these potential consequences (i.e., component 2). For example, when the appraisal process indicates a threat of harm or danger, physiological arousal occurs. These physiological responses influence future appraisals by reinforcing perceptions of overload or underload. Smith proposes that in the case of burnout, chronic stress produces fatigue and other negative physiological symptoms associated with burnout (e.g., sleep disorder and lethargy). The final component of the model relates to athlete coping- and performance-related behaviors. The behavioral result of burnout is proposed by Smith to involve "decreased efficiency and a psychological if not physical withdrawal from the activity" (p. 43).

The crux of Smith's (1986) explanation for the occurrence of burnout lies in his use of SET. Social exchange theory is premised on the notion that people's behavior is heavily influenced by desires to minimize negative experience and maximize positive experience (Smith, 1986; Thibaut & Kelley, 1959). From this perspective, motivated behavior rests on a rational assessment of the potential outcomes. These assessments rest not only on the costs and benefits associated with any particular course of action, but also against assessments of the potential outcomes of alternative courses of action. Stress is viewed as one of the costs when assessing potential outcomes in sport participation. As widely advocated in social psychology (McGrath, 1970), Smith focuses his conceptualization on stress as a perception or appraisal of imbalance between demands and resources rather than simply as a situational demand or imposition.

Smith (1986) suggests that athletic burnout occurs when stress-induced costs rise (without a concomitant decline in perceived sport-related benefits) to the point where an unfavorable cost-benefit ratio is perceived for engaging in a particular sporting activity. Athlete involvement in sport can be maintained despite this unfavorable perception because of the continued presence of substantially valued benefits (some perhaps especially salient from the initial motivation to become involved in the activity) and a lack of recognition of an alternative perceived as providing a more attractive cost-benefit ratio. Indeed, it may be that attractive alternatives are particularly elusive for athletes who are deeply invested in their sport. Even while maintaining physical involvement, however, burned-out athletes exhibit psychological withdrawal (e.g., persistent exhaustion, cynicism and devaluation of the activity, and a decreased sense of personal accomplishment in the sport; Smith, 1986). Ultimately the costs associated with the experience of burnout may result in physical withdrawal from sport or, alternatively, sport separation through organizational deselection processes.

Smith's (1986) model has received support within the extant literature on athlete burnout (e.g., Gould et al., 1997; Raedeke & Smith, 2004). Gould et al., for example, concluded that Smith's stress-mediated model provided a useful interpretive basis for understanding data obtained in their interviews of athletes who experienced burnout as competitive junior tennis players. More recently, Raedeke and Smith evaluated the stress-mediated relationship between coping behaviors and social support satisfaction and athlete burnout hypothesized in Smith's model, as well as an alternative possibility that coping and social support moderate the perceived stress-burnout relationship. Coping and social support are of particular interest because they may account for why athletes can interpret similar demands differently. Specifically, differences in coping behaviors and social support may help account for why one athlete perceives situational stress as motivationally challenging while another perceives situational distress and threat that could, over time, result in burnout. Overall, the hypothesized stress-mediated relationship between coping behaviors and social support satisfaction and athlete burnout was not falsified by their analyses, but no support was observed for the moderation hypothesis. More specifically, the evidence for a stress-mediated relationship between coping behaviors and burnout was relatively strong, but evidence for the possibility of stress-mediated social support effects on burnout was more ambiguous and hence less convincing. Future research is needed to examine the stress-mediated effects of different types of social support on burnout as well as the possibility that social support may be simultaneously acting in both meditating (i.e., acting to directly attenuate the extent to which stress is perceived) and moderating (i.e., acting to ameliorate or buffer the effects of stress once it is perceived) roles in the stress process (Bianco & Eklund, 2001).

Despite some supportive results, Smith's (1986) model of burnout has not been exempt from criticism. Schmidt and Stein (1991), for example, argued that dropout and burnout are not necessarily clearly differentiated in Smith's model by reference to its grounding in SET contentions on rewards, costs, and alternatives. Schmidt and Stein suggested that the appraisal processes leading to the different outcomes might be very similar except in terms of the developmental time frame. Specifically, they speculated that dropout might result from a relatively abrupt shift to an unfavorable appraisal balance. Their conjecture on burnout, on the other hand, was that shifts to a similar unfavorable appraisal balance occurred over a protracted period of time and that burnout might be the result of this prolonged participation under increasingly aversive psychological conditions. As noted by Schmidt and Stein, however, SET does not involve or invoke a temporal component per se. As such, they believed that if prolonged exposure to aversive psychological conditions is requisite, something long considered fundamental to syndrome development (Maslach et al., 2001), SET had limited potential utility for explaining athlete burnout and for distinguishing it from sport dropout. In sum, they believed that conceptual advancement was necessary to guide research and to interpret potential findings on changes in appraisals of rewards, costs, and alternatives relative to the emergence of this aversive experiential state.

Sport Commitment and Athlete Burnout

Schmidt and Stein (1991, p. 259) proposed a sport commitment model to discriminate among "persons staying in sport for the sheer enjoyment of it, those who stay for reasons other than enjoyment, and those who remain as the result of some combination of those factors." Their proposals were grounded in theoretical contentions and research on commitment in close relationships by H. H. Kelley (1983) and Rusbult (e.g., 1980a, 1980b, 1983). In Schmidt and Stein's conceptualization, athletes can be committed to sport (i.e., participate over a long period of time) because they enjoy their involvement or they have reasons unrelated to enjoyment. Commitment, in their conceptualization, is predicted by athletes' satisfaction with their sport involvement (resulting from a subjective cost-benefit analysis), perceptions of potential alternatives, and beliefs about their sport investment. Athletes are proposed to be at risk of experiencing burnout when they become dissatisfied with the costs of involvement but feel entrapped by the efforts and resources already invested and a perceived absence of viable alternatives.

Raedeke (1997) also believed that the motivational imperative for persistence in sport was different for athletes experiencing burnout than for those who did not. In evaluating sport-specific contentions about commitment (e.g., Scanlan, Carpenter, Schmidt, Simons, & Keeler, 1993; Schmidt & Stein, 1991), Raedeke characterized athlete commitment as having "two faces": the face of attraction and the face of entrapment. Attraction-based commitment was posited to be occurring when athletes find their engagements intrinsically rewarding and they *want to be involved.* Entrapment-related commitment, by contrast, was posited to be occurring when athletes feel *they must maintain their involvement* even though they are no longer intrinsically motivated to continue that participation. In his view, entrapment-related commitment to sport elevates the risk of athlete burnout, but attraction-related commitment to sport is relatively benign on that account.

Some evidence has been presented to support Raedeke's (1997) contentions about athlete burnout and the two faces of sport commitment. Specifically, Raedeke evaluated commitment-based hypotheses about athlete burnout in a study involving a reasonably large ($N = 236$) sample of competitive age-group swimmers. In a cluster analysis of indices of sport commitment (e.g., enjoyment, benefits, costs, attractiveness of alternatives, investments, social constraints, swim identity, perceived control), four groups of swimmers were identified. Swimmers in the group most closely exhibiting an entrapment-related profile of sport commitment ($n = 26$) also reported the highest levels of burnout in the sample. In contrast, swimmers with an attraction-based commitment profile ($n = 104$) reported the lowest levels of burnout. Athletes in the other two groups (either not substantially committed to swimming, $n = 66$, or with a mixed attraction/entrapment profile, $n = 40$) reported relatively moderate levels of burnout. Interestingly, however, swimmers with the commitment profile most indicative of entrapment did not entirely conform to

Schmidt and Stein's (1991) expectations about athletes at risk of burnout. Although these swimmers did report relatively low enjoyment, low benefits, and high costs, they also reported a relatively low investment in swimming and felt other activities were more attractive than swimming. It may be that the experience of burnout had already caused these swimmers to reevaluate their investment in swimming and to investigate (or reevaluate) the attractiveness of alternative activities at the time data were collected. Longitudinal evaluation on this account may prove interesting.

In summary, preliminary evidence from cross-sectional investigation supports the hypothesized association between commitment and sport burnout among athletes (Raedeke, 1997) and suggests that explanations based in theories and models of commitment may prove revealing. Nonetheless, it is an open question as to whether athletes' commitment orientations are implicated in the development of burnout, or the development of burnout influences athletes' commitment orientation, or if other processes are concomitantly shaping both. It seems likely that processes relating to both burnout and commitment are intertwined with the stress process. For example, a team captain finding the leadership role aversive may be less likely to consider certain responses (e.g., stepping down from the role, quitting the team, changing teams) because of feelings of responsibility and loyalty to the team. Were burnout to eventuate in an instance such as this, entrapment might be implicated as a stress-mediated antecedent. There are a variety of intriguing possibilities, but more definitive answers await longitudinal or intervention investigation.

Fundamental Psychological Needs and Athlete Burnout

Self-determination theory based explanations for human behavior rely on the idea that people have innate psychological needs that must be satisfied for optimal functioning, social development, and personal well-being (Ryan & Deci, 2000b). In sport, for example, Gagné, Ryan, and Bargman (2003) have presented evidence associating psychological need satisfaction among a cohort of adolescent female gymnasts with athlete well-being and autonomous motivation to practice. It has also been demonstrated that social contexts thwarting fulfillment of these fundamental psychological needs can result in states of diminished functioning, alienation, and ill-being (Ryan & Deci, 2000a, 2000b). The potential of this theory for understanding the occurrence of athlete burnout has not been lost on sport psychology researchers (e.g., Cresswell & Eklund, 2004, 2005a, 2005b, 2006b; Lemyre et al., 2006), and the results from initial investigations guided by SDT have been revealing.

The psychological needs that have been long championed as essential and universal by Deci and Ryan (1985) include the needs for autonomy, competence, and relatedness. The need for *autonomy* concerns the inherent imperative that people have to experience feelings of volition (or a sense of perceived internal locus of causality) in their behavioral enactments. People also have a psychological need for *competence,* or to perceive themselves as effective in challenging endeavors. Finally, humans have a need for *relatedness,* a feeling of being secure and connected with valued significant others. According to Deci and Ryan's (1985; Ryan & Deci, 2000b) self-determination theory, these fundamental psychological needs play a central role in motivated behavior. Energization of behavior in the pursuit of satisfaction of these needs has been termed *intrinsic motivation.* Intrinsically motivated involvement in an activity occurs purely for the rewards inherent in that participation, such as feelings of accomplishment, satisfaction, and enjoyment.

Obviously, need satisfaction is not the only force animating human behavior (Ryan & Deci, 2000b, 2002). Indeed, beyond early childhood, little of people's behavior is, strictly speaking, exclusively energized by innate propensities or needs. In SDT, the other basic types of motivation are extrinsic motivation and amotivation. *Extrinsic motivation* can vary in terms of behavioral valuation and perceptions of autonomous regulation but, in general, underlies engagements that are regulated by the pursuit of some outcome separable from the involvement in the activity itself. *Amotivation,* or the lack of motivation, is typically the result of thwarting or deprivation of psychological need satisfaction and/or a belief that effort will not yield the desired outcome. This state is sometimes described as the motivational signature of burnout (e.g., Cresswell & Eklund, 2005b, 2006b; Kenttä, Hassmen, & Raglin, 2001), although clearly, one can be amotivated without experiencing burnout.

Overall, Ryan and Deci (2002) posit that the variety of motivational types impelling behavior differs most crucially in the extent to which they emanate from the self (i.e., are *self-determined*), and hence that these motivational types can be conceptually ordered into a simplex self-determination continuum. Intrinsically motivated engagements are regarded as the most self-determined, and hence have been conceptualized as lying at one end of the self-determination continuum (see Figure 28.3). Amotivation involves an absence of motivation (self-determined or other-

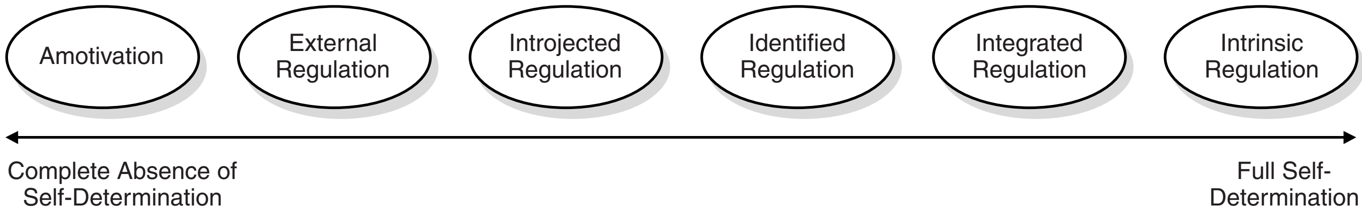

Figure 28.3 Conceptual ordering of motivational constructs along the continuum of self-determination.

wise), and hence falls at the opposite end of this continuum. Integrated regulation, identified regulation, introjected regulation, and external regulation types of extrinsic motivation fall in sequence between intrinsic motivation and amotivation on this continuum. These forms of extrinsic motivation range from those that are controlled externally (i.e., external regulation), through coercion or rewards (and hence least self-determined), through to autonomously regulated valuations (i.e., integrated regulation) that are largely self-determined because they are fully assimilated into the person's sense of self. The relative position of motivational types along the self-determination simplex has received empirical support in sport (Cresswell & Eklund, 2005b; Li & Harmer, 1996; Pelletier et al., 1995).

An SDT motivational explanation of athlete burnout seems to be a natural fit given the burnout motivational signature (i.e., the prominence of amotivation), and particularly given evidence indicating that frustration of fundamental psychological needs across a variety of nonsport contexts results in states of ill-being (Ryan & Deci, 2000a). In sum, it seems theoretically reasonable to expect that the negative experiential state of burnout among athletes occurs when basic needs are *chronically* frustrated or unfulfilled in their sporting efforts. This expectation has motivational significance because, theoretically speaking, competence, autonomy, and relatedness needs serve as the energizing principles of intrinsic motivation but not for motivational types that are not determined by the self. As such, an inverse relationship between burnout and intrinsic motivation among athletes continuing to participate in their chosen sport should be expected on the basis of SDT. At the other end of the self-determination motivational continuum, and consistent with extent evidence from interviews with athletes suffering from burnout (e.g., Coakley, 1992; Cresswell & Eklund, in press; Gould, Tuffey, et al., 1996), a positive relationship should exist between burnout and amotivation among athletes continuing in their sporting endeavors. Empirically, these expectations have been consistently borne out in studies of both amateur and professional athletes (e.g., Cresswell & Eklund, 2005a, 2005b, 2005c; Gould, Udry, et al., 1996; Raedeke & Smith, 2001). Specifically, intrinsic (self-determined) motivation has been consistently observed to have significant small to moderate negative associations with burnout, and amotivation has consistently exhibited moderate positive associations with burnout.

Sport is laden with salient extrinsic rewards (i.e., regulating outcomes that are separable from sport participation itself) that contribute to energizing behavior in the domain, but precisely what should be anticipated in relationships between extrinsic motivational types and athlete burnout is theoretically more ambiguous. The most self-determined types of extrinsic motivation (i.e., integrated and identified regulations) may exhibit inverse relationships with burnout similar to those between intrinsic motivation and burnout because these regulations are largely assimilated into an individual's sense of self (Cresswell & Eklund, 2005b). Less self-determined types of extrinsic motivation (e.g., introjected and external regulations) might be expected to exhibit positive relationships with burnout for athletes continuing to compete (Cresswell & Eklund, 2005b). Similar contentions have been forwarded in other investigations into athlete motivation and burnout (e.g., Gould, Tuffey, et al., 1996; Gould, Udry, et al., 1996; Lemyre et al., 2006).

Empirically, however, there has been relatively little support for these contentions. Yet, there are a couple of caveats to this observation because, in fact, few data have been collected to fully evaluate these hypotheses. Specifically, the most commonly employed measure of SDT motivational constructs in athlete burnout research, the Sport Motivation Scale (SMS; Pelletier et al., 1995), does not include an integrated regulation subscale, and so no data are available on this account. As well, some researchers omitted the Identified and Introjected Regulation subscales in their data collections (i.e., Cresswell & Eklund, 2005b, 2005c), found their external and introjected regulation data to have insufficient internal consistency (i.e., Raedeke & Smith, 2001, Study 2), or had full reporting of their results constrained by journal page limitations (i.e., Gould, Tuffey, et al., 1996). Across three studies (i.e., Cresswell & Eklund, 2005a; Raedeke & Smith, 2001, Studies 2 and 3), the SMS Identified Regulation subscale has been observed to be significantly (albeit modestly) associated, cross-sectionally, with ABQ burnout subscales in the hypothesized direction (i.e., with reduced sense of accomplishment, $r = -.18$ and $r = -.24$, and with sport devaluation, $r = -.13$ to $r = -.17$). Nonetheless, the other five cross-sectional univariate coefficients reported in these studies, although also negative, were essentially zero.

Even less cross-sectional support has been observed for the hypothesized positive associations between burnout and less self-determined types of extrinsic motivation. Introjected regulation was not significantly associated with any burnout characteristic in the only study with reliable measurement of this motivational type (Raedeke & Smith, 2001, Study 3). Likewise, burnout syndrome facets and external regulation associations in cross-sectional analyses have been consistently nonsignificant (Cresswell & Eklund, 2005a, 2005b, 2005c; Raedeke & Smith, 2001, Study 3), except for a single modest *negative* correlation of −.15. Interestingly, however, longitudinal evidence provides some indication that motivation-burnout relationships may not be adequately captured in cross-sectional data.

As a first example, Lemyre et al. (2006) obtained burnout and motivation data across a competitive season (20 to 28 weeks, depending on qualification for championship meets) from 44 NCAA Division I swimmers. They analyzed their motivation data by creating an omnibus "self-determination index" score using Grolnick and Ryan's (1987) formula to provide an indication of where a participant's motivation fell on the self-determination continuum at particular time points. They found that athletes on a trend toward less self-determined motivation during the course of the season scored higher on all dimensions of burnout when compared to athletes with a more self-determined motivational trend. Moreover, the observed effect sizes for these differences ranged from moderate to large in magnitude for the burnout subscales. They also obtained data on weekly positive and negative affect and found that swimmers experiencing increased variability in negative affect tended to be more at risk for experiencing burnout symptoms.

We have also conducted a longitudinal investigation of athlete burnout and motivation in our work with the New Zealand Rugby Football Union (Cresswell & Eklund, 2005a) and found that the relationship between extrinsic motivation and burnout might be more complex than we initially envisioned. Data from three time points (i.e., pretournament, midtournament, and end of tournament) during a 12-week tournament from 102 professional Rugby Union players were examined using linear mixed modeling analytic procedures (also known as multilevel or hierarchical modeling). Not surprisingly, and as observed in cross-sectional investigations, amotivation was observed to be substantially and positively associated with burnout, and intrinsic motivation exhibited significant negative associations with burnout in these longitudinal data. The relationships observed between a composite measure of extrinsic motivation and the various characteristics of burnout, however, differed from previously described cross-sectional results and were much more interesting as a consequence. Nonetheless, the measure of extrinsic motivation employed presents some challenges for interpretation. It was the first of three components identified in a principal components analysis conducted to manage the high correlations among the SMS External, Introjected, and Identified Regulation subscales. This extrinsic motivation component explained 70% of the variation among the scales and was made up of approximately equal proportions of each type of extrinsic motivation. Despite this interpretive obstacle, the results were thought-provoking.

Specifically, extrinsic motivation was observed to be significantly and *negatively* associated with burnout in terms of sport devaluation and a sense of reduced accomplishment among the rugby professionals across time, while also being *positively* associated with feelings of physical and emotional exhaustion (Cresswell & Eklund, 2005a). We had not previously considered the possibility that extrinsic motivation (or the specific types of extrinsic motivation regulations, for that matter) could be differentially associated with individual burnout syndrome facets across time. Nonetheless, this result was observed, and it suggests that our initial hypotheses about burnout-motivation relationships were naive. Broader and more sophisticated consideration of possibilities for understanding burnout-related motivational shifts is required. For example, contemplation of possibilities relative to the developmental sequencing of emergence of syndrome facets may be important given the differential associations observed in this investigation. Certainly, this developmental progression has been a matter of interest among burnout researchers beyond sport (e.g., Golembiewski, Munzenrider, & Carter, 1983; Maslach et al., 2001; Plana, Fabregat, & Gassió, 2003; Van Dierendonck, Schaufeli, & Buunk, 2001). It seems likely that it also merits further consideration and investigation among athletes.

Overall, intriguing evidence has been obtained in investigations on relationships among the different motivational types and athlete burnout. Consistent patterns of association between burnout and intrinsic motivation and amotivation have emerged that are consistent with SDT. Nonetheless, the data do not entirely support the previously identified hypotheses about potential associations between burnout and extrinsic motivational types (Cresswell & Eklund, 2005b). The salience of extrinsic contingencies in sport, however, makes this an issue of some importance and interest meriting further investigation. Longitudinal analysis of athlete motivational profiles may be revealing, particularly with regard to complexities in relationships in this area. It may be also be that contentions of cognitive evaluation theory (Ryan & Deci, 2000b), a subtheory of SDT, can have utility for understanding the role of appraisals of the extrinsic rewards available in sport settings and how they may change in the development of this negative experiential state.

Although clear relationships exist among at least some motivational types and burnout, the question of whether burnout is an antecedent or a consequence of motivation lacking in self-determination is empirically unclear. Moreover, the possibility exists that burnout and motivation are related in a reciprocally causal manner, or that they vary concomitantly without one causally impacting the other. All of these possibilities have been alluded to in the extant literature (e.g., Cresswell & Eklund, 2005b; Gould, Tuffey, et al., 1996; Gould, Udry, et al., 1996; Lemyre et al., 2006). It makes sense to believe that an aversive experiential state such as burnout can result in decreased intrinsic motivation for sport involvement and hence reliance on motivational regulations that are progressively less self-determined in nature (i.e., burnout influences motivation). For example, an athlete experiencing burnout finds his or her participation less satisfying and becomes progressively more amotivated. The possibility also exists, however, that sport involvement for extrinsic contingencies can cause people to appraise their involvements in a way that leaves them vulnerable to burnout (i.e., extrinsic motivation causes burnout). For example, an athlete motivated by pressures or obligations may progressively come to regard participation as aversive. Intuitively, it is reasonable to believe that these processes might be intertwined, and hence that a process of reciprocal causal influence occurs in the burnout process. Alternatively, the possibility exists that motivation and burnout are not reciprocally causal but instead related as a result of a shared common cause. In fact, this possibility is perhaps the one most consistent with SDT given that fundamental psychological needs are thought to underlie intrinsic motivation (i.e., pursuit of need satisfaction) and states of ill-being (i.e., chronic thwarting of psychological needs).

In one study we evaluated three structural equation models featuring the different types of relationships between motivational types and burnout (Cresswell & Eklund, 2005b) in an attempt to obtain clues about the nature of the relationships from cross-sectional data. Specifically, one conceptual model evaluated causal pathways specified from a burnout latent variable to latent variables of the various motivational types. The second model featured causal pathways in the opposite direction. The final model specified noncausal relationships between burnout and motivations varying in extent of self-determination. The degrees of freedom in all models were the same. We found that all models displayed reasonable and comparable fits, although the model featuring concomitant relationships exhibited, by a trivial margin, the smallest chi square. In sum, the analyses of cross-sectional data provided little evidence to falsify any of the models. This inability in itself, however, suggests that unidirectional causation may be improbable because otherwise, one of the two models would have exhibited a more satisfactory fit than the other. Therefore, models of reciprocal causation or concomitant association resulting from a shared common cause as suggested by SDT may be the most fruitful avenues for further investigation—although with longitudinal data, including measurement of psychological need satisfaction, instead of cross-sectional data.

In summary, SDT seems to offer promising conceptual grounding for the study of athlete burnout. The positive psychology perspective embodied in SDT (Schaufeli, Salanova, Gonzalez-Roma, & Bakker, 2002; Sheldon, Williams, & Joiner, 2003) may also be useful in providing practitioners with guidelines for intervention and prevention of this chronic negative experience. Nonetheless, SDT-based explanations for the occurrence of burnout require further empirical evaluation. To date, research has focused on relationships between motivational types and athlete burnout (Cresswell & Eklund, 2005b, 2005c). Clearly, research needs to confirm the proposed relationships between basic need satisfaction and burnout characteristics.

FUTURE RESEARCH DIRECTIONS

The growth in research on athlete burnout over the past decade has unsettling and encouraging aspects. To whatever degree this increased interest is indicative of a growing problem, it is unsettling. Yet it may turn out that athlete burnout is not a growing problem, but rather that awareness has increased about an existing problem. In either event, it is encouraging that scientific energy is now being directed into developing a greater understanding of athlete burnout. Overall, there is still much to be learned, and our understanding of relevant issues is in its infancy. A great deal of research is required to develop knowledge on the prevalence and potential causes of athlete burnout as well as its possible manifestations and associated consequences. Relevant psychological theory and theory development certainly should play an important role in developing this knowledge base. Many of our observations on potential future research directions have been highlighted in relevant places across this chapter, but some additional comment is warranted.

Presently, information on prevalence, incidence, and patterns of occurrence of athlete burnout is sketchy at best. Good epidemiological survey data on athlete burnout is required. The emergence of the ABQ means that at least one measurement instrument suitable for acquiring relevant data is now available to researchers. Unfortunately, at this point we have no solid basis to give meaning to observed scores in terms of threshold values placing athletes at risk for negative consequences. Indeed, the nature of potential associated negative consequences that might eventuate at any given level of athlete burnout is murky at best, and present concerns largely relate to extant research in the general health psychology literature. Clearly there is a great deal of work to be done on all of these accounts.

A variety of burnout correlates have been identified in cross-sectional descriptive investigations over the past decade. These findings provide some tentative clues on potential causes (e.g., Cresswell & Eklund, 2004, in press) and consequences (Cresswell & Eklund, in press) of athlete burnout. Yet, despite the growing number of studies examining these issues, there is need for more substantial investigations into meditating and moderating variables if our understanding of this aversive experiential state is to grow. Experimental investigation in the area is necessarily (and appropriately) limited by ethical appropriateness. Despite these constraints, rigorous study of burnout causes and consequences is possible. Longitudinal, quasi-experimental, naturalistic, and intervention studies and intensive idiographic multimethod approaches (e.g., Tenenbaum et al., 2003a) offer the prospect of extending knowledge on basic and applied issues in the area well beyond the cross-sectional evidence presently available. Creative efforts on these accounts are needed—particularly those guided by and testing hypotheses from relevant psychological theory—to afford substantive understanding and possibilities for prevention and intervention.

As a final note, after reading of broader efforts in health psychology, we have developed a growing interest in the developmental progression and regression in the experience of athlete burnout. For example, the sequence of emergence and developmental interaction among syndrome facets has yet to be considered among athletes. These processes may be sensitive to situational and environmental influences (Maslach et al., 2001). The variety of manifestations and subcultural variations of sport that athletes are involved in may provide a laboratory of particular opportunity for the development of wider understandings in the area. Moreover, enhanced understanding of these processes seems fundamental to the development of effective prevention and intervention programs. As a related matter, successful remediation of relatively moderate levels of athlete burnout may be possible—although the evidence is largely anecdotal on that account—but formalized intervention strategies have not been evaluated. Even less is known about the experience of and remediative possibilities for very high levels of athlete burnout. What are the long-term prognoses on various accounts relative to an athlete's performance and sporting career? And if those prognoses are not favorable, is the progression toward those outcomes amenable to modification? Finally, what is an athlete's vulnerability to developing burnout subsequent to an earlier encounter with this aversive experience? Although answers to these questions can (and should) be pursued in a variety of ways, longitudinal research will certainly play an important role. In any event, the data to address these issues have yet to be collected; hence, a great deal of work remains in the area.

CONCLUSION

Over the past decade, there has been a substantial growth in research on athlete burnout. Researchers have become more convergent in their conceptualizations of the construct, and a variety of important contributions to understanding this aversive experiential state have resulted. Nonetheless, the notoriety of this "Everyone knows what it is" construct remains; hence, burnout too often continues to be regarded as synonymous with depression, overtraining, and dropout. There is, however, an emerging body of research that has a shared conceptualization of burnout as a multidimensional psychosocial syndrome. In this approach, athlete burnout is seen as an athlete-specific manifestation of the syndrome researched extensively in general work and human care settings. Specifically, athlete burnout is proposed to have three central characteristics: physical and emotional exhaustion, reduced accomplishment, and sport devaluation. Despite this convergence and research progress on this shared conceptualization, research in the area remains in its infancy, and a wide variety of important questions await answers. We believe the groundwork is in place for interesting developments in this area, and we look forward to observing and participating in this progression.

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PART VI

Life Span Development

CHAPTER 29

A Life Span Developmental Approach to Studying Sport and Exercise Behavior

DIANE E. WHALEY

There is no denying the fact that as we age we change. Those changes can be physical, such as getting stronger, losing flexibility, or gaining weight; they can be cognitive, such as using different sources to assess our abilities or using different criteria to choose our friends; they can be emotional, such as becoming less impulsive or learning to control our temper; and they can be behavioral, such as the level and type of activity we choose to participate in. These examples have implications for participation, performance, and sustained involvement in sport and physical activity. However, a life span developmental perspective has yet to be embraced by researchers and practitioners in sport and exercise psychology. In spite of tireless efforts by a few developmental sport psychology enthusiasts (e.g., Maureen Weiss, Brenda Bredemeier, Thelma Horn, Tara Scanlan), studies in which age-related differences and, more important, age-related *changes* (as opposed to simply including age as a variable) are investigated, remain sparse.

In this chapter, I explore the importance of examining the psychology of sport from a life span developmental perspective. I begin by defining a life span developmental approach and describe ways researchers can study developmental change. Typically, developmental books and chapters are organized around life stages and the tasks associated with those stages (e.g., Berk, 1998). Although I use this age-graded approach in distinguishing some aspects of child and adult development, I have chosen to focus on the ABCs of psychology: affect, behavior, and cognitions (Gill, 1997). I review theory and research that address cognitive, affective, and behavioral changes that occur over the life span and explore how these changes may impact sport and physical activity participation. For example, I discuss developmental changes in how we assess our competence and measure our abilities (e.g., Frey & Ruble, 1990; Harter, 1990; Horn & Weiss, 1991). This topic has been studied extensively in children and adolescents, but there is evidence for changes well into adulthood. I also explore the development of emotional responses and discuss how social interactions and emotional experiences become increasingly linked as we progress through adulthood (e.g., Carstensen, 1993; Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Crocker, Kowalski, Hoar, & McDonough, 2004). These changes are then linked to actual physical activity (e.g., Leslie, Fotheringham, Owen, & Bauman, 2001) and the strategies individuals use to sustain their sport and physical activity participation over the life span (e.g., Langley & Knight, 1999). Attention is paid throughout to the role of the social context in moderating and mediating the relationship between affect and cognitions on behavior.

In the concluding section of the chapter, I offer suggestions for how a life span perspective might be pursued by researchers and practitioners in sport psychology. I discuss issues related to methodology and attempt to answer the question: Why *isn't* there more life span developmental research in our field? It is my hope that by promoting a life span developmental perspective, we may, as Weiss and Raedeke (2004, p. 2) aptly put it, "demystify the notion of a developmental perspective and advocate its wider use in future research."

DEFINING A LIFE SPAN DEVELOPMENTAL APPROACH

Human development is a field of study devoted to understanding constancy and change throughout the life span (Baltes, 1987; Berk, 1998). Paul Baltes (e.g., Baltes, 1987; Baltes, Lindenberger, & Staudinger, 1998; Baltes, Reese, &

Nesselroade, 1988) has been an instrumental leader and pioneer in the study of life span development and theory. Baltes et al. state that life span research and theory is interested in three components of individual development: (1) interindividual (between individuals) commonalities or regularities in development; (2) interindividual differences in development; and (3) intraindividual (within the individual) plasticity or malleability in development. Baltes highlights two important issues: first, that individuals change in significant ways over the life span, but may do so at varying rates and ways; second, that within any given age group, there is likely to be significant differences between individuals (e.g., interindividual differences), and even within a single individual, situations and life events may necessitate changes in thoughts and feelings over time (intraindividual change). Interindividual differences and intraindividual change also imply that differences are not simply hardwired; individual's thoughts, feelings, and behaviors are impacted by the social context (Schindler & Staudinger, 2005). As a result, as individuals age, differences among individuals in the same age group get larger with commensurate differences in lived experiences. Thus, research should examine both changes *across time* as well as consistencies and discontinuities *within age groups* if we are to truly understand behavior across the life span.

Four assumptions guide theory and research from a life span perspective (Baltes, 1987). The first is that development is a *lifelong process.* Development does not cease at adolescence, and no age period exerts more impact than another; in fact, significant changes occur throughout the life course. Second, researchers embracing a life span perspective see change as *multidimensional* and *multidirectional.* That is, biological, personal, and social forces interact and combine to produce change, a process referred to as *ontogenesis* (Baltes et al., 1998). At any time period, change is best represented as a blend of growth and decline (or loss). For example, say you challenge a young child to a race; she truly believes she can win. We can explain this in terms of level of cognitive development: At this young age, the child is a poor judge of her ability; she has likely received primarily positive feedback (from parents) regarding her athletic ability, and has had little opportunity to test herself next to peers. With time, the child gains experience with the task, has the opportunity to compare herself to others, and perhaps gets more balanced feedback from teachers or classmates. Although the child has gained the ability to more accurately assess her ability (see Weiss & Raedeke, 2004, for a review of this topic), there is also a potential loss: a loss of innocence perhaps, or a loss of pure intrinsic joy. This loss can in some cases lead to disengagement from the activity. Thus, it is clearly development, but it is not exclusively gain. This is not to say that gains and losses remain constant across the life course. In fact, the relative proportion of gain and loss changes over the life span, with younger age periods marked with more gain than loss and the opposite balance in older adulthood (Baltes, 1987). This issue is further discussed later in the chapter with regard to adaptations to loss in adulthood.

The third assumption of life span development is that it is *highly plastic.* Development can take many forms depending on how one's environmental and life history combine with current life conditions (Berk, 1998). Plasticity varies across individuals (interindividual differences), and increasing age generally means decreasing plasticity, because capacity and opportunity for change are reduced. This does not imply that older adults are incapable of or unwilling to change. Research indicates that even the oldest old (over 85) can achieve considerable improvements in memory (Schaie, 1996) and strength (Mazzeo et al., 1998), and changes in personal goals occur across all phases of adulthood (Fung, Rice, & Carstensen, 2005).

The fourth assumption of life span development asserts that development is embedded in *multiple contexts* (Baltes, 1987). Change can be the result of age-graded differences, which are primarily based on biology and thus are rather predictable (e.g., walking, experiencing menopause), but can also be influenced by social customs (e.g., joining a T-ball team, retiring from professional sport). Changes can also have history-graded influences; prime examples are wars and technological advances. Both of these factors have been implicated in physical activity behavior. For example, as women joined the workforce during World War II, they became by necessity more physically active; by the 1950s, a return to peacetime coincided with a reduction in physical activity levels in women as they returned to more traditional and sedentary roles. More recently, the dramatic rise in technological advances has often been cited as a contributor to the inactivity and obesity epidemics (A. M. Smith et al., 2005). These history-graded influences impact large numbers of individuals in similar ways. There are also nonnormative influences that happen to only a few people and do not follow such predictable patterns. Such an influence might be a parent who was involved in professional sport and provides opportunities for his son or daughter that may not be available to the average child (e.g., bat boy/girl for a Major League team). These nonnormative influences can be very powerful and have been implicated in the phenomenon of increasing interindividual variability as we age (Schindler & Staudinger, 2005).

The assumptions of development as lifelong, multidimensional and multidirectional, highly plastic, and embedded in contexts guide research and theory development from a life span perspective.

In the physical domain, Weiss and Bredemeier (1983) were the first to introduce a developmental approach to sport psychology. In their influential paper, Weiss and Bredemeier suggested guidelines for implementing a developmental line of research. They encouraged researchers to review theoretical constructs and models from the developmental psychology literature that may have relevance to sport contexts. Among the theories employed today, competence motivation theory (Harter, 1978), achievement goal theory (Nicholls, 1984), and Bandura's (1986) social cognitive theory have specific developmental components. Other cognitive motivational theories, such as Deci and Ryan's (1985) self-determination theory and Eccles et al.'s (1983) expectancy value approach, are readily adaptable to developmental testing. In this chapter, I highlight several other theories not commonly employed in sport and exercise psychology but that lend themselves to studying change in sport-related behavior over the life span.

Designing Life Span Developmental Studies

Weiss and Bredemeier (1983) cautioned against using measures designed for one age group without carefully scrutinizing the reliability, validity, and meaningfulness of those measures in a different age group. This issue is more thoroughly discussed in the final section of the chapter. They also challenged researchers to develop a line of empirical research to identify systematic differences among age groups. Both of these issues remain important today. Finally, in reviewing the developmental sport psychology literature of the time, they highlighted three ways researchers could conceptualize a life span developmental study (Weiss & Bredemeier, 1983; Weiss & Raedeke, 2004). The first type of developmental study selects ages of participants based on *specific cognitive or physical developmental criteria*. For example, A. L. Smith (1999) examined the influence of peer group members on sport participation in 12- to 15-year-olds. This age group was selected because individuals at this age are likely to use peers and friends as important sources of competence information and because activity rates have been shown to decline in this age group. The important issue for this type of design is that the age of participants is intentionally chosen based on social or cognitive-developmental factors.

A second type of developmental study *compares two or more age groups* at key periods of development. In this approach, it is typical to see the age groups displayed in Table 29.1 compared or contrasted. The groupings presented are typical of life span developmental theory and research, although there is no consensus on age groupings past adolescence. For example, some researchers have called for subcategories within middle age (Lachman, 2004), much like the subcategories designated for older adults (Neugarten & Hagestad, 1976). An example of a developmental study that compares age groups is one conducted by Horn and Weiss (1991). They compared middle versus older children on sources of competence information and the accuracy of those perceptions. These age groups were contrasted based on previous research in the academic domain (e.g., Stipek & MacIver, 1989) that showed age-related differences in competence beliefs. More recently, Steinberg, Grieve, and Glass (2001) assessed achievement goals in young, middle, and older competitive athletes. Again, age groups corresponded with generally recognized life stages. It is not unusual to see studies where exactly the opposite approach is employed; participants may vary in age across several developmental periods (ages 18 to 80), but there is no attempt to examine differences between age groupings. From a developmental perspective, this is at best a lost opportunity and at worst an inappropriate methodology that should be questioned in the review process.

The most infrequently employed methodology for developmental research is a longitudinal approach, *following the same individuals over time*. Typically, a longitudinal approach requires at least two test periods across an "appreciable period of time" (Miller, 1998, p. 27). Miller offers no firm definition of appreciable time, but most texts consider a developmental study to be several months to several years (Berk, 1998). These studies are still relatively rare in the physical domain, a situation Schutz and Park (2004) characterize as disturbing. Examples include Wilcox and King's (2004) study of the effect of life events and interpersonal loss on exercise adherence in older adults measured over the course of 1 year and Wigfield et al.'s (1997) study examining changes in competence beliefs across academic and sport domains over 3 years in elementary school children.

Whatever design a life span developmental researcher employs, an important point to remember is that the interest

Table 29.1 Life Span Periods and Select Developmental Tasks

Life Period	Developmental Tasks
Infancy and toddlerhood: birth to 2 years	Emergence of motor, perceptual, and cognitive tasks (walking, language); emotional expression organized by 6 months.
Early childhood: 2 to 6 years	Parents are principle source of competence information; 5 domains of the self; perceptions of ability inaccurate.
Middle childhood: 6 to 11 years	Parents and peers are important sources of competence information; differentiation of effort and ability; global self-worth constructed; emotions able to be verbally acknowledged.
Adolescence: 11 to 20 years	Puberty occurs; abstract thought possible; personality developed by late adolescence; activity rates begin to decline.
Early adulthood: 20 to 40 years	12 domains of the self; further differentiation of domains; life tasks largely positive.
Middle adulthood: 40 to 60 years	12 domains; work and family dominate; life tasks met via strong social networks; personality relatively stable; greater ability to modulate emotions.
Young old: 60 to 74 years	12 domains; retirement typically occurs; number of relationships decrease, importance increases.
Middle old: 75 to 84	More health-promoting behaviors employed; greater selectivity in choice of social contacts; negotiation of life tasks pose greater threat to sense of self; adaptive strategies developed.
Oldest old: 85 and older	Change still possible in physical and psychological processes; ability to compensate for losses critical.

is rarely in age *differences* alone; often, the more compelling issue is in age *changes* (Miller, 1998). The trick, then, is to discover *what* changes and *how* changes occur in thoughts, emotions, and behavior over the life course.

COGNITIVE CHANGES IN THE SELF OVER THE LIFE SPAN

Schindler and Staudinger (2005, p. 7) define the combination of self and personality as "all that we know about our behavior, past experiences, anticipated and idealized futures, needs and wishes, abilities, or weaknesses." The classical trait perspective argues that personality traits are biologically based, and as such do not change over time (McCrae et al., 2000). However, a life span approach acknowledges and attempts to explain intraindividual change and interindividual differences in intraindividual change (Baltes & Nesselroade, 1979). In a recent meta-analysis, Caspi, Roberts, and Shiner (2005) supported the rank-order stability in personality traits, with the level of stability in childhood and adolescence even higher than originally expected, but some change occurring throughout adulthood, although only modestly after age 50. This is 20 years later than the age at which McCrae and Costa (1997) claimed traits to be fixed. In the same meta-analysis, Caspi et al. found some changes in mean level of personality traits, particularly when metatraits such as extraversion were divided into their constituent elements of dominance and sociability. Even the old and very old (ages 70 to 103) have been shown to change their patterns of thoughts and action (Staudinger, Freund, Linden, & Maas, 1999), and many psychology researchers firmly believe in the notion of changes in the self over adulthood (see, e.g., Fung et al., 2005).

How can we reconcile this issue of stable personalities that actually appear to be capable of change? McAdams (1994) provides one plausible explanation. He views personality as existing on three identifiable and distinct levels, or domains. Level I consists of dispositional traits, which tend to be rather stable and predictable. Level II includes personal concerns that address the question "What am I trying to do"? It is at this level that developmental change is likely to occur. Level III addresses the implementation of those concerns, or what McAdams calls "the making of the self" (p. 306). Personal narratives are formed at this level, making possible the process of identity development. Although little empirical research has examined Level III, we could suppose that development and growth would be a hallmark of this component of personality. This idea of multidimensionality of personality is consistent with Markus and Wurf's (1987) view of a dynamic self, one that constantly interacts with the environment to form new and adaptive behaviors. As a cognitive construction (Harter, 1999), the self can be expected to change over time.

There is ample evidence to support the notion of changes in thoughts about the self over the life span. Cross and Markus (1991) found differences in the content and importance associated with future-oriented self-perceptions (i.e., possible selves) in adults ranging in age from 18 to 86. For example, young adults (ages 18 to 24) mentioned hoped-for selves in the physical category (e.g., "being fat," "being in poor health") less often than respondents over 40, who in turn mentioned this category less often than those 60 and over. Hooker and Kaus (1994) found further evidence that health-related selves become more prevalent in middle adulthood than young adulthood. In the physical domain, Whaley (2003) found that inactive middle-aged women were more likely to describe possible selves related to body image than their more active counterparts; thus, we see an example of interindividual differences based on activity level. Where do these differences emanate from? To understand this phenomenon, it is useful to reach back in the developmental cycle to childhood.

The Development of the Self in Childhood

Harter (1981, 1990, 1999) has done much to establish the developmental nature of the self. She states that, "as cognitive processes undergo normative-developmental change, so will self-concepts, including their very structure and organization" (1999, p. 8). At each developmental period, changes in the self are dictated by cognitive abilities and limitations. Cognitive development in particular impacts two important characteristics of the self: *differentiation* and *integration.* With regard to differentiation, this means that as children develop, they create selves in a growing number of domains of experience. In a series of investigations, Harter and her colleagues showed this proliferation in domains, moving from five domains in early childhood (Harter & Pike, 1984) to 12 in college-age individuals (Neeman & Harter, 1987). In subsequent studies, middle and older adults were found to have a similar number of domains, but the content of those domains continued to show developmental change (Messer & Harter, 1989). Marsh (1988, 1991) has also shown this proliferation in domains across childhood and adolescence in his development of the Self-Description Questionnaire. A review of the theoretical underpinnings and empirical research regarding the differentiation of the self in the academic and physical domains can be found in Horn (2004). She concludes that there is substantial evidence for the proliferation of domains and the further differentiation of domains well into adulthood.

Harter (1999, p. 9) describes integration as a process whereby "cognitive abilities that emerge across the course of development allow the individual to construct higher-order generalizations about the self in the form of trait labels." For example, an individual who demonstrates skill in a variety of sport situations may label himself or herself "athletic." In addition, by the age of 8 or 9, children can construct a concept of their overall worth as a person, labeled by Harter global self-worth. In adolescence, according to Harter, Waters, and Whitesell (1998), the concept of global self-worth (synonymous with global self-esteem) is further differentiated across contexts, referred to as relational self-worth. Thus, a teenager may feel very good about himself when he is around his coach and fellow athletes, but not nearly as good when he is around his teachers. A final example of integration is the cognitive skill of integrating contradictory information about the self ("I am happy sometimes/I am sad sometimes") into abstract conceptualizations ("I am moody"; Harter, 1999). Again, research supporting these assumptions and their application to the physical domain is reviewed by Horn (2004) and is not reviewed here. However, one recent study reminds us of the importance of examining changes *within* developmental periods. Shapka and Keating (2005) found that within the adolescent period, levels of competence across most domains of the self-concept increased with age, although scholastic competence decreased. Perceptions of appearance, a domain that Harter (1990) has found to remain important throughout the life span, were most closely tied to global self-worth in this adolescent sample. Given this discussion, it is clear that changes in the structure and function of the self up to late adolescence are profound. But what of the self beyond adolescence? Does integration and differentiation continue into adulthood, and if so, what does it look like?

The Self in Adulthood

Although traditional theories of psychological development posited that personality was developed by late adolescence (18 to 20 years) and fixed and unchanging by age 30 (McCrae et al., 2000), more recent evidence suggests that personality traits continue to change throughout adulthood (Caspi et al., 2005). The notion of the self as dynamic, active, forceful, and capable of change (Markus & Wurf, 1987) is now widely acknowledged (Schindler & Staudinger, 2005). Although personality continues to change, it does so rather sparingly. However, other aspects of the self, particularly those related to the formation of goals and the criteria used to assess progress toward our goals, change significantly throughout adulthood. The discussion that follows highlights processes used by adults to both develop and achieve goals in adulthood (Frey & Ruble, 1990; Fung et al., 2005).

The period of life from age 22 to about age 30 is marked by a number of significant life events. Graduating from college, starting a career, taking on a life partner, and moving away from friends and family are examples of why this life period might be expected to result in dramatic changes in personality, but this is not the case (Caspi et al., 2005). This finding has been used to underscore the perspective of personality being essentially fixed after age 30 (McCrae et al., 2000), but another explanation focuses not on personality traits but on personal goals. Life changes imply the need to adapt existing goals or change goals entirely. Schaie (1996) theorized that entry into adulthood causes a shift in goals from acquiring knowledge to using it. Frey and Ruble (1990) suggest that it may not be age per se but the phase of skill development (learning versus expert versus declining) that determines one's goals. Although these concepts make intuitive sense, there has been precious little research on this age group in the physical domain. Young adults continue to show decreases in vigorous and moderate physical activity (Leslie et al., 2001), but the mechanism for this change is not understood. Thus, this age group deserves closer scrutiny. One mechanism widely believed to influence adult development is Baltes's (1987, 2003; Baltes & Baltes, 1990) theory of selective optimization with compensation.

Selective optimization with compensation is a general theory of development that attempts to explain ontogenetic change as a system of adaptive adjustment (Baltes, 2003). Recall that ontogenesis includes both biological and cultural components. As we reach adulthood, physical maturation is complete and, biologically speaking, decline begins. Baltes argues that at this point, cultural factors become more important with regard to the development and attainment of goals. He further postulates that a process of goal *selection* occurs whereby the individual, either consciously or unconsciously, selects a limited number of goals from a population of possibilities. From here, a process of *optimization* occurs, focusing on the goal-related strategies needed to achieve the goal. *Compensation* involves the acquisition of new goals, priorities, or strategies to replace goals that have been lost (Whaley, 2004). This process has clear application to the physical domain. Athletes, adult exercisers, and individuals recovering from injury all likely utilize the process of selecting goals, optimizing the environment to achieve those goals, and compensating for changes caused by declining abilities or physical restrictions. Langley and Knight (1999) described this process in a narrative case study of an adult tennis player, but research in the physical domain is scant. This theory holds great promise for helping sport and exercise psychology researchers better understand a host of sport-related topics, such as adherence to and transition from sport.

There are a number of other cognitive strategies adults use to make the journey through adulthood more adaptive. Whaley (2004) outlines several strategies, including identity assimilation and accommodation (Whitbourne, 1996; Whitbourne & Collins, 1998), a process similar to selective optimization with compensation but specific to issues related to appearance, competence, and health and changing the sources used to assess competence (e.g., upward versus downward comparison; Baltes et al., 1998). Frey and Ruble (1990) found that adult runners whose performance was declining were more likely than improving or stable runners to mention how they compared to others in the competition and less likely to mention finish times as a goal. Thus, with declining performance, temporal (past performance) comparisons were not used in favor of social comparison (less adept but similar-age others). Again, this would appear to be a fruitful area for research in sport and exercise psychology. The theory of selective optimization with compensation, in combination with motivational theories commonly employed in sport and exercise contexts, could help to further explain development not only over time but across individuals as well. That is, perhaps it is the ability to effectively manage one's environment through selection, optimization, and compensation that differentiates more successful elite performers from their less successful peers. Only research that directly addresses this issue and employs a proper developmental approach will lead to these answers. However, in sport settings it is evident that cognitions tell only part of the story. We must now turn our attention to affective reactions to further understand how a developmental approach may facilitate our understanding of sport participation.

AFFECTIVE CHANGES OVER THE LIFE SPAN

The 1980s signaled a renewed interest in the study of emotions in personality, social, and developmental psychology (Pekrun, 2000). In the 1990s applied fields such as educational and organizational psychology took up this issue, and researchers in sport and exercise psychology have joined this endeavor. Carstensen, Graff, Levenson, and Gottman (1996, p. 239) suggest that the research to date indicates that emotion "may represent one psychological domain that is largely spared from the deleterious effects of the aging process." Thus, this topic would appear to be important and appropriate to researchers in sport and exercise psychology.

Youth sport researchers have long noted the considerable emotional content of sport participation (Crocker, Hoar, McDonough, Kowalski, & Niefer, 2004), particularly as it relates to youth sport contexts (Scanlan, Babkes, & Scanlan, 2005; Weiss & Stuntz, 2004). In most discussions of emotion, emotional development is intimately associated with cognitive and social development through childhood and adolescence and into adulthood (Berk, 1998; Crocker, Hoar, et al., 2004; Crocker, Kowalski, et al., 2004; Magai & McFadden, 1996). Diverse conceptualizations of emotions place them central to human functioning, serving as guides to thought and action (Carstensen et al., 2000; Lazarus, 1991). Thus, this discussion of affective changes in development by necessity incorporates cognitive and social components. I begin this section with a brief discussion of terminology, a critical issue in the examination of emotional development. Because emotions are discussed elsewhere in this volume, my discussion of theory and research is limited to theories that incorporate a distinct life span component but have largely not been utilized in the physical domain. Throughout, links to sport and exercise participation are forwarded.

Distinguishing among Affect-Related Variables

Crocker, Hoar, et al. (2004) argue that sport researchers have too often used terms such as "emotion," "feeling states," "affect," "stress," and "mood" interchangeably, a trend that has contributed to theoretical confusion. Emotions are characterized by a quick onset, common cognitive antecedents, distinctive physiological or neurological patterns, distinctive subjective feeling states, and distinctive facial expressions (Lazarus, 1991). In contrast, Crocker, Kowalski, et al. (2004) describe mood as a more durable global subjective feeling state. There is an absence of facial expressions and physiological patterns evident in emotions. Crocker, Kowalski, et al. further state, "Moods do not involve relationships between a person and a particular object" (p. 338). Typically, in sport and exercise, mood has been measured as a collection of emotions via the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971). Other researchers have argued that at least in terms of the relationship between precompetitive mood states and performance, the POMS may not be the most appropriate choice (Prapavessis, 2000).

Affect is perhaps the hardest term to define, characterized by Crocker et al. as a subjective feeling state varying in hedonic tone (pleasant or unpleasant). An issue for researchers is that the term *affect* is used in a variety of ways to denote anything from a specific emotion to a generalized feeling state. Finally, stress, according to Lazarus (2000), contains an important emotional component and should be viewed as a single topic. In an effort to be conceptually clear, this section focuses primarily on the development and management of emotions, keeping in mind the links between emotions and terms such as feeling states and mood.

Specific to the sport context, Scanlan et al. (2005) present a conceptual model of the development of emotions in competitive sport. The 3-dimensional model proposes that two key emotional responses, stress and enjoyment, are influenced by intrapersonal factors, situational factors, and significant others. In turn, these sources are dependent on both developmental level and developmental domain (social, cognitive, motor, and physical). Scanlan and her colleagues have accumulated significant empirical research that documents the sources of stress and enjoyment in sport, as well as appropriate operational definitions, measures, and methodologies to enable testing of this developmental model. A sport-specific developmental model is certainly an important addition to the field, and Scanlan et al. have offered researchers a template to further our understanding of emotional responses in the sport domain. However, the model targets responses *to* emotions. Other models in psychology deal specifically with the development of emotions and have the potential to contribute to our understanding of this process in a variety of contexts across the entire life span.

Developmental Features of Emotions

Much like theories of cognitive development, theories concerned with emotional development in childhood stress differentiation and elaboration (Harter, 1999; Izard, 1971, 1978). Although there is no consensus, most researchers agree that basic emotions appear to be present in infancy, and by about 6 months emotional expressions are well organized and specific (Berk, 1998). According to Harter, children do not possess the ability to verbally acknowledge affective reactions to the self until middle to late childhood, although she cautions that "the capacity to *experience* these emotions, as inferred from behavioral displays, developmentally precedes the ability to *verbalize* an understanding of these emotions" (p. 94). Thus, it is important to understand the development of emotions to identify them with associated behavioral outcomes in adolescence and adulthood. Interpersonal relationships are critical to this process, and as such parents and other important adults can influence the formation and meaning associated with emotions such as pride, shame, and guilt. For example, a child who receives a negative evaluation of his or her sport performance ("You are no good at soccer") may feel shame at not living up to parental expectations. Harter states that the child's reaction "will eventually become internalized, such that the child can experience shame in the absence of the overt reactions to others" (p. 90).

Self-related emotions result in behavioral consequences (Harter, 1999). Pride results in enhanced perceptions of competence and self-worth, leading to a desire to share with significant others these positive feelings. The activity is likely to be repeated and practiced for the child to capitalize on these positive outcomes. Collective pride (e.g., a school feeling pride for the accomplishments of an athletic team) is associated with shared positive affective experiences that serve to support social relationships. In turn, these feelings of collective pride result in activities that enable the group to build on these feelings, such as pep rallies and fund-raising events. The behavioral outcomes of shame and guilt are often unfavorable and are typically quite distinct. Shame, as the product of transgressions and wrongdoings that violate one's *own* ideals for the self, motivates the individual to avoid others or to become passive when one's ideals do not match reality (e.g., on the athletic field). Guilt is related to violations of standards or moral rules for how one *ought* to behave toward others and can result in prosocial behaviors by inhibiting aggressive behavior or approaching the individual who may have been harmed (Harter, 1999). Of particular importance, in all of these examples, emotions, perceptions of the self, social relationships, and behavior are intimately related.

Higgins (1987) takes this link between the self and emotions one step further. In discrepancy theory, he posits that an inability to achieve congruence between our self-concept (who we are) and our personally relevant self-guides (who we or others would like us to be or think we are) results in particular negative emotional reactions and associated vulnerabilities (Whaley, 2004). Negative emotional states can represent the absence of positive outcomes, associated with dejection-related emotions such as disappointment and sadness, or the presence of negative outcomes, associated with agitation-related emotions such as fear or aggression. There is a considerable body of research that supports this theory; for example, specific types of discrepancies have been linked to depression (Bruch, Rivet, & Laurenti, 2000) and eating disorders (Snyder, 1997). But it has rarely been employed in the sport domain. However, the theory would appear to have implications for research and practice with athletes and exercisers, particularly as it relates to affective reactions to failure and how these may impact ensuing performance. Of particular relevance here would be potential changes in discrepancies and reactions to discrepancies over the life span.

Differential emotions theory (DET; Izard, 1971) presents another view of emotional development. In this approach, emotional feelings serve as the principal motivational system for human thought and action (Dougherty, Abe, & Izard, 1996). In addition, each discrete emotion (joy, sadness, fear, disgust) is a motivational subsystem of personality, retaining its motivational properties across situations and across the life span. Specifically, emotional *experience* is considered constant across the life span, whereas the cognitions and actions associated with discrete emotions change. Differential emotions theory posits that emotions can occur independent of cognitions, a point that distinguishes this view from others; Lazarus (1991), for example, views cognitions as a necessary antecedent to all emotional experiences (Dougherty et al., 1996).

Differential emotions theory posits several reasons why emotion feelings remain constant while the cognitive system constantly changes. Dougherty et al. (1996, p. 31) state that it is "highly adaptive for the individual to have a stable system of subjective experiences amidst myriad changes and a stable framework of motivational forces for responding to environmental contingencies." For example, danger will always elicit fear, and the constancy of the fear feeling will reliably predict the behavioral response of avoidance. If this feeling were to change, the associated response may change as well. In addition, the constancy of emotion feelings allows individuals to learn and generalize from personal experiences. For example, a loss of someone close allows us to prepare for that eventuality in ourselves and in others, as a predictable response of fear to a threatening situation allows us to plan how to avoid such a threat in the future. This constancy principle is critical for the helping professions to understand, including, one might expect, sport psychologists.

Most researchers acknowledge that adulthood brings with it a greater ability to modulate emotional reactions (Malatesta & Izard, 1984). Thus, in a sport context, we might expect a high school athlete to respond to winning with unbridled enthusiasm, tears, or screams, whereas a master's-level athlete may be content to display his or her emotions through a smile. This increase in the modulation of emotions should not be viewed as an indication of decreased emotional experience in adulthood and older age. In fact, central to DET is the belief that emotions give meaning to individual life and relationships (Dougherty et al., 1996). In previous theories of emotions, the emotional lives of older people have been described as "flat, blunted, and impoverished" (p. 28). A theory that expresses a more positive view of emotions and aging and links emotions to relationships is Carstensen's (1993) socioemotional selectivity theory, or SST.

Emotions and Social Relationships

According to Carstensen's (1993) theory, as individuals' age, interaction is motivated by the regulation of emotion more than either the acquisition of information or the fulfillment of affiliation needs. Accordingly, with time, relationships are more likely to serve an emotional function rather than an informational or affiliative function, such that adults and older adults generally become more selective in their choice of social contacts. Research examining SST has supported propositions of the theory. For example, Lansford, Sherman, and Antonucci (1998) discovered that although older adults had a smaller number of social contacts, the satisfaction with that social network increased. With age, periods of highly positive emotional experience are more likely to endure, whereas highly negative emotional experiences are less stable (Carstensen et al., 2000). Thus, SST combines emotions, goals, and motivation to explain age-related changes in social behavior.

Earlier theories that attempted to explain changes in social relationships, such as disengagement theory (Cumming & Henry, 1961) and activity theory (Havighurst, Neugarten, & Tobin, 1968), took a decidedly negative approach to aging. Disengagement theory posits that reduction in social contact with age is mutual and adaptive, such that society withdraws from the individual and the individual from society in a symbolic preparation for death. Activity theory is not nearly as dire, predicting that older adults desire social contact, but social and physical barriers to interaction result in declining rates of interaction. Neither of these theories satisfactorily explains social relationships in older adults. Even Baltes's (1987) theory of selective optimization with compensation, the model of successful aging discussed earlier, describes how goals are adjusted in reaction to age-related losses (Fung et al., 2005).

In contrast, Carstensen's (1993) theory represents a proactive approach to understanding changes in motivation in older adulthood (Fung et al., 2005). Unlike most developmental life span theories, Carstensen developed her theory in an effort to explain the social relationships of the oldest old, eventually becoming intrigued with the adaptive process evidenced in this population and expanding her research to groups as young as adolescents. One outcome of this research was the realization that the relationships of younger adults mimic that of older persons when the circumstances are right. That is, it is not simply the passage of time that results in change, but the interactions of the person's past, present, and future in combination with environmental opportunities that result in change. For example, Carstensen and her colleagues (Fung et al., 2005) have shown that a number of time-related events that signal endings, from college graduation and geographical relocations to a severe life-threatening illness, elicit motivational changes similar to those seen with aging.

The implications of this theory are numerous. First, people are active agents in their development and, as a result, change goals in an adaptive fashion. With regard to relationships, it is clear from Carstensen's (1993) research that older adults, although they may have a smaller number of close relationships, invest more in those existing relationships. Of particular importance, the process of becoming more selective begins in young adulthood. Thus, it may have implications not only for older adult sport and exercise participants, but for young and middle-aged participants as well. Fung et al. (2005) provide a provocative example. Senior centers around the country attempt to encourage social interaction among their clients. Although the thought of increased social contact is an admirable one, if socioemotional selectivity theory accurately reflects the needs of adults, then encouraging older adults to form new and typically superficial relationships does not meet their emotional and psychological needs. One might extend this example to the exercise domain, where current research encourages practitioners to increase group cohesion (Loughead, Colman, & Carron, 2001) or create "peer captains" in an attempt to increase adherence (Grove & Spier, 1999). We might expect these efforts, however well intended, not to meet older adult needs. Instead, we might be better served to use limited resources to further understand how to link physical activity to the emotional needs of older adults. For example, an exercise program that targets older adults together with their significant social relations (e.g., grandchildren) is likely to be seen by adults as fulfilling their goal of further developing that emotional bond; for the child, it may serve as a novel context for learning more information and developing new relationships.

In sum, the area of emotional development, though fraught with definitional and conceptual challenges, would appear to be ripe for study in sport and exercise contexts. Differential emotions theory and socioemotional selectivity theory offer researchers in sport and exercise new perspectives on the development and role of emotions across the life span. Emotions are intimately tied to cognitions and behavior, a point discussed repeatedly in this section. The following section expands on the issue of behavior, focusing on how developmental changes in cognitions and emotions may influence changes in behavior over the life span.

CHANGES IN BEHAVIOR OVER THE LIFE SPAN

Behavior is more difficult to track than emotion in terms of developmental change. In sport research, behavior is typically measured as a performance-related or participation-related variable, including the choice to participate, the intensity or effort exerted on the task, and the persistence evidenced in remaining with a task. In exercise contexts, behavior is similarly measured, relating to the choice to exercise and then measuring exercise behavior with regard to duration, frequency, mode, intensity, or some combination of those variables. Gill (1997, p. 41) acknowledges that researchers in sport and exercise psychology "do not spend much time on behavior measures, despite their central role in psychology." Perhaps one explanation for this oversight is the difficulty in operationally defining "physical activity behavior."

Physical activity was defined by Caspersen, Powell, and Christensen (1985) as any bodily movement produced by skeletal muscle contractions that result in energy expenditure. This rather general definition can include such diverse (albeit interrelated) constructs as play, exercise, leisure activity, sport, housework, and gardening. In fact, what constitutes physical activity has been the subject of much debate, particularly as it relates to women (Ainsworth, 2000). This wide range of activity types clearly presents a problem in terms of charting behavior and potential behavior change over the life span. For example, over the life course, physical activity participation might be described sequentially as play, competitive sport, exercise, and finally lifestyle activity. Are these changes in mode developmental? Surely some aspects of changes in physical activity behavior include a developmental component, but how do we make this assessment? An example of this dilemma is illustrated in the discussion of physical activity levels that follows.

Perhaps the most recognized change in physical activity-related behavior over the life span is the decrease in activity level (frequency, intensity) with age (Leslie et al., 2001; U.S. Department of Health and Human Services, 1996; World Health Organization, 2002). But is this change developmental in nature? Although development incorporates the study of change over time, development and change are not equivalent terms (Horn, 2004). According to Lerner (1997, cited in Horn, 2004), many changes experienced over the life course may or may not have a developmental component. The classic example is weight. Through adolescence, physical maturation is part of the developmental process. Changes through adulthood, however, are more likely due to diet, lack of exercise, or illness; as such, they are not developmental. Lerner suggests two additional characteristics. Developmental change must (1) be systematic and organized and (2) have a successive character. With regard to the relationship between age and physical activity, although there does appear to be a fairly systematic change with increasing age, this change does not seem to be organized or to have a successive character. Instead, physical activity occurs in the context of life span transitions and cultural contexts (Malina, 1996).

The cultural context is particularly important in examining changes in activity behavior through older adulthood. O'Brien Cousins (1998) described 10 contextual or situational variables that potentially impact late-life exercise, including age, education, employment history, culture, and childhood socialization. Many consider age a social construction that defines social behavior (McPherson, 1994). Thus, age itself may not be responsible for behavior change; instead, cultural norms, values, and belief systems associated with aging (e.g., time earned to rest) guide the behavior of individuals. To understand the relationship between activity levels and age, longitudinal studies, following the same cohorts over time, as well as comparing cohorts across time, are necessary. Because at this point those studies do not exist, we are left to hypothesize reasons for these relationships. One potential window on this phenomenon comes from the health behavior field.

Health-promoting behaviors are defined as behaviors that sustain or enhance well-being (Kulbok, Baldwin, Cox, & Duffy, 1997). Researchers suggests that older adults are more likely to use health-promoting behaviors than younger adults (e.g., Gu & Eun, 2002). Recently, Becker and Arnold (2004) examined the health behaviors of young (18 to 39 years), middle (40 to 59 years), and older (60 to 92 years) adults. Using the Health Promoting Lifestyle Profile II, they assessed behaviors related to spiritual growth, interpersonal relations, nutrition, physical activity, health responsibility, and stress management. Overall, there were significant age group differences on five of the six subscales, with older adults scoring higher than the other age groups on health responsibility and nutrition, but lower than younger and middle-aged adults on stress management. With regard to physical activity, young adults scored significantly higher than middle-aged adults, and older adult scores on that scale were also higher than scores for middle-aged individuals. These findings highlight the complexity of age-related change. The authors explain their findings as relating to perceived health and control over health rather than age per se, but underscore the need for further research that examines *why* older adults tend to use more health-enhancing behaviors. Information from the previous sections, such as the adaptability of adults' self-perceptions to changes in ability and emotional changes, as described by Carstensen and her colleagues (1993, 2000), provide theoretical grounds for such investigations.

A complementary explanation for changes in physical activity behavior with age comes from an examination of developmental tasks. Markus, Cross, and Wurf (1990) describe the need for individuals over the life span to develop competence on a variety of tasks for further development to occur. In young adulthood, these tasks are largely positive (e.g., completing one's education, committing to a career, parenthood). Through middle age changes are less dramatic, and resources for maintaining competence are high (e.g., stable support networks), and so even monumental changes (loss of employment, unexpected health issue) are typically managed effectively. In older adulthood the successful negotiation of life tasks can pose a considerable threat to one's sense of self and perceptions of control (Whaley, 2004).

Fortunately, as discussed in previous sections, older adults develop a variety of adaptive skills and strategies to help them deal with these challenges. These strategies might help to explain why older adults appear more likely than middle-aged adults to embrace physical activity (Becker & Arnold, 2004). For example, physical activity may itself become an adaptive strategy to deal with challenges such as health conditions or the loss of a loved one. Thus, as posited by Carstensen (1993), the perception of time as more limited drives behavior and, in the case of health, may drive health-related behaviors such as physical activity.

A final intriguing connection between age and physical activity relates to body-related perceptions. Harter (1990) has shown how perceived physical appearance is a primary contributor to global self-worth across the life span. Wilcox (1997) found that attitudes regarding the body were important in adults ages 20 through 80, but interestingly, with increasing age, women who exercised had greater body satisfaction than nonexercisers. Loland (2000) also found that satisfaction with the body increased in women who were moderately or highly active, but decreased with age in inactive individuals. Whaley (2003) found a similar relationship with body-related possible selves; nonexercising middle-aged women were more likely to have future-oriented selves related to the body (weight gain, fear of becoming severely overweight) than women who were currently active, even at low levels of activity. These findings suggest that women may be able to use physical activity as a tool for increasing positive perceptions of their body, despite age-related (actual) change; they selectively attune to the positive changes in their body that result from activity, optimizing their environment. Compensation may relate to aspects of their body-related perceptions they choose to focus on: strength rather than shape, or feelings of fitness rather than youth.

This leads to a logical question: Can we *teach* these regulatory strategies to adults who do not seem to develop them on their own? The answer would appear to be yes, *if* the appropriate groups are taught the appropriate strategies. The skills that sport psychology researchers and practitioners utilize with college-age athletes (visualization, goal setting, and other modes of cognitive restructuring) may be a logical starting point. Similar cognitive-behavioral strategies have resulted in increased adherence in adult exercisers (e.g., Haber & Lacy, 1993; Hallam & Petosa, 1998), although the positive outcomes of cognitive-behavioral strategies are not always consistent (van der Bij, Laurant, & Wensing, 2002). Because interventions are most likely to be effective when they are designed for a particular target population's needs (Mann & Kato, 1996), it would seem that including developmental factors along with gender, race, and other variables may maximize program effectiveness. Implications for practitioners and suggestions for future research are discussed in the concluding section.

FUTURE RESEARCH AND PRACTICAL IMPLICATIONS

The preceding discussion of developmental process and theory should provide the reader with a number of significant and important potential research directions. The research to date has primarily focused on developmental changes in youth sport participants' cognitions and affective reactions, particularly relating to self-perceptions and motivation

(Weiss & Raedeke, 2004). Far less research has examined developmental change across adult competitive sport contexts, and even less in exercise and injury-related contexts. Many research examples are provided by the authors in Weiss's (2004) edited text, *Developmental Sport and Exercise Psychology: A Life Span Perspective,* and readers are encouraged to explore this text for ideas. However, there are several ground rules to remember. For example, keep in mind that *changes with age* do not equal *developmental change,* and that studies that include a variety of ages are not always developmental in nature. As I discussed in the opening section of this chapter, there are a variety of ways to construct a developmental study, from comparing age groups to following one age group over time; the critical issue is having a specific rationale for the selection of the age group(s) and paying careful attention to the potential for differences. As important to the selection of age groups is the choice of measurement tools and statistical analyses.

Measurement Issues in Developmental Research

Brustad (1998) discussed measurement issues related to developmental change in children and adolescents in sport. He states, "One very fundamental consideration . . . relates to the fact that children, adolescents, and adults frequently view the world from qualitatively different frameworks due to differences in maturation and experience" (p. 468). This simple truth is often neglected in perhaps the most frequently employed weapon of our research: paper-and-pencil instruments. Using Harter's process of developing age-appropriate self-perception measures as a template for sport and exercise researchers (e.g., Harter & Pike, 1984), Brustad recommends several steps that should be regularly employed before beginning a research study. Researchers should begin the process of research by conducting a content analysis of the topic of interest to assess the potential for developmental differences. This information should be used in designing the study and selecting the measures. For children, it is particularly important to establish the comprehensibility of the measures (e.g., through pilot testing and follow-up interviews), as well as the concurrent and construct validity of the measure for the target age group. Finally, the factor structure of the measure should be assessed to see if a stable factor structure exists across developmental groups. Significant changes in the factor structure across age groups may indicate that the items are construed differently or that the construct in question infers different meaning to the individual. These issues are discussed in Baltes et al.'s (1988) classic research methods text under the label of *equivalence.*

Measurement equivalence, according to Baltes et al. (1988), is a critical issue in developmental assessment. They define equivalence in terms of the following example:

> Suppose we give a test of achievement orientation to a group of males and a group of females and observe a ten-point difference in the average score when the two sexes are compared. Does the difference mean that one sex has more achievement orientation than the other, or that the accuracy of the measure is different for the two sexes, or that the test measures somewhat different attributes in the two sexes? (p. 157)

Although this example focuses on gender, the parallels to age-related change should be clear. The discussion points in this chapter provide several reasons to question the equivalence across age groups of some of the measures typically employed in sport and exercise psychology. For example, it was shown in the discussion of socioemotional selectivity theory that the way adults and older adults form relationships, and the importance associated with those relationships, differs for college-age adults. Why, then, do we consistently see generalizations made from college-age samples to all adult populations regarding the role of significant others in sport and exercise? At the least, we should take a moment to pause and consider developmental differences when we attempt to draw conclusions. Baltes et al. conclude there are no universal solutions to measurement equivalence problems. They suggest that "the reader should grasp the nature and extent of the problem and, until it is more convincingly resolved, realize that the validity of data-based interpretations depends on measurement-equivalence issues and that one should, therefore, qualify conclusions accordingly" (p. 159).

A related issue is which statistical procedures best capture change over time. Again, the 1988 text by Baltes et al. (sadly, now out of print) is an authoritative source. Procedures as familiar as longitudinal designs, less familiar sequential strategies, and time-series analyses are clearly explained. More recently, Schutz and Park (2004) reviewed the need to more carefully consider statistical analyses used with longitudinal designs. They discuss the dilemma inherent in the relationship between the analysis of change and reliability, as the first assumes change over time, whereas the latter assumes no changes in mean scores over repeated assessments. Because of this conundrum, the measurement of change is critical and techniques such as linear growth modeling would appear to be the most appropriate method to employ. There has also been a growing recognition of the value of qualitative designs such as life history and narrative approaches in capturing the intricacies of change over time (see, e.g., Langley & Knight, 1999; Paoletti, 1998). In sum, effective life span research requires knowledge of potential change, together with the use of appropriate measurement tools and techniques. The knowledge base is there; what we seem to lack is the incentive to follow through.

How Can We Encourage a Life Span Perspective?

Throughout this chapter, I have presented an argument for the need to more fully incorporate a life span perspective into sport and exercise psychology research and practice. There is sufficient theory, compelling empirical research, and important practical implications to warrant substantial interest in this area, but this perspective has yet to be embraced in our field. Others (e.g., Weiss & Bredemeier, 1983) as passionate as I have thrown down the gauntlet for more developmental life span research before without success. So, perhaps a new approach is in order. Instead of concluding with why we *should* do life span developmental research, I now focus on the question, *Why shouldn't we?* That is, I hope to show why a life span approach makes sense and can be a manageable, important part of our research agenda.

Recall that four assumptions guide a life span perspective: Development is a lifelong process, a life span perspective is multidimensional and multidirectional, life span development is highly plastic, and life span development is embedded in multiple contexts. The argument can also be made that *physical activity* is a life span process that is multidimensional, highly plastic, and embedded in multiple contexts. Why wouldn't we, then, take a life span perspective in studying the psychology of sport and exercise? In addition, a recurring chapter theme is that development is marked by both stability and change. Whether one is discussing self-perceptions, affective reactions, or actual behavior, we can find components that remain relatively stable (personality, emotional experience) while others fluctuate across time or across contexts (self-efficacy, emotional reactions). Why shouldn't we embrace this perspective in attempting to understand such diverse processes as transitions from sport, the quest for optimal performance, and the choice to persist in exercise versus discontinuing? Our field is all about change, yet we rarely study that phenomenon directly. A life span developmental approach embraces the notion of change and allows for the investigation of the mechanisms underlying change with age. In addition, a life span perspective acknowledges consistency and change within individuals. Thus, it allows us to examine group differences along with intraindividual change. Without this approach, it is more difficult to explain differences in cognitions and feelings in an intact team or to describe why an individual may be wholly committed in his or her chosen sport, only to discontinue participation 6 months later.

There are potential reasons why the field has not embraced this approach. For one, it may seem overwhelming. Although there is a clear and present need for longitudinal studies, the time and investment necessary for such an approach may not be reasonable to expect of many, particularly new professionals. However, recall that there is value in developmental studies that take the approach of comparing groups based on developmental criteria, and of choosing one group based on a solid developmental rationale. The inclusion of this information in research studies would go some distance in promoting a developmental perspective without putting an additional burden on the researcher. In addition, longitudinal studies can often be treated as works in progress, reporting trends and results along the course of the study rather than waiting for the ultimate end point.

Another potential reason for the hesitancy in incorporating a developmental approach is the reliance on convenience samples for our research. As a result, studies that intend to focus on adult issues (e.g., exercise adherence) use college students as their sample population. Although there is value in examining this group, it should be evident that there is a danger in assuming the findings generalize across all populations. One challenge to researchers is to reach beyond the friendly confines of their own institution to community groups, churches, and civic organizations for their sample populations. The more representative our samples are, the more generalizable our findings will be. Creating ties to the community does take time, but the benefits in education, public relations, and service to the community far outweigh the costs.

In conclusion, a careful reading of this chapter should leave the reader with the question: Why *don't* we do more life span developmental research? I have presented information regarding what this approach is and how to structure a life span study. I then reviewed theory and empirical support for life span developmental change in cognitions, emotions, and behavior, focusing on issues of stability and change. This was followed by a discussion of methodological considerations addressing how life span developmental research should be conducted. The tools for designing, conducting, and evaluating a life span developmental study are readily available, along with solid, applicable theories and models to guide these endeavors. The only question remaining is: What are you waiting for?

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CHAPTER 30

Advances in Sport Morality Research

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The view that sport can be a useful venue for developing character has a venerable history. From the writings of ancient Greek philosophers to the declarations of modern politicians, educators, sports people, and theologians, sport has been portrayed as a builder of character. This claim has found a place in popular folk wisdom, reflected in the cultural adage "Sport builds character."

Does participation in sport actually promote good character? No amount of research can answer such a broad and vague question. Sport experiences are infinitely varied, and the term *character* can be defined and operationalized in numerous ways. Every sport context is unique, as is every sport participant. Still, most sports are socially rich environments that provide participants with many opportunities to interact with others in ways that have moral significance. There are ample opportunities to nurture and practice capacities for role-taking, empathy, conflict resolution, and self-control, to name just a few of the social processes that are relevant to character development. It is plausible, then, that active involvement in sports might, under the right circumstances, provide the kind of cognitive and social stimuli needed to promote at least some aspects of character development. On the other hand, some point to the authoritarian way that most sport teams are run and the all too frequent instances of flagrant cheating and aggression (e.g., Shields, Bredemeier, LaVoi, & Power, 2005) to suggest that sports might actually impede moral growth.

At the beginning of our chapter in the previous edition of this *Handbook,* we lamented that the field had received "little empirical attention" (Shields & Bredemeier, 2001, p. 585). Fortunately, in recent years, the study of moral dimensions of the sport experience has advanced considerably. In this chapter, we summarize and comment on the theory and research in this area and suggest new directions for the field.

To economize on space, we do not replicate here the theoretical introduction to the field that is available in the second edition of this *Handbook* (Shields & Bredemeier, 2001). A more extended discussion of theoretical frameworks is also available elsewhere (Kavussanu, 2002; Shields & Bredemeier, 1995; Weiss & Bredemeier, 1990; Weiss & Smith, 2002). In these and other works, the contrasting perspectives of social learning and constructivist theorists are presented. In brief, classical social learning theorists explained human behavior as a response to observed models and the individuals' reinforcement history. In contrast, constructivists adopted an interactional perspective that gave equal weight to the creative, meaning-construing agent and environmental influences. The reader unfamiliar with these theoretical positions may wish to consult these other sources.

In this chapter, we have sought to provide a fair and balanced summary and analysis of the literature on sport and morality. Still, writing is a personal act and the chapter reflects our own biases, as well as our limitations. We write from within the constructivist paradigm in psychology, and our theoretical commitments permeate our reflections and comments. The reader should be aware that others surveying the literature might organize and interpret it quite differently.

The chapter is divided into five major sections. In the first, we focus on personal psychology as it relates to sport experience, examining, in order, the topics of moral values, sportspersonship, moral reasoning, and game reasoning. The second section focuses on research designed to identify factors that might predict moral behavior in sport. Here, we focus initially on specific moral constructs related to moral action, followed by a consideration of motivational issues tethered to moral functioning. In the third section, we review the literature on efforts to use sport or physical education for moral education. Finally, we conclude with an extended discussion of possible directions for future advances in theory, research, and practice. In this concluding section, we discuss such themes as achievement ethics, character and virtue, and civic responsibility.

SPORT EXPERIENCE AND ITS MORAL CORRELATES

In this section, we survey the literature that correlates sport participation with specific constructs related to moral psychology. First, though, it may be helpful to describe what we mean by morality. Morality is concerned with people's rights and duties, whether defined formally or more informally. It involves thinking and dialoguing about needs and interests, what is fair, and what is compassionate. It's about respect and responsibility. Phenomenologically, morality is experienced as an *ought* regarding what should be done. People behave morally when they do the right thing for the right reason. Thus, *moral* behavior can be distinguished from *prosocial* behavior. Whereas prosocial behavior is any action that benefits another (regardless of motive), moral behavior ushers from moral motivation.

Although philosophers debate divergent ethical theories, there is still sufficient consensus about right and wrong to enable scientific investigation of morality (Haan, 1982). For example, there is a general consensus that unprovoked aggression is wrong. In sport, there is broad agreement that seeking to gain a competitive advantage through cheating or extralegal injurious actions is wrong. More positively, there is wide endorsement of the idea that efforts to go beyond the formal rules, when necessary, to uphold basic norms of fairness, respect, and human decency are praiseworthy. Moral research can build on these points of consensus and investigate the causes and correlates of such behaviors.

With regard to moral research in sports, it should be emphasized at the outset that little is known about cause-effect relationships. Almost all of the research to date has been cross-sectional in design; in the future, hopefully, we will see more longitudinal and intervention studies. Still, the existent literature dangles some interesting possibilities before us. Investigators from a variety of theoretical perspectives and research traditions have begun to tackle the complex issues involved in the moral psychology of sport. One of the first research areas in the moral psychology of sport focused on moral values, and we turn now to a summary of that literature.

Moral Values

Schwartz (1994, p. 21) has defined values as "desirable transsituational goals, varying in importance, that serve as guiding principles in the life of a person or a social entity." Two primary methods have been used to investigate the relationship between sport participation and the relative priority given to various values. One approach relies on the use of non-sport-specific value surveys, such as the Rokeach Values Survey (Rokeach, 1973). The other research approach employs sport-specific value surveys.

The first approach lends itself to comparisons among athletes and nonathletes. Lee (1977, 1986) used Rokeach's (1973) approach to assess the value orientation of athletes and a comparison group of nonathletes. He found no difference between the two groups, other than that athletes tended to place more value on being good at what they did. In contrast, Davis and Baskett (1979) concluded that college athletes differed from nonathletes in terms of their terminal but not instrumental values. In Rokeach's values taxonomy, terminal values are those that pertain to desirable end states of existence, whereas instrumental values concern desirable modes of conduct (see Shields & Bredemeier, 1995, for a critique). Lee (Lee & Cockman, 1995) has also employed more open-ended methodological strategies to identify the value structures of athletes.

Webb (1969), exemplifying the second approach, developed a very simple instrument to assess the value priorities of sport participants. In the original Webb Scale, respondents were asked to rank-order the values of winning, playing fair, and playing well. The value of having fun was added by a number of subsequent investigators. Research utilizing the Webb Scale has generally supported the contention that children tend to move from an initial *play orientation,* in which fairness or fun are of greatest value, to a *professional orientation,* in which winning is valued most and fairness least (e.g., Blair, 1985; Knoppers, Schuiteman, & Love, 1986, 1988; Maloney & Petrie, 1972; Mantel & Vander Velden, 1974). After enjoying considerable popularity, the scale fell from use as researchers (e.g., Knoppers, 1985) pointed out that the rank-order methodology did not reveal information about how important each value was to the respondent, that the value terms themselves were open to multiple interpretations, and that ranking values devoid of contextual information was not a reliable way of accessing value priorities. Though some of these problems were addressed in later revisions (Greer & Lacy, 1989; Knoppers, Zuidema, & Meyer, 1989; Lacy & Greer, 1992), researchers have moved on to other approaches.

More recently, Lee, Whitehead, and Balchin (2000; Lee, Whitehead, Hatzigeorgiadis, & Ntoumanis, 2001) have sought to renew interest in values among sport psychologists and have developed the Youth Sport Values Questionnaire. Value items were derived from analysis of moral dilemma interview data. Pilot tests have demonstrated that respondents generally valued enjoyment and personal achievement over winning, and that value rankings were consistent across subgroups based on gender, age, sport type, and level of performance.

Sportspersonship

When people think of morality and sport, often what first comes to mind is sportspersonship. Sportspersonship has been a topic of considerable, but intermittent, interest to sport psychologists who have developed a large number of inventories assessing it over the years (e.g., Haskins, 1960; Johnson, 1969; Lakie, 1964; Vallerand, Briere, Blanchard, & Provencher, 1997). Sportspersonship can be thought of both as a set of attitudes and as behavior that gives expression to those attitudes. Early assessments of sportspersonship often targeted *attitudes* (e.g., Kistler, 1957; Lakie, 1964). It is beyond our scope to review each of these scales separately, nor is there need to do so. Very few have been used beyond pilot investigations, and most did not meet minimal criteria for psychometric adequacy (Bredemeier & Shields, 1998).

Though researchers have had difficulty operationalizing the term, most people would say about sportspersonship what Supreme Court Judge Potter Stewart said about pornography: "I know it when I see it." In fact, there appears to be a fair bit of commonsense agreement about the behavioral meaning of the term. Comparing a list of conceptions offered by children in 1963 (see Bovyer, 1963) with a list compiled nearly 3 decades later (see Entzion, 1991) reveals remarkable consistency in the basic contents of sportspersonship. Children's conceptions of the term include adherence to norms and conventions that serve to maintain the social order (e.g., take turns, follow the rules), as well as more explicitly moral concerns (e.g., don't hurt anybody, don't cheat, don't brag).

To remedy some of the difficulties that have plagued sportspersonship research, Vallerand and his colleagues sought to behaviorally define and measure sportspersonship. In the first phase of their investigation, they asked male and female athletes ($N = 60$) to present their definition of sportsmanship and to offer examples (Vallerand, Deshaies, Cuerrier, Briere, & Pelletier, 1996). From these definitions and examples, 21 situations were identified that potentially exemplified the meaning of sportspersonship. These items were then presented to a sample of 1,056 French Canadian athletes ranging in age from 10 to 18. These athletes rated the extent to which each of the items dealt with sportspersonship. A subsequent factor analysis revealed five factors. The first four of these related to respect and concern for (1) one's full commitment toward sport participation, (2) the rules and officials, (3) social conventions, and (4) one's opponent. The final factor focused on a negative approach toward sport, a "win at all costs" approach.

Based on this preliminary investigation, Vallerand developed the Multidimensional Sportspersonship Orientations Scale (MSOS; Vallerand et al., 1996; Vallerand, Briere, et al., 1997). Subsequent research utilizing the MSOS, however, has raised questions about its psychometric properties (Gano-Overway, Guivernau, Magyar, Waldron, & Ewing, 2005; Lemyre, Roberts, & Ommundsen, 2002; McCutcheon, 2000), especially the negative approach to sport subscale (e.g., Dunn & Dunn, 1999; Lemyre et al., 2002; Ommundsen, Roberts, Lemyre, & Treasure, 2003; Ryska, 2003). To date, we do not know if scores on the MSOS correlate with different types of sport experience, nor do we know if it can capture developmental shifts in underlying values.

Both the study of moral values and the study of sportspersonship focus on the content of moral thought. Seeking to identify specific attitudes, values, or behavioral predispositions is one strategy for conceptualizing psychological characteristics related to morality. But knowing that a person prefers Value X to Value Y does not tell us *why* she or he values one over the other. A recurring limitation of studies of morally relevant attitudes, values, and behaviors is that they often do not effectively describe or explain the nature or workings of underlying cognitive processes. Consequently, it is often difficult to understand how people choose between conflicting values; how and to what degree people's attitudes, especially incongruent attitudes, inform behavior; and how people's development impacts on their attitudes, values, and behavior.

Moral Reasoning

A different strategy for investigating moral dimensions of sport was made possible by the pioneering work of Piaget (1932/1965) and Kohlberg (1981, 1984). These investigators sought to investigate the *structure* of moral reasoning that a person typically employs in situations involving moral conflict and choice. They developed a variant of constructivist theory often called structural developmentalism. The central feature of this approach is the identification of regular, age-related changes that occur in patterns of moral thinking about conflicting values. These theorists make a critical distinction between the *content* of a person's thinking and the underlying *structure* of reasoning. Although there can be an almost infinite variation in the contents of thought, there are relatively few underlying structures.

There are numerous variants in the structural developmental paradigm (see, especially, Gibbs, 2003; Haan, Aerts, & Cooper, 1985; Hoffman, 2000; Kohlberg, 1981, 1984; Piaget, 1932/1965; Rest, 1979; Turiel, 2002). Despite their differences, these theorists share the view that children undergo regular age-related changes in the underlying structure of their moral reasoning, and that with age and appropriate experience comes increasing moral reasoning competence. Progression toward moral reasoning maturity is typically described in terms of a hierarchical sequence of stages, levels, or phases. Most famous and widely utilized is Kohlberg's taxonomy of six developmental stages of moral reasoning development. Based on a combination of empirical evidence (Kohlberg, 1984) and philosophical argumentation (Kohlberg, 1981), Kohlberg claimed that each succeeding stage in the developmental hierarchy is both more mature and more adequate.

For those who look to sports to provide a positive stimulus to development of moral reasoning, the research has not been encouraging. Utilizing Kohlberg's (Colby & Kohlberg, 1987) interview technique with 65 male Division I intercollegiate basketball players, Hall (1986) found that her sample scored lower on moral judgment than reported college norms. Similarly, Bredemeier and Shields (1984b), using Rest's (1979) Defining Issues Test, found that their sample of 24 male and 22 female intercollegiate basketball players scored lower than reported norms of college students.

In the first study to compare athletes and nonathletes directly on moral reasoning maturity, Bredemeier and Shields (1986c) utilized Haan's (1978, 1983, 1991; Haan et al., 1985) interactional model of morality to assess the moral reasoning of 30 male and female intercollegiate basketball players and 10 nonathletes. They found that the athletes had significantly less mature moral reasoning than their peers. However, a follow-up study that added 20 swimmers to the sample concluded that there were no statistically significant differences in moral reasoning development between the swimmers and the nonathletes (Bredemeier & Shields, 1986c). In sum, the basketball players, but not the swimmers, scored lower on moral reasoning than nonathlete peers. Because athletes from only two sports were assessed, it is unclear whether the observed differences were due to factors internal to some types of sports (e.g., team sports versus individual sports, contact sports versus noncontact sports) or factors extrinsic to the athletes' sport experiences (e.g., GPA was not controlled for in the study).

Similar results were obtained by Stevenson (1998), who employed a measure of cognitive moral reasoning developed specifically for his study of 213 Division I student athletes and 202 general student peers. Tapping a broader cross-section of sports, he found that the team sport athletes, both male and female, had significantly lower moral judgment scores than did either the nonathletes or the individual sport athletes. In contrast, utilizing the Defining Issues Test (one of the most well-established measures of moral maturity), Proios, Doganis, and Athanailidis (2004) did not find any significant differences in moral reasoning maturity in athletes across different sport areas (football, handball, and basketball) or in terms of years of experience in sport. Proios et al. also included a sample of coaches and game officials in their study and did not find any significant differences between these sport participants and the athletes.

Most research on moral reasoning and sport has been cross-sectional in design. An exception is a study by Priest, Krause, and Beach (1999). In a longitudinal study of 631 U.S. Military Academy cadets, the authors found a negative impact of sports participation, especially in intercollegiate team sports, on moral reasoning. However, their study used the Hahm-Beller Values Choice Inventory in the Sports Milieu (Hahm, Beller, & Stoll, 1989), an instrument that still needs careful psychometric evaluation (Bredemeier & Shields, 1998).

Overall, the results from these studies suggest that there may be a weak negative correlation between participation in some sports at the intercollegiate level, especially team sports, and moral reasoning maturity. However, results are mixed, and none of the published studies controlled for the fact that recruited athletes, on average, enter college with lower academic test scores (Shulman & Bowen, 2001). Controlling for academic achievement and other potentially confounding variables should be a high priority in future research.

Results are also mixed at the high school level. In a study of 1,330 secondary students, Beller and Stoll (1995) found, using the Hahm-Beller Values Choice Inventory in the Sports Milieu, that nonathletes scored significantly higher than team athletes. However, in the Bredemeier and Shields (1986c) study mentioned earlier, no difference was found between high school athletes and nonathletes. Similarly, Rulmyr (1996) administered the Defining Issues Test to 540 students in Arizona high schools and found no differences between athletes and nonathletes.

Finally, in a study of children in the fourth through seventh grade, it was found that boys who participated in high-contact sports and girls who participated in medium-contact sports were significantly less mature in their distributive justice reasoning than children who had participated in other sports or had not participated in any organized sport program (Bredemeier, Weiss, Shields, & Cooper, 1986). Level of physical contact may be an important variable because of the type of attributions elicited. Children may have a difficult time distinguishing between aggression and physically forceful but nonaggressive play. This, in turn, may impede the development of conceptions of fairness and just distribution of goods and rewards.

Taken together, the results from these studies suggest that it is important not to lump all sports and sport participants together. Though inconsistencies may relate to different methodologies and tools of assessment, it is also true that not all sport experiences share similar moral qualities. Not only do the rule structures of the various sports promote different types of social interaction, but each sport tends to have its own subculture and implicit moral norms, and each individual sport team develops its own unique moral microculture through the influence of particular coaches, athletes, fans, parents, and programs (e.g., Fine, 1987). Moreover, even in a single sport environment, participants' subjective appraisals of the experience may vary substantially (Vallerand & Losier, 1994; Weiss & Bredemeier, 1986, 1991). In those investigations where athletes were found to be less mature in their moral reasoning, it may be that they were differentially attracted to those sports or, alternatively, were selected to participate because of some attribute that itself correlates with less mature moral reasoning (e.g., aggressiveness). Finally, differences may be due to unassessed variables unrelated to the sport experience.

Clearly, it will be important to continue to investigate the potential impact of various sports on moral reasoning utilizing more elaborate or advanced research methodologies. Future research, for example, might profitably focus on specific variables in the sport milieu, such as coaching styles and behaviors, as they relate to or impact moral reasoning.

Game Reasoning

The research just reviewed focused on the relationship between sports involvement and participants' stage or level of moral reasoning. Another line of research relevant to the sports involvement-moral reasoning relationship focuses on how people think about, process, and organize moral situations in sports. Do they do so in the same way, through the same reasoning structures, as they do in other contexts?

Structural developmental theorists have traditionally held that a person's moral reasoning level will remain fairly constant across different types of contents and situations (e.g., Colby & Kohlberg, 1987; cf. Carpendale & Krebs, 1992, 1995; Krebs, Vermeulen, Carpendale, & Denton, 1991). Still, although general consistency in moral stage usage was expected, a few highly irregular contexts have been shown to significantly alter the person's level of moral reasoning. Research conducted in prisons (Kohlberg, Hickey, & Scharf, 1972), for example, demonstrated that inmates used lower stages of moral reasoning in response to prison dilemmas than when they discussed standard hypothetical dilemmas. We have hypothesized that sports are among those contexts where moral reasoning is dissimilar to the pattern of reasoning typically employed (Bredemeier & Shields, 1985, 1986b; Shields & Bredemeier, 1984, 1995). This hypothesis was generated in light of two complementary sets of observations, one theoretical, the other empirical.

The theoretical observation draws from a social science tradition that posits that play, games, and sports are often seen by participants and observers alike as set aside or set apart from everyday life (e.g., Firth, 1973; Handelman, 1977; Huizinga, 1955; Schmitz, 1976; Sutton-Smith, 1971). The separate world of sports is governed by artificial rules and roles, and sport activities are directed toward goals with no intrinsic meaning or value. Handelman suggests that entry into this separated realm requires "a radical transformation in cognition and perception" (p. 186). Similarly, Schmitz has suggested that entry into play involves participants in a world with new forms of space, time, and behavior, "delivering its own values in and for itself" (p. 26). Given this literature, it seemed reasonable to hypothesize that moral reasoning in sports would depart from moral reasoning in everyday life.

The empirical observation comes from studies that involved moral interviews in which participants were asked to reason about both standard *life* dilemmas and a second set of *sport* dilemmas. In these investigations, the life scores were significantly higher than the sport scores (Bredemeier & Shields, 1984a, 1986b). This finding was quite robust, holding for athletes and nonathletes, swimmers and basketball players, college students and high school students, males and females.

Similar analyses were conducted with 110 girls and boys in grades 4 through 7 (Bredemeier, 1995). It was found that sixth and seventh graders' sport reasoning was significantly lower than their life reasoning, and that this life-sport reasoning divergence was significantly greater than that for the younger children. The children below grade 6 did not demonstrate context-specific reasoning patterns. Selman (1980) suggests that it is roughly during the sixth and seventh grades that children develop the capacity to take the generalized perspective of a third party, which may be a prerequisite skill to adopting a context-specific reasoning pattern. Also, no decline in moral reasoning would be expected for the younger sample simply because life reasoning at this age level has not yet developed beyond early stages.

Based on these findings, we proposed a theory of *game reasoning* (Bredemeier & Shields, 1985, 1986a, 1986b; Shields & Bredemeier, 1984, 1995). The theory holds that the context of sport elicits a temporary adaptation in moral reasoning such that egocentrism, typically the hallmark of immature morality, becomes a valued and acceptable principle for organizing the moral exchange. Thus, sports allow for a "legitimated regression" (Bredemeier & Shields, 1986b; Shields & Bredemeier, 1984) to a form of moral reasoning that is similar to less mature moral reasoning. It is important to emphasize, however, that the term *regression* is not meant literally. Individuals in sports do not lose touch with their everyday moral capacities, and the egocentric reasoning that flourishes in sports is not identical to the preconventional reasoning of young children. It is playful egocentrism more than genuine egocentrism.

For game reasoning to remain legitimate, however, one can only *play* at egocentrism. For example, many individuals enjoy playful trash talking during competition; such talk is not disrespectful, even though the words, if taken literally, would be offensive. When the play character of game reasoning is lost, however, sports can (and too often do) deteriorate into breeding grounds of aggression, cheating, and other moral defaults. Thus, game reasoning can take the form of an *illegitimate regression.* Additional research is needed to understand how, when, and why such a shift occurs.

In sum, there is still much to learn about the possible associations between sport involvement and moral reasoning. The research reported here is suggestive, but it is also problematic. It does not adequately take into account the wide variation of sport experience, nor does it control for confounding variables, such as family resources and academic achievement. Future research will need to address these limitations and employ additional experimental designs to advance our knowledge in this area.

MORAL FUNCTIONING AND MORAL BEHAVIOR

The previous section reviewed lines of research that examined moral correlates of participation in sport. Although the methodologies employed preclude drawing conclusions about cause-effect relationships, the research lends itself to developing hypotheses about possible effects that different types of sport experiences might have on the moral psychology of participants. In this section, we explore lines of research that address a different type of question: Given that moral behaviors occur in sport, what are the likely influences on those behaviors? Moral reasoning, for example, is a likely candidate, but there are numerous others.

Effective moral functioning—that is, functioning that leads to behavior consistent with one's best moral thinking—requires coordination among numerous internal psychological processes, as well as effective responses to environmental influences. A useful model of the constituent processes of moral functioning has been provided by Rest (1983, 1984; Rest, Narvaez, Bebeau, & Thoma, 1999). Rest hypothesized that every moral action necessarily entails the activation of four conceptually distinct but interrelated sets of processes: *interpretation* (which includes moral sensitivity), *judgment* (which draws on moral reasoning), *choice* (which stems from motivation), and *implementation* (which requires self-regulation skills). Moral functioning involves effective coordination and integration of these processes. Because moral behavior is the outcome or product of these four processes, moral action itself is not part of the model.

Building on Rest's (1983, 1984) four-process model for understanding moral action, we proposed a 12-component model of moral functioning that adds three sets of influences that operate on each of Rest's four processes (Bredemeier & Shields, 1994, 1996; Shields & Bredemeier, 1995; Shields, Bredemeier, & Power, 2002). Expanding on Rest's processes (interpretation, judgment, choice, and implementation), we identified the following three sets of influences: contextual influences, psychological competencies and dispositions, and intrapersonal performance mediators (such as ego processes). Contextual influences refer to any source of influence that comes from the social or physical environment. By adding psychological competencies and dispositions, we seek to capture those aspects of one's capacities that are reflected when one is functioning optimally, or at one's best. The third category of influences—performance mediators—refers to psychological processes that mediate between optimal capacity and actual performance. For example, under the stresses of competition, an athlete may rationalize an action that she or he later recognizes to be wrong. The resultant 12-component model suggests that moral functioning requires a complex coordination among numerous internal and external influences and that, correspondingly, moral failings can stem from any number of sources.

A focal feature of the 12-component model is the central importance it places on the interaction between contextual and personal influences in moral functioning. It is important to emphasize, however, that the model is heuristic: Its purpose is to help identify and conceptually organize the likely influences on moral behavior. It is not an empirical model of psychological functioning and does not suggest specific hypotheses regarding the nature of interactions between and among components of the model.

Nearly all of the sport psychology research has focused on the second and third processes (judgment and choice) of Rest's (1983, 1984) model, and it is those processes on which we concentrate in this review. In short, moral judgment leads to the formulation of a belief on the part of the actor about what *should* (from a moral standpoint) be done in a particular situation. Choice leads to a decision about what the actor *intends* to do. In the following two subsections, we review the literature pertinent to these two processes, focusing in each section on both the personal and contextual influences. As there is no literature to review, we do not discuss the intrapersonal performance mediators. Perhaps future research will address these important influences on moral action.

The Process of Moral Judgment

When faced with a situation requiring morally relevant behavior, an actor needs to decide what, from a moral standpoint, is the right or best course of action. That process of making a moral evaluation of potential actions is what Rest (1984) means by the process of moral judgment. Depending on the situation, the process may be quite extended. At other times—often in sports—it is done nearly instantaneously based on largely habituated patterns of judgment and response.

If a particular variable is to be included as an important element in the second process of Rest's (1984) model, two questions must be answered affirmatively: Does the variable predict specific moral judgments? For example, do attitudes toward opponents predict specific judgments about the legitimacy of behaviors likely to impact opponents? And does the variable predict behavior? For example, do attitudes toward opponents predict actual behavior toward opponents?

Intrapersonal Influences on Moral Judgment

There are both internal and contextual variables that meet the criteria for inclusion in the model. Not surprisingly, moral reasoning maturity has been the internal factor that has received the most attention. Previously, we reviewed literature regarding possible associations of sport participation with moral reasoning stage. Now we ask: Does moral stage or level predict moral judgments and actual behavior?

In sport morality research, the term *legitimacy judgment* has often been used synonymously with moral judgment. In one study demonstrating that moral reasoning maturity is related to legitimacy judgments, Bredemeier, Weiss, Shields, and Cooper (1987) administered moral interviews to 78 children and showed them slides of potentially injurious sport behaviors. For each slide, the children were asked to indicate approval or disapproval of the actions depicted. Results demonstrated that children with less mature reasoning judged a significantly greater number of potentially injurious acts to be legitimate than their more mature peers. Similarly, Bredemeier (1985) found that moral reasoning maturity negatively correlated with acceptance of higher levels of aggression within a sample of male and female basketball players at the high school and college levels.

Most sport studies that have looked at moral reasoning maturity in relation to actual behavior have focused on aggression. Preliminary evidence that moral reasoning is related to aggression in sport was reported in a basketball study (Bredemeier & Shields, 1984a) discussed previously. In addition to administering a moral maturity measure, Bredemeier and Shields asked the athletes' coaches to rate and rank their players on aggressive behavior on the court. Using the coaches' evaluations as a measure of players' aggression, significant relationships were found between stages of moral reasoning and tendencies to aggress. Specifically, athletes' preconventional moral reasoning was positively correlated with coaches' evaluations of high aggressiveness, whereas postconventional moral reasoning was associated with low aggression scores. In another study, Bredemeier (1994) found that children's moral reasoning scores were predictive of self-reported assertive and aggressive action tendencies in both sport and daily life. Similarly, using a measure that includes an assessment of preconventional and conventional forms of moral motivations (Stephens, Bredemeier, & Shields, 1997), Stephens and colleagues (Stephens, 2001; Stephens & Bredemeier, 1996) found that players' endorsement of maturity-related moral motivations was predictive of temptation to cheat, lie, or aggress.

This sport literature supports the same conclusion that Blasi (1980) reached about moral reasoning in other domains: that it is moderately linked to moral action. This conclusion is consistent with theory. High correlations are not to be expected because moral reasoning stages are deep structures that are neither consistent nor inconsistent with specific moral judgments and actions. For example, an athlete reasoning at Kohlberg's Stage 2 may argue that it is wrong to aggress against an opponent because the opponent is likely to retaliate. Another athlete at the same developmental level may come to the opposite judgment, reasoning that it is right to aggress because people are entitled to do what they can to win. Moral stages are about the *form* of moral reasoning, not the *outcome* of the reasoning process. Still, there are probabilistic associations between moral reasoning stages and specific moral judgments and behaviors leading to moderate correlations.

Moral reasoning stage has been the psychological factor most investigated in relation to moral judgments. Future research might profitably focus on other dimensions of moral psychology, such as values, attitudes, and beliefs, in terms of their impact on legitimacy judgments. These psychological factors may well mediate the relationship that has been found between such variables as gender, length of sport experience, and type of sport involvement (e.g., Bredemeier et al., 1987; Conroy, Silva, Newcomer, Walker, & Johnson, 2001; Gardner & Janelle, 2002) on legitimacy judgments.

In addition to demographic and moral psychological factors, moral judgments are also shaped by contextual factors, as the 12-component model of moral action suggests (Shields & Bredemeier, 1995). In the Bredemeier (1985) study mentioned earlier, the athletes were asked to make their legitimacy judgments in two dissimilar situations: during a midweek interview session in which hypothetical dilemmas were discussed and during an interview session immediately following an important late-season game. In the first, hypothetical condition, the athlete focused on what acts she or he thought would be acceptable for a fictitious football player. In the second, engaged condition, the athlete made judgments about what would be appropriate in her or his own basketball play. Results indicated that athletes judged more aggressive acts as legitimate in the engaged condition than in the hypothetical condition. One interpretation of these results is that competitive stresses in the engaged condition eroded the athletes' capacity to make clear judgments consistent with their most mature reasoning. This would point to the importance of examining performance mediators, the third strand of influences in the 12-component model. Other interpretations focus on changes in the context in which the judgments were made. This study did not directly assess contextual variables, but other studies have sought to shed light on how dimensions of the social context influence moral decision making.

Contextual Influences on Moral Judgment

An individual's capacity for moral reasoning may set a ceiling on her or his ability to think cogently about complex moral issues, but reasoning is also responsive to social influence. In this section, we examine moral dimensions of the social context.

Over time, groups develop shared moral understandings and norms that influence the thought and behavior of members of the group (Power, Higgins, & Kohlberg, 1989; cf. Fine, 1979, 1987). Kohlberg referred to the shared moral norms as an aspect of the group's "moral atmosphere" (Power et al., 1989). In our elaboration of Rest's (1984) model (e.g., Shields & Bredemeier, 1995), we identify shared moral norms as important influences on the process of forming a moral judgment.

Investigation of the moral norms of sport teams began with studies by Shields, Bredemeier, Gardner, and Bostrom (1995) and Stephens and Bredemeier (1996). Shields et al. developed the Team Norm Questionnaire (TNQ) to assess the strength of team norms supportive of cheating or aggression. Simple in design, the questionnaire asks respondents to estimate, on a Likert-type scale, how many of their teammates would cheat (or aggress) if doing so would ensure victory in an important game. Additionally, respondents are asked to indicate whether their coach would approve of cheating (or aggressing) if needed to win. The researchers found that age, year in school, and years playing baseball or softball all correlated positively with expectations of peer cheating and aggression and with the belief that the coach would sanction cheating if necessary to win. Guiverneau and Duda (1998, 2002) modified the TNQ for their sample of male and female adolescent soccer players and found that the perception of team moral atmosphere was the most consistent predictor of self-reported likelihood to aggress; they also found that male athletes believed that more of their teammates would cheat than female athletes believed about their counterparts. Kavussanu, Roberts, and Ntoumanis (2002) also found that moral atmosphere has a direct effect on moral functioning (judgment, intention, and behavior).

In a study that focused on self-described temptation to aggress, Stephens and Bredemeier (1996; Stephens et al., 1997) used a similar technique to investigate moral atmosphere and came to similar conclusions. They found that the strongest predictor of the players' self-described temptation to aggress against opponents was their beliefs about the number of teammates who would aggress in the same situation. This finding, based originally on a sample of young female soccer players, was replicated with other samples, including coed youth soccer players at three age levels (Stephens, 2000), girls' basketball players at two competitive levels (Stephens, 2001), and Canadian male ice hockey players (Stephens & Kavanagh, 2003).

We can conclude that forming a moral judgment is a complex process involving coordination of multiple internal and contextual influences. It is influenced by the developmental maturity of a person's moral reasoning as well as the specific moral attitudes, values, and beliefs that the person holds. It is also a socially mediated process. In forming a moral judgment, the shared moral norms of salient groups are potent influences. Of course, the moral norms of a group must be interpreted by each individual, which often leads to discrepancies in how those norms are understood and applied in specific circumstances (Power et al., 1989). Even when a moral judgment is formed, other processes, often occurring simultaneously, influence action choices. To amplify this point, we turn now to influences on the third process of Rest's (1984) model.

The Process of Moral Choice

The process of forming a moral judgment focuses on uniquely moral considerations and seeks to answer the question: What is the right thing to do? Most social situations, including those in sports, however, are complex and involve a host of considerations, only some of which are moral in nature. Even if a person believes that a particular course of action is the best from an ethical standpoint, there are likely to be competing interests. Rest's (1984) third process highlights the fact that for moral action to occur, it must be prioritized over other alternatives. Because the third process is primarily about prioritizing among competing moral and nonmoral values, it centrally features issues of motivation. The third process answers the question: What do I intend to do? In this process, the actor weighs moral considerations with other considerations, such as the expected utilities of various action choices (cf. Vallerand, Deshaies, & Cuerrier, 1997).

Given the prominence of achievement motivation research in the sport psychology literature, it is not surprising that several investigators have turned to achievement motivation theory to deepen our understanding of the influences on sport morality. In 1989, Nicholls suggested that there is a logical relationship between a person's achievement motivation and the salience that moral issues have for her or him. These reflections made Nicholls's theory an appealing one to pursue. It is organized around the identification of two distinct types of motivation that can be adopted in achievement contexts like sport.

In brief, motivational orientations—also called goal orientations—refer to dispositional tendencies to define the meanings of achievement and success in particular ways. Nicholls (1983, 1989, 1992) gave the names *task orientation* and *ego orientation* to the two primary types of achievement motivation. People are task-oriented to the extent that they define success in self-referenced terms and experience competence when they progress toward goals related to growth and development. People are ego-oriented when success is defined through favorable comparison to the performance of others. Whether a person is primarily task or ego oriented may exercise a potent influence on their choice to pursue moral or nonmoral values when there is a conflict between them.

In addition to individual orientations, contexts can emphasize one type of goal orientation more than the other (Ames, 1992). Thus, *motivational climate* refers to the situational goal structure and it is a likely contextual influence on the process of choice. Theorists have isolated two types of motivational climate, corresponding to the two motivational orientations. Thus, a mastery motivational climate, which tends to augment task involvement, emphasizes such elements as participation, individual progress, and task mastery. A performance climate, which tends to augment ego involvement, places the emphasis on normative success and outperforming others.

There have been a plethora of studies that have investigated numerous variables tethered to achievement motivation theory and moral constructs. This literature has significantly advanced the field of sport morality research. We review it in three subsections. First, we summarize research findings pertaining to the relationship between dispositional achievement motivation and various moral constructs. Next, we review the literature that focuses on the motivational climate. Finally, we turn to investigations that combine both dispositional goal orientations and motivational climate.

Achievement Goals and Moral Constructs

This line of research began when Duda, Olson, and Templin (1991) administered a measure of dispositional motivational orientation and a pencil-and-paper version of Bredemeier's (1985) Continuum of Injurious Acts, along with a sportspersonship inventory. Results indicated that a low task orientation and high ego orientation corresponded to an endorsement of unsportspersonlike play, and that ego orientation positively related to the rating of aggressive acts as more legitimate. A number of studies by various researchers followed. For example, a study by Kavussanu and Roberts (2001) found that for females, but not males, there was a significant but weak relationship between higher ego orientation and greater acceptance of aggression and poorer moral functioning. Table 30.1 summarizes the major findings of studies that investigated dispositional goal orientations and a range of moral variables.

In general, as can be seen in Table 30.1, an ego motivational orientation has been shown to correlate positively with a range of problematic moral variables, including approval of poor sport behaviors and aggression. Task motivation has often been found to correlate negatively with these same behaviors, and positively with more prosocial behaviors.

Although the pattern of findings is relatively clear, there have been exceptions. Gano-Overway et al. (2005) failed to find a relationship between ego orientation and sportspersonship. Despite expectations to the contrary, in some studies task orientation did not have a significant relationship to legitimacy judgments (Duda et al., 1991; Dunn & Dunn, 1999), self-reported temptation to aggress (Stephens, 2000, 2001; Stephens & Bredemeier, 1996), or indices of multiple dimensions of moral functioning (Kavussanu & Roberts, 2001). The inconsistent results for the task motivation variable highlight the need for more complex investigations that examine various motivational profiles, as well as interactions between dispositional orientation and the motivational climate (see later discussion).

Before we turn to studies on motivational climate, a study by Kavussanu and Ntoumanis (2003) illustrates how

Table 30.1 Moral Correlates of Dispositional Motivational Orientations

Orientation	Source
Ego Orientation	
(+) Approval of "unsportsmanlike play"/cheating	Duda et al. (1991), Lee et al. (2001), Kavussanu and Ntoumanis (2003)
(+) Approval of aggression	Duda et al. (1991), Kavussanu and Roberts (2001), Stornes and Ommundsen (2004)
(+) Likelihood to aggress	Stephens and Kavanagh (2003)
(+) Intention to engage in unsportsmanlike play	Stuntz and Weiss (2003)
(+) Antisocial behavior in sport	Kavussanu (in press), Sage et al. (in press)
(–) Sportspersonship (some dimensions)	Dunn and Dunn (1999), Lemyre et al. (2002), Stornes and Ommundsen (2004)
(–) Moral functioning (multiple dimensions)	Kavussanu and Ntoumanis (2003), Kavussanu and Roberts (2001)
(–) High-stage moral reasoning	Proios et al. (2004)
Task Orientation	
(+) Sportspersonship (some dimensions)	Dunn and Dunn (1999), Lee et al. (2001), Lemyre et al. (2002) Gano-Overway et al. (2005), Stornes and Ommundsen (2004)
(+) Moral functioning	Kavussanu and Ntoumanis (2003)
(+) Prosocial behavior	Kavussanu (in press)
(+) Civic responsibility	Duda et al. (2004), LaVoi et al. (2004)
(+) Moral identity	LaVoi et al. (2004)
(–) Unsportspersonlike attitudes	Duda et al. (1991), Stuntz and Weiss (2003)

Note: (+) = Significant positive correlation; (–) = Significant negative correlation.

dispositional goal orientations might mediate the relationship between sport participation and moral functioning. Specifically, they were interested in how length of participation in contact sports among college athletes might influence moral functioning (judgment, intention, and behavior), and how these relationships might be mediated by motivational orientations. Results indicated that length of participation in contact sports positively predicted ego orientation, which, in turn, predicted low levels of moral functioning. The direct effects of sport participation on moral functioning became nonsignificant in the presence of ego orientation. This suggests that it is not participation in contact sport per se that leads to poorer moral functioning, but the adopted goal perspective that often accompanies longer sport participation, at least at the college level.

Motivational Climate and Moral Constructs

In recent years, the influence of the perceived motivational climate on moral variables has also been investigated. Some of the key results are presented in Table 30.2. As can be seen, the findings largely parallel those for the dispositional orientations. Perception of a performance climate, which tends to augment an ego orientation, has been found to relate positively to the same problematic behaviors and cognitions that correlate with the ego orientation. Similarly, perception of a mastery climate, which tends to augment a task orientation, appears to relate to variables similar to those found to relate to task orientation. However, Gano-Overway et al. (2005) failed to find the expected relationship between performance climate and sportspersonship. This negative result may have been an artifact of a sample that had a very low average perception of performance climate.

Interactions among Motivational Variables

Though helpful as quick summaries, the pictures portrayed in Tables 30.1 and 30.2 are less complex than the reality they seek to depict. For one thing, both the task and ego dispositional orientations and the perception of performance and mastery motivational climates are orthogonal constructs. It is possible, therefore, for a person to be high on both task and ego, high on one and low on the other, or low on both; the same is true, at least in theory, of perceived motivational climate. This allows for the investigation of a number of interesting and complex interactions. Moreover, the possible effects of both dispositional goal orientations and perceived motivational climate on moral functioning may be mediated by other variables.

In one of the first investigations to include a more complex model of dispositional goal orientations, Dunn and Dunn (1999) divided their sample of elite adolescent ice hockey players into four goal orientation profile groups based on a mean-split protocol. The groups were then used to predict aggression legitimacy judgments and sportspersonship, as assessed by a modified, hockey-specific version of the MSOS. There were no significant findings for legitimacy judgments, but a multivariate effect was found

Table 30.2 Moral Correlates of Motivational Climates

Climate	Source
Performance Climate	
(+) Antisocial behavior	Kavussanu (in press), Ommundsen et al. (2003)
(+) Aggression	Stornes and Ommundsen (2004)
(+) Acceptance of aggression	Miller, Roberts, and Ommundsen (2005)
(+) Respect for opponents	Stornes and Ommundsen (2004)
(−) Sportspersonship (some dimensions)	Boixados, Cruz, Torregrosa, and Valiente (2004), Miller et al. (2004), Stornes and Ommundsen (2004)
(−) Mature moral reasoning	Miller et al. (2005)
Mastery Climate	
(+) Sportspersonship orientations	Boixados et al. (2004), Gano-Overway et al. (2005), Miller et al. (2004), Ommundsen et al. (2003), Stornes and Ommundsen (2004)
(+) Mature moral reasoning	Ommundsen et al. (2003)
(+) Prosocial behavior	Kavussanu (in press)

Note: (+) = Significant positive correlation; (−) = Significant negative correlation.

for sportspersonship. The authors report that high task orientation groups (irrespective of ego orientation levels) had higher sportspersonship levels than low task groups. Lemyre et al. (2002) also found that participants who were high in task orientation consistently endorsed sportspersonship. However, unlike Dunn and Dunn, they found that those who were high in both task and ego only partially endorsed sportspersonship. These authors also examined perceived ability and found that players high in ego orientation and low in perceived ability expressed the lowest respect for rules and officials and endorsed cheating behavior to reach their goals.

Using a sample of young adolescent elite soccer players, B. Miller, Roberts, and Ommundsen (2004) investigated possible combinations in perceived motivational climate in relation to four of the five dimensions of sportspersonship identified by Vallerand et al. (1996; Vallerand, Briere, et al., 1997). The Negative Approach to Sports subscale of the MSOS was dropped due to psychometric problems. They found that perception of a high mastery and low performance climate was positively associated with three of the four dimensions of sportspersonship, but not with respect for opponents. They also found that perception of a climate that is low mastery and high performance associated negatively with two dimensions of sportspersonship (respect for social conventions and respect for rules and officials) yet positively with respect for opponents.

In a study of early adolescent male handball players, Stornes and Ommundsen (2004) shed further light on the predictors of respect for opponents. Like B. Miller et al. (2004), they found that performance climates were positively associated with respect for opponents but that an ego orientation was negatively associated with that variable. This set of results may suggest that coaches play a particularly significant role. Coaches who create performance climates, climates that generally depress moral functioning, may still encourage respect for opponents.

Stornes and Ommundsen (2004) also reported a significant interaction between dispositional goal orientation and achievement climate. Specifically, mastery climates appeared to moderate the relationship between a player's ego orientation and her or his respect for opponents when ego orientation was high. Highly ego-oriented players reported stronger respect for their opponents when they perceived themselves to be in a stronger mastery climate. This finding is consistent with that of Treasure and Roberts (1998), who also provided evidence that motivational climate may have a tendency to override athletes' achievement goals. The same moderating effect was not found, however, for low ego-oriented players who generally scored high on respect for opponents irrespective of perceived mastery climate.

Gano-Overway et al. (2005), in a study of 202 female club volleyball players from 25 intact teams, also investigated both motivational orientation and climate in relation to sportspersonship. With regard to the "respect for the game" component of sportspersonship, they found a three-way interaction among task orientation, ego orientation, and mastery climate. Specifically, among athletes who perceived a stronger mastery climate, both those with higher and those with lower levels of ego orientation demonstrated a positive relationship between task orientation and respect for the game. However, among those who perceived a weaker mastery climate, only those who were low on ego orientation maintained the positive relationship between task orientation and sportspersonship. These findings suggest that a task disposition and a mastery climate can work together to overcome the potentially negative effects of a high ego orientation.

In conclusion, let us briefly address the practical implications of this motivation and morality research. We reviewed this literature in connection with Rest's (1984) process of choice. This process involves decision making in which an actor weighs acting morally against other alternatives. This literature suggests that motivational variables are important to consider if we seek to increase the likelihood that actors will choose to act on their best moral judgment. If the aim is to reduce morally problematic behaviors and/or to increase prosocial behaviors, then coaches need to increase task motivation and decrease ego motivation. Over time, they can do this by modifying the motivational climate, stressing a mastery climate. For example, they can avoid equating winning with success and positively stress the importance of cooperation and effort. They can encourage their charges to learn from past mistakes and help all team members to progress in accordance with self-referenced goals.

Research in this area can be extended by more careful consideration of issues of gender, culture, and developmental level. We know little about the potential moderating effect of these variables on the relationship between motivational and moral variables. In our next section, we review investigations that sought to promote moral growth through physical activity experiences.

MORAL EDUCATION

In this section, we move from descriptive studies to those that have focused on intervention or education (for a more extended review, see Bredemeier & Shields, 2005). A word of caution, however, is important at the outset. Virtually no work has been done in competitive sport contexts. As a consequence, we review studies conducted in other physical activity settings, most especially physical education. Clearly, generalization to sports is problematic. Still, we have chosen to include this review to encourage researchers to test intervention strategies in sport settings and to suggest some initial foundations on which researchers can build.

Most of the intervention and education research was designed to test or compare the efficacy of strategies derived from either the structural developmental or the social learning approach to morality, or some combination of the two. For example, Bredemeier, Weiss, Shields, and Shewchuk (1986) utilized a summer sports camp to compare the efficacy of such social learning strategies as modeling and reinforcement with the constructivist strategies of dialogue and negotiation. The camp participants (ages 5 to 7) were randomly placed into one of three groups, two of which employed theoretically derived teaching strategies. For 6 weeks, the three groups implemented a common curriculum that had a consistent progression of moral themes. Within-group analyses showed that both experimental groups gained in moral reasoning, but the control group did not. A similar study by Romance, Weiss, and Bockoven (1986) documented the efficacy of a public school physical education class that utilized structural developmental strategies to promote moral reasoning advance.

Gibbons and her colleagues, in two investigations involving children in the fourth through sixth grade, sought to test the effectiveness of the Fair Play for Kids program, which utilizes pedagogical strategies rooted theoretically in both the structural development and social learning approaches. In their first study (Gibbons, Ebbeck, & Weiss, 1995), the researchers compared three groups: (1) fair play when used across the curriculum; (2) fair play when used only in physical education classes; and (3) a control group that did not use the fair play curriculum. After a 7-month intervention, the researchers found that both experimental groups improved significantly on a measure of moral functioning, but the control group did not. There were no discernable differences between the two experimental groups.

In the second study, Gibbons and Ebbeck (1997) focused on only the physical education class. Utilizing a sample of 204 physical education students in grades 4 to 6, they randomly assigned classrooms to one or the other of the theoretically based groups (structural developmental or social learning) or a control group. Assessments modeled after the earlier Gibbons et al. (1995) investigation included students' moral judgment, reason, and intention. Additionally, teachers rated the students on their prosocial behavior. Class-level analyses demonstrated that both experimental groups scored higher than the control group on moral judgment and/or intention, but only the structural developmental group scored higher than the controls on moral reasoning. Student-level analyses largely paralleled those of the class-level analyses, with one additional finding: The students in the experimental groups improved more in their prosocial behavior than those in the control group. The results of this intriguing study raise the question of whether a curriculum utilizing both sets of strategies (as was used in the first study) would be more efficacious than the single-theory approach.

One of the most impressive efforts to implement a physical education program that incorporates moral concerns is that of Hellison and his colleagues. Over the years, Hellison has refined a model of developing self- and social responsibility through physical education. First proposed in 1978, the model has benefited from continual refinement in response to extensive use in the field (e.g., DeBusk & Hellison, 1989; Hellison, 1978, 1995, 2003; Hellison & Georgiadis, 1992; Hellison, Martinek, & Cutforth, 1996; Martinek & Hellison, 1997). At the core of the model is a set of heuristic levels, reflecting increasingly more difficult social goals, through which program participants can move as they progress toward both full participation in the program and full responsibility. Hellison's model has received unparalleled praise from curriculum and pedagogy experts (e.g., Bain, 1988; Jewett & Bain, 1985; Siedentop, Mand, & Taggart, 1986; Winnick, 1990).

Another impressive effort to create a physical education program that incorporates moral education was developed by Ennis (1999). The program, Sports for Peace, served primarily urban students facing the challenges of poverty and limited physical and social resources. The program focused on the development of responsibility, conflict-resolution skills, and a supportive community. In the evaluation study, the program was implemented by 12 teachers in six urban schools in a 9-week unit on basketball. The well-designed qualitative investigation of the program demonstrated that, despite some initial resistance from the more athletically skilled youth, the program was quite successful. As with any omnibus program, however, it is difficult to know which program elements are responsible for which specific outcomes.

Finally, Solomon (1997a, 1997b) employed structural developmental theory in a sociomoral education program with second-grade youth in a physical education context.

She demonstrated positive results following a 13-week program that focused on trust, helping, problem solving, and body awareness. Her interventions included work on communication skills, cooperation, and sharing. Using a pre- and posttest design with experimental and control groups, she demonstrated the program's efficacy in stimulating advances in moral reasoning development.

There are numerous other efforts at character education through physical education or sports that are not reported here, either because the empirical data on them are limited (e.g., S. Miller, Bredemeier, & Shields, 1997) or because character education is only tangentially related to the intervention, such as Danish's (e.g., Danish, 1996, 1997, 2002; Danish & Nellen, 1997; Danish, Petitpas, & Hale, 1992, 1995) life skills programs. Still, those who wish to design interventions may find helpful suggestions in these works. Additionally, interested readers may want to consult more theoretically based discussions of character education through sports (e.g., Arnold, 1984, 1999; Beedy, 1997; Bredemeier & Shields, 2005; Power, Power, Bredemeier, & Shields, 2001; Shields & Bredemeier, 2005).

The cumulative impression left by the various intervention efforts reviewed here is that physical education and sport programs, when deliberately designed to do so, can be used to improve the moral functioning of participants. Even when interventions are successful, however, it is often unclear which component of the program, or which combinations of components, is responsible for the gains. Future researchers should seek to address such issues as fidelity of program implementation so outcomes are tethered to specific program elements.

FUTURE DIRECTIONS FOR THEORY, RESEARCH, AND PRACTICE

In the previous version of this *Handbook,* we identified three primary areas for future research. First, we called on researchers to expand the range of sports considered. Since then, significant progress has been made on that objective. We also stated that sport morality research has been hampered by a lack of valid and reliable measures and related methodological difficulties (see also Bredemeier & Shields, 1998). Some progress has been made in this regard, especially in relation to assessing contextual variables, such as team norms and aspects of motivational climate. Research has generally become more sophisticated, particularly in the kinds of analyses employed. Kavussanu (in press; Sage, Kavussanu, & Duda, in press) has also made an important operational distinction between prosocial and antisocial behavior, pointing out that different causal pathways may be associated with each. Despite advances such as these, more attention needs to be paid to the development of psychometrically sound assessments of moral variables in sport. Finally, in the previous *Handbook,* we shared our hope that other researchers would refine and further test the theory of game reasoning. Little progress has been made on that front.

In this section of the chapter, we offer additional suggestions for theory, research, and practice. In two subsections we address key theoretical issues that can potentially suggest new avenues of research and practice. First, we highlight what we believe is a blurring of ethical and descriptive theory in achievement motivation literature. This analysis leads us to a consideration of what we are calling achievement ethics. In a second subsection, we discuss the concepts of character and virtue. This, in turn, leads to our final reflection on the potential impact of sports on civic character or citizenship.

Achievement Goals or Achievement Ethics?

Nicholls (1989, p. 102) maintained that "different motivational orientations are not just different types of wants or goals. They involve different world views." He hypothesized that a person's goal orientation (task or ego) will correspond with a set of moral attitudes, beliefs, and values. A person with a high ego orientation is likely, Nicholls thought, to demonstrate a relative lack of concern for moral issues like justice or fairness. In reference to the ego orientation, he wrote, "When winning is everything, it is worth doing anything to win" (p. 133). Nicholls thought a person with a high task orientation, on the other hand, would likely be more sensitive to such values as fairness and cooperation. As suggested earlier, it was comments such as these that made Nicholls's theory a natural choice for those interested in exploring connections between motivational and moral variables.

We believe, however, that these oft-cited claims need to be reexamined. There is a tension in Nicholls's theory between a descriptive level of analysis and a prescriptive one. But before we can offer our proposal, we need to amplify on the fundamental concepts of the theory. Citing Maehr and Braskamp (1986), Duda (2001, p. 417) writes, "The central tenet of achievement goal theory is that achievement behavior is a function of the personal meaning an individual assigns to perceived success and failure." The critical issue we would raise is: What is the *meaning* of "meaning"? To what extent is "meaning" rendered in cognitive terms, and to what extent is it rendered in ethical terms?

Typically, the cognitive meaning is highlighted. Accordingly, a task orientation is said to be adopted as a consequence of construing or defining ability as effort. In contrast, an ego orientation is said to be adopted when ability is defined as capacity. This latter construal of competence recognizes that capacity can be evaluated only through social comparison. Thus, according to Nicholls (1983, 1989, 1992), there are two fundamentally different ways to construe competence, and they rely on different personally held cognitive views about the nature of, and relationship between, ability and effort.

Achievement goal theorists simultaneously adopt a parallel way of defining what is at the heart of the task and ego goal orientations. Thus, Duda (2001, p. 129) writes, "A task goal reflects a focus on the development of competence; an ego goal reflects an underlying concern with the demonstration of competence or with the avoidance of being judged incompetent." This language is more explicitly motivational and is tethered to different value stances toward achievement settings. Achievement contexts can be places where one can "make oneself better" or "make oneself look good" or, at least, "not look bad."

Rather than people adopting different achievement goals as a direct consequence of the way they construe competence, we suggest—consistent with another strand in Nicholls's (1989) thought—that people construe competence in a particular way, and define success in a particular way, as a consequence of the goals they endorse. And people adopt different goals largely for ethical reasons. At least some empirical evidence for this can be found in a study by Lee, Whitehead, Ntoumanis, and Hatzigeorgiadis (2001), who found through path analysis that values are antecedents of goal orientations.

The critical question, though, is whether ethical constructs *relate* to goal orientations or whether they reside *within* the current descriptions of goal orientations. We suggest that motivational orientations do not just correlate with moral constructs; they internally contain ethical content. Different renderings of the nature of success, achievement, and competence are not just distinguishable in terms of their cognitive content, but contain different ethical viewpoints. Moreover, it is important to distinguish the ethical theory from the descriptive theory.

Nicholls (1989) seemed to recognize that ethical content was latent in his description of the two goal orientations, and he was not neutral with regard to them: "I count myself among those who advocate task orientation rather than ego orientation. I consider that, ethically, it is more desirable" (p. 102). When Nicholls states that he himself considers the task orientation to be ethically preferable, he is making clear that the task and ego orientations are not just theories about motivation, they are ethical stances. They are theories about what is good.

Most psychologists have generally not treated achievement issues in ethical terms. In this, they differ markedly from Aristotle (1985), who, in his classical treatment of ethics, located the striving for excellence at the heart of virtue and drew on sports as well as the crafts to illustrate his theory. Aristotle posited that humans achieve authentic happiness (or eudemonic well-being) when they exercise their capacities, physical and intellectual, to the fullest in the pursuit of worthy aims.

Aristotle's ethics at least partially map onto Nicholls's (1989) description of task motivation. Does the description of task motivation contain a latent ethical theory about the value of striving and the development of capacity? It would seem so. It is an ethical theory that features an emphasis on the intrinsic worth of each individual, regardless of specific ability. It is an ethical theory that emphasizes the intrinsic value of striving for excellence.

The situation is more complex with regard to the ego orientation. Nicholls (1989) seemed to suggest that the ego orientation is essentially an egoistic orientation. However, it is worth remembering that the ego orientation reflects a developmentally more advanced understanding of the relationship between ability and effort. Is it not possible to employ differentiated concepts of ability and effort without falling into an egocentric moral viewpoint? Can one, for example, desire accurate knowledge of one's ability (which requires social comparison) without succumbing to a mentality that sees others as vehicles by which to demonstrate superiority? It may be that the current approach to defining and assessing the ego motivational orientation needs to be refined to more clearly distinguish among different motivations for employing a differentiated concept of ability.

Clearly, these are preliminary reflections on the theme of achievement ethics. Perhaps they miss the mark. But if it is true that there are implicit moral theories latent in the current descriptions and assessments of task and ego motivational orientations (and, perhaps, in mastery and performance climates), then it is important to clarify how the prescriptive and descriptive languages are related.

Character Development: Theoretical Reflections

Most of the research that we have reviewed in this chapter has been conducted from within a constructivist psychological paradigm and, more specifically, the structural developmental tradition of Piaget and Kohlberg. This is true not only of the moral development literature, but also of the achievement motivation literature, with its roots in the neo-Piagetian work of Nicholls.

In the broader fields of psychology and education, however, a shift has occurred in the past couple of decades among those interested in the moral dimensions of life. The concepts of *morality* and *moral education,* though still very much in use, have been employed with decreasing frequency, whereas the concepts of *character* and *character education* have been on the increase (Molnar, 1997; Nucci, 1989). The reasons for the shift are many. For some, the language change reflects a swing away from a concern with moral reasoning to a concern for behavior and character virtues. For others, the terms carry political connotations, with "character" connoting a more traditional, conservative approach to morality. For still others, the language change reflects a theoretical movement from a psychology informed by the formalist, deontological tradition of ethics to one more consonant with a neo-Aristotelian virtue-ethics perspective.

The last point is particularly important for discussions of sport morality. Some authors (e.g., Jones & McNamee, 2000) suggest that an approach to morality that is focused on moral reasoning should be jettisoned in favor of a morality focused on virtue. Rather than seeking to promote more advanced stages of moral reasoning, teachers and coaches should be concerned with moral character. We suggest, however, that the two may not be so diametrically opposed. However, we do agree that a new emphasis on character can advance the field.

The root meaning of character is "a distinguishing mark," and the word carries distinctive moral connotations. A person of character is a good person. Elsewhere, we have described character as the core of moral agency (Bredemeier & Shields, 2005; Shields & Bredemeier, 2005). Character is a distinguishing mark of a person because moral virtues and vices take root in people differently.

Following Blasi (2005), we see a person's character as having two closely related yet distinct elements. First, character is shaped by *moral desire.* Our deepest and most cherished desires about how life *ought to be* constitute one dimension of our character. These reflect our images of what is good and right, what is noble and praiseworthy. Invariably, our moral desires cannot be given exact definition and are couched in the language of metaphor (Johnson, 2000).

The second dimension of character is *moral will.* Although it makes sense, intuitively and empirically, to talk about *moral will* in the singular, it is composed of a host of distinguishable skills and capacities that enable us, to varying degrees, to live congruently with our moral desire. The ability to delay gratification, to structure time, to set goals, and to tolerate frustration and ambiguity are a few examples of the skills composing moral will. To a significant degree, the competencies of moral will are those associated with the fourth process of Rest's (1983, 1984) model of moral action.

The concept of virtue provides a bridge between moral desire and moral will. Zagzebski (1996, pp. 134–137) defines a virtue as a deep and enduring acquired excellence of a person, involving a characteristic motivation to produce a certain desired end and reliable success in bringing about that end.

A virtue is directed toward a desired end and reflects an acquired capacity to reliably bring about that end. This understanding of virtue allows for the integration of concern for both moral reasoning *and* behavioral consistency. Pedagogically, it points to the importance of providing many opportunities for moral reflection and moral practice. Character involves both thought and disposition.

Reasoning and virtue can work hand in hand. Research has demonstrated a significant link between moral thought and behavior (e.g., Blasi, 1980), but reasoning is only one influence on action. People also tend to have relatively habituated patterns of response and action. Stated differently, people have action tendencies in moral situations, and these are part of their character. These action tendencies, to the extent that they support prosocial behavior, are what is meant by virtues. These are not divorced from thought, however. A typically honest person may have developed a tendency toward honesty, but most likely, she or he also believes in the importance of honesty. She or he has thought about the benefits of honesty and the harm that can flow from dishonesty. The honest person may also recognize that there are times when honesty can be preempted by other moral considerations. Part of moral maturity is to self-consciously develop the virtues of character that are consistent with one's best moral reasoning.

In considering the concept of virtue in relation to sport, we find it helpful to distinguish between relational and performance virtues. Honesty, compassion, respect, and fairness are examples of relational virtues. These are virtues that have intrinsic moral worth. They help give expression and shape to moral desires. We believe they are universally recognized. There are also virtues, such as persistence, dedication, and loyalty, that are not intrinsically valuable but take on moral significance when they are utilized in conjunction with moral virtues. We label these *performance virtues.* They enable us to better perform and carry out our moral intentions. They relate to the moral will.

Sports may provide particularly rich contexts for virtue formation (Arnold, 1999). As Aristotle (1985) pointed out 2 millennia ago, virtues are developed in part through practice, and practice requires an action-rich context. Not only do sports provide such action-rich contexts, but the foundations of sports reflect concern for fairness and well-being, and, consequently, the sport experience is permeated by moral considerations. Additionally, the strenuous effort and persistence required for success in sport offer important analogies for what is required for the development of excellence in any area. Picking up on the previous discussion, sports may provide a salient venue for nurturing a positive achievement ethic which requires an integration of relational and performance virtues.

Citizenship and Civic Responsibility

Our discussion of character points to the final area for future research and application that we discuss. As researchers focus more on how sport may influence the formation of virtues, it may be useful to keep in mind that Aristotle (1985) saw virtues as serving both individual welfare and the welfare of the community of which one is a member. In today's language, we should be concerned not only with character as it manifests itself in interpersonal relationships but with character as it operates in the public domain as well. We should be concerned with civic character and social responsibility. Fortunately, a couple of pioneering efforts have begun to explore this area (Balaguer, Duda, & Castillo, 2004; Duda, Balaguer, & Castillo, 2004; LaVoi, Power, Shields, Bredemeier, & Duda, 2004), demonstrating that variables in sport can predict civic attitudes and behaviors.

As small communities in which one can learn to balance self-interest with collective interest, sport teams can be contexts to develop civic character. Most important, on sport teams participants can develop and explore concepts of the common good and mutual interest. Shared accountability can be a part of one's team experience, even in individual sports. And participation in sports can provide opportunities for learning the democratic arts of self-expression, advocacy, dialogue, compromise, perspective taking, and seeking common ground. Lessons, values, and skills learned in sports related to shaping the common life of a group can provide a foundation for developing a sense of civic responsibility that extends beyond the bounds of sport. Clearly, leadership behaviors will have a profound impact on these potentialities of the sport experience and need to be investigated. Additionally, how learning in sport transfers (or doesn't) to life outside of sports needs to be investigated.

CONCLUSION

We observe that the moral psychology of sport has advanced considerably in recent years. Yet much work remains to be done. We have offered numerous suggestions throughout the text on how researchers can advance work within the main lines of current research, focusing on such topics as values, moral reasoning and moral norms, and motivational orientations and climates. Additionally, we have suggested that theory and research can be advanced by investigation, both theoretical and empirical, of the achievement ethics implicit in achievement motivational theory, by attention to concepts of character and virtue, and by study of the potential of sport to promote civic responsibility. We look forward to the continued evolution of this vital area of sport psychology.

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CHAPTER 31

Family Influences on Children's Sport and Physical Activity Participation, Behavior, and Psychosocial Responses

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Much of the research and applied work in the fields of sport and exercise psychology begins with the observation that there is considerable variability among individuals in their performance and behavior in any sport or physical activity context. That is, individual athletes obviously differ in their performance competencies or abilities, but they also differ in their achievement-related behavior in the performance context (e.g., in their persistence, level of effort, competitiveness, aggressiveness). Similarly, in regard to exercise and physical activity, individuals differ in their performance outcomes but also in such achievement-related behaviors as their commitment to exercise and physical activity and their maintenance of such behaviors over time.

A number of theories have been developed to explain such interindividual variability. Most of these theories focus on personal or psychological characteristics (e.g., type and level of motivation, self-perceptions, attentional capabilities, level and type of trait and state anxiety) as the primary determinants of performance and behavior. Certainly, the research conducted to assess this link has provided consistent support for the importance of these psychological constructs. However, it is equally clear that these characteristics and traits do not explain all of the variability among individuals. Furthermore, it is also important to recognize that these personal characteristics of individuals were not developed in a vacuum. Rather, the degree to which an individual athlete or physical activity participant exhibits an intrinsic or extrinsic motivational orientation, a performance- or task-involved goal perspective, a high or low level of trait anxiety in the sport or physical activity context is a function of her or his interactions over the developmental years with individuals, groups, and organizations in her or his social environment.

This notion is specified in Bronfenbrenner's (1993; Bronfenbrenner & Morris, 1998) bioecological model of human development, which proposes that the development of the individual occurs in the context of a variety of ecological and social forces and systems that both affect and are affected by the developing child. In particular, the child, who is at the center or epicenter of this model, is surrounded in concentric circles first by the individuals, organizations, and institutions in that child's immediate environment (e.g., family, peers, schools, neighborhoods) and then by the broader social, cultural, political, and historical forces that affect both the child and her or his immediate environment.

Thus, according to Bronfenbrenner (1993; Bronfenbrenner & Morris, 1998), the performance and behavior of the individual athlete or exercise or physical activity participant, as well as her or his personal characteristics and traits, are shaped over time by the physical, social, cultural, and historical environment in which she or he lives. From a practical perspective, the family environment may be the most accessible and the most important of the socioenvironmental dimensions to examine. Coaches, teammates, teachers, and peers also play a significant role. But, for most individuals, the family exerts the longest and strongest impact on their development. Thus, the focus of this chapter is on the role of the family in determining the course of the individual's participation in sport and physical activity. In particular, two sets of individuals in the family environment are examined:

the parents and the siblings. This chapter begins with an examination of the influence of the parents.

PARENTAL INFLUENCES

Over the past several decades, a number of research studies have been conducted to examine the role parents play in the development of their children's and adolescents' achievement-oriented behaviors, characteristics, and traits. This research is best reviewed and discussed using a theoretical model that not only provides an organizational framework for examining the current status of the research but also provides an explanation as to how parents affect the psychological responses and behaviors of their children and adolescents in achievement contexts.

One theory that provides such a framework is the expectancy-value model developed by Eccles and her colleagues (Eccles, 2005; Eccles, Wigfield, & Schiefele, 1998) to explain differences between individual children in their motivation and choice behaviors in a variety of achievement contexts (e.g., academic subjects such as math and English, as well as music and sports). The full version of this model provides a framework to delineate how a variety of individuals in a child's immediate environment (e.g., parents, siblings, peers, teachers) can affect that child's success expectancies, perceptions of competence and subjective task values, and motivation and behavior in any particular achievement context. In addition, consistent with Bronfenbrenner's (1993; Bronfenbrenner & Morris, 1998) bioecological model, Eccles's model also recognizes the influence of the broader sociocultural milieu in affecting the child's self-perceptions, attitudes, values, beliefs, and behaviors and also in shaping the adults' attitudes, beliefs, values, and behaviors.

More recently, Eccles and her colleagues (see Fredricks & Eccles, 2004) have presented a modification of their model that focuses specifically on the process by which parents influence their children's performance and behavior in achievement contexts. This model, shown in Figure 31.1, specifies that parents hold general beliefs (e.g., gender-role stereotypes, efficacy beliefs, general and specific values) that most probably are shaped by the cultural milieu in which they live and by demographic factors that are present in the family (e.g., education, family income, number of children). In addition, however, parents also hold a set of beliefs that are specific to each of their children (e.g., beliefs regarding that child's ability, interest) and that are informed or determined by parents' general beliefs as well as by the individual child's characteristics. The combined set of parental beliefs affects or determines the parents' behaviors toward and with the individual child, which, in turn, affects their child's beliefs, values, goals, performance, and achievement-related behaviors.

There are a number of other developmentally based theories (e.g., Ames, 1992; Dweck, 2002; Harter, 1999; Nicholls, 1989) that have provided substantial information relative to the development of individual difference characteristics in children and adolescents. However, these theories are not as clear as that of the expectancy-value model in delineating the particular mechanisms through which parents affect the performance and achievement-related behaviors of their children. Thus, the expectancy-value model is used as the framework for this chapter. Given the complexity of the expectancy-value model and the fact that not all components of the model have been investigated in the sport and physical activity area, the following review of the research is organized using the more simplistic four-component model shown in Figure 31.2. This model begins with parents' belief and value systems (both general and child-specific) and then assumes that these parental beliefs and values determine the type of behaviors (e.g., role modeling, feedback, emotional support, parenting styles) that parents exhibit toward and with their child. The parent behaviors, in turn, affect the child's development of certain belief and value systems (attitudes, beliefs, perceptions, expectancies, and values) that, ultimately, determine the child's performance and achievement-related behavior in sport and physical activity contexts. The research reviewed in the following section begins with those empirical studies that have examined parental belief and value systems, especially as these systems affect or determine the parents' own behavior as well as the belief systems and behaviors of their children.

Parental Belief and Value Systems

As indicated by Eccles and her colleagues (Eccles et al., 1998; Fredricks & Eccles, 2004), parents' beliefs, expectancies, attitudes, and values can be categorized into two groups (see Figure 31.1). The first group includes more general attitudes and beliefs (e.g., perceived value of sport and physical activity, gender-role stereotypes), and the second group includes parents' beliefs and values that are specific to each of their children. In the following review of the literature, the empirical studies corresponding to both general and child-specific parental beliefs and values in the sport and physical activity context are reviewed.

Perceived Value of Sport, Fitness, and Physical Activity

The degree to which individual parents value sport and physical activity participation for their children can be

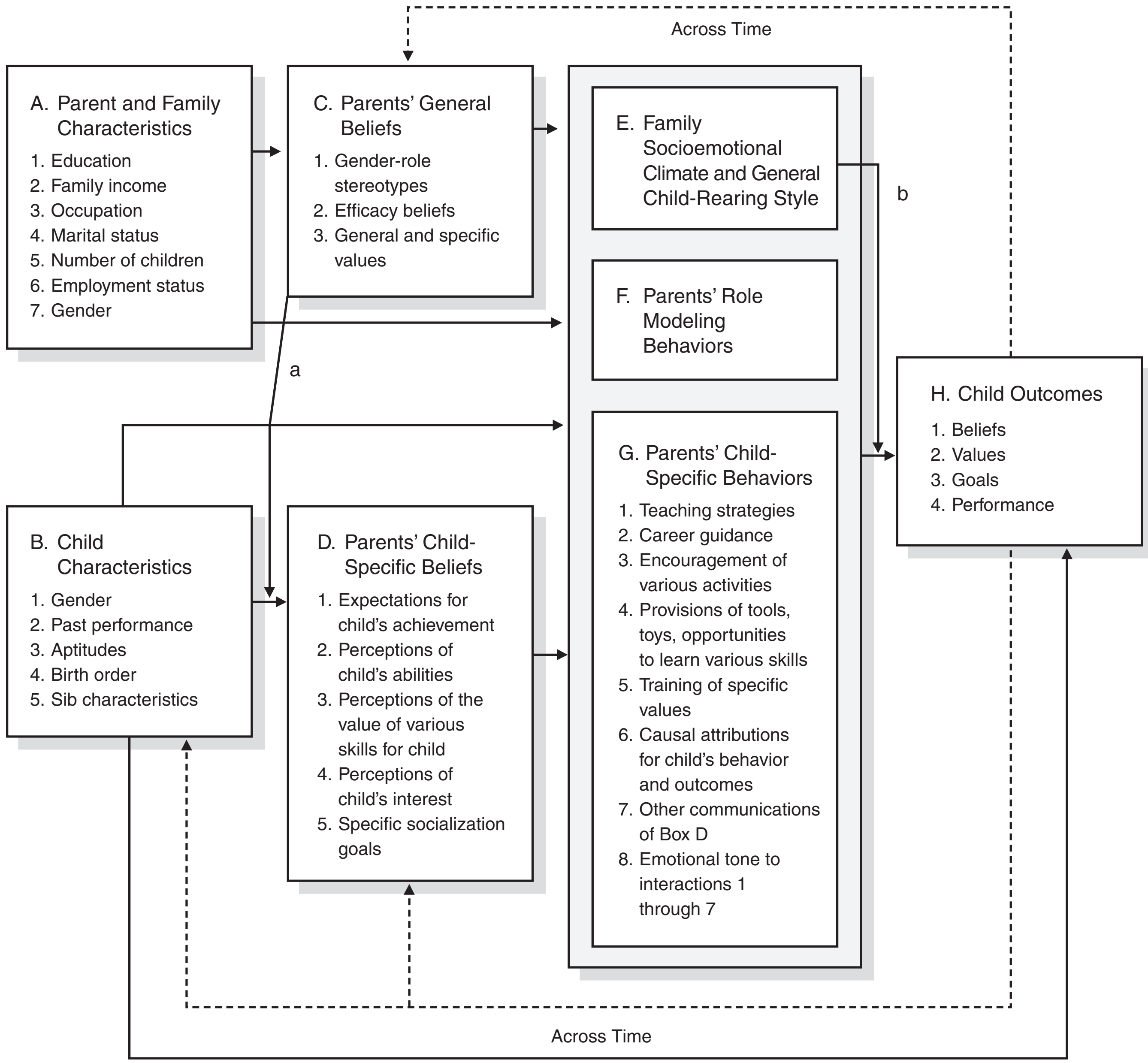

Figure 31.1 Model of parental influences on children's motivation and achievement. *Source:* "Parental Influences on Youth Involvement in Sports" (pp. 145–164), by J. A. Fredricks and J. S. Eccles, in *Developmental Sport and Exercise Psychology: A Lifespan Perspective,* 2004, M. R. Weiss (Ed.), Morgantown, WV: Fitness Information Technology. Reprinted with permission.

assessed either in terms of absolute value ("How much do I want my child to participate in basketball?") or in terms of relative value ("Compared to other activities in which my child could participate, how much do I want her or him to participate in basketball?"; Kimiecik & Horn, 1998). Furthermore, Eccles's (2005; Jacobs & Eccles, 2000) theory proposes that there are four dimensions or components to the value construct: utility value ("How useful will sport participation be to my child in terms of her or his current or future goals?"), intrinsic value ("How enjoyable will sport participation be to or for my child?"), attainment value ("How important is it for my child to do well in sport activities?"), and cost ("What will be the negative consequences—financial, social, psychological—that are associated with my child's sport participation?").

In an early study testing the hypothesized link between parents' value systems and their children's psychosocial responses, Eccles and Harold (1991) found a significant

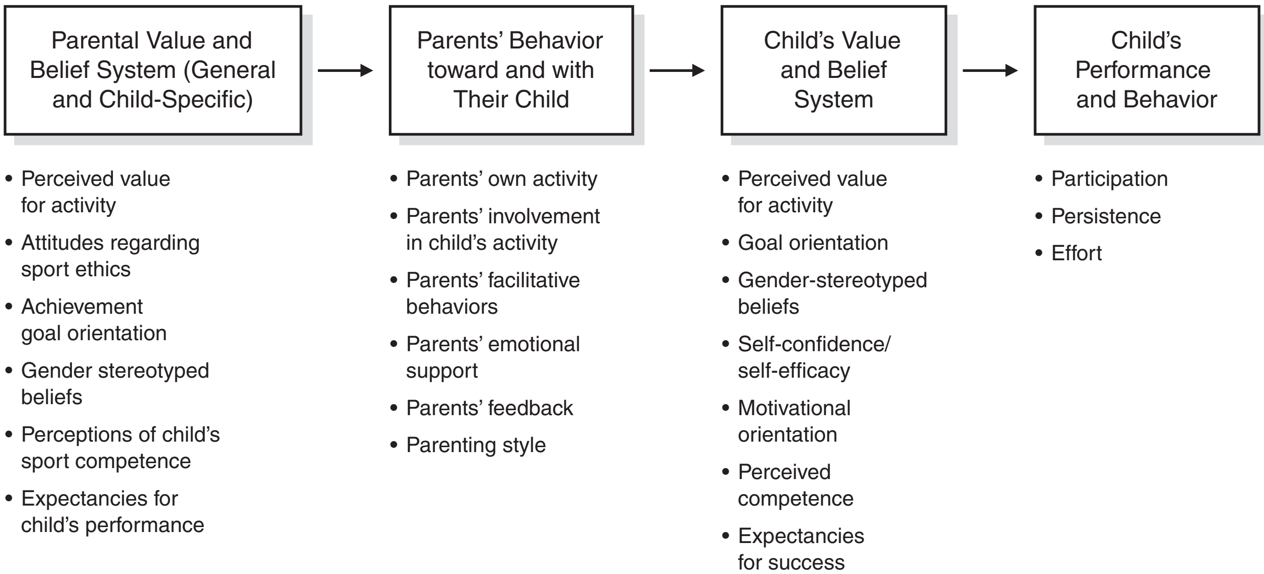

Figure 31.2 Simplified model of parental influences in sport and physical activity settings.

and positive relationship between children's perceptions of the degree to which their parents valued their sport involvement and the child's own level of perceived sport competence. That is, children who perceived that their parents highly valued their participation in sport tended to have higher perceptions of their own physical and sport competence than did children who did not perceive that their parents placed a high value on their sport participation. In a more recent and more sophisticated analysis of parental influences, Fredricks and Eccles (2005) used both cross-sectional and longitudinal analyses to examine the parent-child link in a sample of parents and children in the early to middle elementary grades (second, third, and fifth grades). Their results showed a positive, significant, and predictive (over time) relationship between mothers' and fathers' perceptions of the importance and usefulness of sport participation and their children's perceptions of their sport competence, the value they placed on their own sport participation, and their actual level of participation in sport activities.

Using a more qualitative research approach, Stuart (2003) interviewed two groups of young male and female adolescents (eighth graders) who varied in the degree to which they valued sport participation. Specifically, a high sport value and a low sport value group were interviewed to identify the adolescents' perceptions as to why they did or did not value sport participation. Analyses of the participants' responses clearly indicated that parents' perceptions, beliefs, and values regarding sport participation were factors affecting the adolescents' own values. This was particularly true for adolescents' perceptions of the degree to which their parents believed that sport participation had, or did not have, a utility value.

In summary, then, the studies that have examined the influence parental values can have on their children's belief and value systems as well as on their performance and behavior in sport contexts have provided support for the hypothesized parent-child link. A few other research studies have been conducted to examine the parent-child link in physical activity contexts. Kimiecik and his colleagues (Dempsey, Kimiecik, & Horn, 1993; Kimiecik & Horn, 1998; Kimiecik, Horn, & Shurin, 1996) collected data from middle school children and their parents to assess parents' belief systems regarding their children's participation in fitness-related activities, children's belief systems, and children's actual level of moderate to vigorous physical activity. Their studies indicated that children's perceptions of the degree to which their parents valued physical fitness for them was significantly and positively correlated with children's perceptions of their fitness competence (Kimiecik et al., 1996). However, measures of parents' actual perception of the value of fitness for their children were not predictive of children's actual physical activity levels (Dempsey et al., 1993; Kimiecik & Horn, 1998).

A more recent study was conducted by Xiang and colleagues (Xiang, McBride, & Bruene, 2003) to examine the relationship between parental beliefs and children's motivation and performance in an elementary physical education running program. These researchers directly assessed parents' perception of the value of the running program for their child using both the attainment ("It is important that my child does well in this program") and the utility ("It is useful for my child to do well in this program") dimensions of the value construct. Children's motivation was assessed by calculating the number of laps that they ran or walked over the school year as part of the running program (thus measuring persistence and level of effort). Furthermore, the timed mile run was used to assess children's cardiovascular fitness level. Correlational and regression procedures indicated that parents' value beliefs were significantly and positively related to children's mile run performance and to their motivation level (as assessed via the number of laps completed). That is, children whose parents placed higher value (importance and utility) on their children's participation in the running program were more likely to exert greater effort in the program and to attain better scores on the mile run.

The somewhat mixed results found in these physical activity studies likely are due to differences in the way researchers have measured both the value construct (relative versus absolute; attainment, utility, intrinsic, or cost) and the parents' endorsement of this value (i.e., through assessment of parents directly or through children's perceptions of their parents' value beliefs). Furthermore, as the research discussed next shows, other parental beliefs and attitudes may be as or even more important predictors of children's perceptions, beliefs, values, and behavior than are measures of the value parents place on sport and physical activity participation.

Parental Attitudes regarding Sport Ethics and Behavior

A few studies have been conducted to examine the link between parents and their children in their attitudes and behaviors regarding antisocial or aggressive behaviors in competitive contexts. A series of studies by Michael Smith and his colleagues (see review of this research in Morra & Smith, 2002) have documented the role of parents in encouraging their sons both to perceive highly aggressive acts in hockey as legitimate and to exhibit higher frequencies of such aggressive behavior in hockey games. Similar links between parental attitudes and values concerning the legitimacy of aggressive, assaultive, and antisocial behaviors and their children's corresponding attitudes and values have been found by other researchers (e.g., Guivernau & Duda, 2002; Mugno & Feltz, 1985).

From a related perspective, Stuart and Ebbeck (1995) used a moral reasoning approach to examine the influence of significant other individuals on the moral judgments and reasoning of youth basketball players. These researchers administered self-report questionnaires to a sample of youth basketball players to assess their moral judgment, reasoning, and intended behavior in response to a series of five hypothetical basketball dilemmas (e.g., arguing with an official over a bad call, deliberately injuring another player to prevent a basket). The questionnaires also assessed children's perceptions of the degree to which their mother, father, coaches, and teammates would approve of the described behaviors. Results showed that children's perceptions of the degree to which their parents would approve of the antisocial behavior was predictive of the children's own moral judgment, reasoning, and intended behavior. For the younger children (grades 4 and 5), the mother's perceived approval was the strongest predictor, followed by coach, teammate, and father. For the older children, teammate approval was the strongest predictor, followed by father, mother, and coach.

These research studies, then, do suggest that the degree to which children perceive that their parents would approve or encourage them to exhibit aggressive, antisocial, assaultive, or unethical behaviors is consistently linked to the children's own beliefs and attitudes regarding the legitimacy of such behavior. Whether parental attitudes are also able to predict children's actual behavior in sport has received some support (Morra & Smith, 2002), but more research on this link is needed.

Parents' Goal Orientation in the Physical Domain

Goal orientation theorists (e.g., Ames, 1992; Dweck, 2002; Nicholls, 1989) suggest that individuals are motivated to demonstrate and to achieve personal competence in achievement contexts (e.g., academics, sports). Individuals differ, however, in regard to the goals they establish for themselves and in the criteria they use to evaluate, interpret, and judge their competence in that achievement context. In particular, there are two goal orientations. Task-involved individuals focus on skill development, task mastery, and personal enjoyment as a means to evaluate their competence (e.g., "I feel successful in soccer when or if my skills are improving"). In contrast, ego-involved individuals focus on performance outcomes and peer comparison (e.g., "I feel successful in soccer when my performance is better than my teammates'"). The two different achievement orientations have been found to be associated with different achievement behaviors (e.g., effort, persistence) and with different affective and cognitive responses in performance situations (see recent review by Duda, 2005, as well as Chapter 1 by Roberts, Treasure, & Conroy in this *Handbook*).

A primary issue for the current chapter is the degree to which the goal orientation that parents assume for their child's sport or physical activity participation affects the child's beliefs and values as well as her or his performance and behavior. The few research studies that have been conducted in the sport area have indicated that there is a positive and significant correlation between parents' and children's achievement goal orientations. For example, Duda and Hom (1993) assessed the goal orientations of children (8 to 15 years) attending a summer basketball camp. In addition, these researchers assessed parents' own self-reported goal orientations as well as children's perceptions of their parents' goal orientations. Interestingly, they found that parents' self-reported goal orientations were not correlated with their children's self-reported goal orientations. However, children's perceptions of their parents' goal orientations were significantly related to their own goal orientations. The results of this study suggest that it is children's perceptions of their parents' goal orientations that may exert the most influence on children's own achievement goal orientations or that parents may not be very accurate in their reports of their own goal orientation for their children's sport participation. Ebbeck and Becker (1994) also found a significant and predictive relationship between adolescent soccer players' perceptions of their parents' task and ego goal orientation and the adolescents' own achievement goal orientations.

From a somewhat different perspective, Power and Woolger (1994) asked parents of young swimmers (6 to 14 years) to assess the degree to which they primarily emphasized performance (outcome) goals for their children or mastery or enjoyment goals. They found a curvilinear relationship between fathers' (but not mothers') performance goal orientation and their children's enthusiasm for swimming. That is, the highest level of enthusiasm on the part of the child was found when fathers emphasized a moderate level of performance-oriented goals. When fathers exhibited a low or a high emphasis on performance goals, children's sport enthusiasm was lower. This study suggests that the relationship between parents' goal orientations and children's corresponding psychosocial outcomes may not be a linear one. Certainly, additional research to investigate this possibility is needed.

Some support has also been found for the hypothesized connection between parents' goal orientations and that of their children in the physical activity or fitness areas. Kimiecik et al. (1996) found a positive relationship between children's perceptions of the degree to which their parents held a task-involved orientation and the children's own task orientation as well as their perceptions of their own fitness competence. Dempsey et al. (1993) also found that parents' self-reported task orientation for their children's physical activity was correlated with children's own level of task orientation and with children's expectations for their physical activity behavior. In addition, Kimiecik and Horn (1998) found that mothers' self-reported level of task-involved goal orientation for their children's physical activity participation was a significant, but relatively weak, predictor of their children's level of moderate to vigorous physical activity. In contrast, no significant link was found between parents' goal orientations and their children's level of moderate to vigorous physical activity (MVPA; Dempsey et al., 1993) or between parents' goal orientation and their children's performance on a timed mile run or their level of persistence and effort in a physical education running program (Xiang et al., 2003).

From a theoretical perspective, it does make sense that the goal orientations that parents hold in any particular achievement context would ultimately affect their children. Recently, this parent-child goal orientation link has been examined by looking at the motivational climate created or initiated by the parents. Specifically, based on Ames's (1992) ideas concerning the importance of the motivational climate created by teachers in academic classrooms, White and her colleagues (White, 1996, 1998; White, Duda, & Hart, 1992) have also speculated that parents can create different motivational climates for their children. In a parent-initiated task-involving climate, the child's success in sport is measured through skill development, learning of new skills, and enjoyment of learning, whereas in an ego-involving climate, the child's success is measured through performance outcomes (winning/losing) or through peer comparison. For their research projects, White and her colleagues developed a Parent-Initiated Motivational Climate Questionnaire (PIMCQ and PIMCQ-2) to measure children's and adolescents' perceptions of the type of climate their parents create for them in learning physical skills. Subsequent use of this instrument indicated that adolescent athletes who perceive their parents as providing a task-involving climate are themselves higher in task goal orientation and lower in ego goal orientation, and adolescent athletes who perceive their parents as providing an ego-involving climate are themselves higher in ego goal orientation. In addition, White (1998) found that a parent-initiated ego-involving climate was associated with higher competitive trait anxiety in the athletes, whereas a parent-initiated task-involving climate was associated with lower levels of competitive trait anxiety in athletes. The results of this research establish at least an initial link between the type of climate parents create for their children and the children's own attitudes, values, beliefs, and psychosocial responses. Other researchers (e.g., Harwood & Swain, 2001) have also found links between parents and their children in regard to their achievement goals as well as the motivational climate parents create for and with their young athletes.

Parents' Gender Beliefs and Values

Eccles's (2005; Eccles et al., 1998; Fredricks & Eccles, 2004) expectancy-value model clearly includes the notion that parents' belief and value systems as well as their behavior toward and with their children will vary as a function of the child's gender. Consistent with this idea, a number of research studies have shown that parents tend to (a) value sport and physical activity more for their sons than for their daughters; (b) provide more encouragement for their sons' participation than for their daughters'; and (c) perceive their sons to have higher sport competence than do their daughters (e.g., Brustad, 1993; Eccles, Jacobs, & Harold, 1990; Fredricks & Eccles, 2005; Jacobs & Eccles, 1992). Furthermore, Fredricks and Eccles have recently found that parents of sons bought more athletic equipment, were more apt to encourage them to participate in sport, and spent more time on sport activities than did parents of daughters.

A similar gender difference was found by Welk, Wood, and Morss (2003) in their study on physical activity levels in children from grades 3 through 6. Specifically, boys in this study perceived that their parents provided more facilitation for their physical activity (e.g., provision of equipment, access, or opportunities to be active) than did girls. Furthermore, M. R. Weiss and Hayashi (1995) found that young male gymnasts perceived higher frequencies of positive and supportive behaviors from their father (e.g., attendance at meets, interest shown, encouragement, and provision of instruction during meets) than did female gymnasts. In interviewing adolescents, Coakley and White (1992) found that girls perceived that their parents placed constraints on them that limited their participation in sport. Boys did not perceive such parental constraints. The results of these studies, showing differential perceptions, values, and behaviors on the part of parents for their sons and daughters, have been used to explain why girls and boys consistently appear to differ in their perceptions of their sport, athletic, and physical competence and in the value they place on sport and physical activity participation (e.g., Brustad, 1993; Fredricks & Eccles, 2005; Wigfield et al., 1997).

There are some studies, however, where differences in parents' value or belief systems regarding their sons and daughters have not been found (e.g., Babkes & Weiss, 1999; Bois, Sarrazin, Brustad, Trouilloud, & Cury, 2002; Kimiecik & Horn, 1998; M. R. Weiss & Barber, 1995). It is possible that some of the differences across studies are due to the children's age, their level of skill, or the activity context. That is, more gender differences in parents' beliefs and attitudes may be found with older children or in relation to competitive sport contexts rather than fitness or general physical activity contexts. Further research would be helpful in determining when and why parents exhibit differences in their values and beliefs regarding their sons and daughters.

Another issue that needs to be addressed with regard to parents' values and belief systems is the degree to which individual parents embrace gender stereotypes. Based on cognitive-developmental and gender schema theory (e.g., Bem, 1983; Bussey & Bandura, 1999; Liben & Bigler, 2002), individuals differ in the cognitive schemas they have developed regarding gender and its importance or value in evaluating people, activities, behaviors, and characteristics. Specifically, individuals who are gender-schematic tend to use gender as a primary factor in evaluating or interpreting events, activities, occupations, characteristics, and abilities. Parents who are gender-schematic in their thinking or cognitive patterns would probably perceive sport and physical activity to be a predominantly masculine thing to do, and such parents would believe that males "naturally" have more competence and ability in these areas than do females. In contrast, gender-aschematic individuals do not use gender as a primary factor in evaluating or interpreting events, activities, occupations, characteristics, and abilities. Thus, such parents would be less apt to perceive sport and physical activity as an exclusively masculine domain and would also be less apt to perceive that males are "naturally" better in these areas. Initial research in this area has shown that individual parents do differ in the degree to which they perceive the world from a gender-stereotypical perspective (e.g., Eccles et al., 1990; Fagot & Leinbach, 1993, 1995; McHale, Crouter, & Tucker, 1999; McHale, Shanahan, Updegraff, Crouter, & Bouth, 2004).

Given this gender schema theoretical perspective, it would make more sense to assess the influence of parents' value and belief systems by measuring parents' gender-stereotypical attitudes rather than by just comparing parents' values and beliefs regarding their sons' versus their daughters' sport participation. Such simplistic comparisons do not recognize and incorporate the fact that not all parents are gender-schematic in their attitudes and behaviors. Thus, a cleaner or more accurate assessment of the degree to which boys' and girls' performance and behavior in sport contexts are fostered or created by differential socialization practices on the part of parents can be obtained by comparing parents who are gender-schematic with those who are less so. Only a few studies have been conducted in the sport and physical activity areas using this approach.

In an early study in this area, Eccles and her colleagues (1990) examined a large sample of families who had participated in two longitudinal data collection projects. These researchers found that mothers who endorsed or held gender-related stereotypes (i.e., believed that boys are "naturally better" at math and sports than are girls) had lower perceptions of their daughters' competence in math and sports than did mothers of daughters who did not endorse or hold such gender-related stereotypes. Furthermore, daughters of gender-schematic mothers themselves exhibited lower perceptions of competence in both math and sports than did daughters of gender-aschematic mothers.

Jacobs and Eccles (1992) also assessed mothers' and their children's beliefs and values regarding the children's competence in several activity domains, including math, sports, and social domains, across a 1-year period. As in the previous study, Jacobs and Eccles found that mothers' perceptions of their sons' and daughters' sport competence were predicted by the degree to which mothers endorsed or held gender-stereotypical beliefs (i.e., gender-schematic mothers perceived their daughters to be lower in sport competence than did gender-aschematic mothers). Furthermore, both mothers' perceptions of their child's sport competence and mothers' gender-stereotypical beliefs were directly predictive (using path analysis) of their children's own perceptions of their sport ability. The link between mothers' gender-stereotypical beliefs, their perceptions of their sons' and daughters' sport competence, and the children's own perceived sport competence was significant even though the researchers included a measure of each child's actual athletic competence (as assessed through teacher ratings) as a control variable in this study. These results further indicated that gender-schematic mothers tend to overestimate the sport competence of their sons and underestimate the sport competence of their daughters.

From a somewhat different perspective, researchers in the leisure studies and developmental psychology literature (e.g., Burn, O'Neil, & Nederend, 1996; Katz & Ksansnak, 1994; Williams, Goodman, & Green, 1985) have studied girls who have been labeled by themselves or by others as "tomboys" (i.e., girls who, during childhood and early adolescence, engage in activities that are typically classified to be more masculine in nature and who show a preference for playing with boys) in an attempt to identify the correlates or predictors of such behavioral patterns. These researchers have generally found that parental support was a critical correlate. Williams et al. found, for example, that mothers of tomboys were more likely to have been tomboys themselves and to indicate that they were more accepting or supportive of their daughters' tomboy inclinations. Furthermore, Katz and Ksansnak found that the degree to which children perceived that their parents were supportive of their involvement in cross-sex activities, occupations, and chores was linked to children's tendencies to be less gender-stereotypical in regard to occupation, career, and other activity preferences.

Burn et al. (1996) asked college-age women who identified themselves as "former tomboys" to indicate when and why they had stopped being tomboys. Analysis of the open-ended responses indicated that peer pressure, the desire to attract boys, and pressure from parents at about age 12 to13 were the most common reasons for increased conformity to traditional gender roles in adolescence.

Finally, Giuliano and her colleagues (Giuliano, Popp, & Knight, 2000) compared female college varsity athletes with their nonathlete peers on their recollections of their childhood play activities. The varsity athletes, as compared to the nonathletes, indicated higher levels of childhood play with "masculine-type" toys and games and with male or mixed-gender playmates. In addition, varsity athletes were more apt to report that they were tomboys during their childhood years. In another interesting comparison, these researchers also found differences between female athletes who played nontraditional (i.e., "nonfeminine") college sports (basketball, track, soccer) and those who played more traditionally "feminine" sports (swimming, golf, tennis, volleyball). These comparisons indicated that the nontraditional sport athletes were more apt than the traditional sport athletes to have played "masculine" games (e.g., football and "army") during childhood and to have been considered tomboys.

A couple of studies have also been conducted to examine the predictive relationship between parents' gender-stereotypical beliefs and their sons' and daughters' perceptions of competence as well as their performance and behavior in physical activity settings. Xiang et al. (2003) did not find a significant relationship between parents' gender-stereotypical beliefs and their children's actual performance and level of effort in a year-long physical education running program. In contrast, Horn and her colleagues (Horn, Kimiecik, & Bloom, 2003) did find a significant link between parents' gender-stereotypical beliefs and their children's beliefs, values, and physical activity behavior. Specifically, daughters of fathers who were highly gender-schematic exhibited significantly lower perceptions of physical competence and lower levels of daily MVPA than did daughters of fathers who scored low on the gender-schematic scale. No differences were found between sons of fathers who were highly gender-schematic and those whose fathers were gender-aschematic. Thus, it appears that the degree to which fathers were or were not gender-schematic was important only for daughters; for sons, it made no difference whether fathers were gender-schematic or not.

In general, then, initial research in this area does support the notion that parents' cognitive schema regarding gender affects or determines their perceptions regarding the differential value of sport and physical activity for their sons and daughters, as well as their perceptions regarding the sport competence of their sons and daughters in these areas. There is also some research to show that parents' gender-stereotypical beliefs are reflected in their sons' and daughters' self-perceptions and in their sport and physical activity performance and behavior. However, considerably more research is needed in this area. In particular, the actual mechanisms or processes by which parents' gender-stereotypical beliefs affect their children remain unknown. In the developmental psychology literature, researchers (e.g., Fagot & Leinbach, 1993, 1995) have found differences in the behaviors exhibited by gender-schematic versus gender-aschematic parents in their interactions with their children in play situations. Furthermore, such differential parent behaviors at one time point were reflected in their children's cognitive understanding of gender at a later developmental time point. In these studies, Fagot and Leinbach identified a number of actual behavioral ways in which gender-schematic parents encourage their sons and daughters to exhibit "gender-appropriate" behaviors and, correspondingly, discourage their children from exhibiting "gender-inappropriate" behaviors. More of this behaviorally based research is needed in the sport context to identify the actual mechanisms by which parents convey their gendered beliefs, attitudes, and values to their children in such a way that children's own attitudes, values, beliefs, and behaviors are affected.

Additional research is also needed to examine the role of both fathers and mothers in families. Much of the previous research on gender stereotyping has been conducted with mothers. What research is available to look at the influence of both parents has produced mixed results, with some studies indicating that the father plays a more important role with regard to his effects on both sons and daughters (e.g., Fagot & Leinbach, 1995; Horn et al., 2003; McHale et al., 1999; Updegraff, McHale, & Crouter, 1996). From a more developmental perspective, McHale et al. (2004) found that which parent exerted the most influence varied as a function of the child's age, with mothers having greater influence in the childhood years and fathers having greater influence in the adolescent years.

More research is also needed to look at nontraditional families (e.g., single-parent families, mixed-generation families, gay and lesbian parents). Finally, currently little research exists in the sport or physical activity domain to examine the possible interaction of parents or adult caregivers in families. One study that did look at such interaction was the Horn et al. (2003) study. These researchers found that when both mothers and fathers were gender-schematic, their daughters exhibited the lowest levels of perceived physical competence and the lowest levels of physical activity in the sample. In families where mothers and fathers were not similar (e.g., mother was gender-schematic and father was not, or vice versa), the father was more influential on the daughters. That is, daughters whose fathers were gender-schematic and their mothers were not showed lower levels of perceived physical competence and physical activity levels than did daughters in families where the mothers were gender-schematic and the fathers were not. Additional research of this type would do more to delineate how, why, and when parental attitudes, values, and beliefs interact to affect their children's performance and behavior in the sport setting.

Parental Beliefs Regarding Children's Competence and Success Expectancy

A fairly large number of studies have been conducted to examine the link between parents' perceptions of their child's competence in regard to sport and physical activity and the child's own perception of competence, as well as other aspects of her or his performance, behavior, and affective reactions. Descriptive studies have provided consistent support for the correlation between parents' perceptions of their child's competence (or children's perceptions of their parents' beliefs about their competence) and the child's own level of perceived competence (e.g., Babkes & Weiss, 1999; Dempsey et al., 1993; Eccles et al., 1998; Fredricks & Eccles, 2002; Kimiecik et al., 1996), as well as children's self-reported level of sport participation (Fredricks & Eccles, 2005). Furthermore, Kimiecik and his colleagues (Dempsey et al., 1993; Kimiecik & Horn, 1998) found that parents' perceptions of their children's fitness competence was significantly and positively predictive of their children's actual level of MVPA. Correspondingly, Xiang et al. (2003) also found that parents' perceptions of their children's running ability was positively and significantly predictive of their children's actual performance in the timed mile run and level of effort and persistence in a year-long elementary physical education program.

More recently, the parent-child perceived competence link has been investigated using more sophisticated research designs and statistical procedures. Specifically, Eccles and her colleagues (Eccles, Freedman-Doan, Frome, Jacobs, & Yoon, 2000) used cross-lagged structural equation modeling techniques to compare the across-time impact of mothers' beliefs on changes in children's perceptions to the across-time impact of children's beliefs on changes in mothers' beliefs. These studies provided support for the reciprocal nature of the parent-child link but also showed that mothers' beliefs were very stable over time and ultimately had a stronger impact on their children's self-perceptions than the children's self-perceptions had on their mother's beliefs.

Again, using a longitudinal research design, Fredricks and Eccles (2002) measured children's perceptions of competence and value in two achievement domains, math and sports, with data obtained for the entire elementary and secondary years (grades 1 through 12). They also assessed mothers' and fathers' initial perceptions of their children's ability in the two domains and obtained teachers' assessment of each child's ability along with measures of children's actual motor performance. Analysis of the sport data revealed that mothers' and fathers' beliefs regarding their children's sport competence (obtained in the early elementary years) were found to be positively related to children's perceptions of their sport competence over the following school years. Interestingly, fathers' beliefs were more strongly associated with children's perceived sport competence and value beliefs than were mothers' beliefs. Fredricks and Eccles suggest that fathers may be more influential than mothers in the sport domain because sport is still perceived to be a masculine-based activity. Thus, children may perceive their father's beliefs as a more important source of information for them.

Bois and his colleagues (Bois, Sarrazin, Brustad, Chanal, & Trouilloud, 2005; Bois et al., 2002) have also used more sophisticated research design procedures to investigate the link between parents' and children's competence beliefs. The results of the first longitudinally based study (Bois et al., 2002) showed a predictive link between mothers' assessment of their children's competence at the first wave of the data collection process and their children's perceptions of their sport competence a year later. These results are especially strong because Bois et al. included in their analysis measures of each child's performance on a series of physical tests to control for the child's actual physical competence. In the second longitudinal study, Bois et al. (2005) found that parents' perceptions of their children's sport competence affected the children's perceptions of their own sport competence as mediated through children's appraisal (perception) of their parents' judgments of them. The results of this study provided support for the mediational role of the reflected appraisal process.

In the studies described in the previous paragraphs, it is apparent that children whose parents hold high perceptions of their children's competence or ability and possibly high expectations for their performance are advantaged compared to children whose parents hold lower perceptions of their competence and have lower expectations for their children's performance. It is also possible, however, that parents who perceive their children to have high ability in sport may establish expectations for that child's performance that are too high. Such unrealistic parental expectations and the subsequent parental pressure to perform at high levels have been linked to high anxiety and stress on the part of the child as well as lower levels of sport enjoyment by the child (e.g., Brustad, 1988; Leff & Hoyle, 1995; Ommundsen & Vaghum, 1991). Other researchers (Raedeke, 1997; W. M. Weiss & Weiss, 2003) have found that excessive pressure applied by parents (along with other individuals in the athlete's social environment) resulting in feelings of social obligation on the part of the child to continue his or her sport participation (e.g., "My mother or father would be really disappointed if I quit my sport") affects the young athletes' type and level of sport commitment. Finally, high parental expectations and excessive performance pressure have been shown to be predictive of children's and adolescents' level of burnout (Gould, Tuffey, Udry, & Loehr, 1996; Stein & Raedeke, 1999). Thus, it appears that a high (but not too high) level of parents' perceptions of their children's sport competence and their expectations regarding children's level of performance is optimal and will be most linked with children's own perceptions of competence and sport enjoyment.

In summary, the research provides strong and consistent support for the link between parents' perceptions of their children's sport or physical competence and the children's own perception of their competence. Furthermore, a few studies (Fredricks & Eccles, 2005; Kimiecik & Horn, 1998; Xiang et al., 2003) have found support for the notion that parents' perceptions of their children's sport or physical competence are predictive of their children's actual involvement and performance in sport and physical activity. Again, however, the process or mechanisms by which parents' perceptions actually affect children's self-perceptions have not been clearly established. Based on Eccles's (2005; Eccles et al., 1998) expectancy-value model, it would be hypothesized that parents' values, beliefs, perceptions, and expectancies are conveyed to children through the behaviors that parents exhibit toward and with their children. The research corresponding to the link between parents' belief and value systems and their behaviors is reviewed in the next section.

Parental Behaviors

The research that has been conducted to examine the type, content, frequency, and effects of different types of parental behaviors on children's and adolescents' psychosocial status, performance, and behavior in sport contexts can be categorized into three main areas: parents' own sport or physical activity participation, the encouragement and support they provide for their children to participate in sport and physical activity, and the feedback they give to their children in response to the children's performance attempts. The research and theory corresponding to these three areas is discussed in this section. In addition, a fourth category, the parenting styles that parents exhibit in their interactions with their children, is added to this section based on research and theory from other areas indicating that this may be an important dimension of parental influence.

Parents' Own Sport and Physical Activity Involvement

A number of research studies have been conducted to examine the degree to which parents' own participation and involvement in sport or physical activity is reflected in their children's level of participation and involvement. Most of these studies have focused on the influence of parent behaviors on children's and adolescents' level of daily physical activity. Operating primarily from a role-modeling perspective, these research studies tested the hypothesis that children's and adolescents' level of physical activity would be higher if one or both of their parents were also physically active. Mixed support for this parent-child link has been obtained in these studies. Some researchers (e.g., Anderssen & Wold, 1992; Freedson & Evenson, 1991; Moore et al., 1991; Sallis, Patterson, McKenzie, & Nader, 1988) have found a significant relationship between parents' and children's level of physical activity. In contrast, other researchers have not observed such a significant parent-child activity link (e.g., Brustad, 1993, 1996; Dempsey et al., 1993; Kimiecik & Horn, 1998; Welk et al., 2003).

Some of the inconsistencies in this area may be due to differences across studies in how parents' activity level was assessed (e.g., through parent self-report or through children's perceptions of their parents' activity level) and whether parents' activity level was assessed for both mothers and fathers (separately or in a combined index). Furthermore, the age of the child may also be a factor. Specifically, several of the studies that did find a significant link between parents' and children's level of physical activity (e.g., Freedson & Evenson, 1991; Moore et al., 1991; Sallis et al., 1988) were done with relatively younger children (ages 3 to 9 years). Studies where this association was not observed (e.g., Dempsey et al., 1993; Kimiecik & Horn, 1998; Welk et al., 2003) were conducted with a somewhat older age group (ages 7 to 16). It is possible that parents' level of physical activity is more predictive of their children's physical activity at the younger age levels (when the influence of peers, teachers, and coaches may be lower) than at the older age levels. Some support for this is found in a recent telephone survey of a national sample of parents and children in grades 4 through 12 (Sallis, Prochaska, Taylor, Hill, & Geraci, 1999). In this study, the importance of parents' level of physical activity as a predictor of children's level of physical activity was found to be significant only in boys at the youngest age level (grades 4 through 6) and was not significant at the two older age levels (grades 7 through 9 and grades 10 through 12).

It is also important to point out that in most of the studies that failed to find a predictive relationship between parents' and children's level of physical activity (e.g., Brustad, 1993, 1996; Dempsey et al., 1993; Kimiecik & Horn, 1998; Sallis et al., 1999; Welk et al., 2003), a strong relationship was found between aspects of parents' belief and value systems as well as their behaviors and children's and adolescents' level of physical activity. That is, the degree to which parents valued physical activity for their children, believed their children were physically competent, and supported, encouraged, and facilitated their children's participation in physical activity was reflected in higher levels of physical activity in their children and adolescents and/or higher levels of attraction to and enjoyment of physical activity on the part of the children. Thus, especially as children get older, the aspects of parental support, encouragement, and facilitation may become more important determinants of children's activity levels than the parents' own physical activity levels (see also discussion by Welk et al., 2003, on this issue).

Only a few studies have been conducted to examine the hypothesized connection between parents' sport and physical activity levels and their children's and adolescents' participation in sport. In a 3-year longitudinal study conducted with a large sample of adolescent boys and girls in Finland, Yang and his colleagues (Yang, Telama, & Laakso, 1996) found that children of physically active parents were more likely to participate in competitive sport activities than were children of less active (passive) parents. Their results also suggested that the effects were most profound for fathers. The influence of mothers' physical activity levels was found to be significant for their daughters only and not for their sons. Stevenson's (1990) in-depth interviews with 29 international elite-level athletes indicated that at least some of these athletes were first introduced to their sport via their parents' participation in the sport (i.e., these athletes indicated that as young children they had often accompanied one or both of their parents to the parents' own sport practices or competitive events).

The in-depth interview study conducted by Stuart (2003) with a sample of 10 female and 10 male early adolescents who had been identified as either high or low on perceived sport value also contributed some information regarding parents' sport-related behavior. Specifically, some of the adolescents who did not value sport participation indicated that their parents' lack of interest in sport and lack of sport experience was a factor affecting the adolescents' own low interest and value for sport participation. Similarly, some of the adolescents who did value sport participation also attributed their interest in sport to parents who were interested or active in competitive sport activities.

A recent comprehensive data collection project conducted by Fredricks and Eccles (2005) to examine the influence of several family socialization variables on the sport involvement and motivation of children included an assessment of parents' own involvement in sport. The results of this study indicated that parents' own involvement in sport activities was not a significant predictor of their children's beliefs or their children's participation level. However, measures of parents' values and beliefs were significant predictors, suggesting again that parental beliefs and values supersede their own sport involvement as a factor affecting their children's sport participation and sport-related behavior.

In general, then, there is some support for the hypothesized link between parents' own sport and physical activity levels and their children's level of participation and involvement in sport and physical activity. However, considerable evidence also exists to suggest that parental sport and physical activity behaviors do not exert as significant an impact on their children as do other parental behaviors. The link between parents' supportive, encouraging, and facilitative behaviors and their children's sport participation and behavior is examined next.

Parents' Supportive, Encouraging, and Facilitative Behaviors

Perhaps the most direct way in which parental behaviors can impact their children's sport participation is through the opportunities that parents provide for their children to participate in a sport and to develop their skills and abilities in that sport. Specifically, children's initial involvement in sport begins with parents who enroll them in a program in that sport and subsequently choose to continue or discontinue their children's participation in that program or that sport (e.g., Brown, Frankel, & Fennell, 1989; Côté, 1999; Eccles et al., 1990; Green & Chalip, 1998; Howard & Madrigal, 1990; Stevenson, 1990). Parents support their child's sport participation by providing money for program fees, sports equipment, sports books, videos, magazines, and personal training, and by providing transportation to and from practices and competitive events (e.g., Coakley & White, 1992; Côté, 1999; Duncan, Duncan, Strycker, & Chaumeton, 2004; Fredricks & Eccles, 2005; Sallis et al., 1999; Welk et al., 2003). Furthermore, the degree to which parents are willing or able to rearrange family schedules to accommodate their children's sport participation may certainly affect their children's ability to participate in a sport and may convey to the child how much the parents value the child's sport participation (e.g., Coakley & White, 1992; M. R. Weiss & Hayashi, 1995).

As children's participation in a sport continues, parents may themselves become directly involved in their children's sport activity by volunteering their time to serve as coaches, officials, administrative assistants, or team organizers or leaders (e.g., Babkes & Weiss, 1999; Fredricks & Eccles, 2005; Stevenson, 1990). Researchers have also found that the degree to which parents attend their children's games (or are perceived by their children to attend games) is related to children's participation as well as children's psychosocial outcomes (e.g., enjoyment of sport, perceptions of their sport competence, and intrinsic motivational orientation; Babkes & Weiss, 1999; M. R. Weiss & Hayashi, 1995).

As the research cited in the previous paragraphs suggests, parental involvement in their children's sports activities appears to exert a positive effect on their children's participation and psychosocial outcomes. However, Stein and Raedeke (1999) have demonstrated that from a child's perspective, too much parental involvement can be negative. These researchers administered self-report questionnaires to a sample of 13- and 14-year-old children who were involved in a youth sport program. Athletes were asked to rate the degree to which their parents were involved in their sport activity and also asked to provide an evaluation of whether they perceived their parents were "way too involved," "involved too little," or involved "just right." In addition, children completed scales to measure their overall level of stress and enjoyment as created by their parents in the sport setting. A curvilinear relationship between children's perceptions of the degree to which their parents were involved in their sport activity and children's perceived stress and enjoyment levels was observed. That is, both low and high levels of perceived parental involvement were associated with higher perceived stress on the part of the child, whereas children who perceived that their parents were involved at a "just right" level indicated the lowest perceptions of stress. A curvilinear relationship was also found for children's scores on the sport enjoyment scale and their perceptions of their father's level of involvement.

Similar results have been reported in other studies (e.g., Averill & Power, 1995; Power & Woolger, 1994). Power and Woolger, for example, found that a moderate amount of directiveness on the part of the father (i.e., father's tendency to engage in active instruction with special emphasis on areas in which child needs to improve) was associated with the highest levels of children's enthusiasm for swimming. In contrast, too much or too little directiveness by fathers was associated with lower levels of their children's enthusiasm for the sport. Furthermore, Averill and Power found that young male soccer athletes whose parents exhibited high levels of involvement in their sport experience were perceived as less cooperative with the coach. Averill and Power suggested that such high amounts of parental involvement might undermine the coach's role and lead to problems between coach and child.

Overall, these results do suggest that there is an optimal level of parent involvement, with higher or lower than optimal levels leading to less positive affect on the part of the child. Certainly, more research is needed to identify what the optimal level of parental involvement is.

Another important way parental behavior can influence children's sport participation and behavior is through provision of emotionally supportive and encouraging behaviors. A number of studies have indicated that parental support and encouragement is important to the sport participation and psychosocial reactions of children and adolescents (e.g., Babkes & Weiss, 1999; Brustad, 1996; Coakley & White, 1992; Côté, 1999; Duncan et al., 2004; Fredricks & Eccles, 2005; Sallis et al., 1999; Stuart, 2003; M. R. Weiss & Barber, 1995; M. R. Weiss & Hayashi, 1995). Furthermore, Van Yperen (1995, 1998) has demonstrated in two studies that parents' emotional support can serve as a buffer in helping children cope with performance failure and with the stress engendered by participation in competitive events. Similar results were found by Côté (1999) in his interview study with elite athletes and their families. Specifically, parents were found to be an important source of emotional support when or if athletes encountered sport-related setbacks that they needed to overcome. This link between parental support and children's and adolescents positive sport outcomes is also apparent in the sport injury literature (see comprehensive review by Udry & Andersen, 2002).

In general, then, the research studies cited here have clearly shown that parents' exhibition of encouraging, supportive, and facilitative behaviors are important factors affecting the performance and psychosocial well-being of their children and adolescents in the sport context. Two recently published studies have provided a broader perspective on this topic. Fredricks and Eccles (2005) included a very large sample of children and their parents in a study designed to examine the family socialization process. This study was also unique in that the researchers used a pattern-centered analysis procedure to test the additive effects of a number of parental beliefs and values as well as their supportive, encouraging, and facilitative behaviors (e.g., parents' own level of sport participation, their perception of their children's sport competence, the value they placed on their children's sport participation, their level of encouragement for their children's sport participation, the amount of time they spent with their children on sport activities, and their provision of equipment, books, and magazines). The results of these analyses indicated that boys were more apt to be in families that provided a larger number of sport-promotive factors, and girls were overrepresented in families that provided no promotive factors for sport participation. Furthermore, the total number of promotive factors present in the family was predictive both concurrently and longitudinally in regard to children's perceptions of their sport competence, their sport value, and their level and degree of sport participation.

A second, more global study was conducted by Côté (1999) with a set of four families, each of which included an elite athlete. In-depth interviews were conducted with each available family member to assess the role of the family in the development of young athletes. Three developmentally based stages of sport participation were identified: the sampling years (ages 6 to 13), the specializing years (ages 13 to 15), and the investment years (ages 15 and over). Although parents' supportive, encouraging, and facilitative behaviors were important components for athletes at all three stages, parental roles and responsibilities changed as a function of their child's increasing age, maturation, and skill development. These results clearly point to the need for future researchers to consider developmental stage or age when attempting to identify optimal parental behaviors.

Parental Feedback

In the sport setting, a number of research studies have been conducted to examine the effects of different types of coaches' feedback on athletes' performance and their psychosocial status (see reviews by Horn, 2002, and Smoll & Smith, 2002, as well as in Chapter 5 by Chelladurai). In contrast, relatively little research has been conducted to look at the feedback provided by parents to their children and adolescents in sport contexts. M. R. Weiss and Hayashi (1995) did include measures of children's perceptions of their parents' affective reactions to the children's performance (e.g., perceived level of parents' pride and satisfaction with children's performance) in their study with young gymnasts. Babkes and Weiss (1999) also included a measure of both parents' perceptions of the degree to which they provided positive, contingent responses to their child's performance (e.g., "I congratulate my child after good soccer performances") as well as children's perceptions of these same parental responses. Results indicated that children's perceptions of the degree to which their mother and father provided such positive and contingent feedback was positively and significantly associated with children's perceptions of their soccer competence, their enjoyment of soccer, and their level of intrinsic motivation. In contrast, parents' perceptions of the degree to which they provided such feedback was not significantly related to children's psychosocial responses. Furthermore, the correlation between parents' reports of this type of feedback and the children's perceptions of the feedback were low ($r = .07$ to .09). Thus, it appears that children's perceptions of their parents' feedback may be more important in its effects on children's psychosocial responses than parents' actual feedback. Of course, it is also possible that parents were not very accurate in reporting on the type of feedback they provide their children.

Kidman and colleagues (Kidman, McKenzie, & McKenzie, 1999) conducted a descriptive study to determine the nature of parents' verbal behavior during youth sport games. Analysis of this observational data indicated that a relatively large percentage (47%) of the parental comments were positive in nature. However, a substantial portion (36.6%) of parents' comments directed specifically to their own son or daughter was negative in nature. In addition, these researchers observed that many of the parental comments directed toward their children were instructional in nature (e.g., telling child how to execute a skill or which strategy to use). This study provides a good overview of the types of feedback parents may provide to their children during competitive events, but it doesn't provide information on the effects of such feedback on children.

Research in the developmental and educational psychology literatures has been conducted to examine the feedback patterns exhibited by parents in their interactions with their children (e.g., see reviews by Conroy, 2001; Leaper, 2000; Leaper, Anderson, & Sanders, 1998; Lytton & Romney, 1991; Pomerantz, Grolnick, & Price, 2005). Studies have been conducted in both laboratory and field contexts and generally indicate that parents' comments in play activity, task-related, or achievement contexts can affect the performance, behavior, and psychosocial responses of their children and adolescents. Comparable research could and should be conducted in the sport context.

For example, Gottfried, Fleming, and Gottfried (1994) conducted a longitudinal study in the academic context to examine the effects of different types of motivational practices used by mothers with their elementary school-age children. These researchers measured whether mothers generally encouraged and supported their children's task endogeny (e.g., curiosity, persistence, mastery, task independence) or generally rewarded or punished their children's academic performance with extrinsic consequences and rewards (e.g., money, toys, punishment, privileges).

Structural equation modeling analyses indicated that mothers' use of the task endogeny approach was positively related both to children's level of intrinsic motivation and to their subsequent academic performance levels, whereas mothers' use of task-extrinsic consequences was negatively related to children's intrinsic motivation and performance. Similar research could be conducted in the sport setting to determine whether children whose parents generally tend to encourage, reward, or punish their children for performance outcomes (winning/losing) differ in their levels of intrinsic motivation, performance anxiety, and sport enjoyment from children whose parents tend to encourage and reward their children for performance process (skill improvement, task mastery).

From another perspective, parental feedback to children in sport performance situations could be examined for its attributional content. That is, does parental feedback in the sport setting convey parents' attributions for their child's performance outcomes to luck, effort, ability, task difficulty, or any number of other possible performance causes? Based on attributional theory (e.g., Weiner, 2000), the attributions that are contained in the feedback parents provide to their children after their sport performance successes and failures could have a significant influence on children's own affective reactions to their performances, as well as the children's subsequent motivation, performance, and behavior in that activity (see also Eccles et al., 1990, for more discussion on this point).

As the simplified model in Figure 31.2 suggests, parents' attitudes, values, and beliefs are reflected in their behavior toward and with their children. Parental behaviors, in turn, affect the child's own attitudes, values, and beliefs, which then determine or affect the children's own behavior and performance in the sport context. More research to explore this inclusive set of links in the sport context is needed.

Parenting Styles

As should be evident from the previous review, much of the research examining the effects of parental behaviors on children in the sport and physical activity settings has been conducted on selected aspects of parents' behavior, with each study identifying or testing the effects of one, two, or just a few parent behaviors. Some researchers in the developmental and social psychology literatures have approached the issue of parental behaviors from a broader perspective by identifying different types of parenting or child-rearing styles, and then investigating these types or styles relative to their differential effects on the psychological health and well-being of the child and adolescent. One such example is the work conducted by Baumrind (1971). She initially identified two critical dimensions of parenting behavior: responsiveness (sensitivity, supportiveness, and involvement exhibited by parents) and demandingness (degree to which parents hold high expectations for their adolescents' behavior while monitoring their activities). Baumrind's research further specified four parenting styles, each of which differed in the two critical parenting dimensions. An authoritative parenting style is one that is high on both characteristics; a neglectful style is one that is low in both. An authoritarian parenting style is high in demandingness and low in responsiveness, and an indulgent style is high in responsiveness but low in demandingness.

Steinberg and his associates (Steinberg, 1990; Steinberg, Lamborn, Dornbusch, & Darling, 1992) subsequently reconceptualized Baumrind's (1971) two dimensions of parenting into three: acceptance-involvement (degree of parental sensitivity, supportiveness, and involvement), strictness-supervision (parents' exertion of behavioral control through monitoring and limit setting), and psychological autonomy-granting (parental encouragement of adolescents' individuality and emotional autonomy by reducing psychological control). In general, research with these differing parental styles and dimensions has indicated that an authoritative parenting style (high levels of all three dimensions) leads to the most positive child and adolescent outcomes (e.g., higher perceived quality of life, higher life satisfaction, lower rates of risky health behaviors, higher self-esteem; e.g., Gray & Steinberg, 1999; Petito & Cummins, 2000: Suldo & Huebner, 2004). In an achievement context, adolescents who reported their parents to be authoritative in parenting style had higher perceptions of their academic competence than did adolescents who perceived their parents to be more authoritarian in parenting style (e.g., low in involvement, high in structure, and low in autonomy support or high in parent control; Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994). A number of other studies have indicated both a correlational as well as a causal link between authoritative parenting styles and children's and adolescents' academic performance and behavior (see review of this research by Steinberg et al., 1992).

Another (but certainly related) comprehensive perspective on parenting styles was recently provided by Barber, Stolz, and Olsen (2005), who used previous research and theory to identify three important dimensions of parenting behavior. The first dimension is parental support and includes the degree to which parents exhibit nurturance, warmth, and affection toward their children. The second parenting dimension is psychological control; this dimension is defined as parental control that intrudes on the psychological and emotional development of the child through such parental behaviors as invalidation of the child's feelings, constraining verbal expression, withdrawal of love, and induction of guilt. The third parenting dimension is behavioral control and reflects the degree to which parents supervise and monitor their child's behavior. Barber and his colleagues then collected data on 11 samples of adolescents (ages 13 to 17) from across the United States as well as in several other countries and cultures. Some of the samples were followed over a 4-year period to allow examination of the link between parenting styles and adolescent outcomes from a longitudinal perspective. Analyses of the data indicated that all three parenting behaviors were significantly and consistently linked to children's health and well-being. First, perceived parental support was positively linked with children's interpersonal skill and social initiative and was negatively associated with children's level of depression. Perceived psychological control was particularly predictive of depression in adolescents but also of antisocial behavior (i.e., higher parental psychological control was predictive of higher depression levels and more antisocial behavior in adolescents). Perceived parental behavioral control was predictive of adolescents' antisocial behavior (i.e., higher parental behavioral control was linked to lower rates of child's antisocial behavior).

A third perspective on parenting styles was provided by Pomerantz and her colleagues (2005) in a recent review of the research on the role of parents in affecting their children's achievement approaches. In this review, Pomerantz et al. identify three modalities through which parents can affect their children: parental behaviors, cognitions, and affective interactions with their children. In the behavioral modality, Pomerantz and colleagues identify parents' level of involvement in their children's achievement activity as a potentially important facilitator of their children's performance and achievement behavior, but these researchers also argue that such parental involvement will be most helpful if it is autonomy-supportive rather than controlling. Parents who act in autonomy-supportive ways allow their child in achievement contexts to explore options, initiate their own responses, and work independently. Such parents provide suggestions and feedback to their children, but the behaviors of autonomy-supportive parents are characterized by their continuing attempts to encourage and allow their children to take responsibility for their own achievement performance and behavior. In contrast, parents who act in controlling ways exert continuous pressure on their child in achievement contexts by attempting to regulate their child's behavior with commands, instructions, directives, corrections, and restrictions. Essentially, such parents "take over" their children's achievement-oriented behaviors. Research studies have shown that the behaviors characteristic of autonomy-supportive versus controlling parents are evident very early in the child's life (e.g., infancy and early childhood) and may begin to affect children's achievement behaviors at this early age (for reviews of this research, see Grolnick, 2003; Pomerantz et al., 2005). Based on the research in this area, Pomerantz and her colleagues conclude that children whose parents are autonomy-supportive rather than controlling tend to have higher perceptions of competence in the achievement domain and higher levels of intrinsic motivation. Furthermore, an autonomy-supportive parenting style is linked to higher academic performance on the part of the child and adolescent.

Another aspect of parenting behavior that Pomerantz et al. (2005) identify as important is the degree to which parents provide structure in an achievement context. Structure refers to parenting behaviors that provide assistance to the child in such a way that the child's acquisition of skills is facilitated. Example behaviors in this category are parents' establishment of high performance standards and high expectations for their children's work behavior, as well as parents' provision of contingent feedback in response to their children's performance attempts. Based on the research in this area (e.g., Grolnick, 2003; Grolnick, Deci, & Ryan, 1997; Grolnick & Ryan, 1989), effective parenting behaviors occur when parents provide or exhibit structure that is optimally challenging for the child. Thus, parents' standards and expectations for their children's performance should change as the children mature and their skill level increases. Pomerantz et al. also point out that parents' provision of structure should be proffered in a way that does not undermine the children's autonomy. It is recommended, then, that the two parenting behaviors—autonomy support and structure—should co-occur.

One other key parental practice identified by Pomerantz et al. (2005) as potentially important is the degree to which parents are process- versus person-focused in their interactions with their child in achievement contexts. Specifically, process-focused parental behaviors include feedback, encouragement, and reinforcement for children's skill development, task mastery, and performance enjoyment; person-focused parenting behaviors emphasize performance success and link the child's performance outcomes to such person factors as personal intelligence (ability) rather than to hard work or level of effort. In discussing this dimension of parenting, Pomerantz et al. refer to

Dweck's (2002) implicit theory of personal ability as something that is stable, innate, and not really under the person's own control or as something that is malleable, improved by personal effort, and thus under the individual's own control. Parents may differ in how they view their children's ability, and such differential views may lead to different parent behaviors toward and with their children. The initial research cited by Pomerantz et al. indicates that parenting behavior that is process-focused rather than person-focused is more effective in facilitating high perceptions of competence and high levels of achievement motivation and performance in children.

Self-determination theory (SDT; Deci & Ryan, 2000) has also been used to examine the effect of different types of parenting styles on children's health, performance, and well-being. Core assumptions of SDT suggest that individuals have an essential need to feel autonomous (in control of their own behavior), related to others, and competent (capable of successfully influencing their environment). When these three needs are satisfied, children may adopt a positive approach in achievement contexts and may also exhibit high levels of self-determined (intrinsic) motivation in that achievement context. Furthermore, significant other individuals in the child's social environment (e.g., parents, teachers, coaches) can either enhance or undermine children's self-determined motivation by acting in ways that either facilitate or undermine children's perceptions of competence, autonomy, and relatedness. Several research studies have been conducted in educational contexts to demonstrate that children and adolescents whose parents exhibit an interpersonal style that is high in autonomy support have higher levels of perceived academic competence, higher levels of academic performance, and more self-determined motivational orientation than do children and adolescents whose parents are not autonomy-supportive (Grolnick & Ryan, 1989: Guay & Vallerand, 1997; Ratelle, Guay, Larose, & Senecal, 2004; Vallerand, Fortier, & Guay, 1997). Other research by Vallerand and his colleagues (see summary review by Vallerand, 2001) has shown that the degree to which coaches interact with their athletes using a more autonomy-supportive rather than controlling leadership style affects or influences their athletes' level of intrinsic motivation. Although relatively little work on autonomy-supportive parenting styles has been conducted in the sport setting, one set of researchers (Assor, Roth, & Deci, 2004) did examine parenting styles in relation to college students' psychosocial characteristics and affective reactions in four domains, one of which was sport. The results of this study indicated that college students' perceptions that their parents had used conditional regard (a form of the controlling parenting style) during their childhood and adolescent years in relation to their sport participation showed greater fluctuations in self-esteem and exhibited higher levels of resentment toward their parents than did college students who perceived that their parents did not use this parenting style. Thus, it does appear that this perspective on parenting styles may be applicable in the sport setting.

Although researchers in sport psychology have generally not used the parenting styles approach to assess parental influences in the sport and physical activity setting, aspects of these parenting styles are evident in the sport research. Specifically, as noted earlier in this chapter, the degree to which parents provide emotional support and encouragement to their children has been identified as an important correlate of children's and adolescents' participation, performance, and psychosocial well-being in sport and physical activity settings (e.g., Babkes & Weiss, 1999; Brustad, 1996; Côté, 1999; Fredricks & Eccles, 2005). Furthermore, the issue of psychological control on the part of parents may be reflected in the research on parents' level of directiveness (Averill & Power, 1995; Power & Woolger, 1994), as well as the research on children's sport commitment and burnout (e.g., Raedeke, 1997; W. M. Weiss & Weiss, 2003). Finally, the degree to which parents provide autonomy support to their children in regard to their sport behavior has been linked to children's and adolescents' tendencies to discontinue their sport participation, to devalue sport, and to experience higher levels of burnout in sport contexts (e.g., Coakley, 1992; Côté, 1999; Stuart, 2003). This research on individual aspects of these parenting styles has indicated that these are important dimensions of effective parenting. However, as Pomerantz et al. (2005) point out in their recent chapter, more global or comprehensive research is needed to examine these individual parenting dimensions in one larger study. Thus, future researchers in the sport and exercise psychology field may want to include the more global parenting style measures in their research to examine parental influences in the sport setting.

Parental Influences: Conclusions and Future Directions

Research indicates that parents have a significant effect on their children's performance, behavior, and psychosocial responses in the sport and physical activity settings. Their influences appear to follow, at least in part, the paths specified in Figure 31.2. However, additional research on these hypothesized links is needed.

First, more developmentally based research studies are needed. Given the research and theory (see, e.g., Fry, 2001;

Horn, 2004) suggesting that there are different correlates of children's perceptions, beliefs, and behaviors at different developmental stages, it would make sense that the parenting behaviors that are most effective would change as a function of the children's developmental age or stage. Corresponding research in the developmental and social psychology literatures has looked at changes in parenting behaviors as a function of their children's age (e.g., McNally, Eisenberg, & Harris, 1991) as well as the degree to which different parenting styles are related to children's and adolescents' performance, behavior, and affective reactions at different ages (Suldo & Huebner, 2004). This type of developmentally based research is needed in the sport setting as well.

Second, more research is needed to investigate the possible interplay between various types of parental behaviors. Consistent with the arguments offered by Pomerantz et al. (2005), the degree or *quantity* of parental involvement in their children's sport activities may not be the issue as much as the *quality* of this parental involvement. That is, high levels of parental involvement combined with high levels of parents' autonomy-supportive behaviors may be very facilitative, whereas the same high level of parental involvement when combined with a controlling parenting style may exert a negative effect. Similar interactions between parenting behaviors have been found by other researchers (e.g., Steinberg et al., 1992). Thus, future research that assumes a more global perspective on the measurement of parental influences (i.e., incorporating more than just one, two, or a few very specific parental behaviors) would be beneficial.

Third, more theory-based research in this area is needed. Such research approaches would provide us with much needed information as to how parents' attitudes, behaviors, beliefs, and values affect their children. As noted earlier in this chapter, studies that begin with hypotheses generated from the theoretical literature should provide information relative to the mechanisms and processes that connect the parents' attitudes, values, and beliefs with the child's own attitudes, values, beliefs, and behaviors. In regard to gender, for example, it is no longer enough to document that parents have different values, beliefs, expectancies, and attitudes regarding their sons' and daughters' sport participation. Rather, we need to know how such parental attitudes, values, and beliefs are actually conveyed to their children, and then how such parental attitudes, values, and beliefs result in different performance and behavior on the part of the sons and daughters. Similarly, how do task- and ego-involved parents differ in their behavior toward and with their children? Do the two types of parents differ in their feedback patterns to their children? Does this differential feedback predict, affect, or cause children to exhibit different levels of performance and different types of behavior?

Fourth, more research is needed to examine parent-child influences in a more diverse array of families. That is, more research is needed with children who play at different levels of competition (i.e., those who play at elite levels compared with those who play at less elite but still competitive levels and those who play at recreational levels). Are different parenting behaviors effective at different levels? More research is also needed with families of color, families at lower socioeconomic levels, and nontraditional families (e.g., single-parent, gay and lesbian parents, multigenerational families). Most of the existing research has been conducted with two-parent, heterosexual, Caucasian families from predominantly middle to upper middle classes.

Fifth, although the focus of this chapter is on the effects of parents' attitudes, beliefs, values, and behaviors on their children, more research is needed to identify how, why, and under what circumstances parents develop their beliefs, attitudes, and values. As Eccles's (Eccles et al., 1998; Fredricks & Eccles, 2004) expectancy-value model would suggest, these parent variables are influenced by the sociocultural environment in which parents live or were themselves raised. But it is also likely that parents' own attitudes, values, and beliefs are modified or formed through their children's sport experiences. Thus, the reciprocal link between parents and children needs to be further examined.

Clearly, the research cited in this section shows that parents do significantly affect the course of their children's participation, performance, and psychosocial outcomes in competitive sport contexts. In the next section, the much more limited research on the role of siblings in regard to children's sport experiences is reviewed and discussed.

SIBLING INFLUENCES

The importance of examining sibling influences in the sport and physical activity domain is based on the idea long prevalent in the developmental and clinical psychology literatures (e.g., Berk, 2003; Boer & Dunn, 1992; Cicirelli, 1995; Dunn, 1988; Paterson, 1984; Sulloway, 1995, 1996) that siblings play a substantial role in the development of children's personality and emotions. Furthermore, the sibling relationship continues to exert an influence on individuals throughout their life span (e.g., Cicirelli, 1995; Crispell, 1996; Lamb & Sutton-Smith, 1982).

Recent national surveys of families and households in the United States (see summary by Crispell, 1996) indicated that the average American today has two or three siblings, which can include full, half, and stepsiblings. Furthermore, although family size has declined over the past several decades (Crispell, 1996), 80% of American children today still have at least one sibling (Berk, 2003). As Crispell notes, many, if not most, individuals maintain some contact with their siblings throughout the life span. But even if an individual no longer has contact with one or more of her or his siblings, the emotional, physical, and social ties that they did share earlier in life remain and often continue to affect (positively or negatively) the older adults' lives.

Given that siblings appear to play such an influential role in the development of the individual, it would seem that siblings would also affect the nature and course of the individuals' involvement in and affective reactions to sport and physical activity. However, relatively little research has been conducted to examine sibling influences in these physical contexts. What research has been conducted has tended to be descriptively based and has focused on siblings in combination with other important social agents (e.g., parents and peers). In this section, the research on sibling influences in sport and physical activity is reviewed. This research is grouped into two main areas: role modeling and social support and birth order or family position. Following the review of the research in these two areas, some general conclusions along with some recommendations for future research on sibling influences are offered.

Role Modeling and Social Support

The results of a number of studies conducted to examine factors that affect children's and adolescents' sport and physical activity participation have identified siblings as a positive social influence (e.g., Côté, 1999; Duncan et al., 2004; Stevenson, 1990; Stuart, 2003; M. R. Weiss & Barber, 1995; Wold & Anderssen, 1992). Some of these studies (e.g., Duncan et al., 2004; Stuart, 2003; Wold & Anderssen, 1992) have indicated that siblings may serve as role models. That is, younger siblings participate because their older siblings do or because younger siblings observed their older siblings having positive experiences in sport. Similarly, this research suggests that older siblings may actually introduce younger siblings to their sport (e.g., Stevenson, 1990). Other studies identify siblings' emotional or social support as an important contributor to children's and adolescents' own sport participation, commitment, and work ethic (e.g., Côté, 1999; Stevenson, 1990; M. R. Weiss & Barber, 1995). Furthermore, the results of the studies by Côté and Stevenson suggest that sibling influences may be greater during the adolescent years, whereas parental influence may be greater during the childhood years.

A few studies (e.g., Vilhjalmsson & Thorlindsson, 1998; Wold & Anderssen, 1992) have indicated gender differences in regard to sibling influences. Specifically, early studies (summarized by Greendorfer & Lewko, 1978) indicated that for female athletes, the encouragement, support, and participation of an older brother was especially influential. Similarly, Vilhjalmsson and Thorlindsson found that the physical activity levels of fathers and older brothers (but not that of mothers and older sisters) were a significant predictor of the physical activity levels of male and female adolescents. In contrast, Wold and Anderssen discovered that same-sex siblings and same-sex parents exerted a strong role-modeling influence (i.e., boys were influenced in their sport participation by brothers and fathers, and girls were influenced by mothers and sisters). Then there are studies that have not found gender differences with regard to sibling influences (e.g., Stevenson, 1990; M. R. Weiss & Barber, 1995). Some of these inconsistencies across studies in regard to gender and sibling influences may be due to the level and type of participation (sport versus physical activity; elite versus less elite athletes). In addition, M. R. Weiss and Barber's research comparing female college athletes from 2 different decades (1979 and 1989) indicated that the 1989 athletes reported significantly higher levels of encouragement from older brothers and sisters in childhood and significantly higher levels of encouragement from older sisters in college than did the 1979 female college sample. When these researchers compared the social support perceptions of the 1989 college female athletes with that of their nonathletic male and female peers, the encouragement and support from both older brothers and older sisters discriminated the groups, with the female athletes reporting higher levels of such support from both male and female siblings. It may be, then, that there are fewer gender differences in regard to the role of siblings today than there were in previous decades.

In general, these studies indicate that siblings can serve as a strong source of influence through role modeling and provision of social and emotional support. Of course, as Stuart (2003) found in her interview study, siblings may also exert a negative effect. Specifically, Stuart found at least one adolescent in her sample who expressed low perceived value for sport and attributed this low value in part to an older brother's negative experiences in sport. Along these same lines, Wold and Anderssen (1992) found that male and female adolescents who had same-sex older siblings who were inactive were less apt to participate in sport than were male and female adolescents who did not have an older same-sex sibling. Thus, having an inactive older sibling may actually serve to impede younger siblings' involvement in sport.

From a little different perspective, Van Yperen (1998) found that as the number of siblings in a family increased, young male soccer players perceived that they received less emotional support from both their mother and their father. Van Yperen suggests that these results indicate that young athletes from large families have to share their parents' support with their brothers and sisters. Thus, they receive less support than do athletes from families with fewer children. Finally, Côté (1999), in an in-depth analysis of four sport families, found that at the stage when an individual child in the family reached the "investment" years (ages 15 and up; i.e., the stage in talent development where the talented child receives more of the parents' and family's resources), siblings did experience some feelings of bitterness and jealousy. Thus, it is apparent that siblings can be both a positive and a negative force with regard to children's and adolescents' sport participation.

Birth Order and Position in Family

Some research has been conducted to examine the extent to which children's birth order or position in the family (first born, later born) affects their sport performance, behavior, and psychosocial responses. This type of research is generally based on the idea (e.g., Jefferson, Herbst, & McCrae, 1998; Paulhus, Trapnell, & Chen, 1999; Sulloway, 1995, 1996) that even when siblings in a family share the same genetic heritage (i.e., all children in the family are from the same biological mother and father) and are raised by the same two individuals (mother and father), their experiences growing up may differ considerably depending on whether they were born first, second, third, or later. Some of these differential experiences may be due to family economic status. That is, older children in a family may be more apt to have been raised during a time of limited family income (i.e., parents are younger and earn less money), whereas the younger siblings may have been raised under more lucrative family circumstances. In other families, the reverse may be true. The end result may be that older or firstborn children may have received less (or more) opportunities to participate in sport and to develop their talents.

In addition to possible differences between earlier and later born children in regard to socioeconomic status, it has also been found that parental attitudes, values, beliefs, and behaviors toward and with their children may differ as a function of children's birth order (e.g., Boer & Dunn, 1992; Bukato & Daehler, 2001; Cicirelli, 1995; Hilton, 1967). With older or firstborn children, parents may be less experienced in child rearing and thus may be more cautious or overprotective in their interactions with such children (e.g., allow them less physical freedom to explore) than they are or will be with their later born children. In addition, older or firstborn children may receive more encouragement, support, assistance, and even parental pressure to achieve in academic and occupational settings and to assume more responsibility at an earlier age for their younger siblings.

A third explanation for birth order effects on individuals' achievement and personality is reflected in Sulloway's (1996) ecological theory that firstborn and later born children may develop different talents, abilities, characteristics, and behaviors from each other because they must compete with each other to find their own individual niche in the family. Firstborns may be more apt to choose the traditional mode for parental approval: success in school and the exhibition of mature, responsible behavior. Later borns will need to identify other niches that may lead them to other areas of achievement and other ways to stand out. Thus, according to Sulloway's theory, the talents, abilities, traits, and characteristics that individuals develop are, at least partly, due to their birth order or position in the family and their resulting need to develop their own niche that is reactively different from that of their siblings.

Research conducted on birth order in the personality literature (Paulhus et al., 1999; Sulloway, 1995, 1996) has provided some support for the notion that birth order may be related to individuals' academic achievement and personality. In a recent examination of data from four diverse data sets, Paulhus et al. found that firstborns exhibit higher achievement and academic motivation, but that later borns are more liberal and more rebellious. These results are consistent with hypotheses derived from Sulloway's (1996) model of personality development.

A few early research studies were conducted in the sport literature to examine the effects of birth order on individuals' sport participation (e.g., Casher, 1977; Landers, 1970; Longstreth, 1970; Yiannakis, 1976). These studies generally found that second- and later born children were more apt than firstborns to participate in higher risk sports. Furthermore, some evidence was found that the relative percentage or proportion of later born athletes participating in the more risky sports increased with birth order (i.e., third- and fourth-born were more apt than second-borns to participate in these sports). These results can perhaps be attributed to differential parent behaviors (i.e., firstborns were more restricted in their physical activity behavior, whereas later borns were allowed more physical freedom and fewer safety restrictions). However, these results are also consistent with Sulloway's (1996) arguments that later borns perceive they need to do something more extreme to capture the attention of their parents and to acquire or achieve their unique niche in the family.

A more recent investigation of the effects of birth order in the sport setting was conducted by Flowers and Bloom (2002). These researchers used a $2 \times 2 \times 2$ (gender by sport type by birth order) research design to investigate the effects of gender, sport type (individual versus team event), and birth order (firstborn versus later born) on the precompetitive state anxiety of college track athletes. The results of this analysis showed that firstborn athletes (regardless of gender or sport type) exhibited higher preevent state anxiety (both cognitive and somatic) levels than did later born athletes. Flowers and Bloom suggested that these birth order differences in performance anxiety might be due to differential parental child-rearing behaviors, with firstborns perceiving greater responsibility to achieve in competitive situations. Thus, firstborns may be more apt than later borns to develop higher levels of precompetitive state anxiety. Similar research regarding the link between birth order and preevent competitive anxiety was also found by Martin and Hall (1997).

Although these studies on birth order are certainly interesting and intriguing in their results, this type of research is also relatively simplistic given the myriad other family variables that may interact with birth order to affect individual children. One example of other family variables is number of siblings. Being the eldest in a family of 10 children is likely to provide a child with a much different firstborn experience than being the eldest in a family of two children. Similarly, sibling gender and family spacing (number of years between children) might also interact with birth order to affect individual children. As an example of such interactions, Tuttle and Cornell (1993) recently examined children's perceptions of their sibling relationships under conditions wherein one child in the sibling pair was labeled by his or her mother as academically gifted. The results of this study indicated an interaction between the effects of labeling and birth order on sibling relationships. Specifically, when the firstborn in the family was labeled as the gifted one, the sibling relationship between that child and the younger sibling was perceived to be more positive than when the second born in the family was labeled as the gifted one. That is, when the second born was labeled gifted, her or his sibling relationship with the older child was perceived to be less positive. Such an interaction between birth order and identification of one child as talented could also occur in the athletic setting.

Another interesting and perhaps relevant study was conducted by Rust, Golombok, Hines, Johnston, Golding, and The ALSPAC Study Team (2000), who investigated the effects of having an older sibling on the degree to which preschoolers would exhibit gender-stereotypical behaviors. The results of this observational study indicated that preschoolers (both boys and girls) who had older brothers were more masculine and less feminine in their play behavior and general activity. In contrast, preschool boys who had older sisters were more feminine but not less masculine, and preschool girls with older sisters were less masculine but not more feminine. A similar, but retrospective, study conducted by Colley, Griffiths, Hugh, Landers, and Jaggli (1996) revealed that children and adolescents who had same-sex siblings showed more gender-stereotypical preferences in their play behavior than did those children who had opposite-sex siblings. The results of these studies, as well as others (e.g., Steegmiller, 1980; Stoneman, Brody, & MacKinnon, 1986; Sutton-Smith & Rosenberg, 1970), indicate that siblings do have an effect on each other with regard to the development (or nondevelopment) of gender-stereotypical attitudes, beliefs, and behaviors. However, there are still discrepancies as to exactly *how* sibling influences operate in this area as well as *how* birth order, gender of siblings, and number of siblings might interact. For example, some research has found that boys with sisters (more than one) were more "masculine" than boys with brothers. Correspondingly, girls with brothers were found to be more "feminine" than girls with sisters (Steegmiller, 1980; Sutton-Smith & Rosenberg, 1970). It is possible that Sulloway's (1996) theory may apply here. That is, a girl with all brothers may be more apt to assume a more "feminine" role to achieve her niche in the family; the same may occur for a boy with all sisters. Alternatively, it is possible that gender-schematic parents who have one daughter and two or more sons may encourage the daughter to be more feminine, with the reverse occurring for gender-schematic parents who have one son and two or more daughters (for additional comments on this point, see McHale et al., 1999). Given the relevance of gender-stereotypical attitudes, values, and behaviors to the sport setting, this type of research might be interesting to explore by researchers in sport psychology.

Sibling Influences: Conclusions and Future Directions

As the research suggests, we have more questions than answers with regard to the role siblings play in affecting the sport and physical activity participation of children and adolescents. Much of the research cited was descriptive in nature. Certainly, one direction for future research is to take a more theory-based approach. One example of such an approach would be to extend the descriptive research results from Flowers and Bloom (2002), who found that firstborn collegiate athletes experienced higher levels of preevent state anxiety than did later born athletes. Flowers and Bloom suggested that such birth order differences might be due to different parent socialization patterns. Future researchers might use theories from the socialization literature on performance anxiety (see, e.g., Conroy, 2001) to determine whether firstborn were treated differently by their parents in early achievement-oriented contexts and have thus developed higher levels of competitive anxiety and fear of failure or fear of negative social evaluation in athletic contexts.

The theoretical perspectives provided by Sulloway (1996) might be interesting to assess in regard to the effects of birth order on children's and adolescents' performance, behavior, and psychosocial characteristics in sport and physical activity settings. Additionally, although the cognitive-developmental theories cited earlier in this chapter (e.g., Ames, 1992; Dweck, 2002; Nicholls, 1989) as well as the social-cognitive model espoused by Eccles (2005) do not focus specifically on the influence of siblings, these theories certainly might be used to explore how, when, and to what extent siblings exert the strongest influences on each others' cognitive and social-emotional development.

A second point regarding the current research on sibling influences in the sport setting is that many, if not most, of the studies were conducted to examine siblings as just one in a variety of significant others. Thus, very few of the studies were devoted specifically to the examination of the role of the siblings. Furthermore, the individual research studies have been limited in other ways. For example, in the birth order effects area, researchers have typically compared firstborns with either second borns or with a more generic category labeled later borns. Given research in the general psychology literature (e.g., Boer & Dunn, 1992; Cicirelli, 1995; Sulloway, 1996), it appears that more specific comparisons (e.g., first, second, third) are needed. As well, very little information is available in the sport literature regarding children with no siblings. Again, research in the psychology literature (e.g., Boer & Dunn, 1992; Cicirelli, 1995; Sulloway, 1996) has indicated the importance of examining this family contextual issue as well.

In general, a lot more research is needed to examine the role that siblings play in the sport performance, behavior, and psychosocial responses of children and adolescents. As noted at the beginning of this section, siblings represent a very important social relationship for many individuals. As Berk (2003) points out, sibling interactions (probably during the entire life span) are so frequent and so emotionally intense that they quite likely serve as an important context in which individuals develop. Given the importance of the sibling relationship, it would be likely that siblings would also exert an influence in regard to individuals' performance, behavior, and psychosocial reactions in the sport and physical activity setting.

CONCLUSION

Although this chapter separated the influence of parents and siblings into two different sections, in reality, the two units probably exert an interactional influence. Thus, family-based research is necessary. One recent example of this approach was provided by Côté (1999), who conducted in-depth interviews with four families, each of which included an elite young athlete. The interviews were conducted using a retrospective format so that family influences on the individual child's sport career could be assessed from a developmental perspective. As the results of this study clearly showed, the role of parents and siblings (as well as significant others in the child's sport environment) changed as a function of the athlete's age and skill level. It was also apparent that the sibling relationship changed over time as well. Thus, this study, although limited to four families, does provide a broader and more inclusive perspective on the role of the family as a whole and on its individual parts.

Using a more quantitative approach, Fredricks and Eccles (2005) conducted a broader-based assessment of family influences in the sport setting. These researchers used self-report questionnaires to assess a variety of family environmental variables as well as children's attitudes, values, beliefs, and behaviors across a 3-year period. Obtained data were examined using both standard regression procedures and pattern-centered analyses. The value of this multiple analytic approach was reflected in the fact that Fredricks and Eccles were able to assess the cumulative effects of a number of sport-related promotive factors that were present in the family context. Thus, this research study also extends our knowledge and understanding regarding the role that all individuals in the family context play.

As these two recent studies indicate, research that is family-based and designed in such a way that the interactions between individuals can be examined for their combined influence on the child will probably provide us with the most beneficial information. The scientific literature to date indicates that the development of individuals' personality and behavior is likely affected by both biological and environmental factors, with the two factors interacting in their effect. Based on a review of the literature in this area, Pervin (2003) recently concluded that approximately 40% of the variance in individual personality characteristics can be accounted for by genetics, leaving us with approximately 60% of the variance explained by environmental factors combined with error. Given that the family context may include both genetic as well as environmental factors, it would seem that family-based research would significantly advance our understanding of individuals' performance, behavior, and psychosocial responses in the sport and physical activity setting.

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CHAPTER 32

Career Transitions and Career Termination

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Career development in sport is a fascinating field of research, education, and practice in sport psychology. Career transitions in particular have attracted much attention. Research about career transitions in the past was mainly concerned with *career termination* and its possible side effects, such as changes in identity, the social network, and personal goals. As discussed later, the starting point of the career termination literature was the impression that terminating a sport career was a negative, even devastating event. Athletes were supposed to undergo a crisis and were in need of psychological help. Actually, the prominent examples of athletes who experience a crisis after their career and react with, for example, drug abuse, criminal offense, depression, or even suicide are manifold, but their number is far less than the media would make us believe. An estimated maximum of 20% of retired athletes report major problems with their life after their sport career, as opposed to 80% who report a healthy career transition (Lavallee, Nesti, Borkoles, Cockerill, & Edge, 2000). Career termination is an important turning point in the life of any athlete, but it is not the only one, and not necessarily a negative one. In our review, we point out that career termination is the last in a series of transitions that athletes experience during their career.

After some initial publications in the 1960s (e.g., Hallden, 1965; Mihovilovic, 1968), the topic of career transitions and career termination in sport had growing interest, in terms of both research and practice. From only 15 publications up to 1979, the number increased to 226 in the period between 1980 and 1998 (Lavallee, Wylleman, & Sinclair, 2000). Of these, 94 were devoted to theoretical and applied issues, and 132 reported research studies.

In sport psychology, researchers have investigated career transitions from a developmental and social psychological viewpoint (Wylleman, Alfermann, & Lavallee, 2004). Sociological viewpoints were also integrated. Psychological approaches in research and practice were primarily concerned with mental preparation for career termination (Anderson & Morris, 2000), (negative) psychological side effects of career transitions that may lead to a crisis (Stambulova, 2000; Taylor & Ogilvie, 2001b), athletes' coping efforts and determinants of successful transition (Alfermann, 2000), changes in athletic identity and loss of role obligations (Brewer, Van Raalte & Petitpas, 2000), and intervention strategies such as counseling and mentoring (Lavallee, Nesti, et al., 2000).

Sociological approaches focus primarily on the reasons for career termination and on occupational success or failure in the postcareer (Conzelmann, Gabler, & Nagel, 2001; Hackfort, Emrich, & Papathanassiou, 1997; Nagel, 2002). Typical research questions in this tradition are whether athletes experience an upward or downward social mobility and if they win or lose in prestige and status.

The purpose of this chapter is to comprehensively overview this research area and expand the perspectives provided in the two earlier editions of this *Handbook* (Ogilvie & Taylor, 1993; Taylor & Ogilvie, 2001a). In this chapter, we first define and explain the key concepts of athletic career, career transition, and career termination. In subsequent sections, we discuss the theoretical background, the empirical research, and intervention approaches as they are concerned with career transitions and termination. We close the chapter with suggestions for future research in the career transition area.

KEY CONCEPTS

The topic of career transitions incorporates a developmental perspective into sport psychology with a focus on turning points and phases in athletes' career development. Metaphorically, the athletic career—from initiation of sport participation to retirement from sport—can be described as a miniature life span course, with stages analogous to childhood, adolescence, adulthood, and older ages.

Athletic career is a term for a multiyear sport activity, voluntarily chosen by the person and aimed at achieving his or her individual peak in athletic performance in one or several sport events. "Career" relates only to competitive sports, but on all its levels. Depending on the highest level of sport competitions achieved by the athlete, an athletic career can be local, national, or international. Depending on the athlete's status, the career can be amateur or professional. It is also possible to talk about early and late athletic careers in terms of the age of the career start, and about prolonged versus cut-off careers depending on how long the athlete stayed in sport and how timely he or she terminated.

Athletic career can also be defined as a succession of stages and transitions that includes the athlete's initiation into and continued participation in organized competitive sport and that is terminated by the athlete's voluntary or involuntary discontinuation of participation in organized competitive sport (Bloom, 1985; Wylleman, Theeboom, & Lavallee, 2004). On average, an athletic career starts at the age of 7 to 10 years and sometimes even earlier, depending on the type of sport (e.g., in swimming, artistic gymnastics, figure skating, ice hockey). It usually takes about 10 years of deliberate practice to reach an expert performance level in sport (Ericsson & Charness, 1994), and staying at the top before retirement usually lasts between 5 and 15 years (Stambulova, 1994).

Another approach to consider an athletic career is as a developmental event contributing to life span development in and out of sport. From this perspective, several objective parameters characterize an athletic career (Hanin & Stambulova, 2004; Stambulova, 1994). These include *duration* of sport participation from start to peak and finish, *sport event(s)* practiced with the degree of *specialization,* and *achieved* sport titles, records, and results. Subjective parameters include perceived *benefits* of sport participation and its *costs* (e.g., in terms of time, energy, health, money) as well as *career satisfaction* (one's self-esteem with regard to the athletic career) and *career successfulness* (social recognition of one's athletic career). Successful (or elite) careers are usually associated with athletic excellence and high social recognition, whereas satisfactory careers are associated with achieving an individual peak in athletic performance corresponding to individual resources and environment. Satisfaction is based on a set of self-referenced criteria, but most often it consists of perceived potential in relation to level of achievements and perceived athletic career costs (Stambulova, 1995). Interestingly, athletes may be satisfied with nonelite careers if they value the developmental effects (benefits) of sport participation (e.g., self-knowledge, physical fitness, skills, social contacts that can be used in other spheres of life). In contrast, other athletes may be dissatisfied with their elite careers, especially if they perceive the costs as too high (e.g., deteriorated health, deficits in education, a lack of close personal relationships or any interests outside sports).

Another popular metaphor related to the athletic career topic is the so-called athletic pyramid, showing that only a few athletes from those who participate in sport achieve athletic excellence and elite careers. A majority of athletes drop out at the earlier stages or stay on the lower levels in sport. One explanation for the athletic pyramid is that a lot of athletes cannot cope successfully with career transitions.

In a broader sense, *a transition* is "an event or nonevent [which] results in a change in assumptions about oneself and the world and thus requires a corresponding change in one's behavior and relationships" (Schlossberg, 1981, p. 5). For example, being selected to the national team is an event transition that requires from an athlete various sport-related and social adjustments. But not being selected to the national team (after striving for that) can be seen as a nonevent transition requiring coping on personal and social levels (e.g., Grove, Fish, & Eklund, 2004). One important development in the career transition topic relates to a new view of transition as *a process* and not a single event or nonevent (Wylleman, Lavallee, & Alfermann, 1999).

Applied to athletic careers, transitions are normative or nonnormative turning phases in the course of an athletic career. Transitions come with a set of specific demands related to practice, competitions, communication, and lifestyle that athletes have to cope with to continue successfully in sport or to adjust to the postcareer. Normative athletic career transitions are relatively predictable and include, for example, the beginning of sport specialization and the transition from junior to senior level, from amateur to professional sports, from athletic career to life after sports. Nonnormative transitions are situation-related, idiosyncratic, and less predictable, for example, transitions caused by injury, overtraining, changing one's team or club, changing one's coach or sport partner. These examples illustrate athletes' transitions in the sport-related context. But recently, more and more attention is paid to athletes' transitions in nonsport contexts, for example, in their psychosocial development and academic-vocational career (Wylleman & Lavallee, 2004).

Career *termination* is the clearest example of a normative and even inevitable transition. This transition really mixes sport-related and sport-unrelated contexts. Athletes consider themselves retired when they are no longer participating in competitions on the level they had achieved. But they can continue to practice sport and exercise without a competitive orientation.

The predictability of normative transitions creates an opportunity to prepare athletes to cope with them in advance. In contrast, the low predictability of nonnormative transitions explains why athletes might find them more difficult to cope with.

The athletic career of each individual athlete is unique, but it is also possible to find common patterns in careers of all athletes or in careers of certain groups of athletes (e.g., in different sports, cultures, gender groups, disabled and able-bodied athletes). The most common patterns are presented in theoretical models describing and explaining athletic careers and career transitions. These models are more fully described in the next section.

MODELS OF CAREER TRANSITION

Currently in sport psychology three models are related to athletic career transitions: (1) career stage descriptive models, (2) explanatory career transition models, and (3) career transition intervention models and programs. The first two are presented in this section, and the intervention models appear later in the chapter.

Career Stage Descriptive Models

These models are typically inspired by a metaphoric description of an athletic career as "a miniature life span course." They divide athletic careers into several stages and describe the changes in athletes and in their social environment across the stages. None of these models explains the transition processes, but they describe and predict the existence and order of athletes' normative career transitions that derive from the logic of the career development process. Table 32.1 summarizes five career stage models, with athletic career stages presented in the fist half and normative career transitions predicted by the models in the second half.

Although the models have been developed in different parts of the world (North America, Russia, and Western Europe) it is possible to see overlaps among them.

The *initiation stage* in Bloom's (1985), Salmela's (1994), and Wylleman and Lavallee's (2004) models is analogous to the *sampling years* in Côté's (1999) model, but cover both the *preparatory stage* and *beginning of sport specialization* in Stambulova's (1994) model. The authors agree that during *initiation* children are engaged in fun, playful sport or exercise activities and perceive sport as merely playing a game. Coaches and parents provide guidance and support for young athletes, helping them to test various sport disciplines and to find one or two that are the most suitable to their abilities and interests. Children learn sport rules and might participate in their first competitions, but so far they do sports more for fun than for achieving specific sport goals. Observing young athletes at this stage, it is difficult to predict who will build a career in sports, but it is already obvious that some children develop the social role of an athlete and an identity corresponding to this role.

The *development stage* in Bloom's (1985), Salmela's (1994), and Wylleman and Lavallee's (2004) models corresponds to the *specializing years* in Côté's (1999) model and to *intensive training in chosen sport* in Stambulova's (1994) model. During this stage athletes narrow their focus to one or two sport disciplines that they are hooked by and committed to. Their athletic identities become stronger. Coaches guide athletes to set sport-related goals, to practice in a more structured and deliberate way, and to take part regularly in competitions. Parents continue their support and have to invest more time and money into their children's sport participation. For athletes themselves, sport becomes a sphere of education where they still have a lot of fun, but the focus is on learning sport-specific skills, increasing their physical fitness level, and demonstrating learned competencies in competitions. Practices and competitions take more time and energy than in the initiation stage. It becomes more difficult to combine sport with studies and other activities; hence, the first sacrifices have to be made to guarantee progress in sport.

The *perfection stage* in Bloom's (1985), Salmela's (1994), and Wylleman and Lavallee's (2004) models corresponds to the *investment years* in Côté's (1999) model but covers *culmination* and *final stages* in Stambulova's (1994) model. During the perfection stage, athletes become experts in their sport and feel obsessed and responsible for their practices and competition performances. Coaches often turn into mentors or advisors, and parents play a lesser role because athletes control major aspects of their careers themselves. For top athletes, sport becomes a job or professional activity oriented to high achievements and social recognition. Athletes set high performance goals, have an extensive amount of deliberate practice, and subordinate their lifestyle to sport, making more and more sac-

Table 32.1 Athletic Career Stages and Transitions Predicted by Career Stage Models

Models/Characteristics	Athletic Career Stages	Normative Athletic Career Transitions
Bloom (1985)	1. Initiation 2. Development 3. Perfection	Transitions are not emphasized.
Salmela (1994	1. Initiation 2. Development 3. Perfection 4. Discontinuation	1. From initiation to development 2. From development to perfection 3. From perfection to discontinuation
Stambulova (1994)	1. Preparatory stage 2. Beginning of specialization 3. Intensive training in chosen sport 4. Culmination stage 5. Final stage, followed by discontinuation	1. The beginning of sport specialization 2. The transition to more intensive training in chosen sport 3. From junior to senior/high-achievement sport 4. From amateur to professional sport 5. From culmination to the final stage 6. Athletic retirement
Côté (1999)	1. Sampling years 2. Specializing years 3. Investment years 4. Recreational years	Transitions are not emphasized.
Wylleman and Lavallee (2004)	1. Initiation 2. Development 3. Perfection 4. Discontinuation 5. The four stages in athletic career are presented in coordination with the stages in psychological, psychosocial, and academic-vocational development.	1. The transition into organized sport 2. The transition to an intensive level of training and competitions 3. The transition into the highest or elite sports 4. The transition out of competitive sports 5. The four athletic transitions are presented in coordination with transitions in other spheres of athletes' life.

rifices in other spheres of life. They have a strong athletic identity, and their sport achievements and recognition contribute a lot to their self-esteem. This stage usually lasts between 5 and 15 years and cannot be seen as a homogeneous period. For example, signing a professional contact may mark a new stage, or at least a substage, but it is not reflected in the models. Stambulova identified *a final stage* during which athletes try to maintain their sport results on a high enough level and to prepare for termination. Existence of such a preamble for athletic career termination was also confirmed by Durand-Bush (2000) and was called the *maintenance years.*

The *discontinuation stage* in Bloom's (1985), Salmela's (1994), and Wylleman and Lavallee's (2004) models corresponds to the *recreational years* in Côté's (1999) model and is not emphasized as an athletic career stage in Stambulova's (1994) model. During this period athletes stop participating in competitions on the level they had previously achieved, but they may continue training or sport participation for recreational purposes. Because their new focus is on starting a new professional career or studies and developing an identity related to their new social roles, former elite athletes refocus their life and perceive sport as a part of their life history or as a recreational hobby.

Three of the models presented in Table 32.1 also make an attempt to predict athletes' normative transitions. The transitions are typically marked by specific events, for example, decisive talks between the coach, the athlete, and his or her parents; the first participation in a competition on a higher level; or selection to the national team.

The four stages of sports career model (Salmela, 1994) focuses on *three normative career transitions:* from initiation to development, from development to perfection, and from perfection to postcareer life. The transitions are marked by essential changes in degree of sport involvement and corresponding changes in athletes' attitudes to sport.

The analytical athletic career model (Stambulova, 1994) was initially created on the basis of an analysis of four different stage models of a professional career and sport participation found in the psychological and sport science literature. Some overlap between the models was taken into account, and seven normative transitions of elite athletic careers were predicted. Empirical studies, conducted to test the model (Stambulova, 1994, 1999), provide evidence for *six normative transitions* (see Table 32.1) because the transitions to high-achievement sports and from junior to senior sports were found to greatly overlap. Researchers who tested the model emphasized specific sets of demands related to each normative transition together with athletes' perceived resources to cope with the demands.

The developmental model, integrating an athletic career with three nonathletic developments (Wylleman & Lavallee, 2004), presents the three stages of an athletic career described by Bloom (1985) with a discontinuation stage added by the authors. It also combines athletic career stages with three other levels in athletes' development: psychological, psychosocial, and academic-vocational. A schematic illustration of the model is presented in Figure 32.1.

This model adds a "whole person" approach to a "whole career" approach and helps us not only to see an athlete in the sport context, but also to consider the athlete's demands and transitions outside sport. In fact, it emphasizes links and interactions among four normative athletic transitions (see Table 32.1) and a number of normative transitions in other spheres of athletes' life span development. The model directs researchers and practitioners to consider athletic career demands together with (a) developmental tasks related to childhood, adolescence, or adulthood; (b) changes in relationships and support that athletes get from their significant others, including coaches, parents, siblings, peers, and partners (Wylleman, De Knop, Ewing, & Cumming, 2000); and (c) athletes' progress through the steps in a corresponding educational system or in a vocational career. Transitions in different spheres of life might overlap, and thus might create difficult life situations for athletes. It is really important to be able to predict such overlaps. Chronological age markers for the athletic and nonathletic transitions, suggested by the model, "are averaged over many athletes and several sports" (Wylleman & Lavallee, 2004, p. 516) and need to be specified in research for different sports, genders, and cultures. This model has a sound applied potential and directs applied sport psychologists to create a holistic view of the athlete and his or her social environment that is particularly important in individual counseling interventions.

Career Transition Explanatory Models

Career transition models (Schlossberg, 1981; Stambulova, 1997, 2003; Taylor & Ogilvie, 1994, 2001a) have explanatory potential and focus on reasons and demands, coping

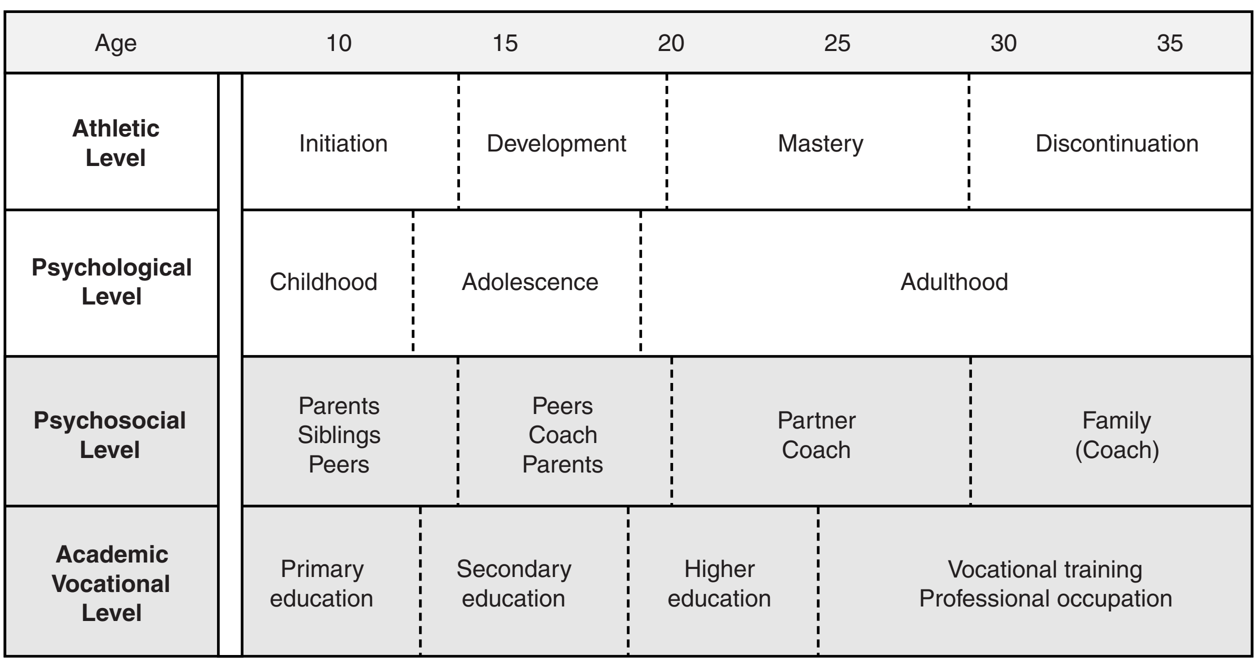

Figure 32.1 A developmental perspective on transitions faced by athletes at athletic, individual, psychosocial, and academic-vocational levels. *Note:* A dotted line indicates that the age at which the transition occurs is an approximation. *Source:* "A Developmental Perspective on Transitions Faced by Athletes" (p. 516), by P. Wylleman and D. Lavallee, 2004, in *Developmental Sport and Exercise Psychology: A Lifespan Perspective,* M. Weiss (Ed.), Morgantown, WV: Fitness Information Technology. Reprinted with permission.

processes, factors influencing coping, outcomes, and later consequences of a transition. According to all these models, coping processes are central in a transition and include all approaches the athletes use to adjust to the particular set of transition demands.

The human adaptation to transition model (Schlossberg, 1981, 1984; Schlossberg, Waters, & Goodman, 1995) explains the process and outcomes of a transition by an interaction of four sets of factors (the 4 S system): (1) *situation* (e.g., event or nonevent transition and how it is perceived by the person); (2) *self* (e.g., individual peculiarities of the athlete); (3) *support* (e.g., availability of different kinds of social support); and (4) *strategies* (e.g., information seeking, direct action, inhibition of action). Strategies to cope with a transition are key elements in the model, and the other three can be seen as groups of factors influencing coping. This model is not sport-specific and was developed as a counseling model for adults experiencing critical life events. But it was adopted in sport psychology research (e.g., Swain, 1991) and was quite influential in the development of sport-specific career transition models.

The athletic career termination model (Taylor & Ogilvie, 1994, 2001a) deals with the last athletic transition—from sport to the postcareer—and focuses on *reasons* for sport career termination, *factors related to adaptation* (developmental experiences, self-identity, perceptions of control, social identity, and tertiary contributors) *available resources* (coping skills, social support, preretirement planning), and *quality of the transition.* The last is presented as a key point determining an outcome of the transition. Two alternative outcomes are predicted by the model: *healthy career transition* and *career transition distress.* In terms of the career transition distress outcome, a need for interventions with both preventive and distress-coping perspectives is outlined. This model has been very valid and has inspired a lot of studies on athletic career termination and retirement from sports all over the world. It successfully replaced the thanatology and social gerontology frameworks in the athletic retirement studies (Taylor & Ogilvie, 2001a). But the application of this model to the transitions along an athletic career is limited. Therefore, we consider in greater detail the most recent career transition model that can be applied to any normative or nonnormative transition.

The athletic career transition model (Stambulova, 1997, 2003) follows the tradition of considering career transition as a process and not as a single event (Wylleman et al., 1999). The sense of this process is coping with a set of specific *demands* (challenges), which is necessary for successfully continuing an athletic career. Transition demands create developmental conflict between "what the athlete is" and "what he or she wants or ought to be," which stimulates the athlete to mobilize resources and to find ways to cope. Effectiveness of coping is dependent on the dynamic balance between *transition resources* and *barriers.* In this model transition resources imply all internal and external factors that facilitate coping processes (e.g., the athlete's knowledge, skills, personality traits, motivation, availability of social and financial support), whereas transition barriers cover all internal and external factors that interfere with effective coping (e.g., lack of necessary knowledge or skills, interpersonal conflicts, absence of good conditions for training, lack of financial or social support, difficulties in combining sport and education or work). In the schematic illustration of the model (Figure 32.2), *coping* is shown as a key point that divides it into two parts.

The upper part of the model considers the demands the athlete must cope with and the factors influencing coping, whereas the bottom part outlines two possible outcomes and consequences of a career transition. These two *outcomes* include successful transition and crisis transition. *Successful transition* is associated with effective coping, when the athlete is able to recruit or rapidly develop all necessary resources and to overcome transition barriers. An alternative outcome is a *crisis transition,* which is related to the athlete's inability to cope with the demands effectively on his or her own and to a perceived need in psychological assistance or intervention. Research and practical experience of counseling athletes in crises (Stambulova, 2000) show various reasons for ineffective coping, including the athlete's low awareness of transition demands, lack of resources or a lot of barriers, and inability to analyze the transitional situation and to make a proper decision.

To change ineffective coping, the athlete needs psychological intervention, which in turn influences the *consequences of the transition.* If the intervention is effective, it is followed by successful but delayed transition. If the intervention is ineffective or the athlete has not received any qualified psychological assistance, the model predicts negative consequences or so-called costs for failure to cope with the transition. Stambulova (1994, 1999) showed that possible costs are decline in sport results, injuries, overtraining, neuroses, psychosomatic illnesses, dropout from sports, and also different forms of rule violation and degradation of personality (alcohol and drug use, criminal behaviors). This last point of the model emphasizes the importance of psychological assistance to athletes in career

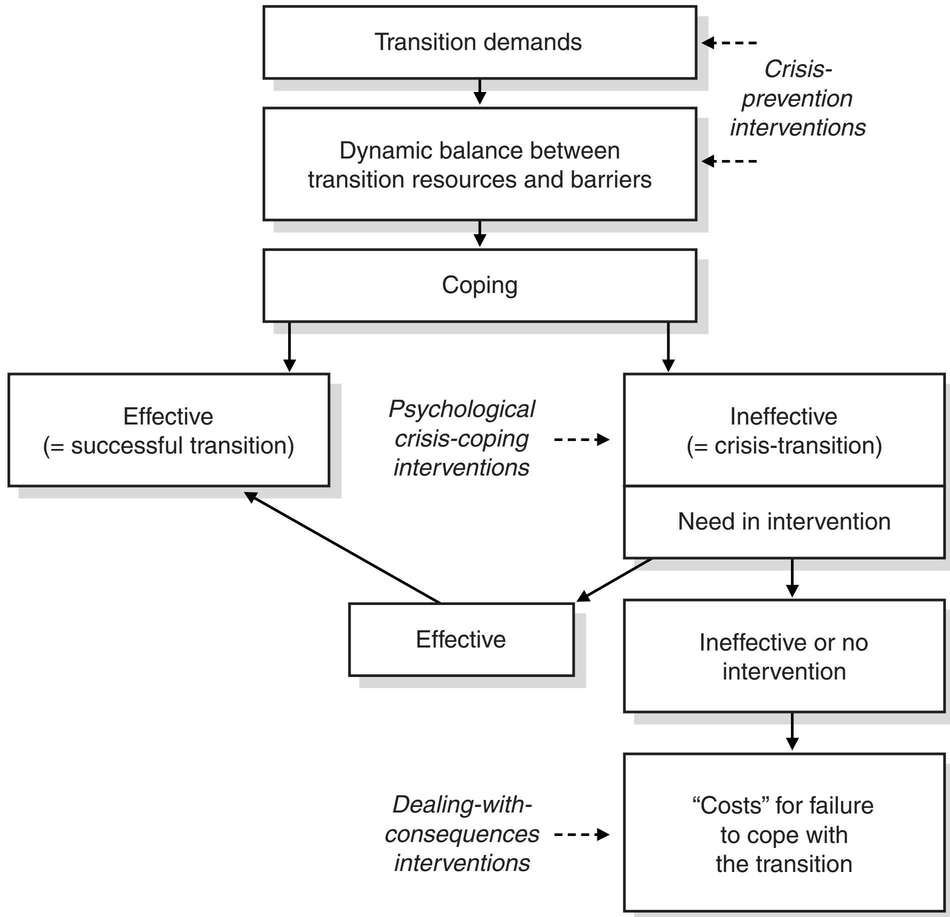

Figure 32.2 The athletic career transition model. *Source:* "Symptoms of a Crisis-Transition: A Grounded Theory Study" (pp. 97–109), by N. Stambulova, in *SIPF Yearbook, 2003,* N. Hassmen (Ed.), 2003, Örebro, Sweden: Örebro University Press. Reprinted with permission.

transitions to prevent crisis transitions and, especially, the costs of failure to cope. As shown in Figure 32.2, three kinds of interventions can be useful in a sports career transition: (1) crisis-prevention interventions, (2) crisis-coping interventions, and (3) dealing-with-negative-consequences interventions.

Crisis-prevention interventions aim at preparing athletes to cope with a transition and help them to develop all necessary resources for effective coping. In other words, crisis-prevention interventions (e.g., goal setting and planning, mental skills training, organization of a social support system) can help to form the athlete's *readiness for a normative sport career transition* (Alfermann, Stambulova, & Zemaityte, 2004). Therefore, these interventions are effective before or at the very beginning of a transition. Psychological crisis-coping interventions are necessary when it is becoming obvious that an athlete is in crisis. These interventions may help the athlete to analyze his or her situation and to find the best available way to cope. Psychotherapeutic or clinical interventions most often have to be administered when an athlete already experiences one or several of the negative consequences of not coping with a crisis transition.

Summary

In the past decade there has been an observable increase in the number of theoretical models developed for the career transition processes. There is also a clear shift from theoretical frameworks that originate from developmental and social psychology to sport-specific models that serve both for research and applied work in career transitions. Career stage descriptive models predict the normative transitions athletes might experience in the course of an athletic career. Describing career stages, the models emphasize

(a) changes in athletes' perception of or attitude toward sport, and the degree to which they identify themselves with the athletic role; (b) changes in athletes' social environment and the role of coaches, parents and family, and peers in career development; (c) changes in time and energy investment across the stages; and (d) changes in the degree to which they have to sacrifice other spheres of life to accomplish their sport goals. Career transition models describe what happens with athletes in a process of transition and explain why some athletes cope successfully with both normative and nonnormative transitions and others do not. They emphasize primary and secondary appraisal processes when coping with the transition.

RESEARCH ON CAREER TRANSITIONS

Methodological issues and major research findings in career transition and career termination studies are presented in this section.

Empirical Approaches to Career Transitions

Most studies on career transitions and concomitant changes in athletes are concerned with career termination and its consequences, and only a very limited number of studies are dedicated to other transition experiences. Here we consider the methodological approaches on career transitions and the main research results on transitions during athletic careers. Afterward, we summarize the literature on career termination and transition to the postcareer.

Definitionally, a transition involves a developmental aspect. Methodologically, therefore, one might anticipate the use of longitudinal designs. Unfortunately, these designs have only rarely been employed. Instead, retrospective and cross-sectional analyses dominate the literature. Taken as a whole, studies on career transitions use a great variety of methodologies in data assessment and design. Quantitative methods, such as questionnaires and standardized scales, usually done with somewhat larger samples, are as popular as qualitative methods, such as in-depth interviews and case studies. With quantitative methods, it is easier to compare the data with other athletes or comparison groups and to draw conclusions about similarities and differences. With qualitative methods, the individual experiences and inner feelings may be assessed in greater detail, but very often at the expense of larger samples and comparability. Both kinds of methods contribute to a rich knowledge base on psychological foundations and effects of career termination and, to a lesser degree, on career transitions.

Designs range from prospective to retrospective, from one-shot to longitudinal studies. Some prospective studies exist about causes and consequences of dropout in sport and about career transitions. Typically, measures are taken from promising young athletes and reassessed once or several times in later years. With this design investigators can determine whether transitions can be predicted from data at the first point of measurement. For example, Gabler (1981), with elite swimmers, and Bußmann and Alfermann (1994), with junior national elite track and field athletes, were able to identify psychological variables that predicted later dropout. In both studies, highly motivated athletes, striving for success, were less likely to drop out than athletes with lower motivation. Athletes who made a successful within-career transition from a lower to a higher phase had higher parental support (Wuerth, Lee, & Alfermann, 2004), and higher coach attention (Alfermann, Lee, & Würth, 2005) compared to athletes without transition support.

A very popular approach is asking athletes about their experiences, actions, and development in retrospect. This approach has been used with quantitative and qualitative methods. Analyzing interviews and written practice schedules, Salmela, Young, and Kallio (2000) described typical developmental changes in athletes, their parents, and coaches as seen in retrospect from the athletes' viewpoint. At the beginning of their careers, successful athletes were raised in a supportive environment with "parents and coaches who are willing to support the child's love for the activity" (p. 192). Entering the developmental phase, athletes had "to accommodate to a more goal-directed mode in which both the athlete and the parents begin to rigorously commit more training and resources" (p. 192). Entering the mastery phase demands a full obsession to the sport and high performance from the athletes, parents, and coaches.

Based on interviews with four junior national-level athletes and their family members, Côté (1999) likewise suggested three career phases with an emphasis on special demands and sacrifices from athletes and their families during the within-career transitions. Based on semistructured interviews with three adolescent tennis players, their parents, and coaches, Wolfenden and Holt (2005) corroborated Côté's findings of three career phases and the parent-athlete social system. In their study, parents were responsible mainly for social support and pressure and coaches for teaching expertise and commitment to tennis.

Bennie and O'Connor (2004) investigated track and field athletes when transgressing or dropping out from junior to senior level. The main facilitating influence on a successful transition was a supportive environment regarding the psychological, social, and economic situation.

Quantitative studies often employ questionnaire data collection by mail. This is economically efficient and can result in larger samples than found in qualitative and prospective studies. Yet, although the number of cases may be greater, retrospective data has the disadvantage of (unknown) time lags between the transition and the point of measurement, which may lead to distortions in memory and to more aloof feelings than during or immediately after the transition. Retrospective studies are a valuable contribution to the body of research results but should be complemented by prospective and longitudinal studies.

Longitudinal studies with accompanying data points before, during, and after transitions are a promising approach to discover transition-dependent psychological changes in athletes. Typically, athletes in transition are compared with no-transition athletes, for example, comparing retired athletes with no retirees. Unfortunately, only a handful of studies have used a longitudinal approach. A strength of longitudinal studies lies in the ability to examine developmental processes in athletes as a consequence of the transition *and* to compare these processes with control groups. For example, Grove et al. (2004) investigated the athletic identity of female athletes vying for selection in state all-star teams. Results showed a significant decrease in athletic identity of nonselected players and a stable identity of selected players over time. Stephan, Bilard, Ninot, and Delignières (2003a, 2003b) found a U-curve development of physical self and well-being in retired compared to nonretired athletes. In the Stephan et al. studies, retired athletes first reported a loss of well-being not found in still active athletes, but in the long run they could recover psychologically from retirement.

Major Empirical Findings on Career Termination

As a consequence of changing theoretical perspectives on career termination, there resulted changes in empirical approaches. Earlier studies regarded career termination as a critical, even devastating life event and consequently focused on problems and difficulties in adaptation to the postcareer (Ogilvie & Howe, 1986). Career termination is now regarded as an open-ended process that may result in a crisis or, more positively, in a chance for development and personal growth (Perna, Ahlgren, & Zaichkowsky, 1999; Perna, Zaichkowsky, & Bocknek, 1996). In their contribution to a former edition of this *Handbook,* Taylor and Ogilvie (2001a) emphasized that the consequence of career termination as a crisis or as a challenge depends on, among other things, the causes of career termination, its circumstances, and the individual athlete's personal and social resources.

Causes of Career Termination

Ogilvie and Taylor (1993; Taylor & Ogilvie, 2001a) postulate four main causes of ending a career: age, deselection, injury, and free choice. The fourth cause, free choice, occurs when an athlete ends his or her career freely. Athletes themselves decide if and when to retire, seemingly without external reason or even pressure. The first three causes correlate with decreasing performance, which, as a whole, may lead to a more involuntary decision to end the career. Deselection out of a team, not getting a new contract, and so on clearly lead to forced career termination. Zaichkowsky, King, and McCarthy (2000) describe the example of the Boston University football team, whose contract was terminated overnight due to the decision of the university.

Career-terminating injuries can also be regarded as causes of forced transition. An injury-caused end of career correlates with a more difficult adaptation than any other cause (Mayer, 1995; Webb, Nasco, Riley, & Headrick, 1998). This is particularly true if an injury leads to a premature dropping out of sport (Bußmann & Alfermann, 1994). Injuries lead not only to a more difficult adaptation to the postcareer transition, but also to dissatisfaction with the whole career and career service. For instance, in a study with former soccer players in England, injured players were less satisfied with all the services provided by their football association than noninjured former athletes (Drawer & Fuller, 2002). Injuries obviously combine several aspects that lead to difficulties in the transition process: The transition is unforeseen, unplanned, unchosen, and out of the athlete's control.

Age is different. An aging athlete who realizes that he or she is losing skills and may no longer be able to compete equally with other opponents must sooner or later decide to end the career. This may not happen involuntarily, but may be freely chosen, at least from the athlete's viewpoint. In addition, retirement can be planned.

Instead of listing a number of causes, as Taylor and Ogilvie (2001a) did, it is also possible to dichotomize them into voluntary (e.g., free choice) and involuntary causes. In addition, it should be emphasized that, in most cases, career termination results from several causes, and not only one. But what seems to be most important for the transition process is the athlete's impression of controllability of career termination. If an athlete feels that retirement is his or her own decision, regardless of the cause(s), this leads to a more positive adaptation. Whether the termination is forced or free choice makes a big difference for coping with the transition. It is therefore suggested that researchers lay emphasis on this distinction, instead of giving lists of causes for career termination. Webb et al. (1998) suggest the same dichotomy when they distinguish between voluntary/freely chosen and externally forced retirement. Freedom of choice contributes to differences in emotional adaptation to the transition process, in coping patterns, and in life satisfaction after the athletic career. It can be shown that adaptation runs more smoothly after freely ending the career than after involuntary retirement (Alfermann, 2000). But even with forced retirement, interindividual differences in adaptation point to additional influences on the transition process, such as the athletes' personal and social resources, as well as the macrosystem, for example, the sport organizations and the national culture.

Which causes for career termination are found in the literature? Typically, researchers emphasize the multicausal nature of the career-ending process. Though in many studies athletes report one or two main causes, these must be seen as the tip of the iceberg, with additional causes under the surface. This should be kept in mind in the following discussion.

Though studies with professionals are quite rare, quantitative studies show that a majority seem to retire involuntarily, with reasons of aging, injury, and deselection mentioned most often (Drawer & Fuller, 2002; Reynolds, 1981; Rosenberg, 1981). Qualitative studies show a different picture (Allison & Meyer, 1988; Swain, 1991), with athletes emphasizing voluntary retirement for reasons of family planning or occupational involvement. Unfortunately, the number of participants in these studies is quite small.

Studies with amateur athletes and nonprofessionals show some similarities and differences in the process and the cause(s) of retirement. Similar to professionals, the transition to the postcareer is very often the result of a longer decision process, which may or may not lead to several career termination efforts before definitely ending the career. The causes are slightly different from those for professionals. The main group of causes is finishing education and planning an occupational career; this means that job-related concerns are the main reasons (Greendorfer & Blinde, 1985; Hastings, Meyer, & Kurth, 1989). A number of studies point to the importance of distinguishing between free choice and forced retirement and between planned and unplanned retirement. Injuries, skill deterioration (Alfermann et al., 2004; Taylor & Ogilvie, 2001a) and a loss of financial resources (Koukouris, 1991, 1994; Werthner & Orlick, 1986) are mentioned as causes for an involuntary and unplanned retirement. In contrast, job-related reasons and family planning are typical causes for voluntary and planned retirement (Alfermann & Groß, 1998; Alfermann et al., 2004). Psychological causes—time constraints, loss of motivation, lack of support, and feeling "the time is ripe"—may also contribute to the decision to end the career (Hastings et al., 1989; Mayer, 1995; Sands, 1978; Sinclair & Orlick, 1994).

Male and female athletes show many similarities and only minor differences in the causes of career termination. If gender differences exist, these are due to inequalities in career chances and in gender roles in a society. In particular, women retire more often than men for family reasons (Hastings et al., 1989). Compared to men, they expect and get fewer rewards from their athletic career (Alfermann, Sichart, & Dlabal, 1993; Greendorfer & Blinde, 1985), and they are less likely to get jobs in the sport system, such as coach or manager (Alfermann et al., 1993; Hastings et al., 1989).

In sum, the literature suggests that career termination is multiply caused and is very often the result of a longer process of reasoning and decision making. Regardless of the particular causes of career termination, research shows that the athlete's subjective feeling about the decision as voluntary or involuntary is a crucial point for adaptation. In addition, making timely plans for life after the career helps tremendously to cope with transition and to build a new life. The coping process depends not only on the causes, but also on the individual and social resources of the athlete. Strengthening the individual resources by, for example, education, competence training, and goal setting for the post-career could help athletes to find a healthy adaptation. Social resources, such as social support of the family and postcareer services from sport federations, could also help tremendously in the career transition process. This process should lead to the adoption of new roles in occupation, family, and the sport system.

Adaptation to the Postcareer

Since the 1980s a growing number of studies have been concerned with elaborating the determinants of a successful or healthy transition versus a crisis transition. The outcome may be evaluated along one or both of two criteria: *successful coping* with career termination and *success in life.* With regard to the latter, research is primarily concerned with life satisfaction and success in job and family; with regard to the former, research focuses on coping efforts and the psychological effects of career transition (e.g., well-being and self-concept).

The first aim of postcareer research is concerned with the athletes' individual interpretation of and coping with the process of career termination. The quality, the advantages and disadvantages, the problems and prospects of career transition, the coping strategies, and the process of adaptation to the postcareer are the focal points of research. Whereas the analysis of the occupational and life development of former athletes gives information about if and how former athletes were able to solve important developmental tasks, the analysis of the individual experience of career termination gives a deeper insight into the quality of coping, its corresponding psychological processes, and particularly the determinants and consequences of the quality of transition, namely, a healthy or a crisis transition. It is remarkable that this line of research presents a less favorable picture of the postcareer than the studies about occupational development. In the majority of studies, career termination is regarded as a critical life event, as a stressful situation (Sinclair & Orlick, 1994), or even "as a complex interaction of stressors" the effects of which "may produce some form of distress" in athletes (Taylor & Ogilvie, 2001a, p. 684). Though career termination may result in distress for many athletes, at the same time there are great interindividual differences in the reactions to career transitions. For example, in a study with former elite athletes, we found that only half confessed that career termination was a critical period in their life (Alfermann et al., 2004). When looking at intraindividual differences in reactions to career termination over a 12-month period, Stephan et al. (2003b) found, first, decreasing well-being of former elite athletes, and then a recovery to an even higher level after 12 months. When looking at the physical self-concept of the same athletes, a similar development could be observed (Stephan et al., 2003a). What are the main determinants of the quality of adaptation to transition experiences after sports?

Four determinants are mainly responsible for the quality of adaptation to career transition. First among these is the cause of career termination, namely, if it happened *voluntarily* or involuntarily. Second, *planning* the postcareer helps in having a smoother transition. Third, *athletic identity* and fourth, the athlete's personal and social *resources,* particularly social support, have an important impact on the quality of the transition process (Alfermann & Groß, 1998; Alfermann et al., 2004; Allison & Meyer, 1988; Bußmann & Alfermann, 1994; Grove, Lavallee, & Gordon, 1997; Parker, 1994; Sinclair & Orlick, 1994; Swain, 1991; Taylor & Ogilvie, 2001a; Ungerleider, 1997; Webb et al., 1998; Werthner & Orlick, 1986).

To end an athletic career out of *free choice* obviously facilitates the adaptation process and contributes to a healthy transition (Webb et al., 1998; Wheeler, Malone, VanVlack, Nelson, & Steadward, 1996). Athletes who end their career freely report more positive emotions, such as relief and joy, and fewer negative emotions, such as sadness and disappointment, than athletes who are forced to retire (Alfermann, 2000; Alfermann & Groß, 1998). In contrast, the latter need more coping strategies and social support, and they prefer more passive (reappraisal, downplaying) and less active coping strategies, for example, job search, leisure activities (Alfermann, 2000). If the career ends due to an injury—an involuntary cause—athletes experience particularly high distress, and the quality of adaptation to the postcareer is likely to be impaired (Webb et al., 1998).

Besides voluntary retirement, which often happens as a scheduled event, *planning* the postcareer has great advantages for a healthy transition. Planning not only helps athletes find a smoother transition to life and the job market after sports, it is also helpful for developing a positive identity (Crook & Robertson, 1991; Ogilvie, 1987; Pearson & Petitpas, 1990; Sinclair & Orlick, 1993; Werthner & Orlick, 1986). Athletes who planned their retirement adapt faster to the postcareer and experience more positive emotions and greater life satisfaction (Alfermann et al., 2004; Perna et al., 1999; Torregrosa, Boixadós, Valiente, & Cruz, 2004; Wheeler et al., 1996). Unfortunately, a majority of athletes tend not to plan their retirement and their life after sports. For example, Svoboda and Vanek (1982) found that 71% of their sample of former athletes had never planned for the postcareer. Even in a study 20 years later, it could be shown that only 40% of retired athletes had made plans for the time after career termination (Alfermann et al., 2004). Conclusions that can be drawn from this kind of research point to the importance of helping athletes in postcareer planning and giving them psychological support. An overview about forms of interventions is given in the next section of this chapter.

The *athletic identity* may be an Achilles' heel for a healthy career transition. On the one hand, elite athletes are extremely involved in their sport. It is evident that this typically results in a very high athletic identity, which in turn leads to an increase in active involvement in sports—a circular relationship (Brewer et al., 2000). Thus, involvement and identity are interrelated. High athletic identity is consistent with pursuing a career, whereas low identity is inconsistent and may contribute to career termination. For example, female track and field athletes who ended their career prematurely had lower athletic identity than athletes who persisted longer (Bußmann & Alfermann, 1994).

On the other hand, athletes with high athletic identity have problems with adaptation to critical life events, such as injuries (Brewer, 1993) and career termination, particularly when the athlete was exclusively devoted to sport. In other words, there is a negative relationship between identity and experiencing and coping with career termination, as is shown in numerous studies. Athletes with high athletic identity are more reluctant to end their career, experience more negative emotions and traumatic incidents, need more time for adaptation, and are susceptible to depressive symptoms (Alfermann et al., 2004; Brewer et al., 2000; Cecić Erpič, Wylleman, & Zupančič, 2004; Grove et al., 1997; Lavallee, Gordon, & Grove, 1997). Athletes who derive their identity, self-esteem, and life satisfaction predominantly or even exclusively from being an athlete have problems adapting to a life without sports (Ungerleider, 1997).

Last but not least, an athlete's available resources are important. His or her ability to cope with the new situation (i.e., coping strategies and career planning after sports) and the social support system have great implications for adaptation to career transition. Athletes can use cognitive strategies, such as mental rehearsal of behavioral strategies in the future postcareer, or set goals for the postcareer. Anything that helps former athletes make plans for the future, pursue goals, and be active is helpful.

Similar to the double-edged sword of athletic identity, the social support system of athletes is differentially helpful before and after the career. During their athletic career, athletes have friendships primarily, and often even exclusively, from the world of elite sport. This is of functional relevance for the career. But when the career ends, friends from outside the sport world are more helpful. For an athlete postcareer, it is therefore essential to have a social network outside sports (Bußmann & Alfermann, 1994). Studies so far emphasize that social support during the postcareer comes primarily from family and friends outside sport (Sinclair & Orlick, 1993; Taylor & Ogilvie, 2001a, p. 681), and less from coaches and the sport system. The more psychologically grounded the career education programs offered by sport organizations and sport psychologists, the more athletes may make use of these professional offers of support.

How about the second aim of career termination research? Numerous studies focus on athletes' development in job and family after termination of the athletic career (Alfermann et al., 1993, 2004; Conzelmann et al., 2001; Curtis & Ennis, 1988; Greendorfer & Blinde, 1985; Hackfort et al., 1997; Hastings et al., 1989; Koukouris, 1991; Lerch, 1981; Nagel, 2002; Perna et al., 1996; Reynolds, 1981; Sands, 1978; Snyder & Baber, 1979). Are elite athletes better or worse prepared for an occupation and success in the job market (Brown, Glastetter-Fender, & Shelton, 2000)? Does an athletic career contribute to personal gain or loss (Conzelmann et al., 2001)? Does the equation "Medals in sport—success in occupation" (Nagel, 2002) really apply to elite athletes' postcareer? Typically, the results of studies about former athletes' development point to the fact that athletes are no less successful in life than comparable nonathletes (Curtis & Ennis, 1988; Hackfort et al., 1997; Snyder & Baber, 1979). This means that an athletic career does not put people at a disadvantage. Alfermann et al. report that the high educational level of their sample of German former elite athletes (many of them from track and field or handball) contributed to successful occupational careers more often for males than females. Hackfort et al. and Nagel found that the occupational careers of former athletes in most cases correspond to their occupational training. The group of amateurs in the study by Hackfort et al. showed neither social downward nor upward mobility. In consequence, "no proof of a correlation between social mobility and involvement in elite sports could be found" (p. 126). The pattern of results was different for the professionals: They were more at risk for downward social mobility than amateurs due to their exclusive involvement in sport.

Conzelmann et al. (2001) and Nagel (2002) investigated 616 German former successful Olympic athletes who had participated in the Olympics between 1960 and 1992 and who had reached at least the top six (individual sports) or four (team sports) places in their respective sport. The overwhelming majority of these athletes made an occupational career that mirrored their educational and training level. A minority showed upward mobility, which means that they had a higher position than would be expected from their education. An even smaller minority showed downward mobility, having less qualified positions than would be expected from their educational level. These results corroborate earlier findings from American College Sport showing that elite sport does not undermine an individual's occupational development and life satisfaction (Greendorfer & Blinde, 1985).

Nevertheless, the high involvement in elite sport may prolong an athlete's personal growth and occupational development. Studies with college athletes in the United

States showed that they were less well prepared and less determined to make decisions about their future and to pursue an academic or occupational career than comparable nonathletes (Blann, 1985; Brown et al., 2000; Kennedy & Dimick, 1987). This lack of career maturity was more pronounced in athletes who had high athletic identity and high identity foreclosure (Murphy, Petitpas, & Brewer, 1996), though Brown and Hartley (1998) were unable to find a correlation between high athletic identity and low career maturity.

Possibly, it is less the athletic identity per se that leads to lower career maturity, and more the identity foreclosure, which results in single-minded focusing on sport. Athletes with high athletic identity foreclosure pursue their career at the expense of all other areas of life, particularly their professional education and personal growth. These athletes may be more likely to run the risk of ending up in a crisis after career transition (Baillie & Danish, 1992; Ungerleider, 1997). To put it differently, on the average, a good education is a better predictor of later life satisfaction than success in sport alone (Kleiber & Malik, 1989).

In sum, it may be said that an athletic career does not necessarily hinder a successful occupational career in later life (e.g., Greendorfer & Blinde, 1985; Hackfort et al., 1997; Nagel, 2002). Some athletes even show an upward mobility, which may be attributed to their success in sport (Conzelmann et al., 2001). Unfortunately, this conclusion is based on the data of only those athletes who responded; respondents and nonrespondents may differ in their development and life satisfaction after career termination. It is possible that the nonrespondents are less successful in life. Therefore, our conclusions about athletes' development in the postcareer phase may be ignoring the situation of the nonrespondents. Even in the group of respondents we find some cases of downward mobility, as was shown by Nagel and by Hackfort et al. in the case of professional athletes. The occupational development of former athletes depends on their (a) individual resources, such as personal goals (Hackfort et al., 1997) and athletic identity (Ungerleider, 1997) and (b) environmental factors, such as the team or group (Lavallee, Gordon, & Grove, 1996), the type of sport, and the athletic support system (Hackfort et al., 1997; Koukouris, 1994; Lavallee et al., 1996; Nagel, 2002). Timely planning of the postcareer, playing multiple roles during the sport career, and getting support from the social environment (parents, friends) can help athletes to make a successful occupational career.

The studies considered in this review were conducted with athletes from different countries and continents: Europe, North America, and Australia. Nevertheless, the results contribute to quite similar conclusions with regard to the career transition process and its positive and negative influences on the quality of coping and life satisfaction. Unfortunately, systematic comparisons between different nations or cultures with different support systems for athletes are lacking. The study of Alfermann et al. (2004) with German, Lithuanian, and Russian athletes is only a first step. It would be helpful to analyze more systematically the possible influence of national and cultural systems and of mentality on career transitions to gain more insight into the contribution of structural aspects, besides personal and social variables.

CAREER TRANSITION INTERVENTIONS

Based on career transitions research, a need to help athletes to prepare and go through transitions was clearly recognized in sport psychology, and corresponding applied approaches have been developed. Nowadays, the *career/developmental perspective* in applied work with athletes in transition unifies several interrelated approaches or principles that are important for an effective intervention.

Major Principles of Applied Work in Career Transitions

A *whole career approach* means helping athletes to cope with both normative and nonnormative transitions throughout the whole course of an athletic career, including the last athletic transition from sport to the postcareer. This principle reflects a shift from helping athletes mainly with athletic career termination to assisting them in coping with all kinds of athletic transitions (e.g., Stambulova, 2000; Wylleman et al., 1999).

A *whole person approach* implies helping athletes to deal with not only athletic but also nonathletic transitions. According to Wylleman and Lavallee (2004), these include (a) psychological development (e.g., from childhood to adolescence; from adolescence to adulthood), (b) psychosocial development (e.g., from being dependent on parents and coaches to becoming more autonomous), and (c) academic-vocational development (e.g., from primary to secondary education; from school to college or university; from education to a workplace). The developmental model (see Figure 32.1) demonstrates an overlap between athletes' transitions in various spheres of life. When at least two transitions coincide, a failure to cope with one of them might drain the athlete's resources to cope with the other(s).

A *developmental approach* provides links between the past career experiences, the present situation, and the athlete's perceived future. Athletes in transition are typically concerned with their current situation, or "today issues," and want magic advice on how to solve the issues as soon as possible. They often refer to their past transition experiences as resources to cope with the current situation, but they seldom coordinate their coping with anticipation of forthcoming situations, or "tomorrow issues." The developmental principle in consulting means, among other things, helping athletes to be more proactive or "to make decisions from the future," that is, selecting ways to cope with the current situation, which at the same time may help to prepare for forthcoming demands.

An *activity-specific approach* means taking into account not only common but also sport-specific demands in each athletic transition. For example, in the transition from junior to senior level, athletes in team sports can expect high social demands and athletes in complex coordination sports (e.g., gymnastics, figure skating) should be ready to solidly increase the complexity of their performance routines.

A *culture-specific approach* implies helping athletes to adjust to a particular sport system and culture. As our cross-national study demonstrated (Alfermann et al., 2004), athletes from different countries have not only a common pattern but also specific patterns in how they cope with athletic retirement. There is a lack of data about within-athletic career transitions, but it is possible to hypothesize that specific features of sport systems in different countries might work as resources or as barriers for athletes in transition.

An *individual approach* implies focusing on the athlete's perception of the transition and his or her idiosyncratic internal and external resources and barriers (e.g., Schlossberg, 1984; Stambulova, 2000).

A *transferable skills approach* includes helping athletes to develop mental skills applicable both in and outside of sport (e.g., stress management, cooperation and communication skills). This approach is widely used both in individual work with athletes and in a series of sport-based life skills programs (e.g., Danish, 2001; Danish, Petitpas, & Hale, 1993).

A *multidimensional approach* suggests that any intervention should involve enhancement, support, counseling, and other kinds of interventions depending on the athlete's needs (Lavallee, Wylleman, et al., 2000; Petitpas, Champagne, Chartrand, Danish, & Murphy, 1997).

A *multilevel approach* means treating athletes in transition not only on the symptomatic level (e.g., negative emotional reactions), providing "technique-based symptomatic relief" (Corlett, 1996, p. 88), but also addressing a variety of issues behind the symptoms (e.g., perceptions, decisions, attributions, attitudes, meanings).

An *empowerment approach* means helping athletes to develop coping resources and strategies to allow them to become autonomous after psychological interventions as an alternative to making athletes dependent on consultants and their services.

There are a number of studies demonstrating the importance of helping athletes in transition. Nonetheless, there is also a lack of research assessing the effectiveness of that assistance and suggesting criteria for effective individualized career transition interventions or for organized sets of career-related psychological services. Taking this into account, we first discuss some practical questions related to crisis transitions and then discuss various aspects of career transition interventions.

Crisis Transitions

In a certain way, all career transition interventions relate to crisis transitions. Sport psychology consultants contribute to *preventing* a crisis transition or to *coping with* it or to *handling negative consequences* of a failure to cope. As described earlier in the chapter, a crisis transition is conceptualized as a transition that the athlete has to cope with but is not able to do on his or her own and, therefore, needs psychological assistance and intervention. In fact, not only the content but also the timing of the intervention is an important issue to prevent negative consequences of not coping with the crisis.

How to determine that an athlete is in a crisis transition? This very practical question relates to *symptoms of a crisis transition,* that is, the athlete's cognitions, feelings, and behaviors that can serve as indicators (for both the actor and the observer) that the athlete is in crisis. Qualitative analyses of athletes' crisis narratives (Stambulova, 2003) resulted in four categories of crisis symptoms: a decrease in self-esteem, various forms of emotional discomfort, an increase in sensitivity to failures and in the number of psychological barriers, and disorientation in decision making and behaviors. Athletes and their significant others can use this set of symptoms as a reference point in defining a proper time for psychological intervention if necessary.

Another practical question, especially in counseling interventions, is how to *categorize crisis transition cases* so that consultants can use their previous experiences in working with athletes in transition. One possible answer to this question is an empirical classification of nonnormative crisis transitions based on the analysis of 552 athletic career narratives (Stambulova, 2000). This classification includes 15 types of crisis transition cases, depending on the content of transition demands (e.g., relationship crisis, crisis of change, crisis of break, crisis of failure, crisis after a big success, crisis of injury/overtraining/illness, moral crisis).

To summarize, both normative and nonnormative transitions have a potential to turn into a crisis if the athlete is not able to cope effectively. Normative transitions are predicted by career stage models (see Table 32.1); nonnormative transitions are classified post hoc from empirical data. A set of crisis symptoms might help to determine a proper time for interventions. Some specific features and strategies related to preventive and crisis-coping perspectives in career transition interventions are presented next.

Preventive Perspective in Career Transition Interventions

Preventive interventions aim at preparing athletes in advance for normative and nonnormative transitions by developing their resources for effective coping. Intervention usually involves assessment, career planning and goal setting, education and counseling, mental and life skills training, and strengthening the social support system. Prevention of crisis transitions is one of the key purposes of career transition programs developed around the world (Lavallee, Kremer, Moran, & Williams, 2004; Wylleman, Alfermann, et al., 2004; Wylleman et al., 1999;). In particular, these programs focus on preparing athletes for athletic career termination and starting an occupational career, or helping athletes to coordinate sport and education or work. As reported in the literature (Carr & Bauman, 1996; Lavallee & Andersen, 2000; Petitpas, Brewer, & Van Raalte, 1996), major theoretical frameworks for preventive interventions include the dynamic psychosocial model (Erikson, 1950), the human adaptation to transition model (Schlossberg, 1981, 1984), the athletic career termination model (Taylor & Ogilvie, 1994, 2001a), the developmental model (Wylleman & Lavallee, 2004), and, most often, the life development intervention model (Danish et al., 1993).

Preventive interventions address several interrelated aspects: helping athletes to anticipate their normative and nonnormative athletic and nonathletic transitions and their possible demands, educating athletes about a transition process, analyzing athletes' actual coping resources, anticipating potential barriers in the transition, planning ways to cope, and developing new resources—both internal and external—for coping with forthcoming demands. All these aspects of preventive interventions help to increase athletes' sense of control over forthcoming transitions and their self-efficacy to cope with it. For example, helping adolescent athletes to develop multiple self-identities works as a precondition for more successful coping with athletic career termination (Lavallee & Andersen, 2000). Athletes' guide for career planning (Petitpas et al., 1997), with its clearly preventive perspective, helps still active as well as retiring athletes to make a sequence of effective decisions related to professional education, career choice, and planning. Career planning is presented as a three-phase process: phase 1: self-exploration, career exploration, and career acquisition; phase 2: planning for transition; and phase 3: career action planning. Each phase includes detailed advice for athletes on how to proceed through the phases. Torregrosa et al. (2004) present the Tutoresport program, which aims at helping elite athletes to combine their athletic careers with university studies. Tutors provide the athletes with support and advice to face their athletic, psychological, psychosocial, and academic-vocational transitions and act as contact persons with the university.

Among a variety of preventive approaches in career transition interventions there is one that penetrates all the others. The transferable skills approach, or life development interventions, involves teaching both physical and mental skills. There is extensive literature (e.g., Carr & Bauman, 1996; Danish et al., 1993; Mayocchi & Hanrahan, 2000) describing and classifying transferable skills and providing recommendations on how to teach them to athletes. Recently, Lavallee (2005) evaluated the effects of a life development intervention on the sports career transition adjustment of retired professional athletes, using a control group design. In the pretest, both intervention and control groups experienced considerable adjustment difficulties and felt only moderately resourceful in coping with the transition. In the posttest, the intervention group showed a significant increase in coping skills compared to the control group. All in all, athletes who developed new life skills became more resourceful in coping with athletic retirement and felt better prepared for future life demands.

To summarize, preventive interventions enhance athletes' *readiness* for the transition by helping them to recognize forthcoming transition demands and develop matching resources, especially relevant competencies and skills.

Crisis-Coping Perspective in Career Transition Interventions

"The origin of the word [crisis] is Greek and it means *decision*" (Danish et al., 1993, p. 359). Metaphorically, athletes often describe a crisis transition as being in a "dead-end" situation. This metaphor can be seen as a holistic expression of the set of crisis symptoms and is especially illustrative for disorientation in decision making and behaviors. *Psychological crisis coping* interventions typically start with individual counseling aimed at helping the athlete to analyze his or her situation, to make a decision about coping, and to develop and carry out an action plan. Sometimes individual counseling is coordinated with small-group workshops, joining together athletes who experience similar transition situations (Lavallee & Andersen, 2000; Petitpas et al., 1997).

A number of psychological strategies, such as cognitive restructuring, stress management, and emotional expression, are used in helping athletes to cope with a crisis transition. As defined by Taylor and Ogilvie (2001b), a career transition may be characterized as a complex interaction of stressors that is especially true for a crisis transition; therefore stress management can be seen as a penetrating approach in crisis-coping interventions.

Lavallee, Nesti, et al. (2000) describe mentoring, information processing, and existential psychology approaches. *Mentoring* refers to a close relationship in which a mentor counsels, supports, and guides an athlete in a transition process. An *information-processing* approach is recommended as part of mentoring (Perna et al., 1996) and is based on the theoretical conception of account making in response to stress (Harvey, Weber, & Orbuch, 1990). Applied to athletes in transition, account making includes describing, explaining, and emotionally reacting to the transition demands. This results in creating storylike narratives with a relatively in-depth understanding of the situation and the adjustment experiences. Then a process of confiding is recommended, which implies sharing one's narrative with a significant other or others. Stress reduction in the athlete is expected when confidants react with empathy to his or her story, but the athlete's stress may increase when confidants are not emotionally involved in the discussion of the account. An *existential psychology approach* focuses on four key existential concerns: death, freedom, isolation, and meaninglessness. In addition, anxiety holds a central place and is seen as a functional feeling for personal growth. Lavallee, Nesti, et al. conclude that anxiety in career transitions can be used "creatively to help develop a deeper level of self-knowledge and to grow toward new configurations of meaning" (p. 127).

The *mobilization model* of counseling athletes in crisis (Stambulova, 2000) is a framework for a dialogue between a consultant and an athlete in crisis. It is based on the athletic career transition model (Figure 32.2), and Vygotsky's (1984) ideas on developmental conflicts as reasons for a crisis. According to these frameworks, athletes in crisis transitions need help in formulating the problem(s), analyzing resources and barriers to cope with, identifying alternatives in coping, decision making and creating an action plan, and increasing self-efficacy to cope with the crisis. Five interrelated steps of this model are (1) listening to the athlete and formulating the problem (developmental conflict); (2) analyzing the athlete's resources and barriers for coping; (3) discussing three strategic alternatives in coping (termed *rejection, acceptance,* and *fight*) and stimulating the athlete to make a strategic decision; (4) goal setting and developing the action plan based on the decision made; and (5) providing support for the athlete. One of the ideas employed in the model is to help the athlete transform his or her perception of the transition from "being at a dead end" to "being at a cross-roads."

To summarize, there is a range of approaches to consulting athletes in crisis transitions, and the choice of the strategy in individualized intervention programs depends on the athlete's situation and the consultant's expertise. But what is crucially important for crisis-coping interventions, regardless of the approach taken, is a quality and trusting relationship between the consultant and the athlete (Lavallee & Andersen, 2000). Based on the decision-making process and action plan developed during counseling, intervention programs can be complemented by psychological assessment, education, and mental and life skills training.

When Clinical Intervention Is Needed

Clinically relevant symptoms often appear as a result of not coping with normative or nonnormative transition or a combination of transitions. In fact, a failure to cope brings an athlete to a new and more complicated crisis. It is possible to consider this new crisis separately, for example, to work with overtraining or an eating disorder as sets of particular symptoms. But a developmental perspective is more beneficial in such cases and can help to identify the underlying reasons for a crisis and thus to treat both the reasons and the symptoms. Earlier in the chapter, clinical issues such as injuries, overtraining, neuroses, psychosomatic illnesses, alcohol and drug abuse, and criminal behaviors were mentioned among the costs of a failure to cope with crisis transitions (Stambulova, 1994). Reports on clinical issues in applied sport psychology (e.g., Andersen, 2001; Barney & Andersen, 2000; Cogan, 2000; Eyal, 2001; Petrie & Sherman, 2000) give a more comprehensive picture of possible negative consequences of not coping with transitions, including, for example, negative identities, sexual orientation issues and homophobia, eating disorders, anger and aggression, grieving, clinical depression, and suicidal thoughts. As clinical interventions are beyond the scope of this chapter, we recommend nonclinical sport psychologists to make referrals to clinical psychologists or related professionals if their clients experience clinical problems.

Career-Related Programs and Services

The need to help athletes coordinate their sport participation with other activities and to prepare for athletic retirement was recognized about 20 years ago. This resulted in a number of pioneer programs, such as the Olympic Athlete Career Center (Canada), the Career Assistance Program for Athletes (United States), and the Olympic Job Opportunities Program (Australia, South Africa, and the United States). Since that time, a growing number of programs and services have been developed around the world.

Overviews of the career programs (e.g., Anderson, 1993; Anderson & Morris, 2000; Lavallee et al., 2004; North & Lavallee, 2004b; Wylleman et al., 1999, 2004) and analyses of the concrete programs, for example, the Australian Athlete Career and Education (ACE) program (Gorely, Bruce, & Teale, 1998; Gorely, Lavallee, Bruce, Teale, & Lavallee, 2001), the ACE U.K. program (North & Lavallee, 2004a, 2004b; U.K. Sport, 2001), and others (Petitpas et al., 1997), allow us to summarize the target groups and main issues they address. Target groups for such programs are retiring and retired high-level athletes, still active high-performance and elite athletes, and student athletes. The contents of the programs include lifestyle management, life skills programs, and career guidance. More specifically, common patterns in the programs consist of (a) assessment of athletes' individual developmental needs; (b) support for athletes' personal growth (e.g., identity, meaning, self-esteem); (c) balancing lifestyle (priorities, optimal recovery, combining sport with other activities); (d) educational guidance (combining sport and studies, developing transferable skills); (e) career guidance (exploration, acquisition, planning); (f) support in career transitions, especially in the transition to the postcareer; and (g) social psychological issues (social support group, quality of relationships with significant others). All in all, the career programs try to help athletes in their personal growth to reach both athletic and personal excellence.

Development of career programs around the world is a dynamic process; each year some programs are initiated and others terminated. This makes it difficult to pick up the current status in the process. Typically, all the programs experience some organizational problems. First, the programs are nonprofit initiatives, and they need solid funding to start and to proceed. As soon as funding stops, the programs have to be terminated. Unfortunately, many programs have been terminated (Anderson & Morris, 2000). Second, one of the problems is advertising the programs and services to athletes, convincing them to participate, and planning potential users of the programs (North & Lavallee, 2004b). Third, effectiveness of the programs is only rarely established. There is a lot of anecdotal evidence about the effectiveness of career transition programs but a lack of empirically based evidence. Recently, Gordon, Lavallee, and Grove (2005) summarized existing studies on the evaluation of career-related programs, particularly the Australian ACE program (Gorely et al., 2001), the ACE U.K. program (U.K. Sport, 2001; North & Lavallee, 2004a, 2004b), and a career assistance program for young Australian cricket players (Bobridge, Gordon, Walker, & Thompson, 2003). For example, 70.7% of athletes eligible for the Australian ACE program contacted the program during a 1-year period. The most popular service included career guidance and planning and help with school or university studies. At the same time, specific career transition services were among the least used by the athletes. Analyzing the quality of career programs' assessment instruments and procedures, Gordon et al. concluded that evaluations are mainly descriptive and focus on athletes' usage of the services involved and satisfaction with the services and their perceived reasons to use and not to use such services. This can be seen as a first step that should be followed by more deep assessment of the services' outcomes (e.g., jobs received or behavioral changes) based on a longitudinal design and a multimethod approach.

To conclude, more applied research related to career transitions, better assessment and promotion of existing career programs and services, exchange of expertise between the programs, extending the target groups of programs (e.g., to coaches), and addressing a wide range of transition issues are on the future agenda in the career transition programs.

PROSPECTS FOR FUTURE RESEARCH AND INTERVENTIONS IN CAREER TRANSITIONS

Suggestions for future research and interventions are directed toward three aspects: terminology, methodology, and research and interventions.

Terminology

The term *transition* originates from counseling psychology and as such, needs to be adapted to the field of sport. At first glance, it is a more neutral and comprehensive term than, for example, "adaptation" (Taylor & Ogilvie, 2001a) or "crisis" (Stambulova, 2000). On the other hand, the term may be too global and encompass any kind of critical incident or life event.

So far, normative transitions are more clearly defined and more easily detectable than nonnormative transitions. For example, is making it to the national team (Grove et al., 2004) or winning a gold medal (Nagel, 2002) a transition experience? How can we distinguish between transitions and other types of development during an athletic career? In the future, we should specify the defining characteristics of transitions, or at least develop a classification system.

Methodology

Currently, there is an abundance of correlational and retrospective studies. What is now needed are more longitudinal studies with athletes in the process of transition compared to control groups, like the study of Grove et al. (2004) with athletes who were selected for a state team, and of Stephan et al. (2003a) with athletes during and after career termination. Prospective studies could help to better predict relevant variables for career development and career transitions (e.g., dropout) of athletes. In addition, we need more studies about other transitions than career termination, such as the transition from junior to adult level, an obviously critical period when many athletes disappear from sport.

There is a lack of cross-cultural studies to find common and culture-specific patterns of transitions. It seems important to increase our knowledge about, for example, culture-dependent and transition-dependent adaptation processes. This could help us to gain a better understanding of cultural and contextual influences on career transitions and to develop intervention forms that are aware of cultural peculiarities.

Similarly, we need more studies about possible specific aspects of transitions in different types of sport and different settings (e.g., amateur versus professional sport), which should help to specify sport-dependent transition experiences.

Research and Interventions

To date, research on transitions in athletic careers is more descriptive and less theory-guided. An exception to this rule is the study of Grove et al. (2004), who used self-categorization theory to predict and explain identity changes of athletes before and after a transition event and a nonevent. The primary focus of most studies is on reasons for and coping with transition. Changes in athletes' psychological well-being, social relationships, or self-concept related to the transition are assessed in retrospect in most studies. Transition models, as shown in Figure 32.2, could help to define the transition period, to select the relevant variables (e.g., resources such as social support, readiness to transition), to derive clear hypotheses, and to choose a proper research design.

Interventions and intervention programs for athletes in transition, like those described in this section, should be evaluated. Evaluation studies are urgently needed. Comparing a treatment and no-treatment control group on such outcome measures as well-being, coping experiences, and life satisfaction may help to clarify the impact of career interventions and to further improve the intervention programs (Lavallee, 2005).

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PART VII

Measurement and Methodological Issues

CHAPTER 33

New Perspectives on Measurement and Testing in Sport Psychology

BERND STRAUSS, DIRK BÜSCH, and GERSHON TENENBAUM

The development and application of so-called probabilistic models is a growing field of research in psychology. Numerous articles, textbooks, and edited books are now available, and these provide an excellent overview (see, e.g., Fischer & Molenaar, 1995; Hagenaars & McCutcheon, 2002; Hambleton, Swaminathan, & Rogers, 1991; Lord, 1980; McCutcheon, 1987; von Davier & Carstensen, in press; Wright & Stone, 1979). The reason for this growing interest is that applying probabilistic models can help to (a) test models and theories, (b) optimize diagnosis processes, (c) gain a deeper insight into the properties of scales and questionnaires, and (d) obtain item and person scores that have tested properties within the framework of a specific formal model. In the past decade, this interest has been further encouraged by the development of powerful and easy-to-use statistical software tools (e.g., ASCORE, WINMIRA, ConQUEST, FACETS).

Probabilistic models also have several theoretical advantages compared with classical test theory (CTT; e.g., Gulliksen, 1950; Lord & Novick, 1968) and it more complex extensions, such as factor analysis (e.g., Fischer, 1974; Lord, 1980; Rasch, 1960; Wright & Stone, 1979). One major advantage is that probabilistic models can examine item parameters (e.g., the difficulty) independently from the person sample in question and, vice versa, person parameters (e.g., ability) independently from the item sample (sample-free measurement). One of the main reasons for this is that nearly all probabilistic models possess the property of local stochastic independence.

However, this is only true when the probabilistic model holds for a certain data set. This can be examined by goodness-of-fit tests. The use of adequate goodness-of-fit tests is another advantage over CTT-oriented approaches.

Nonetheless, probabilistic models have rarely been applied in research in the field of sport psychology. Only a few first attempts are to be found in the 1980s and 1990s, and even Duda's (1998) comprehensive textbook on measurement instruments in sport psychology contains only a single chapter by Tenenbaum and Fogarty (1998) in which probabilistic models are used to analyze the scales of the Task and Ego Orientation in Sport Questionnaire (TEOSQ).

Currently, we can see some changes to this situation. Tenenbaum, Strauss, and Büsch (in press) have recently published a short overview of some applications of probabilistic models to, for example, running discomfort, anxiety and precompetitive anxiety, flow experience, goal orientation, actual and retrospective measures of introspection, aspects of the self-concept, and perceived exertion. There are also studies examining motor abilities in a search for motor components and strategies.

The goal of the present chapter is to provide an overview of the most important probabilistic models and their main applications in sport psychology. It pays less attention to the numerous mathematical and technical details, such as parameter estimation, and focuses on more fundamental issues, such as the opportunity to test the model fit.

The chapter starts by considering the basic structure of probabilistic models. This requires differentiation of unobservable, latent versus observable, and manifest variables and between quantitatively scaled and qualitatively scaled latent variables. This differentiation leads to two distinct lines of probabilistic models: latent trait models and latent class models.

LATENT AND MANIFEST VARIABLES

One major concern in psychology is to define and describe psychological constructs, or other unobservable variables, such as a person's anxiety, extroversion, intelligence, goal orientation, or coping strategies. Measurements, tests, and item responses are generally used as indicators for such constructs. A psychological or other construct is confirmed empirically when it is substantiated by (valid) indicators such as observations or tests.

In probabilistic models, psychological or other constructs are represented by *latent variables.* A person parameter, θ_v represents the position (i.e., measure) of a person v on the latent variable (e.g., the person's ability). In the case of a one-person parameter θ, this means that the person is also assigned one, and only one, value on the latent variable. In other cases (e.g., in the case of multidimensionality), a person is assigned several person parameters.

Additionally, an item i can be described by one or more item parameters (e.g., item difficulty σ_i or item discrimination $ß_i$) in probabilistic models. This is the position of the item on the latent variable.

Item responses, observations, and other empirical data are called *manifest variables.* These are symbolized by $X_1, X_2 \ldots, X_i \ldots$, and X_p for the representation of p manifest variables (e.g., p items). A single observation of a person v on item i is represented by the expression X_{vi}. All observations of N persons on p items are summarized into a person $\times$ item matrix. The vector of all p responses of a person v on p items is called a *response pattern.*

Probabilistic models often differentiate manifest variables into *dichotomous* variables (with two response options, such as yes versus no, solved versus unsolved, or criterion met versus not met) and *polytomous* variables (with several response categories). The latter can be differentiated further into variables with either *unordered* or *ordered* categories. Unordered response categories lack any rising or descending order in terms of importance, quality of performance, and so forth. In contrast, such an order is assumed in ordered response categories (e.g., ratings).

There are different ways of defining such an order (e.g., Rost, 2004):

- *Order assumption a:* The widths (i.e., distance among categories) are different for all categories but the same for all items.
- *Order assumption b:* All widths are the same for one item (equidistance assumption) but vary from item to item. This results in a different dispersion for each item.
- *Order assumption c:* This variant is a combination of the first two assumptions obtained by adding different dispersions across the items.
- *Order assumption d:* Widths differ for each item and each category.

Probabilistic models are used to make formal connections between latent and manifest variables and to estimate the values of a person on the latent variables, as well as the values of the item parameters from the observable manifest variables (e.g., item responses). These formal models can be conceived as theories about the response behavior of persons. As a result, they are also called IRT models (IRT = item response theory; see, e.g., Hambleton et al., 1991).

Of course, IRT models are not always probabilistic models, and the differentiation between latent and manifest variables is not just a property of probabilistic models. For example, it is also found in structural equation models. However, the particular property of probabilistic models is that they connect manifest variables with latent variables through a probability function, and in most cases, this leads to the major and attractive principles of local independence and monotonicity (e.g., von Davier & Strauss, 2003).

The first basic assumption is *local independence;* that is, for a certain person with given ability, all his or her item responses will be independent. This means that subsequent item responses are not influenced by whether prior tasks have been completed successfully. The assumption implies that if there are any learning effects, and these are considered valid for all, these are only overall learning effects.

The second basic assumption in the majority of probabilistic models is that of monotonicity in person and item parameters. This means that the probability of successfully solving an item increases as a function of an increasing person parameter (e.g., ability). Similarly, the item parameter also increases monotonically as a function of the probability of carrying out the item successfully. The following sections examine some of these probability distributions in more detail.

DIFFERENTIATION OF LATENT VARIABLES

Psychological constructs can be differentiated into *types* and *traits* (e.g., Gangestad & Snyder, 1985; Meehl, 1992; Mischel, 1976).

Traits are dimensions on which persons or objects differ *quantitatively.* Trait approaches are more common in the psychology of individual differences. Such dimensions are frequently analyzed with exploratory or confirmatory factor analyses. Examples of such dimensions are neuroticism, extroversion, goal orientations (task and ego), anxiety (somatic and cognitive), or inductive thinking. Whereas participants in typological studies can exhibit a certain characteristic or not, all persons in trait studies possess the trait or dimension in question, but to a different degree: One person is more or less anxious than another person or more or less extroverted. When the latent variable represents a trait-oriented psychological construct, it can be labeled as a quantitatively scaled latent variable. Within the framework of probabilistic models, this leads to the application of *latent trait models.*

Types are usually discontinuous categories or classes (e.g., male or female) into which persons or objects can be classified. This approach conceives types as classes of persons with a specific pattern of characteristics. In other words, it differentiates persons in terms of their relevant specific characteristics. Meehl (1992) calls such types *taxa.*

However, at times, types are also conceived as the end poles of bipolar dimensions. In other words, persons exhibiting extreme scores on one dimension (or one trait) are assigned to one type (e.g., Eysenck's extroverts versus introverts). Such types are called "polar types," and they are only the outcome of a dimensional analysis.

In this chapter, we view types as characteristics by which persons from different categories or groups are assigned criteria that can be differentiated *qualitatively.* For example, this could be Snyder's concept of high and low self-monitors (see Gangestad & Snyder, 1985) or Spence and Helmreich's (1978) concept of androgyny that differentiates four sex-role types: masculine, feminine, androgynous, and undifferentiated. Type models are not just appropriate for describing personality, but can also be used when persons repeatedly apply specific behavior and thought patterns such as specific problem-solving strategies (see, e.g., Büsch & Strauss, 2005; Kyllonen, Lohman, & Woltz, 1984; Schunn & Reder, 2001). Strategies are goal-directed, potentially conscious, and controllable processes that represent a hierarchically high-level process. A strategy can then be conceived as a type of behavior or a type of reasoning.

An individual can belong to only one of the possible types, and all persons within one type are dealt with equally. In terms of probabilistic models, a latent variable representing a typological psychological construct can be labeled a qualitatively scaled latent variable. This leads to the application of *latent class models.* Latent trait models and latent class models are the two major lines of development in probabilistic models (e.g., Langeheine & Rost, 1988; Rost, 2004; Rost & Strauss, 1992; Strauss, 1999).

LATENT TRAIT MODELS

Way back in 1928, Thurstone pointed out that scale values (such as specific sum scores) present all information about a variable exhaustively when they possess a defined zero or an origin. Whereas this is not the case in CTT, it is the case in the Rasch model, named after the Danish mathematician Georg Rasch (1960). The Rasch model is the classic latent trait model, even though Lord had already presented a first latent trait model in 1950: the normal-ogive model derived from the normal distribution (see Lord, 1980).

Some Historical Remarks

The measurement of a psychological variable relies on selecting a representative sample of items out of a larger universe of items. Essential prerequisites for test construction according to Thurstone (1928) are (a) consistent definitions of the variable by statements of opinions, attitudes, and the like; (b) identification of items that best represent the universe of the content; (c) constructing a scale; and (d) applying the scale to a sample of the population to examine whether the person's individual response pattern and items calibration is consistent with this expectation. Already Thurstone (1925, 1927) argued that estimated scale values could not be invariant to sampling. Thurstone (1928, p. 417) further underlined that measurement of opinions requires that items should share a linear continuum:

> In almost every situation involving measurement there is postulated an abstract continuum such as volume or temperature, and the allocation of the thing measured to that continuum is accomplished usually by indirect means through one or more

> indexes. Truth is inferred only from the relative consistency of the several indexes, since it is never directly known. We are dealing with the same type of situation in attempting to measure attitude. We must postulate an attitude variable, which is like practically all other measurable attributes in the nature of an abstract continuum, and we must find one or more indexes, which will satisfy us to the extent that they are internally consistent.

This view was supported by Guttman (1944), who argued that if a sample of attributes is given to any sizable random sample of individuals, and the attributes form a scale, these attributes should be scalable for the entire population of individuals. Thus, scores on an attitude scale are most meaningful when they share one continuum. Only then can it be claimed that two individuals with identical scores are similar qualitatively and quantitatively on the measured variable.

Linearity requires *item calibration* and *item fit* to avoid unsatisfactory measures provided by various persons. In principle, the linear continuum is supposed to remain consistent, and each individual or sample should not alter it in any sense. Thus, calibrating items on a linear continuum should be independent of the sample of subjects responding to the items. It is therefore similar to that of a yardstick, which is used to measure the height of persons. In this sense, it is an early call for sample-free measurements.

Thurstone (1928) further stated that scales are limited in telling us whether one is happy or unhappy, calm or anxious, as there is no *origin datum,* or *zero point.* Psychological scales have only an arbitrary origin. Guttman (1947) suggested a "meaningful cutting point," which is intrinsic and free from an external criterion. He developed the *intensity function* to determine the origin of an introspective measurement. An origin and a linear continuum require the determination of a *unit of measurement.* The need for an origin and a unit of measurement on a linear continuum was also expressed by Torgerson (1958). As he noted, "Numbers are assigned to the objects so that the relation between the numbers reflect the relations between the objects themselves with respect to the property" (p. 15).

Thurstone (1928) and Guttman (1947) independently desired to construct opinion-attitude scales that manifest characteristics of physical measurement. This led them to the notion of *unidimensionality,* whereby persons are classified in an unequivocal order. However, their desire was not met, particularly because the models they used were insufficient to validate the concepts they introduced. Despite several inconsistencies, Thurstone and Guttman introduced the foundations of sufficient and sample-free measurement (Tenenbaum, 1999), which are met today by the Rasch model.

The Dichotomous One-Parameter Rasch Model

The original Rasch model (one-parameter Rasch model or unidimensional Rasch model; Rasch, 1960) is a probabilistic model with one latent variable θ_v (person ability of a person *v*) and one manifest variable that is coded dichotomously with [0, 1].

Let $p(x_{vi} = 1)$ denote the response probability that a person *v* will succeed on an item *i*. The main idea in the dichotomous Rasch model is to decompose $p(x_{vi} = 1)$ into a linear combination of an item parameter σ_i (difficulty) and the person parameter θ_v (person's ability). Both person parameter and item parameter are located on the same latent variable. Because the probability term can vary only between 0 and 1, it is not the probability itself, but the logits of these probabilities that are decomposed:

$$\ln\left(\frac{p(x_{vi}=1)}{p(x_{vi}=0)}\right) = \theta_v - \sigma_i \tag{33.1}$$

That is, the response probabilities (in logits) are equal to the difference between a person's ability θ_v and the item difficulty σ_i.

In contrast to the classical error model, in which an observable manifest variable, *X,* of a person *v* for an item *i* is decomposed additively into the unobservable variables θ (true score) and *e* (error component), the decomposition in the Rasch model refers to the logits of the response probabilities (equation 33.1).

A simple transformation of equation 33.1 leads to the better known response function of the Rasch model:

$$p(X_{vi}=1) = \frac{e^{(\theta_v - \sigma_i)}}{1+e^{(\theta_v - \sigma_i)}} \tag{33.2}$$

where $e = 2.71$ is Euler's constant. This relationship between latent variables and the response probability is often represented by the item characteristic curve (ICC), an exponential curve (see Figure 33.1).

The probability of answering an item correctly increases as a function of the increasing size of the person parameter. The curve approximates 0 and 1, but does not bisect this line. Item difficulty is also plotted on the *x* axis. It corresponds exactly to the value of θ when $p(x_{vi} = 1)$ equals .5.

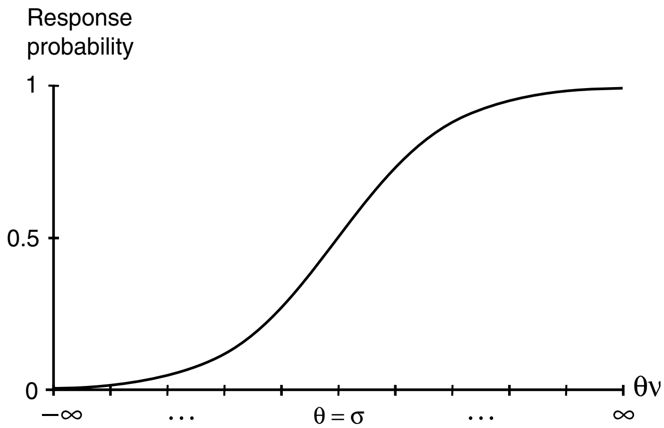

Figure 33.1 Item characteristic curve (ICC) of one item (θ represents the person parameter).

If item difficulty parameters were to be greater, the ICCs would shift to the right parallel to (i.e., also without bisecting) the ICC plotted in Figure 33.1. If the item difficulty were to be smaller, the ICCs would shift to the left parallel to that in Figure 33.1. The ICCs are parallel and do not bisect because each item has a slope parameter of 1.

The latent variable in the Rasch model is assumed to be scaled metrically or quantitatively. Whenever differences in degree are assumed, for example, differences in the ability to perform a certain task, individual differences are modeled by means of quantitative latent variables. One standard case for this assumption is when a number of very similar tasks are given, but the same underlying ability governs the probability of success. Even if the tasks differ in difficulty, it is assumed that the same ability underlies performance on the tasks as a set.

The basic assumptions of all probabilistic models—local stochastic independence and monotonicity—naturally hold for the Rasch model as well. A further, stronger assumption in the one-parameter Rasch model is that the *number of successes* on a given set of tasks *is a sufficient measure* of the underlying ability. This means that the raw score of a person (the sum of the single responses to p items) contains all relevant information from the person's response pattern.

Monotonicity, local independence, and the sufficiency of the number of successes lead to two outstanding features of the Rasch model: *person homogeneity* and *item homogeneity.* These features imply that item parameter estimations or calibrations are independent of the sample drawn from the population of persons (i.e., the same item parameters must be valid for all persons: person homogeneity) and that estimations of the person's ability are independent of the particular selection of test items drawn from the population of items (i.e., the same person parameters must be valid for all items: item homogeneity). In this sense, Rasch measures can be called sample-free (e.g., Fischer & Molenaar, 1995; Rasch, 1960). However, this is not the case in CTT, in which item and person parameters depend on the characteristics of the item and person populations (see, e.g., Fischer, 1974; Rasch, 1960). Consequently, CTT-related measures are not sample-free.

Only a few studies in sport psychology have used the one-parameter Rasch model with dichotomous responses. One major reason for this is the strong restriction of dichotomous response categories and the focus on unidimensionality—something that frequently cannot be assumed realistically in sports. Bös and Mechling (1983) used this model to investigate the dimensionality of coordination skills. This led to two movement coordination tests: the Bewegungskoordinationstest (movement coordination test; Bös & Mechling, 1986) and the Bewegungskoordinationstest für die Praxis der Therapiekontrolle (movement coordination test for the practice of therapy evaluation; Bös & Wydra, 1984). Other applications were designed to test the unidimensionality of the Bilder-Angst-Test (picture anxiety test; Bös & Mechling, 1985) and a questionnaire on teacher behavior (Ungerer-Röhrich, 1984). Spray (1990) used the Rasch model to demonstrate the unidimensionality of psychomotor tests.

The dichotomous one-parameter Rasch model has been extended to form a number of other models that refer to the number and type of parameters. This leads to a strong increase in the possibilities for its application. Overviews of latent trait models can be found in, for example, Fischer and Molenaar (1995) and von Davier and Carstensen (in press). We focus on some major lines along with those that have been used by sport psychologists.

Ordinal Rasch Models

One of the most attractive extensions of Rasch models is that for ordered categories. These permit an analysis of not only dichotomous, but also polytomous manifest variables. Probabilistic models for unordered categories (i.e., those with more than two response categories with no order) were a very early development. Although Rasch had already described a multicategorical Rasch model in 1961, this had numerous parameter estimation problems and the disadvantage of requiring several dimensions.

Ordinal Rasch models with ordered response categories use threshold parameters that have to be added in equation

33.1. The basic idea of ordinal Rasch models is that a rater always has to cross a threshold to pass from one response category to another (Wright & Masters, 1982; Wright & Stone, 1979). Assuming five response categories (e.g., a rating from 0 to 4), the rater has to cross four thresholds (from Category 0 to 1, 1 to 2, 2 to 3, and 3 to 4). The threshold parameter can be interpreted as the difficulty of making that crossing. All response categories have a category characteristic curve, analogous to the ICC, indicating the probability that a certain category is preferred over the other one. This is depicted in Figure 33.2.

The probability for the lowest response category 0 (e.g., "I disapprove the statement completely") *decreases* as a function of increasing values in the person parameter. The probabilities for all intermediate response categories (there are three of these in Figure 33.2) increase initially in a certain sector of the dimension and then decrease. The highest and the lowest response categories always show monotonic functions, whereas the intermediate categories have a unimodally shaped curve. The threshold is located where two neighboring categories intersect. As Figure 33.2 shows, the probability of choosing both categories is identical at their point of intersection and then increases as one passes into the next category. The distance between two neighboring threshold parameters defines the size of the intervening category. This general idea led to different ordinal Rasch models. They are usually related to the four order assumptions described earlier (e.g., whether all distances are assumed to be equidistant; order assumptions a to d). The most restrictive ordinal Rasch model is the rating scale model by Andrich (1978; order assumption a). Andrich (1982) also presented the equidistance model (order

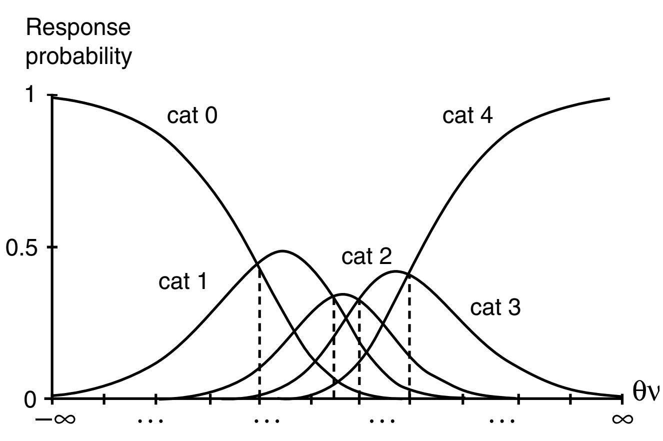

Figure 33.2 Category characteristic curves for the response categories.

assumption b), and Rost (1988) the dispersion model that follows order assumption c. The partial credit model by Masters (1982) is the model permitting the greatest degrees of freedom regarding the distances between the threshold parameters across the different items (order assumption d).

In sum, these variants differ in their assumptions regarding, for example, the width of the response categories. Applications of these ordinal Rasch models are in testing response sets, regression toward the middle category, preference for extreme values, and whether the data in any way permit an ordinal scaling. Zhu (2002, p. 12) describes these opportunities as "optimal categorization." This can be tested by considering the order of the threshold parameters (e.g., Eid & Zickar, in press). All of the major properties of the dichotomous Rasch model, in particular, person and item homogeneity, and therefore sample-free measurement, also hold for the ordinal Rasch models.

Rating Scale Model

Hands and Larkin (2001) used this model to study general motor abilities in children. They gathered data on 24 different motor tasks from 332 children age 5 to 6 years. The tasks covered fundamental movement skills such as running, jumping, and balancing. Results produced two separate one-dimensional scales for boys and girls.

Mainly Zhu (2002; Zhu & Kang, 1998; Zhu, Timm, & Ainsworth, 2001; Zhu, Updyke, & Lewandowski, 1997) has used the rating scale model to determine the optimal categorization of different scales. Zhu et al. (1997) administered the Psychomotor Self Efficacy Scale to 2,022 children. The entire scale consists of 50 items, each with five original response categories. The results of different Rasch analyses showed that the use of the five original response categories seems to be inappropriate. Zhu et al. (1997) recommend applying the items of the Psychomotor Self-Efficacy Scale with only three response categories. This optimal order of the categories has also been found in the Korean version of the Psychomotor Self-Efficacy Scale (Zhu & Kang, 1998).

Myers, Payment, and Feltz (2004) used the rating scale model to transform the raw scores of 243 ice hockey players into logit-based measures as an estimation of their person parameters. The athletes responded to the Collective Efficacy Scale by Feltz and Lirgg (1998), which contains 7 items (each with 11 response categories).

Myers, Wolfe, and Feltz (2005) calibrated their data to the rating scale model to evaluate coaches' scores of the Coaching Efficacy Scale (CES; Feltz, Chase, Moritz, &

Sullivan, 1999). The results pointed out that coaches have to distinguish among too many levels (items are scored on a 10-point Likert scale) of coaching efficacy. The authors proposed an improved four-category rating scale structure for follow-up applications.

Tenenbaum (e.g., Tenenbaum, 1984, 1999; Tenenbaum & Fogarty, 1998; Tenenbaum, Fogarty, & Jackson, 1999; Tenenbaum, Fogarty, Stewart, et al., 1999; Tenenbaum & Furst, 1985; Tenenbaum, Furst, & Weingarten, 1985) has used the rating scale model repeatedly to perform dimensional analyses of questionnaires and to calibrate item parameters. Tenenbaum and Fogarty studied the TEOSQ (Duda & Nicolls, 1992, one of the most frequently used questionnaires for measuring goal orientation in sport and exercise). It consists of 13 items (on two dimensions) rated on 5-point scales. Their sample contained 1,591 adult athletes. One result of their rating scale analyses was that many of the athletes' responses to the task orientation items produced misfit values because they gave these items consistently high ratings, eliminating any discriminatory power between athletes who differed on task orientation.

Tenenbaum, Fogarty, and Jackson (1999) investigated the multidimensional process of the flow experience (Csikszentmihalyi, 1993) by studying the Flow State Scale (Jackson & Marsh, 1996), which contains 36 items on 9 dimensions (5-point response format). They used the rating scale model to analyze the responses of 790 athletes and were able to detect 5 misfit items by using person-fit statistics of 62 abbreviated response patterns.

Tenenbaum, Fogarty, Stewart, et al. (1999) developed the Running Discomfort Scale (RDS), containing eight dimensions. A total of 171 runners responded to 32 items on 5-point scales. Rating scale analyses revealed that each of the RDS dimensions could be regarded as unidimensional. Additionally, item difficulties were computed to examine the spread of the items on each of the eight linear continua, and item-fit statistics were generated to assess how far each item elicited the expected responses from persons who differed in their feelings of running discomfort.

Tenenbaum et al. (1985) used the rating scale model to evaluate whether the items of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) can measure anxiety trait and state reliably in athletes. One hundred student athletes completed the trait anxiety scales, and 55 high-level athletes completed the state anxiety scales 30 min prior to a competition. Results indicated that there was a sufficient number of items to differentiate high trait-anxious athletes but not low trait-anxious athletes. A similar analysis performed on the state anxiety scale uncovered similar concerns with many misfit items. To investigate the reliability of athletes' retrospective introspections on their emotions and mood, Tenenbaum and Furst (1985) administered the STAI to 55 athletes both before and after competitive events. The rating scale analysis indicated that, apart from a slight tendency to rate items higher under real-life stressful conditions, items remained in relatively similar locations along the linear state anxiety continuum.

Further applications of the rating scale model can be found in research on rehabilitation, particularly to investigate the dimensionality of functional independence measures such as mobility, locomotion, and communication (Dickson & Köhler, 1996; Heinemann, Linacre, Wright, Hamilton, & Granger, 1993; Linacre, Heinemann, Wright, Granger, & Hamilton, 1994) or to develop clinical tools for measuring manual disability (Penta, Thonnard, & Tesio, 1998).

Dispersion Model

Strauss (1995) demonstrated the unidimensionality of the German Sport Spectators' Identification Scale (GSSIS) and calibrated the item parameters by means of the dispersion model. This scale (derived from the English SSIS scale by Wann & Branscombe, 1993) consists of 7 items, each rated on a 5-point response format. The sample consists of 404 randomly chosen citizens of the German city of Kiel who filled in these items. The items are related to the THW Kiel team, the former championship winner in the German team handball league, one of Germany's favorite sports. Whereas classical analyses confirmed Wann and Branscombe's results, unidimensionality was also tested with ordinal Rasch models. Using several model-fit techniques, the results indicate a satisfactory fit for the dispersion model.

Partial Credit Model

Zhu and Kurz (1994) used the partial credit model for the assessment of gross motor competence by means of the Carson Assessment of Motor Patterns (Carson, 1985) with 3- to 9-year-old boys and girls. Four different striking tasks (e.g., "Strike a quickly moving ball") were administered to 128 children (64 boys and 64 girls). Only two tasks ("Strike a supported 6-in. ball on a traffic cone" and "Strike a quickly moving ball") indicated a satisfactory fit of model and data.

Graded Response Model

Samejima presented the graded response model in 1969 to analyze ordered response categories (in accordance with order assumption d). This was 1 decade before Masters, Andrich, and others presented their ordinal Rasch models, described earlier. One major difference in these approaches is that Samejima's model assumes a different slope parameter for each item. This is not the case with the ordinal Rasch models of Andrich (1978, 1982), Masters (1982), and Rost (1988). However, the disadvantage compared with the ordinal Rasch models is that the threshold parameters in the graded response model (in which they are called category boundaries) are defined through cumulative probabilities, so that individual category boundaries cannot be determined independently (e.g., Masters, 1988).

Only a few studies in sports have used the graded response model. Fletcher and Hattie (2004) and Fletcher (1999) studied the item structure and provided a calibration of the items in the Physical Self-Description Questionnaire (PSDQ; Marsh, Richards, Johnson, Roche, & Tremayne, 1994). The PSDQ is derived from a hierarchical conception of the physical self-concept and consists of 11 subscales composed of 70 items, each rated on 6-point scales. Fletcher and Hattie were able to show that the items were more or less representative of the respective variable, and also that the PSDQ discriminated better among persons with a low physical self-concept than among persons with a high physical self-concept. This meant that fewer items were needed to assess the former compared with the latter.

Further Extensions of the Rasch Model

Some extensions of the Rasch model add item parameters along with item difficulty. The two-parameter model of Birnbaum (1968) has a very similar equation to the dichotomous Rasch model; it merely enters the slope parameter ß into the equation as an additional item parameter that can be interpreted as a discrimination parameter. This leads to bisecting (i.e., not parallel) ICCs for different items.

This model can be extended to a three-parameter model by introducing a guessing parameter γ to the equation. This integrates the person's guessing behavior. Although, in practical testing, it is frequently more appropriate to assume different item discriminations or one guessing behavior, both the two- and three-parameter models possess the disadvantage of not being able to perform a sample-free measurement or an independent estimation of parameters. This disadvantage also applies to Samejima's (1969) graded response model, in which the slope parameters lead to bisecting ICCs. It should be mentioned that four-parameter models have also been presented (e.g., Hessen, 2004). A further line of extension refers to the properties of the manifest variables. Müller (1987), for example, extended Andrich's (1982) equidistance model so that it could also be used to analyze continuous response variables (i.e., with an infinite number of thresholds).

The Poisson model for count data, which Rasch described in 1960, is a special case of the ordinal Rasch model. Although it assumes an upper limit for the number of response categories, this number differs from person to person (e.g., the number of errors or attempts). Given independent events, this number is assumed to have a binomial distribution. It was adopted by Safrit, Zhu, Costa, and Zhang (1992) to examine how difficulty varied in 18 different sit-ups tests for training abdominal muscles. A total of 426 college students performed the 18 tests in an 8-week period. The number of attempts within 1 min was recorded. The simplest item was performance with hands on thighs and feet anchored, whereas the most difficult item was performance with hands clasped behind the neck and elbows pointed forward.

The third extension involves the number of latent traits. Up to now, we have always considered one latent trait θ, that is, a person variable. However, there are now a great number of *multidimensional respective item component models.* Generally speaking, this means that the response to an item depends on several latent variables. Although Rasch presented a multidimensional model in 1961, it contained the very restrictive assumption that the response probability for each response category depends on its own particular latent variable or person characteristic (see Rost, 2004, p. 259).

A more frequent special case, which is also applied in sport psychology, is Fischer's (1973, 1974, 1983) linear-logistic test model (LLTM). This model decomposes item difficulty additively into further components, for example, into various elements involved in processing a task. The LLTM can also be used to analyze data sets with polytomous response categories, thereby applying the ordinal Rasch models (i.e., partial credit model, rating scale model). Moreover, the LLTM and its variants are very suitable for analyzing change (Fischer, 1974, 1987; Glück & Spiel, 1997; Meiser, in press). In the sport psychology domain, we do not know any study that uses these fruitful approaches to analyze changes. However, not only the item parameter but also the person parameter can vary in the LLTM. This produces multidimensional models in which one person is assigned several person parameters.

The LLTM has been used frequently in the study of cognitive and motor operations. In a study of 704 Spanish boys ages 7 to 14 years, Sanchez-Banuelos and Roth (as cited in Bös & Roth, 1978) applied the LLTM to the dichotomized data from 18 different ball tasks assessing movement skills such as throwing, catching, bouncing, and rolling (the components). They were able to confirm the one-dimensionality of the tasks, and they found that the latent variable "ball coordination" could be scaled most successfully through the movement tasks containing successive or simultaneous combinations of the movement skills throwing and catching.

Roth (1982) applied the LLTM in a study in the motor domain. He examined 482 children ages 9 to 14 years who performed different fundamental movement skills such as jumping, hopping, balancing, and throwing (the components). Roth managed to find two underlying factors: the ability to coordinate under time pressure and the ability to control movements precisely. He was able to confirm Rasch homogeneity for the ability to control movements precisely (see also, Bös & Mechling, 1983).

A special case of the LLTM (Rost & Carstensen, 2002) is the *many-faceted Rasch analysis* by Linacre (1989, 2004). This model is now used widely because it permits very detailed psychometric analyses of judgments in a wide range of applied fields (see Eckes, 2005). It can therefore also be used to analyze polytomous responses. In a facet design, data are not just organized into a two-dimensional matrix (with the facets Persons × Items). Numerous other facets can be studied, such as the judgments of raters who classify persons' responses. This already provides a three-dimensional data structure (Persons × Item × Rater). In principle, this can be extended by any arbitrary number of further facets, such as the person characteristics (Rost, 2004) of gender and age, or situations, such as paired comparisons typically found in tournaments (Linacre, 2002a).

There are different model variants associated with the facet design. The simplest assumes two facets, that is, when persons work on only one single task. Some variants also permit the analysis of interactions between facets. This is the reason the many-faceted Rasch model belongs to the set of models that permit the analysis of differential item functioning (DIF), like Samejima's (1969) graded response model. Overviews on models, also including those that go beyond the latent trait approach (e.g., the Maentzel-Haensel approach), can be found in, for example, Penfield and Lam (2000) and Potenza and Dorans (1995). Raju, Laffitte, and Byrne (2002) provide a comparison of the Samejima model and structural equation models with respect to the general DIF approach.

Tenenbaum, Falk, and Bar-Or (2002) formulated a two-facet design to analyze the responses of 21 athletes on the Borg Scale (Borg, 1970) for measuring perceived exertion (one item with 15 categories) as one facet after an exercise task, which was considered a further facet. They conclude that the scale measures "cumulative exertion" rather than exertion, resulting in smaller measurable distances at the end of the scale, which provide a more reliable reflection of the process of exertion accumulation rather than exertion per se.

Zhu and Cole (1996; see also Zhu, 2001) examined the advantages and potential applications of the many-faceted Rasch model by analyzing performance on the much evaluated and repeatedly applied Test of Gross Motor Development (TGMD; Ulrich, 1985). They administered the TGMD to 909 children (451 boys) ages 3 to 10 years. This test battery contains two motor categories, "locomotion" and "object control." The former contains 7 subtests assessed through four performance criteria, the latter 5 subtests assessed through three performance criteria. To calibrate the TGMD over the many-faceted Rasch model (Linacre, 1994), eight facets were defined: five examinee-related facets (disability status, ethnicity group, age, gender, examinee) and three item-related facets (subtest, item, category). Results showed a clear age and gender effect. Furthermore, the fundamental movement skills in the object control category were more difficult than those in the locomotion category. Zhu and Cole used these analyses to formulate a recalibrated new scoring form for the TGMD that provides the experimenter with information on which are the easiest and the most difficult items (i.e., tasks) for a certain child, and how this skill-oriented information should be judged in relation to (gross motor) coordination ability in motor development.

There are also some studies (Duran & Fisher, 1996; A. G. Fisher, 1993; W. P. Fisher, 1993) that use the many-faceted Rasch model in the field of rehabilitation. The studies focus on the relationship between instrumental or domestic activities of daily living and different motor and process skills. For example, by defining gender as a facet, Duran and Fisher and A. G. Fisher could identify that men and women differ slightly in their process ability (with an advantage for the women), but not in their motor ability.

However, up to now, a frequent use of the many-faceted Rasch model in sports has been to analyze sports statistics and rankings in contests (baseball: P. Fisher, 1991; basketball: Linacre, 2000; football: Linacre, 2000; ice skating: Looney, 1996; Linacre, 2002b; platform diving: Linacre, Wright, & Lunz, 1990; sailing: Lang, 2002; Lang & Wilkerson, 2005). As well as providing a statistical demonstration, these studies reveal the potentials of the model in, for example, identifying unfair judges in ice skating (Linacre, 2002b; Looney, 1996).

LATENT CLASS MODELS

In latent class models, in contrast to latent trait models, latent variables are assumed to be scaled categorically or qualitatively (see Formann, 1984; Hagenaars & McCutcheon, 2002; Langeheine & Rost, 1988; Lazarsfeld & Henry, 1968).

As early as 1950, Lazarsfeld presented a probabilistic model that forms latent classes (or subpopulations) from response probabilities in which persons have the same probabilities of answering items correctly within classes, but different probabilities between classes. Thus, there are no quantitative differences between persons within classes. As a consequence, all persons within the same class receive the same person parameter. However, between the classes, the person parameters differ.

Formann (1984) has shown that the latent class model follows three simple assumptions: Given a test of *p* discrete observed variables, it is assumed that (a) the entire population consists of a limited number of discrete and exhaustive subpopulations or latent classes, (b) the response probabilities are class-specific, and (c) within the latent classes, the tasks (observed variables) are stochastically independent.

The assumption of person homogeneity, as introduced for the Rasch model, does not hold; each item can take different parameter values in different classes. Through the formation of latent classes, a latent class analysis (LCA) can be used to identify classes or types. Within each class, persons cannot be differentiated in quantitative terms. However, persons who belong to different classes differ in qualitative terms. The response probability of a person *v* in a dichotomous latent class model is now defined as

$$p\left(X_{vi}=1\right)=\sum_{g}^{G}\pi_{g}\pi_{i|g},$$

with the restriction

$$\sum_{g}^{G}\pi_{g}=1 \tag{33.3}$$

in which G is the number of subpopulations or latent classes, π_g a probability parameter defining the size of class *g*, and $\pi_{i|g}$ the probability of success on item *i* within class *g*.

Rost's (1990) mixed Rasch model (MRM) presents a combination of the latent trait and latent class approaches. This model assumes that "the Rasch model holds for all persons within a latent class, but it allows for different sets of item parameters between the latent classes" (p. 271). The MRM can be viewed as the "super" model of the Rasch model and of latent class models. This can be seen more clearly when looking at the response function of the dichotomous mixed Rasch model described by equation 33.2:

$$p\left(X_{vi}=1\right)=\sum_{g}^{G}\pi_{g}\frac{e^{\left(\theta_{vg}-\sigma_{ixg}\right)}}{\sum_{x=0}^{m}e^{\left(\theta_{vg}-\sigma_{ixg}\right)}} \tag{33.4}$$

The response probability $\pi_{i|g}$ from equation 33.3 is now reformulated in line with the Rasch model. It can be seen that when there is only one latent class, the MRM is reduced to the Rasch model. When there are different classes but no variation in the ability parameters within each class, the MRM correspondingly becomes a simple latent class model. However, through its combination of latent class models and the Rasch model, the MRM provides two parameters for each person. Based on their response patterns, persons are assigned a value on the qualitatively scaled latent class variable, and based on the number of items solved, they are assigned a class-specific, quantitative person parameter.

An extension of the MRM, the hybrid MRM (see, e.g., Rost & von Davier, 1995), permits a free mixture of (a) latent classes with no quantitative differences between the persons and (b) latent classes with quantitative person differences. Of course, a minimum of two classes is necessary. Von Davier and Rost (1995) presented an instructive application of the hybrid MRM model in a reanalysis of the self-monitoring data set from Gangestad and Snyder (1985).

There are not only dichotomous latent class models and MRM models but also ordinal latent class models (Langeheine & Rost, 1988; Rost, 1988) for analyzing ordered response formats. The ordinal Rasch models (e.g., the partial credit and rating scale models) can be integrated into the framework of the ordinal MRM by adding the model-specific threshold parameters (Rost, 1991). Although numerous studies have now applied LCA as well as the MRM (see Rost & Langeheine, 1997; von Davier & Carstensen, in press), this line of probabilistic models has been used only infrequently in sport psychology.

Strauss (1994) used LCA and the MRM to identify types of sports spectators ($N = 2{,}311$ team handball spectators) in terms of their attendance motives. However, the main result was the detection of numerous response sets (e.g., tendency toward the middle; "optimal categorization", Zhu, 2002) among spectators that could not be identified through other nonprobabilistic procedures. These response sets led to the conclusion that survey data should be interpreted very cautiously in such situations. This was also the major result in another study on self-efficacy expectancies in health programs (Strauss, 1998). Eid and Zickar (in press) have shown more generally how powerful the MRM is in detecting response sets and to study the optimal categorization (see Zhu, 2002).

Büsch and Strauss (2005) analyzed coordination strategies by means of the LCA und the MRM (and using the partial credit approach of Masters, 1982). A total of 503 participants were asked to perform fundamental movement skills. Results showed two latent classes that could be interpreted as indicating that persons performing gross motor tasks may be differentiated according to an accuracy coordination strategy in precision tasks and a speed strategy or a speed-accuracy strategy in time-pressure tasks.

Using LCA and the MRM again, a further study on coordination (Büsch, 2004) tested whether movement tasks with and without a ball are determined by different skill levels (Büsch, Hagemann, & Thielke, 2001) or by different coordination strategies (Büsch & Strauss, 2005). A total of 305 participants (155 ball game athletes and 150 non-ball game athletes) performed three time-pressure tasks with no ball and three time-pressure tasks with a ball. Results supported the assumption of the two different coordination strategies.

GOODNESS-OF-FIT TESTS

One of the most attractive properties of probabilistic models is that they allow us to test whether they fit the data, or whether a certain latent trait or latent class model is valid for the data. However, this means that the calibration of person and item scores can be considered sample-free or Rasch-homogeneous only after this has been confirmed by goodness-of-fit tests. Therefore, all analyses performed with the help of probabilistic models also require goodness-of-fit tests.

The question of whether a probabilistic test model fits the data cannot be answered absolutely with a yes or no but only in terms of whether it fits the data *better* or fits the data *worse*. When a model fits the data, one can determine, for example, whether the empirical validity of a theory can be attained with the smallest possible number of simple assumptions. This is called the *simplicity criterion* of a theory, whereby simplicity always has to be judged in relation to a theory's validity domain (Rost, 2004).

The empirical validity of latent trait and latent class models is frequently tested with inferential statistics (such as likelihood-quotient tests or $\chi2$ tests). These significance tests possess the technical advantage that ascertaining a critical limit provides a rational criterion for accepting or rejecting the model. One disadvantage is that the models need to have a hierarchical relationship if they are to be compared. This is not the case for the class solutions of LCA or the MRM. In addition, strict conditions have to be met regarding the distribution assumptions and the necessary cell occupancies. For this reason, Rost (2004) and others have supported using alternative approaches such as information criteria, person- and item-fit statistics, and bootstrapping procedures.

Approaches Based on Statistical Inference

The main area in which these approaches are applied is in testing the model fit of latent trait models. Since the 1960s, a number of tests using inferential statistics have been developed that address various properties of the Rasch model. To test the global fit of Rasch models, it is possible to discriminate between model tests that examine either item homogeneity or person homogeneity in line with the sample-free measurement property of the Rasch model (see chapter introduction). Two examples for testing the item homogeneity are Martin-Löf's (1973) *conditional likelihood quotient test* and Rost's (1982) *unconditional likelihood ratio test.* These model tests use inferential statistics to form two groups of items and compare their person parameters.

However, model tests that examine the person homogeneity are applied more often. Person homogeneity is present when all persons respond to the items on the basis of only one trait. Several model tests have been developed to examine this assumption: Wright and Panchapakesan's (1969) Statistic Y, Fischer and Scheiblechner's (1970) Statistic S, Martin-Löf (1974) procedure, and van den Wollenberg's (1982) Q statistics. However, the most well-known procedure is Andersen's (1973) *conditional likelihood ratio test* (CLR test). In principle, this follows the graphic model test already described by Rasch (1960). The basic procedure is to form two or more groups of persons, estimate item parameters for each group, calculate the conditional likelihoods (the probability that the data will be true when a specified model is assumed, under the condition of the raw score, the sufficient statistic) for both the total sample and for each group formed, and test the extent to which the item parameters in each group differ from each other. The various person groups are formed on the basis of more or less theoretically derived manifest criteria such as gender, age, or raw scores.

Information Theory Approaches

Comparisons of different test models, particularly (but not only) within the framework of LCA, are made with indices from information theory. Normally, the most commonly used significance test when analyzing latent trait models, that is, the likelihood ratio test, is not appropriate for testing the fit of latent class models. This is often because the likelihood ratio statistic does not always have an asymptotic χ^2 distribution.

Rost (1990, 1991, 2004) suggests three such indices: Akaike's information criterion (AIC; Akaike, 1973), the best information criterion (BIC; Schwarz, 1978), and the consistent Akaike's information criterion (CAIC; Bozdogan, 1987). The BIC is superior to AIC when the number of items is large and pattern frequencies are small (Rost, 2004). The CAIC, in turn, is recommended for its robustness (Bozdogan, 1987). Both CAIC and BIC additionally include sample size, unlike AIC. The use of the CAIC index is frequently recommended (Read & Cressie, 1988).

One solution applies when controlling model validity: The smaller the indices (AIC, BIC, or CAIC), the better the fit between the model solution and the data. Because there is no formal decision rule for a test model based on significance tests, it is necessary to include criteria of empirical validity and simplicity when deciding on a test model. However, the particular strength of these indices is that they use the same information (likelihoods and estimated model parameters) as the likelihood-quotient tests. One advantage of these indices is that it is still possible to compare models with each other even when there is no hierarchic relation between them, as, for example, between latent class and Rasch models (Read & Cressie, 1988; Rost, 2004).

With the help of information indices, the mixed Rasch model (Rost, 1990) can be used as a model test of person homogeneity in latent trait models. However, in this case, groups are formed not on the basis of manifest criteria (as in Andersen's, 1973, CLR test) but on the basis of latent classes. This is the strictest conceivable criterion, because maximum person heterogeneity exists between the classes. Accordingly, Rost and von Davier (1995) have been able to show that a test of person homogeneity based on the mixed Rasch model is more sensitive than Andersen's CLR test (1973).

The weakness of information indices is, first, that they are sample-dependent. In other words, an increasing number of cases can lead to an inflation of the number of classes, and thus to overparameterizations. Nonetheless, this weakness is also found in the inferential statistics mentioned previously (McDonald & Marsh, 1990). Second, no rational criterion (such as significance limits) is available with which to decide whether the difference between two scores is high or low.

Person- and Item-Fit Statistics

Person-fit and item-fit statistics are used to evaluate aberrant response patterns of persons and items with respect to a specified probabilistic model. Detailed overviews can be found in, for example, Tatsuoka (1996) and von Davier and Strauss (2003).

Considering, for example, the monotonicity assumption of the Rasch model, responses indicating mastery of difficult tasks and failure on easy tasks are not very probable when the Rasch model holds. Person-fit and item-fit measures have been developed to estimate the deviation of observed response patterns from the expected responses, given that the model holds.

Various person-fit indices have been proposed for the two- and three-parameter models (e.g., Levine & Rubin, 1979; Tatsuoka, 1984) as well as for the (dichotomous) Rasch model (Molenaar & Hoijtink, 1990; Wright & Panchapakesan, 1969; Wright & Stone, 1979). The mixture-distribution-person-fit index Z has been proposed for a broad class of latent trait and latent class models (von Davier & Molenaar, 2003).

Rost and von Davier (1994) proposed the Q index to evaluate the appropriateness of a single item. Such an index, with a range between 0 and 1, is formed for each item. The lower the value, the better the item fits the expected model. This judgment can be tested by performing a significance test for each item.

Person- and item-fit indices (the infit and outfit statistics) are used particularly for model testing within the framework of the many-faceted model (Linacre, 2004; Wright & Masters, 1982), but not only in this model. These indices are standardized residuals that can be defined by comparing the expected with the actual responses of each subject or item (see also Wright & Masters, 1982; Wright & Stone, 1979). This means that an efficient and sufficient measurement should produce items that elicit expected responses from persons responding to them. Sufficient measurement requires that the more one is on the measured variable, the higher one will rate each item in comparison to a person who is lower than one on the measured variable. A item that does not meet this requirement is considered a *misfit.*

The infit statistic is the weighted average of the squared standardized residuals; the outfit statistic is the unweighted average. Linacre (2004), for example, reports upper and lower thresholds for both statistics, defining when one can consider an acceptable model fit.

Bootstrapping

One particular problem when testing model fit is that there are frequently a great number of variables in a rather small number of participants, so that many of the cells in the contingency tables contain no or only a few occupants—even when samples are very large (Howell, 2002; von Davier, 1997a). Bootstrapping (Efron, 1979) is a promising approach for testing model fit by using simulated data sets produced by a random generator. It is a further development of the jackknife procedure (Miller, 1974). Bootstrapping has an economic advantage: The large samples necessary for controlling model fit in psychometric analyses do not need to be assessed repeatedly, but can be estimated from the study sample itself.

The bootstrap is called a resimulation or a resampling analysis in which the estimated parameters of the test model are used to generate an arbitrarily large number of simulated random samples from a sufficiently large sample from an original study with replacement from the sample. These are the so-called bootstrap samples. This means that the sample defines a pseudo-population from which the bootstrap sample statistics and the bootstrap sampling distribution of the statistics can be derived.

Whereas parametric procedures estimate the population parameters, such as the mean, standard error, and confidence intervals, on the basis of the restrictive assumption of a normal distribution, bootstrapping estimates the population parameters on the basis of bootstrap samples that require no such comparable assumption (Efron & Tibshirani, 1993; Zhu, 1997; Zhu & Zhang, 2004). Because of the great number of bootstrap samples (up to $N = 10{,}000$ depending on the parameters under investigation; Chernick, 1999), bootstrapping, just like randomization tests and Monte Carlo tests, is also called computer-intensive statistics (Noreen, 1989).

The parametric bootstrap is recommended for the control of model validity. It does not generate samples from the original data but simulates data generated with the parameter estimates of the model to be tested. This should ensure that the empirical distribution of the goodness-of-fit statistics of the bootstrap samples will approximate the distribution when the model is valid (von Davier, 1997a). If the estimated parameters of the simulated data sets do not reveal any major deviations from the initial parameters, the test model can be retained. Because of the problem of having to assume unoccupied or sparsely occupied cells in the contingency tables, only Pearson's chi-square and the Cressie-Read statistics can be recommended as appropriate (i.e., robust and consistent) test statistics for the model selection (von Davier, 1997b). The test score p should be as large as possible to confirm the validity of the model statistically. Values of $p > .025$ are already considered to be a very good model fit. Nonetheless, it should also not be forgotten that when samples are very large, even the smallest deviations from the model can lead to a rejection of the model specified in the statistical null hypothesis.

COMPUTER TOOLS

Nowadays, several programs are available for statistical analyses with probabilistic models. However, as the examples in this chapter reveal, studies in sport psychology have preferred to use the programs FACETS, WINMIRA, ConQUEST, and ASCORE (now labeled RUMM2020). Because the programs themselves have been developed further, some are no longer available in the versions used in published research. We provide a brief overview of the current versions. Limited student, demonstration, and evaluation versions are available for all of these programs, providing good insight into their functions and options.

The program FACETS (Linacre, 2004) implements Linacre's (1989) many-faceted Rasch measurement model. The program is designed particularly for the logarithmic transformation of categorical observations. The facets are modeled as operating independently and with their measures combining additively on the latent variable. The parameter estimation method is the joint maximum likelihood (JML, also called the unconditional maximum likelihood, UML), which estimates person and item parameter at the same time. This method is easy to carry out. The disadvantage is the dependence of item and person parameter estimations. Linacre (2004) recommends that one should start by getting to know the simpler Rasch measurement program WINSTEPS (Linacre, 2005) before going on to tackle the FACETS program. The Rasch models implemented in WINSTEPS include the dichotomous Rasch model, the polytomous rating scale model, and the polytomous partial credit model. The estimation method is also the JML. Linacre's (2004, 2005) WINSTEPS and FACETS programs can be downloaded at http://www.winsteps.com. The full version of WINSTEPS can handle up to 30,000 items and 1 million persons in the dichotomous Rasch model. The polytomous models can handle up to 255 categories per item. The demonstration version can handle a maximum of 30 items and 200 persons. Although the evaluation version of FACETS is just as functional as the full version, the number of observations that can be analyzed is strongly limited. The WINSTEPS and FACETS programs contain a detailed user's guide (as a PDF document).

WINMIRA 2001 (von Davier, 2001) is a computer program for estimating and testing a large number of discrete mixture models for categorical variables. WINMIRA 2001 can be used for analyses with LCA, the Rasch model, the MRM, and hybrid models for dichotomous and polytomous data. For polytomous data, WINMIRA is capable of estimating four different submodels: the partial credit model, the rating scale model, the equidistance model, and the dispersion model. The CML (conditional maximum likelihood) parameter estimation method is used to estimate item parameters. The advantage of such CML estimators is that they provide item parameter estimations independently of knowing the person parameters. With WINMIRA, the JML (or UML) method is then used to estimate person parameters. The program has an option for computing the maximum likelihood estimators and weighted likelihood estimators. This computer program can be downloaded at http://winmira.von-davier.de or http://www.assess.com. The full version permits an analysis of 256 items, 100,000 observations, 200 latent classes, and 30 categories per item. In contrast to the registered version, the demo does not write SPSS files, does no bootstrap fit tests, and is restricted to 1,000 cases, 12 items, and 4 latent classes with a maximum of 5 categories. All features of the software are outlined in a manual (HTML document) that is included only in the registered version.

ConQUEST is a computer program developed at the Australian Council for Educational Research for fitting item response models to test and questionnaire data (Wu, Adams, & Wilson, 1999). It can be used to analyze the dichotomous logistic model, the rating scale model, the partial credit model, the ordered partition model, the linear logistic test model, multifaceted models, generalized unidimensional models, multidimensional item response models, and latent regression models for dichotomous and polytomous data. Model parameters are estimated with the marginal maximum likelihood (MML) method. The MML algorithm is an extension of the CML method and uses the distribution of the person parameters (e.g., by assuming a normal distribution of the person parameters) to estimate the parameters. However, the CML and the MML methods produce very similar item parameter estimations (Rost, 2004). The full version of ConQUEST permits an analysis of 300 items and 100,000 persons. The demonstration version is restricted to 1,000 persons and 100 parameters. A user's guide is available only in the full version. The program can also be downloaded at http://www.assess.com or ordered directly from the Australian Council for Educational Research (http://www.acer.edu.au).

The computer program ASCORE (Andrich, Lynne, & Sheridan, 1990) used in several studies is no longer available. The current version of the program for carrying out a Rasch item analysis is labeled RUMM2020 (Rasch Unidimensional Measurement Model; Andrich, Sheridan, & Luo, 2004) and can be downloaded at http://www.rummlab.com.au. RUMM2020 backs up the analysis of item response data using the class of Rasch models for the measurement of dichotomous and polytomous data. The program uses a pairwise algorithm to estimate the parameters in which the estimated values are equivalent to the CML-estimated values (Rost, 2004). There is also an option for estimating the person parameters with the weighted likelihood and maximum likelihood methods. RUMM2020 is also available as a student edition with limited capabilities.

CONCLUSION

Back in 1987, Spray was already arguing that probabilistic models should be viewed not as an alternative in motor research, but as a meaningful extension of classical test theory. She pointed out that despite the almost complete neglect of probabilistic models up to that time, they "might hold the future of measurement research in physical education" (p. 208; see also, Cole, Wood, & Dunn, 1991; Safrit, Cohen, & Costa, 1989). This statement is just as true today.

Factor analysis and CTT are two of the most frequently applied analytic procedures in (sport) psychological research, particularly when performing sport psychological diagnoses and looking for relations between items, latent variables, or factors. This makes them a standard tool in the empirical sciences, and therefore in sport psychology as well. Nonetheless, they also reveal numerous problems in determining the number of factors, selecting an appropriate rotation method, and choosing a mathematical procedure to start with, such as principal factor analysis, image analysis, or maximum-likelihood analysis (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Tabachnick & Fidell, 2001).

Of course, CTT and the related factor analysis have their justification, particularly when examining the reliability of scores and criterion-oriented validity. However, the particular advantage of probabilistic models is that they turn item responses into theoretically derived scores (such as estimated person and item parameters). One major criticism of CTT procedures and factor analysis is that their outcomes are determined decisively by the sample and the items being used (Fischer, 1974; Safrit et al., 1989, 1992). In contrast to probabilistic models described here, CTT and factor analyses are not sample-free.

A further aspect is that in a factor analysis, the identification of latent variables (the factors) is based not on multivariate associations between the response variables, but on bivariate ones. It is assumed that the correlation between two response variables can be explained by the common effect of latent variables (factors). In situations where many bivariate associations are zero or close to zero, factor analysis is unable to extract meaningful factors. Thanks to the principle of local stochastic independence, probabilistic models consider not only bivariate but also multivariate relations. In line with Meehl's paradox (Meehl, 1950), this means that when multivariate associations are present, but no (or small) bivariate associations, probabilistic models are able to identify meaningful latent variables.

There is no longer any justification for avoiding the analysis of item responses, and this holds for sport psychology as well. We now possess a number of different probabilistic models that can be applied to answer a broad range of diagnostic questions. We also have several very powerful computer tools that have made analyses much easier to perform.

However, the great strength of a probabilistic model is retained only when its validity has first been confirmed with goodness-of-fit tests. If this is neglected or tests prove unsuccessful, the scores and results generated are no more valid than the results of CTT or factor analysis. Moreover, samples have to be sufficiently large to ensure the stable and precisely estimated parameters needed to carry out model testing with a high degree of sensitivity. Sometimes, samples were used that are clearly too small. A very extreme example has been provided by Penta et al. (1998), who administered 57 items to 18 patients to investigate the dimensionality of a tool for measuring manual disability. Due to the resulting tremendous estimation errors and the relevant loss of power, each fit statistic will always indicate necessarily the unidimensionality of the measures, although multidimensionality could be true.

In sport psychology, probabilistic models have generally been used to test properties of questionnaires such as the TEOSQ, STAI, CES, and PSDQ, or to examine several research questions in the motor domain. However, extending the application of these models in the sport sciences holds great promise from both methodological and content-related perspectives. We believe that the studies presented in this chapter have underlined this very clearly.

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CHAPTER 34

Measurement in Sport and Exercise Psychology

A New Outlook on Selected Issues of Reliability and Validity

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This chapter consists of two parts. In the first part we introduce a new method for evaluating temporal stability of introspective measures. The use of a simple correlation to elicit test-retest reliability as an indicator of variance error attributed to time instability is a common practice among test developers. However, this procedure is very limited in meeting the requirement of stability over time period, and may be even misleading in cases where the correlation is strong but the observed measurement values shift up or down the scale during the second test administration. The method we introduce takes into account both the correlation between the two measures and the shift of values in the second measure compared to the first one, given any time interval between the two measures. If adapted in the sport and exercise domain, better estimates of temporal stability of measurement tools will be obtained, and stronger tools will be used by practitioners and researchers alike.

The second section centers on a measurement issue in the sport and exercise domain that is a major concern practitioners and researchers frequently encounter when using measurement tools during an activity that an exerciser or an athlete is engaged in. On one hand, one is tempted to administer a multi-item questionnaire proven to be psychometrically sound. On the other hand, athletes and exercisers are unwilling, and in most cases are unable, to respond to such questioners while engaged in their respective activities. Thus, the reliability-ecological validity trade-off is a major issue that reflects on both scientific inquiries and practical interventions. Do environmental constraints impose serious measurement issues for sport and exercise psychologists? We discuss this issue and offer an optimistic solution accompanied with examples and illustrations.

STABILITY OF RETROSPECTIVE MEASURES OF INTROSPECTION

If one is interested in knowing how trustworthy are the introspective reports of athletes when given in retrospect, at least two measures of one selected variable should be administered: one in real time (say, 5 minutes prior to competition) and the others in retrospect (say, 1 to 2 days after the competition). In this particular case, one should distinguish between two concerns related to the temporal stability of retrospective reports. The first concern is the stability of trait measures over time. The second concern is the stability of retrospective reports given at two "not too far away" distinct events. The first concern relates to internal changes in attitudes, traits, physical characteristics, and the like that change with time and growth. The second concern relates to changes that may occur in two retrospective reports due to memory limitations, situational consequences, and social biases. Because of inherent differences between the two concepts of stability, the sources of variance errors also differ between the two. Thus, the method for estimating the stability of traits should differ from the method aimed at estimating the stability of two reports that pertain to the *same event.*

Long and Schutz (1995) tested the stability of stress and coping measures eight times over 2 years. Schutz (1998) illustrated how repeated measures over time can indicate the *reliability* of the *measure* and the *stability* of the *trait.* He stated, "Traditionally, a correlation coefficient, usually the Pearson product moment correlation coefficient (PPMC) has been used to quantify both" (p. 393), and stability and reliability were considered synonyms in representing longitudinal consistency of a set of observed scores. Schutz further claimed that recent developments, mainly in the use of structural equation modeling, provide a sound basis for the estimation of stability and reliability. He outlined the source of error associated with reliability measures and concluded that the traditional methods tend to underestimate the reliability of the measured trait by ignoring the distinction between random measurement errors and systematic error variance.

When a stable measure is administered to persons twice or more over a period of time, variability over repeated measurements may be attributed to its inherent lack of measurement reliability (i.e., random error associated with the manifest variable, and a systematic error associated with the time lapse). In this case, once the researcher secures the inherent reliability of the measurement tool (i.e., test-retest, internal consistency, split-half), the variance error associated with instability can be attributed to the changes that occurred between the two periods of time the measure was administered. Schutz (1998) claimed that the structural equation modeling method allows the quantification of the temporal stability of the error variances by separating out the systematic and random components of error variance. This structural equation modeling concept, however, may not be applicable in estimating stability of introspective reports due to the fact that it relies on multiple indicators for measuring a construct. In the current chapter, we propose a method to estimate the temporal stability of introspective measures, where a single indicator for each one of two time points for each person is sufficient.

The concept of stability we refer to considers fluctuations in introspective reports that may occur due to differences in mood and emotional state at the two reported occasions of the same event (i.e., in real time and in retrospect) or short-term recall capacity as error variance that signifies the extent of instability, in addition to the random error (i.e., measurement error due to unreliability of the measure). Therefore, the magnitude of discrepancy between two measures should be judged with respect to the instrument's unreliability (i.e., the questionnaire measurement error as a *standard of comparison*). If the magnitude of discrepancy is equal to or smaller than the measurement error, then stability can be inferred. However, when the discrepancy is larger than the measurement error, instability is evidenced. Usually instability is caused by factors others than the measurement itself. Once this happens, the researcher or the practitioner can attribute instability to failure to memorize accurately feelings and thoughts retrospectively due to personal, social, or environmental constraints. Thus, the ratio between the time-lapse error variance and the measurement error is a reasonable index that indicates how much a person deviated in two or more measures due to factors that are beyond the mere sources of measurement errors (i.e., recall capacity and bias, mood state).

Correlations, Structural Equations, and Agreement Measures

The correlation coefficient between repeated measures has been commonly used to indicate differential stability or consistency of individual scores over time (e.g., Caspi & Bem, 1990; Long & Schutz, 1995; Schutz, 1998; Usala & Hertzog, 1991). In studies that rely on introspective measures (see Jokela & Hanin, 1999, for a meta-analysis), a correlation between the two measures was calculated to infer stability. The correlation, however, is not a sufficient indicator of stability due to the systematic error that may be evident within the measure administered in the two separate occasions, as pointed out by Schutz (1998) and other authors.

A reminder is needed here for the purpose of clarification. A correlation is an estimate of association between two or more variables, and it indicates the symmetry between the variances of two or more variables (i.e., covariance) relative to their variances. The correlation coefficient is *not* an estimator of stability, but rather of *association.* A correlation coefficient can be a measure of stability only under the assumption that the differences between the two measures are attributed solely to random measurement errors (i.e., the true scores and their variances remain identical under the two conditions). Such an assumption cannot be made, however, as long as identical scores for each individual are not evident in the two conditions.

In Table 34.1, hypothetical data are presented to illustrate the difference between *association* (i.e., correlation) and *difference* (i.e., stability-instability). The real values indicate the actual anxiety states reported by the athletes before a competitive event, and the recalled values indicate how they reported the same anxiety state after 24 hours in retrospect. In this case, all athletes, except Athlete 10, overestimated their anxiety level by 5 points after 24 hours. Only Athlete 10 recalled precisely his or her anxiety state level.

The mean difference between the real and recalled anxiety state values using paired t tests resulted in a significant difference ($p \cong .00$), which indicates a mismatch (i.e.,

Table 34.1 Hypothetical Data for Real and Recalled Anxiety State in 10 Athletes

	Anxiety State	
Athlete	Real	Recalled
1	45	50
2	57	62
3	61	66
4	33	38
5	42	47
6	54	59
7	27	32
8	37	42
9	58	63
10	70	70
Mean	48.4	52.9
SD	13.75	12.94
	$t = 9.00$ ($p \cong 0.00$)	

instability) between the actual and recalled states. The correlation between the real and the recalled anxiety states, however, approximated unity ($r = .995$), though only one athlete reported an accurate recalled anxiety state. In this hypothetical example, the correlation between the two measures relating to the same distinct event was high because the anxiety measures of most of the athletes remained in the *identical positions relative to each other* in the two distributions; however, it fails to reflect the athletes' overestimated anxiety states in the retrospective (i.e., delayed) reports. This hypothetical example clearly suggests that the stability of the recalled anxiety state measure should incorporate the comparison of the magnitudes of the measures on the two occasions, rather than simply the association between them.

In structural equation modeling, the path weight (ß) between two latent variables parallels the correlation coefficient. *Differential stability* is assessed through the correlation between the errors of the latent variables. *Mean stability,* according to Schutz (1998), refers to the equality of means over repeated measures. Thus, when the correlation is 1.0 and the mean difference is 0, mean stability is perfect. Schutz also elaborates on *structural stability,* whereby a multifactorial structure is examined over time, termed also *factorial invariance* (Usala & Hertzog, 1991) and *invariant factor loading* (Marsh, 1993). Schutz claimed that temporal stability should be assessed by comparing the within-subject standard deviation (*SD*) of the repeated measures separately for each subject, with low *SD* indicating strong temporal stability, and vice versa. Over time, however, *variability* increases and systematically biases the *SD*. In addition, "there is no direct statistical test of the hypothesis of stability as there is with the [structural equation modeling] approach" (Schutz, 1998, p. 397).

To overcome these limitations, Schutz (1998) suggested using a confirmatory factor analysis model for a single factor, where the indicators are the repeated measures of the same construct. Joreskog and Sörbom (1993) and Marsh (1993) termed this procedure the simplex model, plausible stability model, or higher-order (general factor) model. Schutz tested several models with different assumptions and used fit indices to infer the temporal stability of the measures over time. Although the testing procedures advocated in these models are comprehensive, complex, and contain many assumptions, they rely on multiple indicators to measure a construct. Therefore, they are not always appropriate for estimating the stability of retrospective reports, where practitioners often rely on a single indicator to measure a construct.

Bland and Altman's Method

A simpler method of estimating *agreement* between two measures of the same variables was proposed by Bland and Altman (1999). They obtained the limits of agreement by computing the mean difference plus/minus 1.96 times the standard deviation of the mean differences, assuming that the mean differences are normally distributed in the data. Then the standard errors and confidence intervals for the upper and lower limits of agreement were obtained. Bland and Altman suggested eyeball examinations of the width of the limits of agreement relative to the confidence intervals of the limits. If the width of the limits of agreement is much wider than the confidence intervals of the limits, the two methods are in a disagreement. On the other hand, if the width of the limits of agreement is as narrow as the confidence intervals of the limits, agreement of the two methods is reasonably acceptable.

Bland and Altman (1999) pointed out that the lack of *repeatability* (reliability) of each measure might affect the comparison of the two methods of measurement. To estimate such differential reliability, they suggested collecting repeated-measure data for each of the two methods of measurement. In sports, however, one often has to rely on a brief single measure because of situational constraints. In such conditions, the same measurement instrument is provided for the same event twice, in effect, pre- and post-competition. For this reason, the random error is likely to remain the same, and it may not be necessary to obtain multiple measures for each occasion. The information about the reliability of the measure, which is common to the two measures, can be obtained either from prior knowledge about the measure or from the data.

Proposed Method

We propose an indicator that is a ratio between the total errors and the random error. This is similar to Bland and Altman's (1999) method; however, the proposed method evaluates the ratio between the total errors and the random error, rather than eyeball examination of the total variation and the error variation. Therefore, one can obtain a reasonably interpretable quantity to evaluate the magnitude of the total error (systematic error + random error), relative to the magnitude of the random error. In addition, the ratio we propose is a statistic, which has a distributional property, thus allowing one to test the magnitude of stability among athletes of different genders, skill levels, and the like.

Standardized Root Mean Squared Difference

A method for stability evaluation for two measures, where one indicator measures each, is introduced. Let X_{1i} be the first measure of X for ith person, X_{2i} be the second measure of X for ith person, and n be the number of tested individuals ($i = 1 \ldots, n$). The sum of the squared difference from the mean is

$$\left(X_{1i} - \frac{X_{1i} + X_{2i}}{2}\right)^2 + \left(X_{2i} - \frac{X_{1i} + X_{2i}}{2}\right)^2 = \frac{\left(X_{1i} - X_{2i}\right)^2}{2} \quad (34.1)$$

Then, the root mean squared difference (RMSD) of X is defined to be

$$\mathrm{RMSD}(X) = \sqrt{\frac{\sum_{i=1}^{n}\left(X_{1i} - X_{2i}\right)^2}{2n}} \quad (34.2)$$

which is the square root of the mean of the squared differences across n individuals. Conceptually, RMSD(X) is an average deviation of the two measures (X_1 and X_2) from their midpoint (i.e., the mean of X_{1i} and X_{2i}). If X_{1i} and X_{2i} are the same for all i, RMSD(X) is 0, indicating that there is no discrepancy between X_1 and X_2 (i.e., the stability of X). On the other hand, if there is some discrepancy between X_1 and X_2 (i.e., instability of X), the RMSD(X) is greater than 0.

For example, RMSD(X) is computed to be 3.35 by equation 34.2 for the hypothetical data presented in Table 34.1, indicating that there is some discrepancy between the real and the recalled anxiety measures (i.e., instability of the recalled measure). Also, RMSD(X) is equivalent to the square root of the total amount of the error variance (systematic error + random error). In the context of repeated-measure ANOVA, it is the same as the square root of the within-people variation (the between-measures variation + residual variation). Results of the variance decomposition by the repeated-measure ANOVA are summarized in Table 34.2. By taking the square root of the mean square of within-people variation 11.25, we obtain, $\sqrt{11.25} = 3.35$, which corresponds to the computation based on equation 34.2.

To evaluate the magnitude of RMSD(X), it needs a yardstick (i.e., reference measure) to be based on. For example, how should we evaluate RMSD = 3.35 for the hypothetical data in Table 34.1? To what extent does the value 3.35 indicate low, moderate, or high stability level? A reference measure is required for this purpose. We use the standard error of measurement (SEM) as a reference point. Technically, SEM is the square root of the error variance (i.e., the standard deviation of the sampling distributions of the measures). Conceptually, it is the magnitude of variation one should expect by measurement errors. Then we define the standardized root mean squared difference (SRMSD) of X to be

$$\mathrm{SRMSD}(X) = \frac{\mathrm{RMSD}(X)}{\mathrm{SEM}(X)} \quad (34.3)$$

where SEM(X) is the SEM of X. In this way, SRMSD indicates how large the RMSD is, relative to SEM. If SRMSD = 1.0, it would indicate that the average deviation of X_2 from X_1 is equivalent to the standard deviation of the sampling distribution of X. In other words, the amount of discrepancy is what we would expect from random error itself. This can be expected when X_1 and X_2 have the same mean and observed variance. Any SRMSD ≥ 1 would indicate that the difference between X_1 and X_2 is greater than the

Table 34.2 Repeated-Measure ANOVA Table for the Hypothetical Data

Source of Variation	Sum of Squares	*df*	Mean Square
Between people	3,196.05	9	355.12
Within people	112.50	10	11.25
Between measures	101.25	1	101.25
Residual	11.25	9	1.25

Note: Within-people variation has been partitioned into between-measures variation and residual variation.

measurement errors, and it is an indication of systematic error (i.e., instability of X).

One approach to obtain SEM(X) is to estimate it from the data. In fact, the residual variation from the repeated-measures ANOVA is conceptually the same as SEM(X). Computationally, we take the square root of the mean square of the residual. In the hypothetical example in Table 34.1, SEM(X) = $\sqrt{1.25} = 1.12$ is obtained from Table 34.2.

Accordingly, $\mathrm{SRMSD}(X) = \frac{3.35}{1.12} = 2.99$. It can be interpreted that the difference between the actual and the recalled measures was almost 3 times the measurement error. This is a very large SRMSD relative to the amount of the measurement error. Thus, it is an indication that the difference between the two measures involves much more than measurement error, and the recall measure cannot be trusted. In this way, an SRMSD can be evaluated relative to its measurement error, and SRMSDs from different scales can be compared to each other directly.

Another approach is to use prior knowledge about the reliability of the scale. Then the observed standard deviation σ_X can be easily estimated from the data, and consequently SEM(X) is estimated by $\mathrm{SEM}(X) = \sqrt{\sigma_x^2(1 - \rho_{xx'})}$, where $\rho_{XX'}$ is the estimate of the reliability, and σ^2_X is the observed variance of X. For example, a conservative estimate of the reliability, namely, the lower bound estimate, Cronbach's coefficient alpha, can provide a conservative estimate of the SEM (i.e., the upper bound). The coefficient alpha is relatively easy to obtain either from the data or the manual of the scaling instrument, or from the data used for the particular sample.

Distributional Property of the Standardized Root Mean Squared Difference. We can show that examining the SRMSD is analogous to examining the mean difference between X_1 and X_2. Also, we can show that the sampling distribution of the RSMSD can be derived from a reasonable assumption. First, $\mathrm{SEM}(X) = \sqrt{\sigma_x^2(1 - \rho_{xx'})}$ and equation 34.2 are substituted for equation 34.3. Then we obtain

$$\mathrm{SRMSD}(X) = \sqrt{\frac{\sum_{i=1}^{n}\left(X_{1i} - X_{2i}\right)^2}{2n\sigma_x^2\left(1 - \rho_{xx'}\right)}} \tag{34.4}$$

For statistical convenience, we consider the standardized sum of squared difference (SSD),

$$\mathrm{SSD}(X) = \left[\mathrm{SRMSD}(X)\right]^2 \times n = \frac{\sum_{i=1}^{n}\left(X_{1i} - X_{2i}\right)^2}{2\sigma_x^2\left(1 - \rho_{xx'}\right)} \tag{34.5}$$

where all the terms were defined previously. An assumption is made that X_1 and X_2 are sampled from a bivariate-normal distribution with equal variances. In other words, we assume that X_1 and X_2 are both normally distributed and have the same variance in the population, and that they are correlated at some degree. Then the sampling distribution of the mean difference, $X_1 - X_2$, is normally distributed with the mean of $\mu_{X1} - \mu_{X2}$ and the variance of $\sigma_X^{\ 2} - 2\rho_{XX}\sigma_X\sigma_{\ X} + \sigma_X^{\ 2} = 2\sigma_X^{\ 2}(1 - \rho_{XX})$, which is the same as the denominator of the SSD(X) in equation 34.6.

Now we can standardize the mean difference by

$$\frac{X_1 - X_2}{\sqrt{2\sigma_x^2\left(1 - \rho_{xx'}\right)}} \tag{34.6}$$

which is normally distributed with mean = 0 and variance = 1. Then the square of equation 34.6 is

$$\frac{\left(X_1 - X_2\right)^2}{2\sigma_x^2\left(1 - \rho_{xx'}\right)} \tag{34.7}$$

The SSD(X) is the sum of equation 34.7 over n individuals. Because the SSD(X) is the sum of n squared standard normal deviates, under H_0: $\mu_{X1} = \mu_{X2}$, the SSD(X) is distributed as a chi-square distribution with $n - 1$ degree of freedom. Therefore, the obtained value of the SSD(X) (i.e., $[\mathrm{SRMSD}(X)]^2 \times n$) can be compared to the corresponding critical value, for example, 123.225 with $\alpha = .05$ and $n = 100$, to conduct a hypothesis testing. Alternatively, one can compute the p value based on the SSD(X) and the $df = n - 1$. Also, a critical value of SSD(X) can be transformed into the scale of the SRMSD by the inverse function of equation 34.5:

$$\mathrm{SRMSD}(X) = \sqrt{\frac{\mathrm{SSD}(X)}{n}} \tag{34.8}$$

In Figure 34.1, the relationship between n and the critical SRMSD(X) value is depicted. For example, with $n = 10$, SRMSD(X) greater than 1.30 would result in a p value

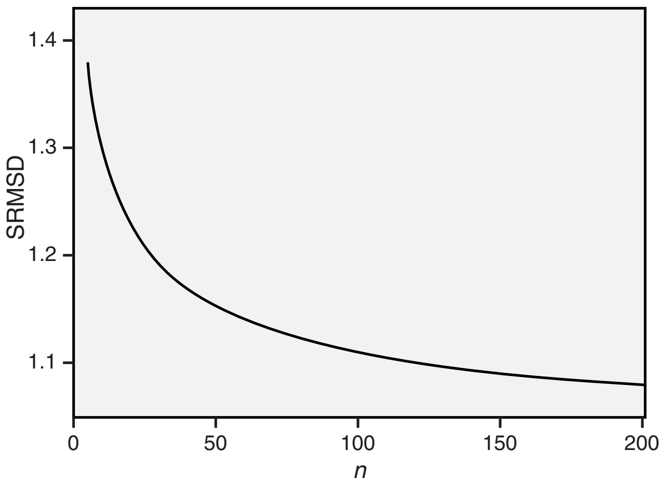

Figure 34.1 Critical SRMSD values with $\alpha = .05$.

smaller than .05, while SRMSD(X) has to be only 1.11 to obtain a p value smaller than .05 with $n = 100$.

Illustration 1

The data set in Bland and Altman (1999, pp. 137–138) is analyzed for the purpose of illustration. The data set consists of systolic blood pressure measures, where simultaneous measurements were made by three methods. The stability between the first measures of Method J (J1) and Method R (R1), as well as the stability between the first measures of J1 and Method S (S1), are examined. Repeated-measure ANOVA tables are presented in Tables 34.3 and 34.4. Correlation between the two measures, SRMSD, SSD, and corresponding p value are summarized in Table 34.5. The limits of agreement, 95% confidence interval (CI) for the limits and 95% CI for the mean differences, are included in the table, based on Bland and Altman's method, as well as the mean and the *SD* of score differences.

The stability between J1 and S1 was also examined by Bland and Altman (1999). Consequently, they reported 95% CI for limits of agreement, the same as the results in Table 34.5. Based on these values, Bland and Altman concluded that "even on the most optimistic interpretation there can be considerable discrepancies between the two methods" (p. 142).

The proposed method in this chapter provides additional information from different perspectives, which helps one clarify the stability between two methods. First, RMSD of 17.966 was obtained, which is the total amount of error and higher than SEM, which was estimated as 13.876. Consequently, the ratio of RMSD to SEM is 1.295, indicating that the total error is about 30% more than the measurement error. Along with the observed mean of difference scores (−16.294), it is evident that the stability of the measures between the two methods is not supported. The resulting SSD is 142.493, which is associated with the p value < .001. Therefore, we have sufficient evidence to infer that the discrepancy between the two measures is more than the measurement error.

In the second comparison (Method J and Method S), RMSD of 1.503 was obtained for the consistency between J1 and R1, and the corresponding SEM was 1.498. Conse-

Table 34.3 Repeated-Measure ANOVA Method J versus Method S in Bland and Altman's (1999) Data

Source of Variation	Sum of Squares	*df*	Mean Square
Between people	165,060.800	84	1,965.010
Within people	192.000	85	2.259
Between measures	3.388	1	3.388
Residual	188.612	84	2.245

Note: Within-people variation has been partitioned into between-measures variation and residual variation.

Table 34.4 Repeated-Measure ANOVA Method J versus Method R in Bland and Altman's (1999) Data

Source of Variation	Sum of Squares	*df*	Mean Square
Between people	161,467.976	84	1,922.238
Within people	27,436.500	85	322.782
Between measures	11,283.676	1	11,283.676
Residual	16,152.824	84	192.296

Note: Within-people variation has been partitioned into between-measures variation and residual variation.

Table 34.5 Summary of Analyses of Bland and Altman's (1999) Data

	J1 vs. S1	J1 vs. R1
Summary		
$\bar{d}$	−16.294	0.282
$SD_{\bar{d}}$	19.611	2.119
95% CI for $\bar{d}$	[−20.5, −12.1]	[−0.175, 0.739]
Correlation	0.820	0.998
Bland and Altman's Method		
Limits of agreement	[−54.732, 22.144]	[−3.871, 4.435]
95% CI for lower limit	[−61.9, −47.5]	[−4.654, −3.088]
95% CI for upper limit	[14.9, 29.3]	[3.652, 5.218]
Proposed Method		
RMSD	17.966	1.503
SEM	13.867	1.498
SRMSD	1.295	1.003
SSD	142.493	85.568
df	84	84
p value	< .001	.432

quently, SRMSD is 1.003, indicating that the total amount of the error is almost the same as the measurement error. Along with the small mean difference score ($\bar{d}$ = .282) and very high correlation between the two measures (r = .998), consistency between the two measures is supported. The SSD is 85.568, which is associated with the p value of .432. This also supports the consistency between the two measures.

Illustration 2

The data set in our second example is from 40 dressage horse riders who participated in an organized competition. Each rider was requested to complete the Positive-Negative Affect Scale (PNA; see Hanin, 2000b, for details). The PNA is a sport-specific stimulus list consisting of 14 lines of 46 pleasant (positive) emotions and 14 lines of 50 unpleasant (negative) emotions. The emotions in each list are further divided into functional (positive direction) and dysfunctional (negative direction) emotions, resulting in 4 categories of emotions: positive-positive (PP), positive-negative (PN), negative-positive (NP), and negative-negative (NN), with respect to pleasantness and direction of functionality. The riders rated the intensity of each line of emotions using verbal anchors ranging from "Not at all" (0) to "Very very much" (10) a few minutes prior to the beginning of their dressage routine in the competition. Three, 7, and 14 days later, they were requested to respond again to the PNA items but rated them in accordance with what they felt prior to the distinct dressage competition in which they participated (i.e., retrospective measures of introspection). Summary statistics of their responses are listed in Table 34.6.

The mean score difference ($\bar{d}$), 95% CI for $\bar{d}$, and correlations between the base measure and the retrospective measures, as well as the estimates of RMSD, SEM, SRMSD, SSD, and the corresponding p values are summarized in Table 34.7. SRMSD was computed using equation 34.5. In this example, the PNA reliability coefficient (ρ_{XX} = .76) was

Table 34.6 Summary Statistics for Data in Illustration 2

Emotion		Actual Measures	Retrospective Measures 3 days	7 days	14 days
PP	*M*	25.70	22.91	21.24	20.83
	SD	8.86	10.15	11.15	11.46
PN	*M*	22.31	20.51	18.81	19.09
	SD	9.53	10.14	10.61	12.21
NP	*M*	8.26	8.76	8.09	7.69
	SD	7.36	8.02	8.23	8.06
NN	*M*	8.28	8.13	8.73	7.81
	SD	7.11	8.48	8.85	7.86

Note: n = 40 for all measures.

Table 34.7 Relationship between Base Measure and Retrospective Measures for Illustration 2

Emotion		Retrospective Measures 3 days	7 days	14 days
PP	$\bar{d}$	2.79	4.46	4.88
	Correlation	0.83	0.74	0.77
	RMSD	6.30	8.64	8.72
	SEM	4.67	4.93	5.01
	SRMSD	1.35	1.75	1.73
	SSD	72.99	122.83	120.86
	p value	<.001	<.001	<.001
PN	$\bar{d}$	1.80	3.50	3.23
	Correlation	0.86	0.81	0.84
	RMSD	5.39	7.10	7.35
	SEM	4.82	4.94	5.37
	SRMSD	1.12	1.44	1.37
	SSD	50.01	82.55	75.02
	p value	0.111	<.001	<.001
NP	$\bar{d}$	−0.50	0.18	0.58
	Correlation	0.86	0.83	0.84
	RMSD	4.10	4.53	4.46
	SEM	3.77	3.82	3.78
	SRMSD	1.09	1.19	1.18
	SSD	47.21	56.20	55.63
	p value	0.172	.037	.041
NN	$\bar{d}$	0.15	−0.45	0.48
	Correlation		0.84	0.85
	RMSD	5.01	4.77	4.16
	SEM	3.84	3.93	3.67
	SRMSD	1.31	1.21	1.13
	SSD	68.31	58.78	51.32
	p value	.002	.022	.089

derived from the literature (Hanin, 2000b). The pooled variance between the two measures was derived from the data as an estimate of σ^2_X for each comparison. Consequently, SEM was estimated by $\mathrm{SEM}(X) = \sqrt{\sigma_x^2\left(1 - \rho_{xx'}\right)}$.

The p values were computed based on the value of SSD and its associated degrees of freedom (*df*). For example, the SSD for the PN scale between the actual 3 days' delay measure was 50.01 with $n - 1 = 39$ *df.* Then, to obtain the p value, the chi-square distribution function was used (such a function is available in most spreadsheet software packages, such as Microsoft Excel). For the present example, the function "= CHIDIST(50.01, 39)" was executed on Excel, and p = .111 was obtained. Alternatively, a critical value can be computed based on the inverse-chi-square distribution function to estimate the critical value of SSD (see equation 34.6), and subsequently the critical value can be transformed into the scale of SRMSD by equation 34.8. For this example, by a function [= SQRT(CHIINV(.05, 39)/40)] in Excel, the critical value in the scale of SRMSD with $\alpha = .05$ and $df = n - 1 = 39$ is obtained as 1.168. Therefore, we can conclude that any SRMSD larger than 1.168 is associated with p value < .05.

For this example, PP, PN, and NP had relatively small SRMSD for a 3-day delay, but the magnitude of SRMSD became larger for the 7- and 14-day delays. For PP, the SRMSD was significantly large for all retrospective measures, implying that the measurement difference contains systematic error, in addition to the random measurement error. This indicates instability of the retrospective measures of the PP at any delay. On the other hand, for PN and NP, the SRMSD was small for the 3-day delay, and the data do not support rejecting the null hypothesis. This implies that the retrospective measures of PN and NP were stable after 3 days of delay. This was not the case for PP and NN. The measures of all the retrospective emotions following 7 and 14 days of delay were unstable, with one exception (NN after 14 days). Note that as time delay increased from 3 to 7 and 14 days, the SRMSD index increased respectively, except NN.

Simulation

A series of simulations was conducted to illustrate how the values of SRMSD are affected by the characteristics of the second measures (X_2). In the simulation, it was assumed that two measures (X_1 and X_2) were obtained from 100 individuals, and the mean and standard deviation of the first measure (X_1) were assumed to be fixed at 100 and 15, respectively. Characteristics of the second measure (X_2) were manipulated so that (a) the means were 100, 110, and 120 (i.e., mean difference = 0, 10, and 20, respectively); (b) the standard deviations were 5, 10, 15, 20, and 25; and (c) the correlation between X_1 and X_2 were .9, .7, and .5. These three factors created $3 \times 5 \times 3 = 45$ conditions. Here, the correlation between X_1 and X_2 represents the variation of the discrepancy between X_1 and X_2 across individuals. Thus, the lower the correlation, the higher is the magnitude of overall discrepancy between X_1 and X_2, when the mean difference between X_1 and X_2 is held constant. The data were assumed to be sampled from normally distributed populations with the specified characteristics for both X_1 and X_2. For each condition, data were sampled 1,000 times, and SRMSD were computed for each one of the 1,000 samples. In computing SRMSD, it was assumed that the reliability of X and the observed standard deviation were known to be .90 and 15, respectively. Accordingly, it was assumed that $\text{SEM}(X) = \sqrt{15^2(1-.9)} = 4.74$. Here, note that SEM($X$) was arbitrarily chosen and held constant across all conditions. The mean of SRMSD from 1,000 replications was computed for each condition. Also, for the condition in which the two measures are sampled from the identical distributions (i.e., the null hypothesis and the equal variance assumption are met), the hypothesis testing decision was made for SSD based on $\alpha = .05$. Then the proportion of erroneous decisions (i.e., Type I error rate) was evaluated.

First, conditions in which X_1 and X_2 had the same standard deviations, but different means, are considered (see Figure 34.2a). These are cases where X_1 and X_2 were sampled from the same shape of distributions, but the locations of the distributions varied. The results of the simulation for these cases are displayed in Figure 34.3. As depicted in the figure, SRMSD increases gradually with the increase in the two measures' mean difference. This tendency was consistent for all levels of correlation between X_1 and X_2. Also, SRMSD was larger with lower correlation between X_1 and X_2; however, the difference was smaller when the mean difference was larger.

Second, conditions in which X_1 and X_2 share the same mean but differ in standard deviations are considered (see Figure 34.2b). These are cases where X_1 and X_2 were sampled from different shapes of distributions, but the locations of the distributions were identical. The results of the simulation for these conditions are graphed in Figure 34.4. As the figure illustrates, when standard deviations for X_2 exceeded 15, SRMSD increased in magnitude. This tendency was consistent for all levels of the correlation between X_1 and X_2. However, when the standard deviation for X_2 decreased less than 15, the results were somewhat mixed. For $r = .90$, SRMSD for $SD = 10$ was higher than for $SD = 15$. However, SRMSD decreased slightly for $r = .70$ and .50 with $SD = 10$. When the standard deviation for X_2 was 5 and $r = .50$, SRMSD was almost identical to the one for $SD = 10$. However, SRMSD increased for $r = .90$, and .70. This result indicates the fact that any deviation from the first measure contributes to the increment of SRMSD.

Finally, Figure 34.5 displays results from other conditions, in which both the mean and the standard deviations were different for X_1 and X_2, as well as the correlation between them (see Figure 34.2c). In general, as the mean difference increased and the correlation between X_1 and X_2 decreased, SRMSD increased.

One important fact is that the mean of SRMSD is 1.00 when the two measures have the same mean and standard deviation values, and they correlate similarly to the magnitude of the reliability coefficient (the condition with mean difference = 0, $r = .90$, and $SD = 15$). The amount of discrepancy between the two measures is expected to be the same as the measurement error when two measures are

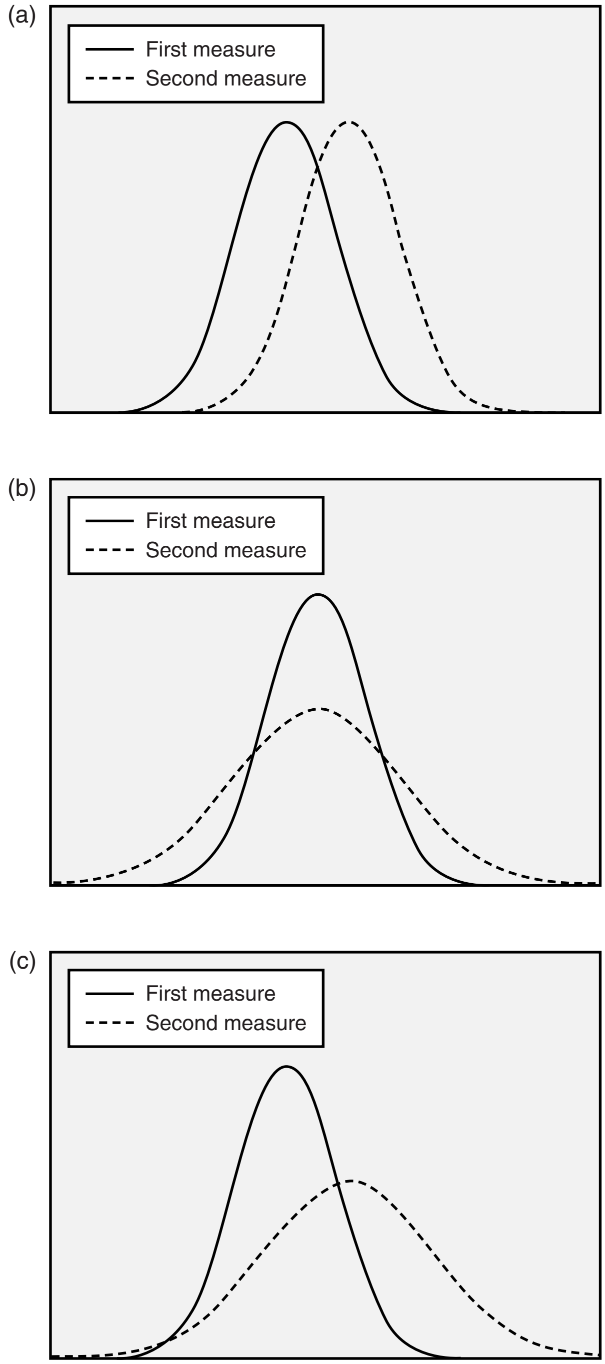

Figure 34.2 Graphic representations of the simulation conditions. (a) Different means and identical standard deviations; (b) Identical means and different standard deviations; (c) Different means and different standard deviations.

sampled from the identical population. This fact was confirmed in the simulation. Also, the null hypothesis was still rejected 52 times out of 1,000 replications in this condition. This result implies that the empirical Type I error rate (52/1,000 = .052) from the simulation result was consistent with the theoretical Type I error rate ($\alpha = .05$). This confirms that the distributional property of SRMSD described previously is appropriate. On the other hand, as the conditions depart from this base condition, SRMSD increased above the value of 1.0.

The illustrations indicate clearly that the correlation coefficient between two introspective measures fails to provide sufficient information about the stability of the measure over a relatively short time period. The SRMSD has been proposed to overcome the insufficiency of the correlation coefficient as a measure of stability by taking into account the magnitude of the difference between the two

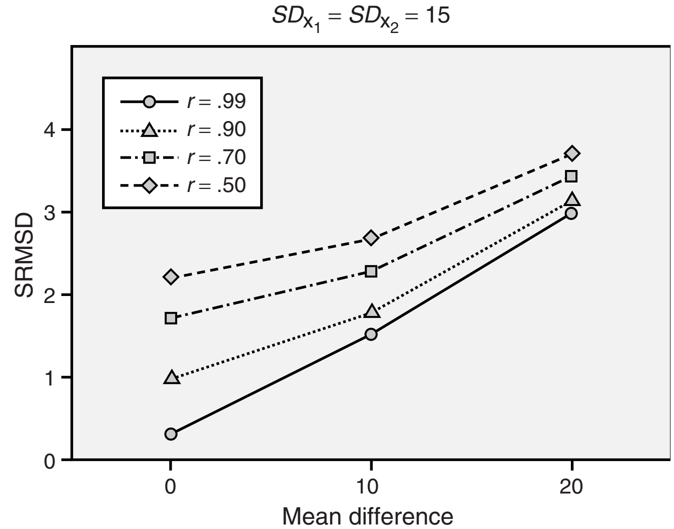

Figure 34.3 Simulation results: different means and identical standard deviations.

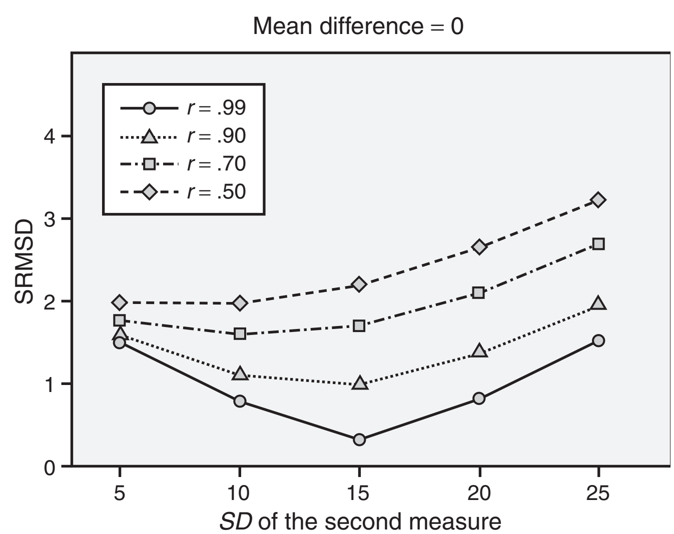

Figure 34.4 Simulation results: identical means and different standard deviations.

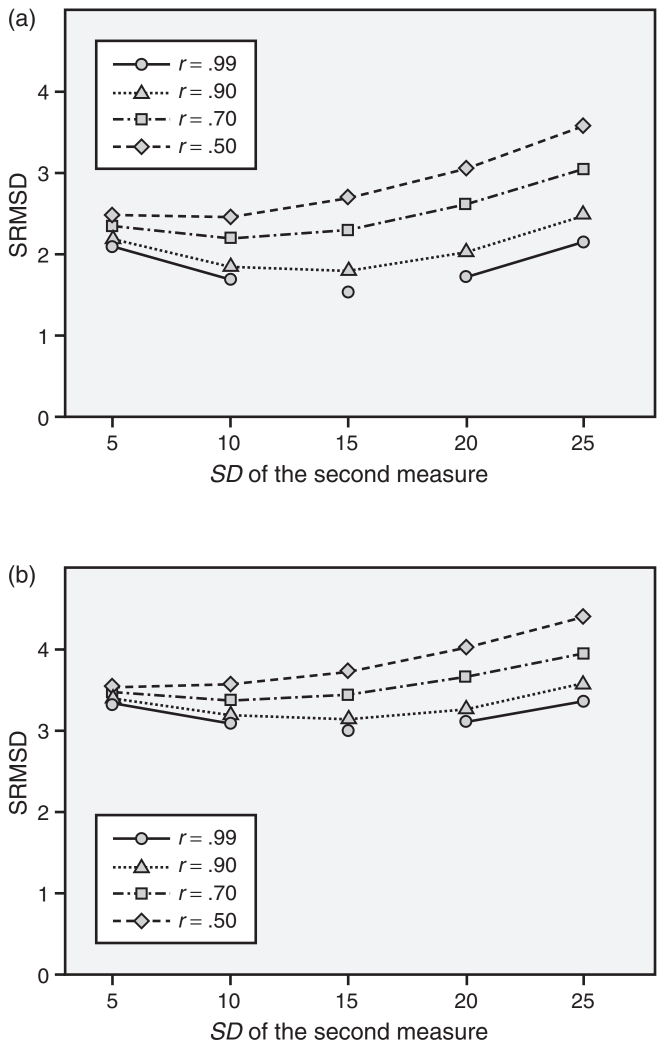

Figure 34.5 Simulation results: different means and different standard deviations. (a) Mean difference = 10; (b) Mean difference = 20.

measures. Because SRMSD is in the unit of measurement error, any SRMSD value greater than 1 indicates that the difference between the two measures involves more than measurement errors (i.e., instability).

Finally, the SRMSD is an indicator of the magnitude of error that goes beyond the random measurement error. Therefore, it should be emphasized that the SRMSD itself does *not* indicate the quality of retrospective measures. For example, if the reliability of the measure is very low, one can still obtain the SRMSD of 1.00 with a very large discrepancy between two measures. In such a case, one should not consider that one has achieved a good stability. To deduce the quality of the retrospective measure, the reliability of the measure should be sufficiently sound, in addition to the low SRMSD. Therefore, the reliability of the measure is an important prerequisite for making judgments on the stability of the retrospective measure.

RELIABILITY-VALIDITY TRADE-OFFS IN SPORT AND EXERCISE PSYCHOLOGY MEASUREMENT

This section discusses a measurement issue regarding a relatively short measurement instrument, which is frequently utilized in sport and exercise psychology research. First, general concepts of reliability and validity are clarified. Then, reliability-validity trade-off will be discussed in sport and exercise psychology contexts, along with several examples.

Reliability, Measurement Error, and Validity

Introspective measures in the form of questionnaires are required to be reliable and valid. Reliability refers to how error-free the measure is (i.e., how *trustful* the measure is; how much of the variance among persons it produces is a *true variance* and how much is an *error variance*). Validity is a concept that provides some confidence that the tool we are using does indeed measure what we expect it to measure. A yardstick obviously measures people's height, but how sure can we be that an anxiety questionnaire measures anxiety? To avoid being misled in this regard, several theoretically sound and practically functional procedures have been developed. The main validity procedures are construct-referenced (such as discriminant and convergent), content-referenced (i.e., face and factorial), and criterion-referenced (predictive and concurrent). Usually these procedures are viewed holistically and are considered necessary to assure users that their measure is valid (see Figure 34.6). We do not intend to elaborate on reliability and validity indices in this section, as these are widely introduced in many other sources in the psychological measurement domain (e.g., AERA, APA, & NCME, 1999). Instead, we introduce evidence that our measures do not meet the requirement of sufficient measures, and thus, we must be cautious about their generalizability. Surprisingly, one-item measures could provide more predictive and concurrent information about the state of a performer than a long and reliable so-called valid questionnaire.

Introspective measures consist of many items, so they awkwardly represent the variable these items operationalize. In most cases, such questionnaires are designed to measure a disposition, dominance, and a given orientation.

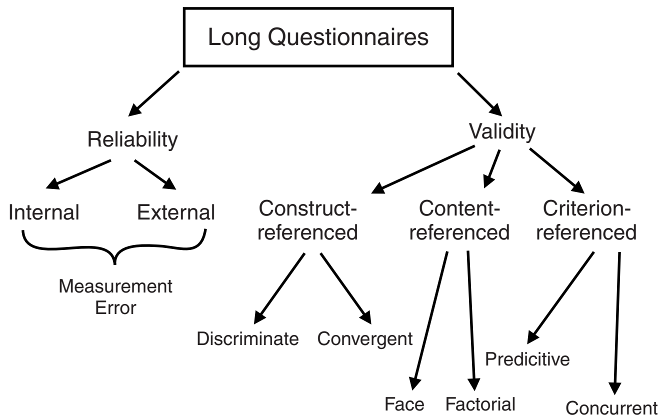

Figure 34.6 Reliability and validity indices of introspective measures.

These measures are believed to stay relatively stable over time. Measures of state, such as mood, are supposed to alter with time, circumstances, and events. These measures must reflect the alterations in the state, and thus show instability. To elicit reliable responses from persons, items must be stated neutrally, allowing the respondent to select the option that best represents him or her from the response alternatives. Instead, the majority of the questionnaires in use consist of items such as: "I like to win," "I want to improve my skill," and "I like the excitement," and the respondent is asked to indicate the degree to which he or she endorses this statement on a Likert-type scale. Biased phrasing attracts biased responses, thus reducing the true variance and increasing the error variance among responses. Instead, one could use the following stem:

To what degree do you do things because you

- Are excited
- Like teamwork
- Desire reward
- Need to release tension

and attach to it a Likert-type response format of "endorsement," "frequency" or other.

Measures must be internally consistent, that is, share some *commonality,* but also some *uniqueness.* Many recommend .70 as the minimum criterion value for considering a measure to be internally consistent, though we do not recommend using this criterion as a magic number. To illustrate this point, we demonstrate the consequences of assuming that this is the only source of error variance in measuring a disposition such as goal orientation, by using the Task and Ego Orientation in Sport Questionnaire (TEOSQ; Duda & Nicholls, 1992), a widely used introspective tool in sport psychology. According to Duda and Whitehead (1998), the TEOSQ has an average internal consistency (alpha) value of .81 for Ego and .79 for Task scales across 56 studies. The temporal stability ranges between .68 and .72 over short time periods using test-retest correlation, relatively low stability for a disposition measure. Instead of using the summed total scores for the Ego and Task scales, we consider the item average score on the scale (items range between 1 and 5) with the corresponding standard deviation. Based on the *SD* and alpha values of internal consistency, we can calculate the measurement error (σ_{meas}) for every score of a person on the two subscales and get the following results:

$$\sigma_{meas,\ Task} = SD\ (1 - \alpha^2)^{1/2} = .57\ (1 - .79)^{1/2} = .35$$
$$\sigma_{meas,\ Ego} = SD\ (1 - \alpha^2)^{1/2} = .81\ (1 - .79)^{1/2} = .48$$

The means and *SD* values used here are based on more than 70 studies that used the TEOSQ. Accordingly, the true score for a person, which lies within 95% or 99% CI of the observed score, is as follows:

95% CI:
Task: $4.08 \pm 1.96 \times .35 = [3.39, 4.77]$
Ego: $2.87 \pm 1.96 \times .48 = [1.93, 3.81]$

99% CI:
Task: $4.08 \pm 2.58 \times .35 = [3.18, 4.98]$
Ego: $2.87 \pm 2.58 \times .48 = [1.63, 4.11]$

These confidence intervals are of substantial range. A person with an average score on Task Orientation ($M = 4.08$) may have a task orientation within the range of approximately 3 to 5 out of 1 to 5 possible. A person with an average score on Ego Orientation ($M = 2.87$) may be within the range of approximately 1.6 to 4.1. If additional error stemming from temporal instability has been added to the measurement error estimate, the CIs would be further widened, making any inference about persons' goal orientations very difficult. The correlations reported by Duda and Whitehead (1998) to indicate validity of the TEOSQ, with variables such as "purpose of sport," "enjoyment interest, satisfaction/mood," "aggression and rule violation," "motives for sport participation," and "beliefs about causes for success," were all low to moderate in magnitude. Because validity is somewhat dependent on reliability (Anastasi & Urbina, 1997), we may assume that the failure to meet higher reliability standards resulted in underestimation of these correlations. We claim, however, that the main reason for the failure to precisely measure psychological variables is the reliance on correlational methods, rather than meeting the basic assumptions of measurement. Two examples for this claim are given next.

Meeting Measurement Assumptions in Sport and Exercise Psychology Measures

We assume that most of the scales used in the sport and exercise psychology domains are not meeting the main assumptions of measurement (i.e., lack of accepted origin, unit of measurement, linearity, and being sample-free). We demonstrate our claim with two instruments widely used in our two domains: the TEOSQ (Duda & Nicholls, 1992) and Borg's (1970) 15-category Rating of Perceived Exertion scale (RPE).

The TEOSQ consists of two scales, Task and Ego, with 7 and 6 items, respectively, using a 5-point Likert-type response format. Though it has been extensively tested and used, it was first subjected to rating scale Rasch analysis (Wright & Masters, 1982) by Tenenbaum and Fogarty (1998), only once, using 1,591 adolescents active in sport and exercise. The items' locations on the Task and Ego Orientations continua for males and females are presented in Figure 34.7. As one can see (a) the items do not cover a sufficient space (i.e., narrow scales) on the linear continua, indicating insufficient use of the 5 categories; (b) three of the Ego items produced misfit values; (c) the items of the Task and Ego scales do not share similar locations for males and females; and (d) many Task responses resulted in being misfit because most persons rated the items by selecting only the "4" and "5" categories. To be considered a sound measurement tool for eliciting goal orientation in sport, substantial additional work is needed.

Borg's (1970) RPE scale (6 to 20) consists of a set of numerical response categories in a stimulus-response context analogous to heart rate (HR) range between 60 and 200 b/min (1 : 10 ratio). Tenenbaum, Falk, and Bar-Or (2002) applied a Rasch FACET analysis (Linacre, 1989) on children's and adolescents' RPE responses to cycle-ergometry testing, which corresponds to their HR. The results are presented in Figure 34.8.

The analysis indicates that when exertive sensations are evoked during a progressive maximal aerobic power test, and HR is the physiological criterion against which exertion feelings are estimated, the qualitative and quantitative semantics do not share equal units. Persons move faster in the upper section of the scale than in the lower section, meaning it takes more to move from 8 to 10 than from 18 to 20. This indeed reflects the process of cumulative exertion that is of an exponential rather than a linear nature.

There are many more such examples, which shed light on future directions we must take when developing new scales and refining old ones. We must incorporate latent trait models when designing psychological introspective measures. The desire to verify measurement assumptions through correlational methods such as exploratory and confirmatory factor analyses must supplement, but not dominate, the construction of measurement and testing in our domain.

One-Item Measures: Evidence for Construct and Predictive Validity

We cannot estimate the reliability of one-item scales based on internal consistency. Thus, how can one trust one item to indicate a measure of a state? The few, but convincing, examples we provide here show that one-item measures can indicate persons' state on a given variable of interest and account for more variance of behaviors than reliable long questionnaires that theoretically are linked to this behavior. We do not wish to claim here that long and reliable questionnaires do not have place in sport and exercise psychology, but rather argue that for both practical and scientific reasons, short, convenient, and task-related questionnaires provide valuable and important information to athletes, exercisers, coaches, and scientists, despite being traditionally considered unreliable. We demonstrate our views via few examples.

Coping with Effort Sensations

Individuals engaging in physical tasks inevitably expose themselves to physically and psychologically demanding conditions. Tenenbaum et al. (2001) investigated the predictive power of motivational constructs on local muscular endurance and running endurance. The first task was 50% of maximal power on a handgrip squeezing dynamometer. The second task was running 90% VO_2 max on a treadmill until voluntarily stopping the run. The time on task was an indicator of mental and physical power to sustain feelings of high physical load sensations, discomfort, and exertion. Several predictors were used: long and reliable questionnaires submitted to the participants before exposure to the tasks, and very short, task-specific nonreliable questions that share high face validity. The well-established multi-item motivational constructs consisted of goal orientation dimensions (i.e., ego and task), dispositional physical self-efficacy, perceived physical ability, perceived self-presentation, and self-control (i.e., resourcefulness). The task-specific one-item questions

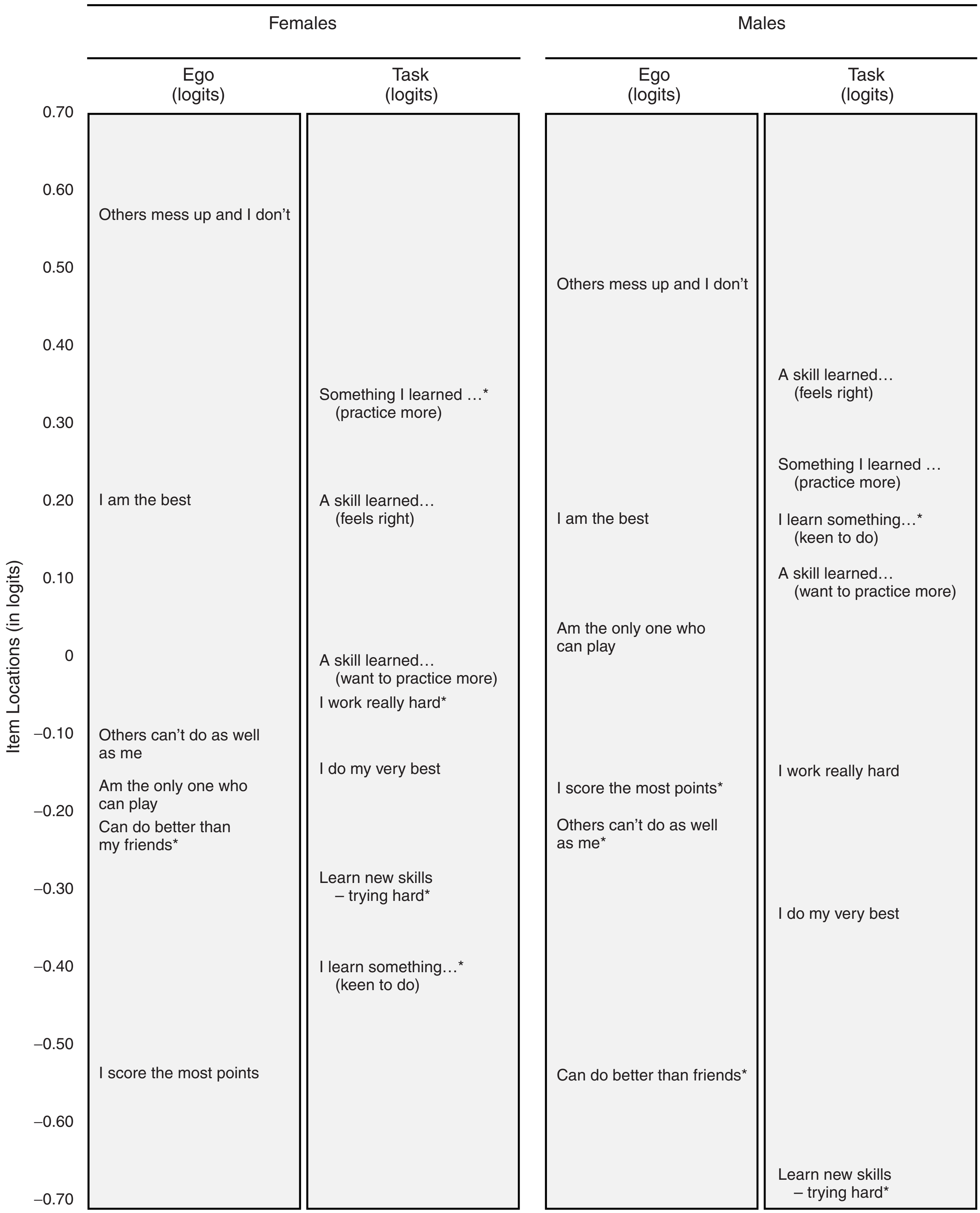

Figure 34.7 TEOSQ Ego and Task items' locations in logit units on their respective continua for male and female samples. *Note:* *Misfit items.

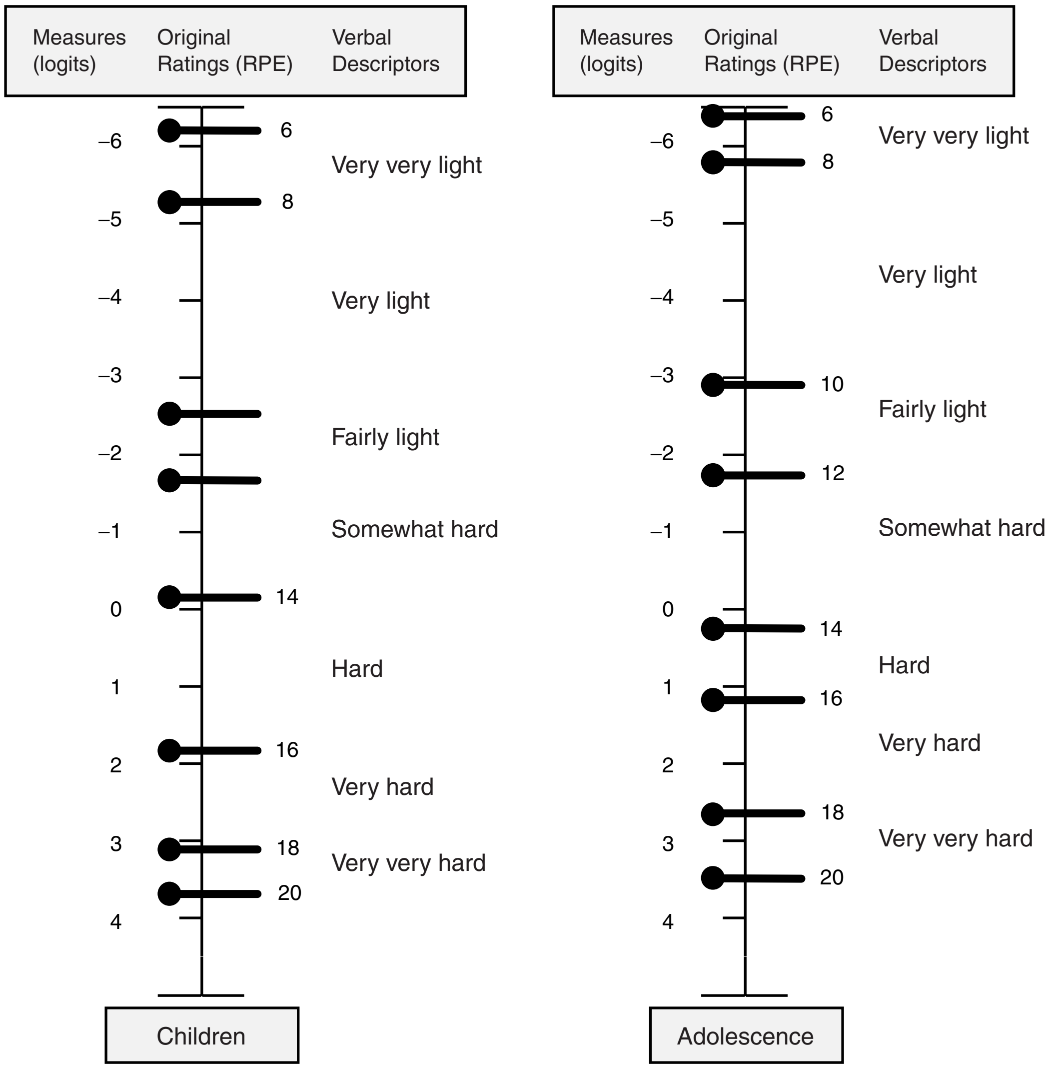

Figure 34.8 Rate of perceived exertion measurement units (logits) for children and adolescents.

pertained to how committed and ready to sustain exertion and invest effort in the task the participants were. The highest correlations ($rs > .50$) were obtained between the single task-specific questions and physical effort tolerance. The dispositional measures together accounted for 20% to 30% of exertion tolerance, and the three specific single items added 16% and 11% accounted variance. Though it is accepted that state measures may account for more behavioral variance than dispositional measures, the point is that traditional reliability measures are of less predictive validity of objective psychological outcome. One-item measures are easy and convenient to administer, easy to respond to, contain high relevance, and share high face validity. Therefore, both practitioners and scientists can use them without the need to justify reliability; justifying face validity, however, is crucial.

Determining Affect-Related Performance Zones

Hanin's (2000a, 2000b) individual zone of optimal functioning model, modified by Kamata, Tenenbaum, and Hanin (2002), has served as a conceptual basis for the qualitative and quantitative analyses of the structural and functional relationship between affective states and performance quality while providing probabilistic estimations. The revised individual affect-related performance zones (IAPZs) model illustrates the reciprocal relationship between the perceived intensity of an affective state and the quality of an ensuing performance. The revised model consists of the structure and functions of idiosyncratic affective experiences of each performer in various competitive situations. More specifically, it emphasizes the within-individual dynamics of perceived states based on varied degrees of performance quality. Therefore, the unit of analysis is the individual in relation to his or her personal performance.

The IAPZs are usually determined using the affect grid (Russell, Weiss, & Mendelsohn, 1989). The affect grid is a 9 × 9 grid. The vertical dimension represents arousal and ranges from a score of 1 (very low arousal, i.e., "feeling sleepy") to 9 (very high arousal, or "frantic excitement"). The horizontal dimension represents pleasantness and ranges from a score of 1 ("very unpleasant, negative feelings") to 9 ("very pleasant, positive feelings"). Participants place a single X point in one of the 81 cubicles of the grid, and the response is scored along both the valence and the arousal dimensions. The two affect dimensions, arousal (activation) and pleasantness, which are operationalized by a single continuum each, allow for establishing IAPZ for each performer if a sufficient number of affect observations is paired with performance observations. Results (Golden, Tenenbaum, & Kamata, 2004) indicated that Kamata et al.'s (2002) conceptualization of the IAPZ was supported via probabilistic estimations, which demonstrated that varying levels of affect were associated with different levels of performance within and between the participants (i.e., each participant maintained unique and idiosyncratic IAPZs). A multimodal approach allows for the assessment of specific psychological and psychophysiological indices necessary to determine well-defined IAPZs derived from the probabilistic method. This conception grants a basis for understanding the link between performance-related physiological and affective states in competitive circumstances. In addition, these emergent conceptualizations may assist in identifying and understanding the relationship between perceived affective states and the motor programming strategies and action tendencies of athletes during performance.

Figure 34.9 shows IAPZs for one participant who performed a computerized auto racing task and was measured

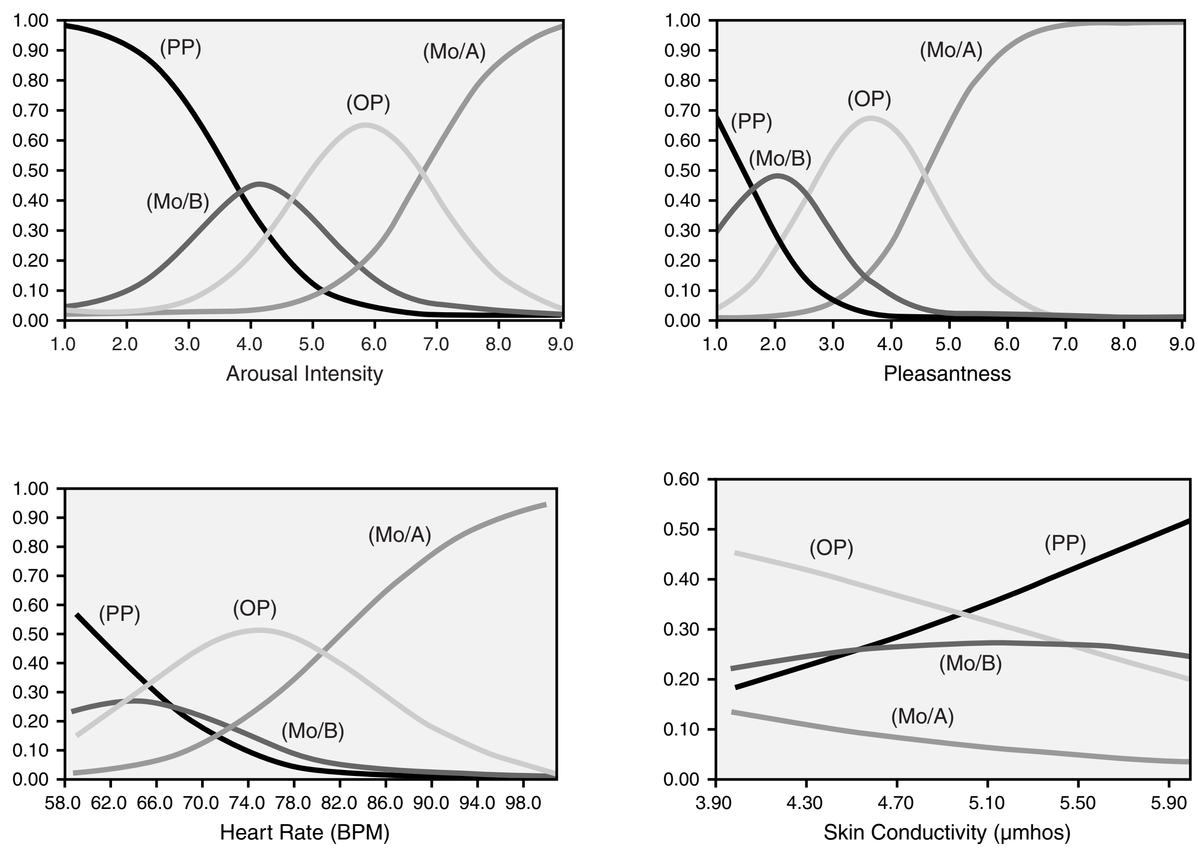

Figure 34.9 Probability curves for determining affect-related performance zones using two perceived and two objective measures of arousal.

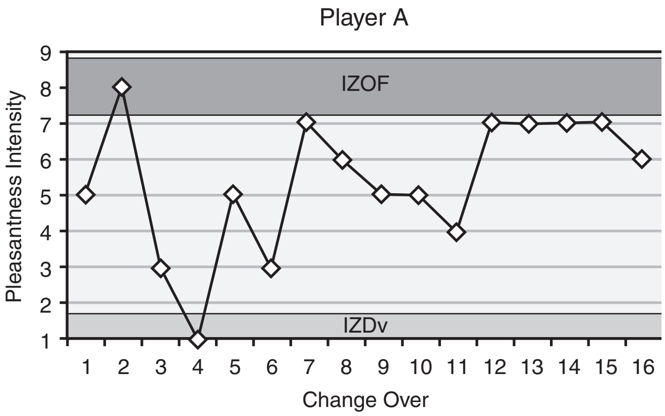

Figure 34.10 Fluctuation of feeling pleasant in affect-related performance zones during 16 tennis game changeovers in one player.

simultaneously throughout the task on four variables: pleasantness, arousal, HR, and skin conductance (SC). Participant A's optimal level of arousal and pleasantness (scale of 1 to 9) ranged from 4.8 to 6.8 and 2.7 to 4.4, respectively. Heart rate ranged from 67.7 to 83.0 b/min, and SC ranged from 4.0 to 4.4 µmhos, with an average probability of .59 for sustaining an optimal zone under the reported states. Alternatively, Participant A's poor performance levels for arousal, pleasantness, HR, and SC ranged in intensity from 1.0 to 2.7, 1.0 to 1.6, 59.4 to 61.9 b/min, and 5.7+ µmhos, respectively, with an average probability of .62 for sustaining a less than optimal zone under the reported states. The method, which consists of one-item measures, permits us also to trace back performance consistency at each competition once the IAPZs were determined. An illustration is presented in Figure 34.10. The IAPZs for the performer (a tennis player, in this case) are visually demonstrated by drawing parallel lines to the x-axis from the boundaries of the IAPZs, which were located on the y-axis. Throughout the game, this player performed within his moderate zone, with some fluctuations to his optimal and nonoptimal affect-related zones.

CONCLUSION

This chapter was devoted to the concepts of reliability and validity of measurement in the sport and exercise psychology domains. An alternative method for estimating introspective measures was introduced. Currently and paradoxically, one-item questions, considered by most psychometricians to be an unreliable measure, prove to have remarkable value in accounting for emergent behaviors of athletes and exercisers. The evidence we have provided supports the view that measurement must extend beyond the traditional views, which stem mainly from correlation and covariance matrices. Researchers must seek out methods that are more ecologically valid, if a better fit between science and practice is a desired outcome in domains where performance consists heavily of dispositions, orientations, and states of motivation, physical effort, and decision making.

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CHAPTER 35

Application of Confirmatory Factor Analysis and Structural Equation Modeling in Sport and Exercise Psychology

HERBERT W. MARSH

Little more than a decade ago, Schutz and Gessaroli (1993) argued that confirmatory factor analysis (CFA) and structural equation modeling (SEM) were the most important statistical tools for the 1990s, but that these techniques had seen almost no application in sport and exercise psychology. They speculated as to why this might be the case, but concluded for many applications, CFA/SEM should be the methodology of choice and recommended that sport and exercise psychologists make greater use of these techniques. They suggested that sport and exercise psychologists might have been overwhelmed with the complexity of the analyses and the difficulty of actually conducting the analyses, but that it was likely to be used more frequently in the future. Even a casual perusal of the major sport and exercise journals shows that the popularity of CFA/SEM has increased substantially over the past decade.

Despite this growing popularity, there appears to be an ever-widening gap between state-of-the-art methodological and statistical techniques that should be part of the repertoire of serious empirical researchers and the actual skill levels of many applied researchers. Because CFA/SEM has considerable flexibility for addressing complex substantive issues in sport and exercise psychology, there is an increasing need for heuristic, nontechnical overviews of these techniques to assist potential users. Thus, the purpose of this chapter is to provide such an overview, as well as to illustrate the major concepts and issues using published examples. Here I draw primarily on examples from my own research program, in which I have used a wide variety of multivariate quantitative analyses (CFA, SEM, causal modeling, multilevel analysis, longitudinal data analysis, and multitrait-multimethod designs) to address substantive and theoretical issues from a construct validity perspective. I hope that this strategy will render CFA/SEM less esoteric and technically daunting for applied researchers, and thereby promote its application as a standard statistical methodology for tackling questions in our field.

The chapter is divided into three sections. First, I describe the construct validity approach and the multidimensional perspective; these provide substantive bases for CFA/SEM studies in my quantitative research program. Second, I present a general discussion of CFA/SEM as an increasingly important research tool in sport and exercise psychology. Third, I summarize selected studies from my research program that illustrate interesting applications of CFA/SEM.

CONSTRUCT VALIDATION: A MULTIPLE PERSPECTIVE APPROACH

Much of the research and the methodological approaches described in this chapter are based on a construct validity approach to the design, analysis, and interpretation of the results of multivariate research. More generally, I assess the construct validity of inferences based on a research study—the validity of the interpretation of the results. The evidence for construct validity includes the content, response processes by participants, internal structure in terms of consistency and factor structure, and convergent and discriminant validity in relations with other constructs, including,

I would like to thank the many colleagues who coauthored and contributed to research studies cited in this chapter. In particular, I would like to thank Ulrich Trautwein, Oliver Lüdtke, Cameron McIntosh, Klaus Boehnke, Tor Neilands, and Symeon Vlachopoulos for comments on earlier versions of this chapter.

for example, experimental manipulations, criterion-related validity, and validity generalization to relevant and similar situations or populations.

All constructs in sport and exercise psychology are hypothetical constructs, and so must be validated using a construct validity approach. For example, even a construct as apparently tangible as "body fat" is a hypothetical construct, as can be readily seen in the diverse and only partly consistent ways in which this construct is inferred. The claim to a gold standard approach to inferring body fat must be based on a construct validation approach rather than on the sophistication and cost of the technical equipment. High-tech measures have to be good in relation to typical standards of construct validity and in comparison to more easily obtained measures before they earn this label.

Among sport and exercise psychology researchers the need to develop sport-specific instruments and to evaluate them within a construct validity framework is well established (Duda, 2001; Gauvin & Russell, 1993). D. L. Gill, Dzewaltowski, and Deeter (1988, pp. 139–140) concluded, "Within sport psychology the most promising work on individual differences involves the development and use of sport-specific constructs and measures." They argue for the construction of multidimensional instruments based on theory, item and reliability analysis, exploratory and confirmatory factor analysis, tests of convergent and divergent validity, validation in relation to external criteria, and application in research and practice. From a construct validation perspective, theory, measurement, empirical research, and practice are inexorably intertwined, so that the neglect of one will undermine the others (see Marsh, 1997).

Particularly in nonexperimental studies, in which the independent variable is not experimentally manipulated, it is often desirable to have multiple indicators of the independent, mediating, and outcome variables. Even in experimental and quasi-experimental studies, it is advisable to have multiple operationalizations of the experimentally manipulated variable. Thus, for example, Marsh and Peart (1988) compared the results of competitive and cooperative interventions designed to enhance physical fitness. Although both interventions enhanced fitness, the cooperative intervention also enhanced physical self-concept, whereas the competitive intervention led to a reduction in physical self-concept relative both to pretest scores and to a randomly assigned no-treatment control group. They argued that the short-term gains in physical fitness were likely to be undermined by declines in physical self-concept associated with the competitive intervention. Hence, construct validation is relevant to experimental as well as to nonexperimental research and is useful in evaluating the researcher's interpretation of the experimental manipulation.

Overview of the Conduct of Studies Using Confirmatory Factor Analysis and Structural Equation Modeling

In this section I provide an overview of some critical issues relating to the conduct, interpretation, and reporting of the results of CFA/SEM analyses. Although based in part on my own experience, I also acknowledge useful overviews, including textbooks (e.g., Bollen, 1989; Byrne, 1998; Hancock & Mueller, 2006; Kaplan, 2000), chapters (e.g., Hoyle & Panter, 1995; Millsap, 2002), and journal articles (e.g., Boomsma, 2000; McDonald & Ho, 2002; Shah & Goldstein, 2006). It is convenient to discuss three broad stages of the conduct of CFA/SEM studies: model specification, parameter estimation, and model fit evaluation. Model specification requires the researcher to specify an a priori model based on substantive theory and technical requirements inherent in the conduct of CFA/SEM. Parameter estimation is the generation of a set of model parameters in relation to a particular estimation procedure. Evaluation of model fit is the determination of how well the model parameters are able to reproduce the data, subject to the constraints imposed by the researcher in the model specification stage.

Model Specification: Terminology and Pictorial Representations

CFA/SEM is a suite of statistical techniques used to evaluate patterns of relations between measured variables and some smaller number of latent constructs (factors) that they are designed to represent, and the relations among latent constructs. Within this highly flexible approach, researchers place constraints on the model and test the ability of the model to fit the data. It is convenient to distinguish between what is sometimes referred to as the "measurement model" and the "structural model."

Measurement Model

The measurement model is the pattern of relations between each measured variable and the latent factor it is designed to reflect, measurement errors (variously referred to as residual variance or disturbance terms), and relations among the latent factors. An important aspect of the CFA/SEM approach is that measurement error is an explicit component of the model. This allows researchers to separate aspects of the results associated with random error from the more substantively important results. In this respect, error is the noise in the observed measures that attenuates relations among constructs if not controlled (e.g., MacCallum & Tucker, 1991).

Typically there are multiple indicators of each factor—hopefully at least three, and sometimes many more. Key parameter estimates are the factor loadings relating indicators to their associated latent constructs. Studies that consist of only the measurement component are sometimes referred to as CFA models. It is typical to represent factor models in terms of diagrams. Although there are alternative conventions in construction and labeling, it is typical to represent measured variables as rectangles and latent factors as ovals. A (typically straight) line with a single-headed arrow represents a directional effect, whereas a (typically curved) line with a double-headed arrow reflects a nondirectional covariance. For example, in Figure 35.1a there are two latent constructs (the ovals), each based on responses by three indicators (measured variables, represented by boxes). There are directional effects relating each latent factor to the corresponding indicator (straight lines with a single-headed arrow), and a single (curved line, nondirectional; double-headed arrow) correlation between the two latent constructs. Also shown are directional arrows reflecting disturbance terms (measurement errors)

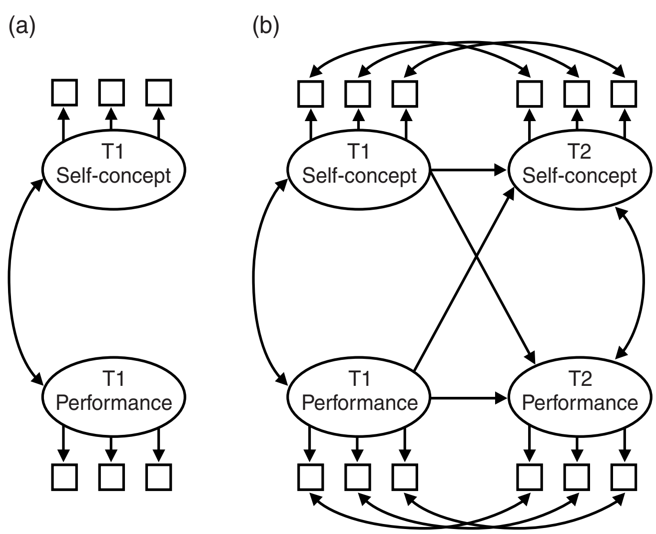

Figure 35.1 (a) Diagrammatic representation of a confirmatory factor analysis model with two correlated latent constructs (T1 Gymnastics self-concept and T1 Gymnastics performance) represented by ovals, each having three indicators (represented in boxes). (b) Diagrammatic representation of a structural equation model of relations among four latent constructs, the same two constructs collected on each of two occasions (T1 and T2).

associated with each measured variable. Note also that arrows go from each latent factor to the multiple indicators of the factor, based on the assumption that the latent factor leads to or causes the indicators rather than merely reflecting the indicators. Although it is possible to posit formative constructs in which arrows go from indicators to the construct, on the assumption that the construct is an index of the different indicators (e.g., socioeconomic status), formative constructs are more complicated to model and are not widely used in SEM research (see Kline, 2006). In CFA studies, the most typical factor structure is an *independent clusters model* in which each indicator is associated with one and only one latent construct per factor (i.e., factor loadings on all other factors are zero).

How Many Good Indicators of Each Factor Are Needed in Studies Using Confirmatory Factor Analysis and Structural Equation Modeling?

In Figure 35.1a there are three indicators for each latent factor, but growing research evidence (e.g., Marsh, Hau, Balla, & Grayson, 1998) shows that it is better to have more rather than fewer indicators per factor. Several studies evaluating the effects of the ratio of the number of indicators per factor (e.g., Boomsma, 1982; Ding, Velicer, & Harlow, 1995; Gerbing & Anderson, 1993; MacCallum, Widaman, Zhang, & Hong, 1999; Marsh et al., 1998; Velicer & Fava, 1998) found that the likelihood of fully proper solutions increased with increasing numbers of indicators per factors, the sample size (*N*), and the size of factor loadings. Gerbing and Anderson and Marsh et al. demonstrated that standard errors of parameter estimates were smaller when *N* and the number of indicators per factors were higher. Hence, the desirable minimum number of indicators depends to some extent on the quality of the indicators (e.g., size of factor loadings relating indicators to their latent factors) and *N*. Although there should typically be at least three indicators per factor, it is always desirable to have more, particularly when both factor loadings and *N* are modest.

Two-Indicator Factors. It is typically recommended that each latent factor should have at least three indicators (e.g., Marsh et al., 1998). It is well-known that two-indicator solutions are likely to be very unstable when the population correlations are small (Bollen, 1989). Due to sampling fluctuations, associated problems with empirical estimation are likely to be exacerbated when *N* is small. Hau and Marsh (2004; also see Marsh et al., 1998; Shah & Goldstein, 2006) found that two-indicator solutions were problematic even when population factor correlations were not close to zero. They recommended that researchers avoid the use of two-indicator factors.

Single-Indicator Factors. Ironically, one-indicator factors are typically less prone to estimation problems than are two-indicator factors. There is, of course, a major drawback to this approach in that without multiple indicators of a latent factor, it is not possible to evaluate the factor structure underlying a latent construct or to estimate and control appropriately for measurement error. When there is only a single indicator of a latent factor, it is typical to fix the factor loading of the latent construct to 1.0 and to fix measurement error to 0. Alternatively, if there are plausible estimates of measurement error, it is possible to fix measurement error to nonzero values that reflect measurement error (Jöreskog & Sörbom, 1988). In general, when multiple indicators of a factor are available, they should be incorporated into the analysis. In particular, it is not appropriate to conduct SEM analyses on relations among scale scores when multiple indicators are available for at least some (most or all) of the constructs, thereby negating many of the advantages of the CFA/SEM approach (also see Shah & Goldstein, 2006).

Item Parcels. It is better to have more indicators per factor. There is, however, an understandable reluctance on the part of applied researchers to incorporate large numbers of indicators per factor, particularly in large complex models that involve many different factors. Also, there can be technical problems in estimation when the total number of indicators approaches *N*. One potentially useful compromise is to collect a large number of indicators per factor, but to use indicator parcels in the analyses. For example, 12 items designed to measure each of 10 factors could be used to form four item parcels per factor that are actually used in the analysis (e.g., take the average of the 1st, 5th, and 9th indicators to form one parcel, the 2nd, 6th, and 10th indicators to form a second parcel, and so forth). However, the use of item parcels is fraught with difficulties and should be pursued with caution.

Bandalos and Finney (2001), in a review of articles in major education, psychology, and marketing journals, found that 20% of the applied CFA/SEM studies used some type of parceling procedure. The posited advantages of parcels included increased reliability of item-parcel responses, less violation of normality assumptions, closer approximations to normal theory-based estimation, fewer parameters to be estimated (optimizing the variable to *N* ratio, as discussed earlier), more stable parameter estimates, reduction in idiosyncratic characteristics of items, and simplification of model interpretation. However, Bandalos and Finney further noted that even though Marsh (e.g., Marsh & O'Neill, 1984) was often cited in support of the practice of parceling (70% of studies using parceling in their review), researchers typically failed to heed Marsh's advice that items being parceled should be reasonably unidimensional (as determined, for example, by separate CFAs of each factor based on responses to items). Hau and Marsh (2004) subsequently evaluated the use of item parcels as a strategy for nonnormality problems but found only modest support for it.

The use of item parcels tends to hide possibly trivial or potentially serious problems of misfit. The fit for a single factor based on a large number of indicators will almost always be poorer than the corresponding fit based on a much smaller number of parcels constructed from the indicators. In some cases, the misfit in the solution based on (individual) indicators may be trivial, but more typically the use of parcels tends to camouflage potentially serious violations of unidimensionality. For example, assume that 12 items designed to reflect a single underlying factor actually reflect three correlated factors. A single-factor solution based on the items will probably provide an unacceptable fit that appropriately represents the violation of unidimensionality. If, however, four parcels are constructed such that each parcel has one indicator from each of the underlying three factors, the single-factor solution is likely to provide an apparently good fit and inappropriately support the construct's unidimensionality. Although it can be argued that the violation of unidimensionality is substantively unimportant, such arguments should be made explicit rather than being camouflaged by the use of parcels. Furthermore, there are more effective ways to deal with problems of violation of unidimensionality. For example, the researcher might fit a model in which there were three first-order factors (accurately reflecting the actual factor structure) and one higher-order factor (reflecting the single factor based on analyses of the parcels). It then becomes an empirical question as to whether the relations between the three first-order factors and other constructs (e.g., related constructs, validity criteria, background variables, experimental manipulations) can be explained in terms of the single higher-order factor.

Similar arguments can be made when the use of parcels camouflages potential cross-loadings in the typical independent clusters structure. Although the consequences of minor cross-loadings (or correlated uniquenesses) for items representing different factors may be substantively trivial, this is not always the case. Again, although it may be possible to support this assumption by rational argument based on theory or previous research, a stronger rationale is provided by empirical tests based on analyses at the individual item level.

In summary, when researchers use item parcels, they should provide an explicit justification based on an appropriate combination of theory, logic, previous empirical research, and preliminary analyses of individual indicators used to construct the parcels.

Number of Indicators and Statistical Power. Inferential approaches to fit indices, the construction of confidence intervals, and power estimates (MacCallum, Browne, & Sugawara, 1996) provide another mathematical basis of support for the Marsh, Balla, and McDonald (1988) conclusion that more is better with regard to the number of indicators per factor. As emphasized by MacCallum et al., power estimates and precision (i.e., the narrowness of confidence intervals about fit indices) increase monotonically with degrees of freedom (*df*) as well as sample size (*N*). In CFA/SEM studies, *df* is the difference between the number of data points ($p\,[p + 1]/2$, where $p =$ number of measured variables) and the number of parameter estimates. Because *df* increases substantially as the number of items per factor increases, models with more indicators per factor are more powerful than comparable models with fewer indicators. Whereas power is greatest when both *N* and *df* are large, there is a compensatory relation between *N* and model size in which small *N* can be compensated for by large *df,* leading MacCallum et al. to conclude that "adequate power for the recommended test can be achieved with relatively moderate levels of *N* when *d* [*df*] is not small" (p. 144). Hence, in small-*N* research, adequate power can be achieved only in large models (for a more general discussion of power, see Hancock, 2006).

Structural (Path) Model

The structural or path model describes relations (some of which are hypothesized to be in some sense causal) between the latent variables. That is, unlike the measurement model, where all relations among latent constructs are represented as double-headed curved arrows, at least some of the relations in the structural part of the model are represented as single-headed (directional) straight lines. In special cases, there may only be a measurement model (as in CFA studies) or perhaps only a structural path model (when there are not multiple indicators of the latent variables).

It is also useful to distinguish between exogenous and endogenous latent constructs. *Exogenous* constructs are determined by variables that are not included in the model (i.e., that are external to the model). *Endogenous* constructs are determined, at least in part, by the exogenous variables. In the CFA measurement model with no structural component, all latent constructs are exogenous constructs in that none of the latent constructs is caused by any other variables that are included in the model. In an SEM model with a structural component, at least some of the latent factors are endogenous in that they are posited to be caused by other latent factors in the model; this is referred to as the structural component of the model.

Figure 35.1b is a more complicated diagram of an SEM model. The critical feature is that relations between T1 exogenous constructs and T2 endogenous constructs are depicted as path coefficients: directional relations represented as straight lines with single-headed arrows. Thus, for example, the path leading from T1 gymnastics self-concept to T2 gymnastics self-concept represents a path coefficient: the effect of T1 gymnastics self-concept on T2 gymnastics performance after controlling for the effect of T1 gymnastics performance. As in Figure 35.1a, the two constructs at T1 are correlated with each other. There is also a curved double-headed arrow relating T2 gymnastics performance and T2 gymnastics self-concept. However, because variance terms for these constructs are residual variances (variance that cannot be explained in terms of the T1 constructs), the covariance term is between residual variance terms.

It is also possible to include a path model in which there are three or more waves of data (i.e., T1, T2, and T3 constructs; see subsequent discussion of Figure 35.2). Particularly in this situation, it might be expected that there is a causal chain of effects such that most of the relations between T1 and T3 constructs are mediated by T2 constructs. Whereas T1 constructs might have direct effects on T3 constructs (represented by straight single-headed arrows, as in Figure 35.1b), much of the effect would be expected to be indirect (i.e., mediated through T2 constructs; see MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Thus, the total effect relating T1 constructs to T3 constructs can be divided into direct effects (path coefficients) and indirect effects that are mediated by intervening constructs.

Path Coefficients as Representing Causality

For many SEM applications the main substantive purpose is to evaluate a priori hypotheses about the structural

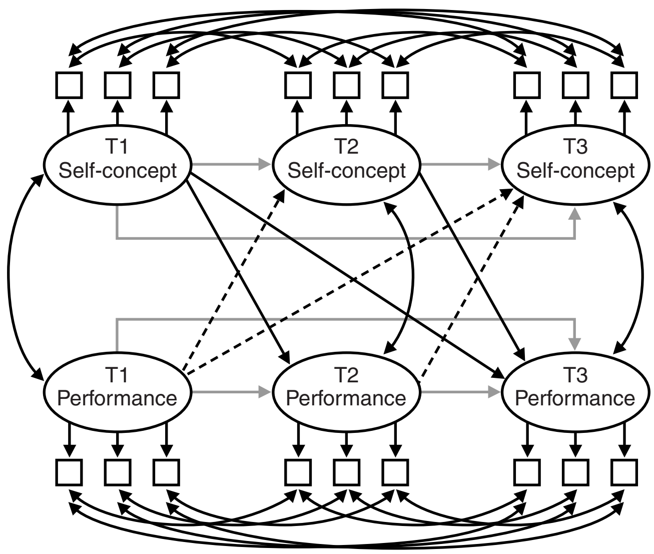

Figure 35.2 Prototype causal ordering model to test self-enhancement, skill development, and reciprocal effects models.

model; the measurement model should be subservient to this aim. Structural paths in some sense reflect a hypothesized causal relation that is justified on the basis of substantive theory and the nature of the data. The discussion of causality is a highly technical philosophical issue (see Pearl, 2000) that is beyond the scope of this chapter.

It is worth repeating the well-known caveat that correlation does not imply causation. This is particularly relevant in that SEM is often applied to correlational data. Just because a causal model is able to fit the data does not imply that assumptions of causality underlying the model have been proved—only that the data are consistent with the model. Thus, in a simple model with two latent constructs (X and Y), three different models (X and Y are merely correlated, X → Y [X causes Y], and Y → Y causes X) are all able to fit the data equally well (for further discussion of equivalent models see Hershberger, 2006; Raykov & Penev, 1999). Even when there is a theoretical or substantive basis for positing that an effect reflects a causal influence of one variable on another, there are likely to be competing interpretations of the effect that may not reflect a causal relation. Although stronger inferences about causality are possible in longitudinal, quasi-experimental, and true experimental (with random assignment) studies, trying to prove causality is usually a precarious undertaking. In SEM, it is probably reasonable to characterize a path with the more neutral term of "effect."

From its early application (see historical overview by Wolfle, 1999), substantive theory has been an important basis for the construction of path diagrams. For example, recognizing how difficult it is to translate theory into a path model, Hoyle and Panter (1995) provided a detailed discussion of the correspondence between the SEM path model and the underlying theory. As emphasized by these authors, and subsequently reiterated by McDonald and Ho (2002), researchers should ideally provide a theoretical justification for the inclusion (and noninclusion) of all paths in their path. Particularly when the causal ordering cannot be defended by the temporal ordering of the variables, the nature of the variables (e.g., background variables such as gender and race typically come before other variables), or the design of the study (e.g., random assignment), the justification for the proposed causal ordering should be defended as part of the rationale for the path model.

Identification

Although a technical discussion of model identification is beyond the scope of this chapter (see Pearl, 2000), it is important that researchers have some understanding of this concept. In nonmathematical terms, identification refers to whether one can obtain a unique solution estimate for the unknown parameters in the model. If a model is identified, one and only one set of values will best reproduce the observed data, under the constraints imposed on the model by the researcher. If more than one set of values can reproduce the data equally well, then the researcher will obtain only a set of arbitrary parameter estimates that have no substantive meaning regarding real-world effect sizes. Such a model is referred to as underidentified. If a unique set of parameters does not exist, then a model is not testable.

There are no fully satisfactory guidelines for identification. A necessary, but not sufficient, test of identification is that the number of data points is greater than the number of parameters so that *df* is positive (Bollen, 1989). An underidentified model with $df < 0$ is not identified. If a model is identified, and has $df = 0$, it is said to be just identified. Because just-identified models will always be able to perfectly fit the data, they do not provide a test of the overall model (i.e., they are not falsifiable). However, the parameter estimates from a just-identified model are still useful in describing relations among the variables. If a model is identified and has $df > 0$, the model is said to be overidentified. Most CFA/SEM models are overidentified; they can be tested in relation to their ability to fit the data and are falsifiable.

Having more date points than estimated parameters (i.e., $df > 0$) is not sufficient to guarantee identification. However, there are some fairly general conditions under which the CFA measurement model is identified. In particular, McDonald and Ho (2002) indicated that the CFA measurement model is identified for an independent clusters model (in which each measured variable indicator is associated with one and only one factor) if each latent factor has at least two indicators when factors are correlated and at least three indicators when factors are not correlated. However, even when a model is identified in a mathematical sense, it is possible that the model becomes empirically underidentified when fitted to a particular set of data. Thus, for example, a model with two indicators per factor is identified when there are at least two correlated factors (three are needed if the factors are uncorrelated), but it becomes empirically underidentified when the correlation between the two factors approaches zero. McDonald and Ho note that conditions that guarantee identification are generally met, but they argue that it is incumbent upon the researcher to demonstrate that a model is identified when these conditions are not met. Fortunately, most SEM software packages perform some tests of identification and provide diagnostic information, though of varying usefulness.

Typically, the structural path models form a set of *recursive* relations in which there are no feedback loops (closed cycles) in which latent construct can both affect and be affected by another latent construct. In nonrecursive models there are feedback loops in which a given latent variable is both a cause and an effect of another latent variable. This may occur directly such that X → Y and Y → X, or may involve three or more variables, such as X → Y, Y → Z, and Z → X. McDonald and Ho (2002) note that there are no general conditions that guarantee the identifiability of nonrecursive models and that there may be no clear justification for their use. In contrast, there are a number of generally sufficient guidelines that guarantee the identification of recursive models under very general conditions. In particular, McDonald and Ho note that if a model has no double-headed (nondirected) relations between causally ordered variables, the model is certainly identified. My recommendation is that nonrecursive models should generally be avoided unless there is a clear theoretical justification for positing nonrecursive relations, and the researcher has the technical expertise to evaluate that the model is identified (but also see Kline, 2006).

For models with latent constructs to be identified, the researcher must also impose a set of scaling constraints. The reason scaling constraints are needed is that the underlying metric of the latent construct is unknown, so that the model would be underidentified if such constraints were not imposed. A typical set of scaling constraints is that all the latent factor variances must be 1.0. When this scaling constraint is imposed, estimated relations among factors are expressed as factor correlations. Alternatively, the researcher can choose to fix one otherwise freely estimated factor loading to a predetermined value (typically 1.0) for each factor in the model, thus establishing the associated item or measured variable as a reference variable and tying the metric of the latent factor to that variable. For the independent clusters model, either of these scaling constraints is sufficient to guarantee that the model is identified (for further discussion, see Steiger, 2002).

DATA AND ESTIMATION

The estimation process is aimed at generating the best fit to the data given the constraints imposed by the a priori model. Here I briefly discuss a number of complications associated with the available data that may complicate the estimation process.

Maximum Likelihood and Violations of Multivariate Normality

Although various estimation procedures are available in most CFA/SEM statistical packages, maximum likelihood (ML) is the most widely used. A potentially important limitation of ML is that it assumes multivariate normality—an assumption that is almost never satisfied in sport and exercise psychology. Similarly, violations of multivariate normality may result from the use of ordered categorical variables, such as responses to Likert response scales, rather than continuous variables. Fortunately, ML estimation procedures are robust in relation to violations of normality, particularly in relation to parameter estimates—factor loadings, factor correlations, path coefficients, and so on (Boomsma, 1982; Hau & Marsh, 2004; Hu, Bentler, & Kano, 1992; Jöreskog & Sörbom, 1988; B. Muthén & Kaplan, 1985)—that typically are the main concern of applied research. However, this research also suggests that the ML ratio test is too large and that ML standard errors are too small under some conditions of nonnormality (Hu et al., 1992; West, Finch, & Curran, 1995). Alternative estimation procedures (e.g., asymptotic distribution free [ADF] estimates) that do not require multivariate normality do exist, but typically they are only appropriate when *N*s are huge ($N > 5{,}000$).

Hau and Marsh (2004) specifically evaluated alternative strategies for dealing with nonnormal data, particularly when N is small or moderate. In two simulation studies, they systematically varied (a) nonnormality (skew and kurtosis); (b) sample size (Ns = 50, 100, 250, 1000); (c) number of items per factor; and (d) estimation procedure (ML versus ADF). In evaluating results of their simulated data, they considered convergence (whether solutions converged to fully proper solutions), systematic bias of observed parameter estimates relative to known population parameters used to generate the simulated data, the variability of parameter estimates, and goodness of fit. The major findings were these: (a) Solutions based on two indicators (items or item parcels) per factor were problematic (poor convergence, biased parameters and fit measures); (b) ADF solutions were biased, particularly for small Ns; (c) the ML parameter estimates were robust and unaffected by nonnormality even with small Ns; (d) compared to solutions based on normally distributed items, ML χ^2 estimates and their variability were positively biased and systematically larger for nonnormal data; (e) corrections for nonnormal data improved the behavior of the χ^2 test statistics, but there was no support for the improved accuracy of robust standard errors (SEs) of parameter estimates.

Because Hau and Marsh (2004), as well as many others, have found that SEs based on nonnormal data underestimated actual SEs, tests of statistical significance of parameter estimates are positively biased. Whereas this is particularly worrisome for parameters that are of borderline significance, the size of the bias decreases with N. Because Ns are typically large in CFA/SEM studies, parameter estimates that are borderline in terms of statistical significance are unlikely to be substantively important. Although it is beyond the scope of this chapter, there is active research on alternative estimation procedures (such as those implemented in MPLUS; L. K. Muthén & Muthén, 2004), robust standard errors, and bootstrapping approaches that might provide more accurate estimates of standard errors (for further discussion of new and evolving strategies, see Finney & DiStefano, 2006).

It is easy for researchers to summarize the degree of multivariate normality in their data using existing SEM packages, yet they are still left with the apparent dilemma of what to do about the problem. Unless researchers have the luxury of working with very large Ns, they may still be forced to rely on the robustness of ML estimation. Fortunately, there is reasonable support for this robustness in relation to many aspects of CFA/SEM solutions.

How Large Should the Sample Size Be in Studies Using Confirmatory Factor Analysis and Structural Equation Modeling?

The most unambiguous answer to this question is that more is better. Ultimately, the resolution of this critical issue must be somewhat idiosyncratic to each particular study, as the desirability of larger Ns is balanced in relation to the associated costs of larger Ns (additional resources required to increase N). In his classic Monte Carlo study, Boomsma (1982) found that the percentage of proper solutions, accuracy of parameter estimates, sampling variability in parameter estimates, and appropriateness of the ML χ^2 test statistic were all favorably influenced by having larger Ns (see also Gerbing & Anderson, 1993). He recommended that N should be at least 100 and noted that Ns of 200 or more were desirable. Marsh et al. (1998) and others (e.g., MacCallum et al., 1999; Velicer & Fava, 1998) argued that concerns about the minimum N have produced many guidelines but limited empirical support of these guidelines. They noted that although it might be good to have as large an N as possible, there was no systematic support for rules positing minimum N as a function of the number of factors, the number of measured variables, the number of measured variables per factor, or the number of estimated parameters. Velicer and Fava (1998; Marsh et al., 1998) also found that increasing N, the number of measured variables per factor, and the size of factor loadings favorably influenced convergence to proper solutions and accuracy of estimates.

Correlated Uniquenesses and Other Post Hoc Model Modifications

Historically, applications of CFA typically included extensive post hoc modifications of the original, a priori model to achieve an acceptable level of fit, but current practice is typically critical of this strategy. Nevertheless, post hoc modifications are most justifiable when (a) the modifications actually made are identified as part of the analysis; (b) implications of such modifications to critical parameter estimates are articulated (i.e., critical parameter estimates are shown to be relatively unaffected by post hoc modifications); (c) there is a clear (post hoc) justification for such modifications on the basis of prior empirical research and theory; and (d) the modifications are based on large samples (thus avoiding inherent dangers of capitalizing on chance) and shown to generalize over distinct groups for the current data (and, hopefully, new data that might be available). Nevertheless, the critical reader should always pose the question: If the justification for the post hoc modifications is so strong, why was it not part of the a priori model?

One possible compromise is to show that substantively important parameter estimates are unaffected by the inclusion of additional, post hoc parameters. However, if post hoc modification does alter critical parameter estimates, interpretations should be cautious and subject to replication. Alternatively, where there are multiple, competing hypotheses about the structure of the data, these should be tested as competing, a priori models (preferably a set of fully or partially nested models; see subsequent discussion of comparative fit).

Correlated uniquenesses (see Figure 35.1b) represent relations between responses to two indicators that otherwise cannot be explained in terms of the posited factor structure. It is important to distinguish between a priori and post hoc inclusion of correlated uniquenesses. Although the inclusion of correlated uniquenesses as post hoc modifications is historically popular, as with post hoc modification more generally, current practice has shifted dramatically so that it is now seen as dubious.

There are situations in which correlated uniquenesses should be included in an a priori model, such as for longitudinal data in which the same measured variables are administered on more than one occasion (as in Figure 35.1b). Marsh and Hau (1996; also see Jöreskog, 1979) emphasize that if the same measurements are used on multiple occasions, as is typical in longitudinal research, the corresponding residual error variables will tend to be correlated, and, to get accurate estimates of relations among the constructs, correlations among errors should be included in the a priori model (see Figure 35.1b). For simulated data, they demonstrated that the exclusion of correlated uniquenesses resulted in positively biased estimates of test-retest correlations. A similar logic is evident when a strictly parallel set of items is used to measure different constructs; for example, the item stem "I am good at . . ." is used to measure math self-concept ("I am good at mathematics"), reading self-concept ("I am good at reading"), and academic self-concept ("I am good at all school subjects"). Again, failure to include correlated uniquenesses relating responses to parallel worded items is likely to lead to a positively biased estimate of the correlation between the corresponding latent factors. A compromise might be to propose multiple a priori models specifically designed to test a specific hypothesis (e.g., the existence and implications of correlated uniquenesses) and to then evaluate the fit for the alternative, a priori models (Shah & Goldstein, 2006). Of particular importance, the critical feature common to all of these uses of correlated uniquenesses is that they are based on a priori models rather than post hoc modifications.

Missing Data

Missing data are typical in most sport and exercise psychology research. This is a potentially important problem, particularly if missing data exceed 5% (e.g., Graham & Hoffer, 2000). Traditionally, missing data have been handled with listwise deletion of missing data (blanket removal of all cases with any missing data), mean substitution (replacing each missing value with the mean of the corresponding variable), or pairwise deletion of missing data (construction of covariance matrices with all available cases for the particular pair of variables so that the cases used are idiosyncratic to each covariance). These approaches to missing data have potentially serious limitations and are becoming increasingly unacceptable.

Appropriate methods of addressing missing data problems depend on the mechanisms responsible for the missing data. If data are missing completely at random or missing at random (Little & Rubin, 1987; Peugh & Enders, 2004), current procedures such as multiple imputation based on the expectation maximization algorithm and full-information maximum likelihood (FIML) will produce unbiased parameter estimates. In the multiple imputation approach, multiple estimated covariance matrices are generated based on multiple imputed data sets (typically 5 to 10). Separate analyses are then conducted on each of the different imputed data sets, and parameter estimates and standard errors are pooled. In the FIML approach, in contrast with multiple imputation, no missing values are actually replaced prior to estimation. Rather, FIML computes the model parameters based on all available data; in this way, both complete and incomplete records contribute to the analysis, and no statistical information is wasted. Although the multiple imputation approach is typically less convenient than the FIML approach, it is easier to include additional variables (e.g., background and demographic variables) that are not formally part of the model but might be useful in the imputation phase (see Collins, Schafer, & Kam, 2001).

If data are not missing at random, then it may not be possible to obtain completely unbiased estimates. Furthermore, although there are some guidelines for evaluating whether data are missing at random, it will typically be the case that they are not missing at random except in special cases where data are missing by design (e.g., participants are randomly assigned to complete different sections of a long survey). Although multiple imputation and FIML estimates may still be less biased than other procedures (Peugh & Enders, 2004), the evidence is unclear about how robust these procedures are in relation to different missing data situations. In summary, there is no fully satisfactory solution for the applied researcher when data are not missing at random. However, there have been dramatic changes in what is accepted practice in dealing with missing data, and new developments are likely to continue (see Enders, 2006). As minimum requirements, researchers should make explicit the extent to which there are missing data and provide a justification for the method they used to content with this issue.

Multicollinearity

Multicollinearity is a ubiquitous phenomenon that can produce strange, misleading, or uninterpretable results when a set of highly related independent variables is used to predict a dependent variable (Pedhazur & Schmelkin, 1991). It can render the interpretation of parameter estimates meaningless because standard errors are so inflated that potentially important effects cannot be estimated accurately or because none of the set of independent variables has a significant effect that is unique from the other independent variables even when some of the independent variables are considered separately and the set of independent variables has a substantial effect. Whereas multicollinearity becomes particularly problematic when the number and relatedness of the independent variables increase, the issue exists even when correlations among variables are moderate, so that unique effects of each predictor variable differ from the corresponding correlation. At least the detection and consequences—if not the resolution—of multicollinearity problems are well understood in traditional analyses of manifest (nonlatent) variables. Whereas CFA/SEM provides powerful tools to aid researchers, many problems that are well-known in traditional analyses of manifest (nonlatent) variables, such as multicollinearity, do not disappear.

Illustrating this problem, Pietsch, Walker, and Chapman (2003) found that the path leading from self-efficacy to achievement (.55) was apparently much larger than the path leading from self-concept to achievement (–.05), suggesting—erroneously—that self-efficacy was a better predictor of achievement. However, the self-concept, and self-efficacy factors were very highly correlated ($r = .93$), and the standard errors for these two paths were so large (.25) that interpretations were problematic. Marsh, Dowson, Pietsch, and Walker (2004) reanalyzed these data, using a model comparison approach to this multicollinearity problem. They tested an alternative model in which the two paths were constrained to be equal. This model provided a better description of the data in terms of model parsimony and goodness of fit, but also substantially reduced the standard errors (from .25 to .03). The results demonstrate potential problems of interpreting SEM results in the presence of multicollinearity and the need to pursue follow-up analyses when such problems are encountered.

MODEL EVALUATION AND GOODNESS OF FIT

An important, unresolved issue in CFA/SEM is how to evaluate a model and how to select among competing models. Once parameter estimation is complete, the next phase of the CFA/SEM endeavor involves examining the correspondence between the model and the data. Model selection and evaluation are based on a subjective combination of substantive issues, inspection of parameter estimates, goodness of fit, parsimony, interpretability, and a comparison of the performances of competing models. Although there are no well established guidelines for what minimal conditions constitute an adequate fit, the general approach is to (a) evaluate whether the solution is well defined by establishing that the model is identified, the iterative estimation procedure converges, parameter estimates are within the range of permissible values, and the size of the standard error of each parameter estimate is reasonable; (b) examine the parameter estimates in relation to the substantive, a priori model and common sense; and (c) evaluate the χ^2 and indices of fit for the model and compare these to values obtained from alternative models. The evaluation of fit has a long and controversial history (see Marsh, Hau, & Grayson, 2005), and it continues to be a contentious, unresolved issue. Ultimately, researchers must also rely on nonstatistical criteria to resolve the inevitable compromise between model parsimony and goodness of fit.

Tests of Statistical Significance

Goodness of fit is evaluated in part with an overall χ^2 test; the posited model is rejected if the χ^2 is large relative to *df,* and accepted if the χ^2 is small or nonsignificant. However, this classical form of statistical hypothesis testing is generally inappropriate for evaluating CFA/SEM models. The failure to obtain a nonsignificant χ^2 may reflect a poorly specified model, the power of the test, or the failure to satisfy other assumptions underlying the statistical test. Furthermore, hypothesized models such as those considered in CFA/SEM are best regarded as approximations to reality rather than exact statements of truth, so that any model can be rejected if the *N* is sufficiently large. Conversely, almost any model will be accepted if the *N* is sufficiently small. From this perspective, Cudeck and Browne (1983), and many others, argue that it is preferable to depart from the hypothesis testing approach that assumes that any model will exactly fit the data. Accordingly, many fit indices that are a function of the empirical discrepancy have been proposed for evaluating fit between the model and the data and for comparing alternative models.

Comparative Fit

Bentler (1990) noted the usefulness of testing a series of nested models $M_0 \ldots, M_i \ldots, M_j \ldots, M_k \ldots, M_s$, in which M_0 is a suitably defined null model (e.g., a model in which each measured variable is an independent factor so that the reproduced matrix is diagonal); M_s is the saturated model, with $df = 0$; and M_i, M_j, and M_k are models with positive *df* of intermediate complexity. Any two models are nested so long as the set of parameters estimated in the more restrictive model is a subset of the parameters estimated in the less restrictive model. Under appropriate assumptions, the difference in χ^2s between two nested models has a χ^2 distribution and so can be tested in relation to statistical significance. Ironically, current practice seems to reject the usefulness of tests of statistical significance for purposes of evaluating a single model, but to endorse the usefulness of statistical significance for purposes of evaluating the difference between two nested models. This significance test of the difference between two nested models has essentially the same strengths and weaknesses of the χ^2 test applied to any one model, and the statistical assumptions underlying it are far more stringent than those based on tests for a single model. For these reasons, researchers (e.g., Bentler, 1990; Marsh, Hau, & Grayson, 2005) recommend that goodness of fit be scaled along a 0-to-1 continuum in which the end points are defined by M_0 and M_s, respectively. This provides a potentially useful frame of reference against which to evaluate the fit of any one model or the difference between a pair of models. For purposes of model comparison, tests of the relative fit of models testing more or fewer invariance constraints are of greater importance than the absolute level of fit for any one model. Thus, for example, Cheung and Rensvold (2001) suggested that for incremental fit indices (e.g., Tucker-Lewis index and relative noncentrality index), decreases in fit greater than .01 might be important.

Although tests of statistical significance should not be taken too seriously, I encourage researchers to formulate a set of nested or partially nested models specifically designed to evaluate particular aspects of interest. Hence, it is useful to compare a target model with alternative, nested models to evaluate the extent to which more restrictive models result in a poorer fit, and less restrictive models improve fit. For example (in applications considered in more detail later in the chapter): (a) SEM models are typically nested under the corresponding CFA models in which correlations among all the first-order factors are freely estimated; (b) higher-order factor models are typically nested under the corresponding CFA model in which the first-order factors are freely estimated; (c) tests of factorial invariance of parameter estimates across independent groups (e.g., men and women, different age groups, elite versus nonelite athletes) can be formulated as a set of fully (or partially) nested models in which the end points are models with no invariance constraints and models with all parameter estimates invariant across all groups; and (d) in CFA approaches to multitrait-multimethod (MTMM) data, a series of partially nested models has been developed that compares the fit of models positing different formulations of trait effects and method effects.

Goodness of Fit Indices

Marsh, Hau, and Grayson (2005) constructed a compendium of indices considered in the CFA/SEM literature that they categorized into functional families, providing a definition of each index and alternative names that have been ascribed to each. In their review they critically evaluated a wide variety of indices and the criteria typically used to evaluate them (e.g., unbiased in that they do not systematically vary with *N;* appropriately penalize model complexity and reward parsimony; provide an interpretable metric and appropriate cutoff values). Based on this review, they found support for Dk (the rescaled noncentrality parameter; McDonald & Marsh, 1990), Mc (the measure of centrality; McDonald & Marsh, 1990), RMSEA (root mean square error of approximation; Browne & Cudeck, 1993; Steiger & Lind, 1980), TLI (Tucker-Lewis index; Tucker & Lewis, 1973; also known as the nonnormed fit index, NNFI), and RNI (relative noncentrality index; McDonald & Marsh, 1990), or equivalently, its normed version, the CFI (comparative fit index; Bentler, 1990), as well as other, less widely used indices.

Marsh, Hau, and Grayson (2005) argue that much of the apparent appeal, particularly for the incremental fit indices and, perhaps, RMSEA, is the implicit assumption that they can be evaluated in relation to absolute cutoff values (e.g., TLI > .90 or .95) that establish a minimum criterion for an acceptable level of fit that has broad generalizability across different situations. The critical question is whether there are absolute criteria of acceptable levels of fit—golden rules or even recommended guidelines—that are a necessary basis for valid interpretations. Marsh, Hau, and Wen (2004) argued that justification for cutoff values can be based on ambit claims, a normed reference approach, or a criterion-referenced approach. Historically, rules of thumb about acceptable levels of fit (e.g., incremental fit indices > .9) have been ambit claims based on intuition, accepted wisdom, and current practice. Research by Hu and Bentler (1998, 1999) in particular has been interpreted as providing a criterion-referenced approach to this problem in relation to the ability to detect misspecified models, but Marsh, Hau, et al. (2004) argue that their suggested new, more demanding "absolute" criteria are not justifiable. In particular, Hu and Bentler based their results, in part, on "misspecified" models that should have been deemed acceptable even by their new, more demanding criteria. Marsh, Hau, et al. (2004) further noted that the apparent overinterpretation of the Hu and Bentler results by reviewers, journal editors, and applied researchers in search of golden rules was inconsistent with the many cautions offered by Hu and Bentler about the generalizability of their results. Using a normed reference approach, Marsh, Hau, et al. (2004, p. 325) proposed the following strawperson claim:

> Conventional CFA goodness of fit criteria are too restrictive when applied to most multifactor rating instruments. It is my experience that it is almost impossible to get an acceptable fit (e.g., CFI, RNI, TLI > .9; RMSEA < .05) for even "good" multifactor rating instruments when analyses are done at the item level and there are multiple factors (e.g., 5 to 10), each measured with a reasonable number of items (e.g., at least 5 to 10/per scale) so that there are at least 50 items overall. If this is the case, then I argue that "conventional" rules of thumb about acceptable fit are too restrictive (even though there has been a recent push for even stricter standards).

Marsh placed this claim on SEMNET (an electronic mail network on the discussion of various structural equation modeling issues) and invited the 1,500 members to provide counterexamples. Although many interesting points were raised in response to this strawperson claim, no one offered a published counterexample to refute it. Based on this and on simulation research suggesting a flaw in the logic underlying the new, more demanding cutoff values proposed by Hu and Bentler (1998, 1999), Marsh Hau, et al. (2004) concluded that these new guidelines are not appropriate as absolute criteria of a goodness of fit.

Current Practice and Recommendations

McDonald and Ho (2002) reviewed published SEM studies to evaluate what constitutes current practice, including goodness of fit. Not surprisingly, all 41 studies in their review reported a global χ^2 test as well as at least one subjective index of fit. The most popular index was CFI or RNI (21 studies), followed by RMSEA (20 studies), the goodness of fit index [GFI] (15 studies), TLI or NNFI (13 studies), and others. Researchers typically reported more than one fit index. Standards of an acceptable fit were typically .9 or better for those indices designed to vary on a 0-to-1 scale (e.g., RNI, CFI, GFI, TLI), whereas RMSEA values of less than .05 were interpreted as a good fit and those of less than .08 were interpreted as an acceptable fit. In addition, a majority (33) of the studies also used χ^2 difference tests to choose the best model from among nested models.

Following Marsh, Hau, and Grayson (2005; Marsh, Balla, & Hau, 1996; Marsh et al., 1988), I recommend the use of the TLI, the RNI or the CFI and the RMSEA (along with, perhaps, its confidence interval) to evaluate goodness of fit, as well as presenting the χ^2 test statistic and a detailed evaluation of parameter estimates (and their SEs). The TLI and RNI vary along a 0-to-1 continuum in which values greater than .90 and .95 are typically taken to reflect acceptable and excellent fits to the data, respectively. RMSEA values of less than .05 and .08 are taken to reflect a close fit and a reasonable fit, respectively, whereas RMSEA values between .08 and .10 reflect a mediocre fit, and values greater than .10 are generally unacceptable. The RNI contains no penalty for a lack of parsimony, so that improved fit due to the introduction of additional parameters may reflect capitalization on chance, whereas the TLI and RMSEA contain penalties for a lack of parsimony. I stress, however, that these cutoff values should be interpreted as guidelines to supplement a detailed evaluation of parameter estimates in relation to theoretical predictions. Whereas statistical significance and indices of fit aid in the evaluation of the fit of a model, ultimately a degree of subjectivity and professional judgment is required in the selection of a best model (Marsh et al., 1988).

Interpretation of Parameter Estimates

Interpretation of the parameter estimates involves making sense of the results. Standardization of results is a traditional custom in most psychometric research to aid in this task (e.g., analogous to the difference between standardized and unstandardized beta weights in traditional applications of multiple regression). Because some form of standardization typically is necessary to achieve identification (e.g., fixing either factor variances or factor loadings to 1.0), and presentation of a completely standardized solution aids interpretation of the results, I recommend that researchers present completely standardized solutions (i.e., where both the measured and observed variables have been rescaled to have unit variance). However, as emphasized by McDonald and Ho (2002), many commercially available software programs do not provide appropriate standard errors for the standardized parameter estimates. Instead, typical practice is to use the unstandardized coefficients and their SEs to assess statistical significance and then report standardized coefficients as descriptive statistics. Alternatively, models can sometimes be reformulated so that standardized coefficients can be tested directly (e.g., Marsh, Dowson, et al., 2004).

In the evaluation of empirical results based on an a priori model, researchers must critically assess the size, direction, and statistical significance of individual parameter estimates. If, for example, a model predicts that a critical path should be positive and the estimated path is negative, then there is no support for the a priori model—even if the model is able to fit the data. Out-of-range parameter estimates (e.g., negative variance estimates, called Heywood cases), excessively large standard errors, and parameter estimates that otherwise do not make sense are all clues that something is wrong. Empirical estimation problems such as multicollinearity (see earlier discussion) can complicate the interpretation of parameter estimates or lead to erroneous conclusions. Hence, it is essential for users to pursue additional models to resolve these issues, ensuring that a superficial examination of problematic models is not used to support inappropriate interpretations and propagate spurious substantive conclusions. More generally, within a construct validity perspective, the role of researcher should be that of a skilled data detective who follows many alternative leads (Marsh, Byrne, & Yeung, 1999; Marsh & Yeung, 1997). Researchers, like detectives, should develop appropriate tests of plausible counterinterpretations of their conclusions, pursue these tests as part of an ongoing research program, and make a case for the most defensible interpretations. In defending their final models, researchers should provide a sufficiently clear audit trail, starting with a priori models, to allow the reader to evaluate the appropriateness of their alternative models and conclusions. This approach to SEM, although discouraging to any remaining pure logical positivists, more fully recognizes the role of SEM as a tool to aid substantive research, as an art form that cannot be completely codified, and as a means to pursue a construct validity approach to the evaluation of interpretations of data.

SUBSTANTIVE APPLICATIONS OF CONFIRMATORY FACTOR ANALYSIS AND STRUCTURAL EQUATION MODELING

Much of my research has focused on the development, validation, and application of measurement instruments, particularly ones designed to measure multiple dimensions of self-concept. CFA, SEM, and related techniques have been fundamental to my research. For example, Marsh and Hocevar (1985) provided one of the early demonstrations of the use of CFA to evaluate first- and higher-order factor structures based on responses to multidimensional self-concept responses. This study was specifically designed to evaluate theoretical predictions from the Shavelson, Hubner, and Stanton (1976) model of self-concept in relation to responses from a self-concept instrument based on that model, demonstrating the usefulness of CFA for this purpose.

In sport and exercise psychology—as well as other disciplines—it is increasingly seen as appropriate for all new and existing measures to be evaluated using CFA or related statistical tools to assess the factor structure underlying the constructs claimed to be measured by an instrument. This recommendation is particularly relevant to traditional psychological measures in which there are multiple items designed to evaluate each of the a priori factors (as illustrated in physical self-concept research). It is also relevant to performance measures such as batteries of physical fitness indicators hypothesized to reflect latent fitness factors.

Early Applications of Confirmatory Factor Analysis in Sport and Exercise Psychology

Here I briefly review some of the early applications of CFA in my sport and exercise psychology research. These studies are of historical interest, demonstrating the relevance of CFA to sport and exercise psychology as well as my focus on construct validation and a multidimensional perspective. However, they also provide a foundation for my subsequent research program. In some cases, subsequent advances in the application of CFA could have improved the original CFA analyses (recognizing that in this rapidly evolving area, specific strategies used may be superseded by subsequent developments).

The Multidimensional Structure of Physical Fitness: Invariance over Gender and Age

The Australian Health and Fitness Survey consisted of a comprehensive array of health and fitness measures, including physical activity and health-related behaviors; field exercises, including measures of cardiovascular endurance (1.6km run), dynamic strength (sit-ups, push-ups), explosive strength/power (standing long jump, 50m dash), flexibility (sit-and-reach), and body composition (height, weight, and body girths); technical measures (e.g., physical working capacity, the workload at a heart rate of 170 beats per minute [PWC170], dynamometer strength tests, skin folds, blood pressure, lung function); and laboratory measures (e.g., VO_2 max). Marsh (1993) evaluated the ability of an a priori factor structure to fit these data and the extent to which the same factor structure generalized across large, nationally representative samples of boys and girls ages 9, 12, and 15. The results consisted of a well-defined factor structure and supported the invariance of factor loadings and factor correlations across all six age/gender groups. Substantively, the study extended the exploratory factor analytic approach pioneered by Fleishman (1964). Methodologically, it provided an early demonstration of the usefulness of CFA and multiple group tests of invariance in the sport and exercise area. It also provided an important basis for positing self-concept factors in the Physical Self-Description Questionnaire (PSDQ).

Multidimensional Physical Self-Concept and Multiple Components of Physical Fitness

Marsh and Redmayne (1994) tested first- and higher-order factor structures based on an early version of the PSDQ and related these to a battery of fitness measures. The first-order factor structure positing six components of physical self-concept and five components of physical fitness was well defined and fit the data reasonably well. Consistently with a priori predictions, endurance self-concept was most highly correlated with endurance fitness ($r = .64$), and strength self-concept was most highly correlated with the static strength ($r = .44$) and shuttle run ($r = .44$) tests. Whereas Flexibility self-concept was significantly correlated with the flexibility test ($r = .21$) and shuttle run ($r = .36$); it was also significantly correlated with the endurance and static strength tests. In a hierarchical model, they found a very high correlation between the general fitness and general physical self-concept factors ($r = .76$) that supported the convergent validity of the physical self-concept responses in relation to physical fitness and fit the data surprisingly well given its parsimony.

Sport Motivation Orientations: Beware of the Jingle-Jangle Fallacies

Marsh (1994) argued that, given the proliferation of apparently similar measures in sport and exercise psychology, it is important to evaluate the Jingle Fallacy (assuming that two scales with the same label measure the same construct) and the Jangle Fallacy (assuming that two scales with different labels measure different constructs). He applied CFA to relate motivation scales from Roberts's 1993 Perceptions of Success Questionnaire (POS; mastery and competitiveness) and D. Gill's 1993 Sport Orientation Questionnaire (SOQ; competitiveness, win, goal orientations). Following Duda (1993), he hypothesized that POS Mastery and SOQ Goal scales reflect a mastery orientation, whereas the POS Competitiveness and the SOQ Win and Competitiveness scales reflect an ego orientation. However, a more careful examination of the SOQ Competitiveness items suggested that they could refer to either competition with others, which implies an ego orientation, or competition with internal goals or standards, which might imply a task orientation. A five-factor model fit the data very well (TLI = .980). The large correlation (.79) between the POS Mastery and the SOQ Goal factors suggested that these were similar constructs, but the SOQ Competitiveness factor was more highly correlated with the SOQ Goal factor (.70) and the POS Mastery factor (.56) than with the POS Competitiveness factor (.50). Whereas the lack of correlation between the POS Mastery and SOQ Win factors (.07) was consistent with expectations, the size of the correlation between the SOQ Win and POS Competitiveness factors was not as high as might be expected (.58). These results, along with those based on alternative 2-, 3-, and 4-factor structures, suggested that two factors with different labels (POS Mastery, SOQ Goal) reflected a similar construct, whereas two factors with the same label (POS Competitiveness, SOQ Competitiveness) reflected different factors. Relations with external constructs (gender, year in school, and multiple components of physical self-concept) also suggested that the POS and SOQ Competitiveness scales reflected clearly different constructs. The results provide a good demonstration of the usefulness of CFA in the evaluation of jingle-jangle fallacies and evaluation of psychological instruments.

Marsh, Craven, Hinkley, and Debus (2003), based in part on analogous work in the big-five factor theory of personality, posited a big-two-factor theory of motivation orientation. First-order CFAs of test-retest data provided support for each of the 8 a priori motivation factors: ego, competition, mastery, intrinsic, cooperation, individual, approach success, and avoid failure. Higher-order CFA models fit the data reasonably well for each time considered separately and demonstrated well-defined, higher-order learning and performance factors posited in their big-two theory. For the combined T1 and T2 data, however, the substantial test-retest correlations for first-order factors were not fully explained by the higher-order factors. However, gender differences in the eight specific scales were captured by the two higher-order factors, thus supporting the big-two factor theory.

Confirmatory Factor Analytic Approaches to Multitrait-Multimethod Data: Convergent and Discriminant Validity

The MTMM design is widely used to test convergent and discriminant validity in relation to interpretations of a test and is a standard tool for evaluating measurement instruments. In the MTMM approach, Campbell and Fiske (1959) advocated the assessment of construct validity by measuring multiple traits (T1, T2, etc.) with multiple methods (M1, M2, etc.). In self-concept research, for example, the multiple traits typically represent multiple dimensions of self-concept. The term *multiple methods* was used very broadly by Campbell and Fiske to refer to multiple tests or instruments, multiple methods of assessment, multiple raters, or multiple occasions. Whereas the analytic procedures for evaluating MTMM data are appropriate for different types of multiple methods, the substantive interpretations differ. Campbell and Fiske's paradigm is perhaps the most widely employed construct validation design. Although their original guidelines are still widely used to evaluate MTMM data, important problems with their guidelines are well-known (see reviews by Marsh, 1989; Marsh & Grayson, 1995). More recently, researchers have used CFA approaches to evaluate MTMM data in relation to a taxonomy of partially nested MTMM models specifically designed to evaluate different aspects of convergent and discriminant validity (Marsh, 1989; Marsh & Grayson, 1995; Widaman, 1985). Although the MTMM paradigm is clearly appropriate for sport and psychology research, it has received surprisingly little application in our field.

Multitrait-Multimethod Study of Responses to Three Physical Self-Concept Instruments

In apparently the first application of this CFA-MTMM approach in sport and exercise psychology, Marsh, Richards, Johnson, Roche, and Tremayne (1994) demonstrated a useful variation of the standard CFA approach based on responses to three physical self-concept instruments: (1) 11 factors from Marsh's PSDQ (Marsh et al., 1994): appearance, strength, condition/endurance, flexibility, health, coordination, activity, body fat, sport, global physical, global esteem; (2) 7 factors from Richards's (1988) Physical Self Concept (PSC) 7 scales: activity, appearance, health, competence, strength, body build, satisfaction; and (3) 5 factors from Fox and Corbin's (1989) Physical Self-Perception Profile (PSPP): physical condition, physical strength, body attractiveness, sport, physical self-worth.

Marsh et al. (1994) began with a content analysis of 23 scales from the three instruments and classified them as matching (e.g., Strength scales from the three instruments), nonmatching, and partially matching (e.g., PSDQ Body Fat and the Body scales from the other two instruments). Treating the extent of "matchingness" as having at least three categories instead of two represented an important concession to the reality that existing measures typically do not consist of strictly parallel scales, as is implicit in the traditional MTMM application. Although Marsh et al. considered a variety of complex CFA models derived from the MTMM literature, their initial 23-factor model provided a good fit to the data and a good overview of the results.

There was good support for convergent validity in that the 9 correlations among factors posited to be matching (.79 to .90; Md = .84) and the 6 correlations for partially matching scales (.61 to .73; Md = .68) were all substantial. Further support for construct validity—and the usefulness of the two categories of matchingness—came from the fact that correlations in the first category were systematically larger than those in the second category. There was also good support for discriminant validity in that the remaining 152 correlations (.02 to .74; Md = .44) were smaller than all convergent validities in the first category and smaller than most of the convergent validities in the second category. These results support the convergent and discriminant validity of PSDQ responses, the focus of this study. The comparison of responses from the PSDQ, PSPP, and PSC instruments (see Marsh et al., 1994, for more detailed discussion) provided stronger support for convergent and discriminant validity for the PSDQ and PSC instruments than for the PSPP instrument. Overall, the results provided good support for the convergent and discriminant validity of responses to the three instruments. This pattern of results for the PSDQ and PSPP was replicated in a study of Turkish university students (Marsh, Asci, & Tomás-Marco, 2002).

Other Applications of Multitrait-Multimethod Data

Multitrait-multimethod data are used to compare the responses to multiple traits by different respondents (e.g., self and significant others). Thus, for example, in self-concept research there is a long debate over the distinction between self-report self-concept (i.e., one's own self-concept) and inferred self-concept based on responses by significant others (e.g., teacher, coach, family member, friend). Convergent validity is inferred from substantial correlations between self-ratings and inferred ratings on matching self-concept traits. Discriminant validity provides a test of the distinctiveness of self-other agreement and of the multidimensionality of the self-concept facets; it is inferred from the lack of correlation between nonmatching traits. In an application of this MTMM design, Marsh and Byrne (1993; also see Marsh & O'Neill, 1984) compared self-report responses on 13 factors on the Self Description Questionnaire III [SDQIII] with self-concepts inferred by a significant other who knew the person well. Factor structures based on self-report and responses by significant others were similar. Convergent validities (self-other agreement) were very high (mean $r = .57$), and discriminant validity was supported by the modest correlations between different self-concept factors.

In a number of MTMM studies, the multiple methods have been represented by multiple occasions such that convergent validities are test-retest stabilities. Interpretations of convergent validities in this application clearly have different implications than those based, for example, on responses by different raters (e.g., the self-other agreement studies) or different instruments. Nevertheless, this is still a useful design for evaluating support for discriminant validity (see Marsh, 1996; Marsh, Ellis, Parada, Richards, & Heubeck, 2005).

More generally, Marsh, Martin, and Hau (2006) claim that the logic of MTMM design is the foundation of multimethod approaches to construct validity: evaluating areas of convergence and nonconvergence in measures of the same construct across multiple methods; different items used to infer the same latent construct at the micro level, different instruments designed to measure parallel or overlapping constructs or responses from different types of informants at the intermediate level, or different research methodologies (e.g., qualitative and quantitative studies) at higher levels of abstraction.

Cross-Cultural Validity of the Sport Psychology Measures, Models, and Theories

Cross-cultural comparisons provide researchers with a valuable heuristic basis to test the external validity and generalizability of their measures, theories, and models; to test current psychological perspectives in other cultures; to explore and discover new aspects of the phenomenon being studied; and to integrate what has been learned to generate a more nearly universal psychology that has pan-human validity (Segall, Lonner, & Berry, 1998). As emphasized by Gauvin and Russell (1993), it is surprising that more attention is not given to cross-cultural measurement issues in sport and exercise psychology, given that the discipline transcends so many geographical and cultural boundaries.

Strong tests of the cross-cultural generalizability of responses to self-concept instruments are possible when responses to the same instrument are collected in different cultures or countries. Critical design features are the translation of items from the original language, which requires a delicate balance of psychological, linguistic, and cultural adaptations (Byrne, 2003; Gauvin & Russell, 1993), and ensuring that the samples from different countries are comparable. Given appropriate data from two or more countries, it is important to evaluate the extent to which the responses to items are associated with similar factors (the same factors exist), relations between items and latent factors are similar (invariance of the factor loadings), relations among the different factors are similar (invariance of the factor correlations and factor variances), and measurement error is similar. In an application of this approach, Marsh, Tomás-Marco, and Asci (2002) compared the factor structures based on large samples of Spanish high school students, Australian high school students, and Turkish university students. The Spanish sample was specifically constructed to match the Australian sample in terms of age and gender, whereas the Turkish sample was based on university physical educational students. In a series of tests of the invariance of different parameters, the authors chose a best solution in which factor loadings were invariant across all three groups, factor correlations and factor variances were invariant across the Spanish and Australian groups (but not the Turkish group), and the uniquenesses were freely estimated in each group. However, there were only small differences in the fit indices for all the different models considered. Thus, for example, the median coefficient alpha estimate of reliability was .89 in all three groups. Substantively, the results provided good support for the cross-cultural generalizability of the factor structure based on responses to the PSDQ instrument. Methodologically, the results illustrate interesting issues in the application of multigroup CFA to cross-cultural comparisons.

In a particularly strong application of this multigroup, cross-cultural approach, Marsh, Hau, Artelt, Baumert, and Peschar (in press) evaluated the cross-cultural generalizability of responses to the Organisation for Economic Cooperation and Development's [OECD] Student Approaches to Learning (SAL) instrument. This 52-item instrument was designed to measure 14 factors that assess self-regulated learning strategies, self-beliefs, motivation, and learning preferences. Selection of the measures by OECD was made on the basis of advice from substantive and statistical expert panels and results from extensive pilot studies. Marsh et al. evaluated SAL responses from nationally representative samples of approximately 4,000 15-year-olds from each of 25 countries ($N = 107{,}899$) in OECD's PISA study. Marsh et al. used multiple group CFAs to show that the a priori 14-factor solution was well defined and invariant across the 25 countries, as were relations between SAL factors and four criterion variables (gender, socioeconomic status, and math and verbal achievement). The results supported posited relations among constructs derived from different theoretical perspectives and their cross-cultural generalizability.

In a preliminary (total group) CFA based on the total sample of students from the 25 different countries, a highly restrictive a priori model with 14 factors provided excellent goodness of fit (RMSEA = .044). Separate CFAs were then conducted for each of the 25 countries, followed by a systematic evaluation of invariance of parameter estimates across the 25 countries. In the baseline model with no invariance constraints there was a total of 4,875 parameter estimates, 195 parameter estimates (52 factor loadings, 52 uniquenesses, and 91 factor correlations) for each of 25 countries. In the final model of total invariance there were only 195 parameter estimates, a reduction in the number of estimated parameters of from 4,875 (totally free model) to 95 (totally invariant model). According to current standards of goodness of fit, even the most restrictive model requiring all parameters to be invariant across the 25 countries provided a reasonably good fit to the data (TLI = .957) compared to the baseline, no-invariance model (TLI = .968). Given the extremely demanding tests of invariance across the 25 countries, there was remarkably good support for the invariance of at least factor loadings, factor variances, and factor correlations, and reasonable support for the invariance of uniquenesses.

In cross-cultural research there is often a tension between cross-cultural differences and cross-cultural generalizability. Ultimately, if based on sufficiently large and diverse samples, there must be statistically significant cross-cultural differences even if there is also strong support for cross-cultural generalizability. Clearly, the focus of the Marsh, Hau, Artelt, et al. (in press) investigation was on cross-cultural generalizability. Of particular importance, not only do the results show strong support for the cross-cultural applicability of the SAL instrument, but they also demonstrate much stronger cross-cultural generalizability in the patterns of relations among variables than many cross-cultural psychologists would have believed possible. The apparent explanation is the combination of the strong design of materials and data collection by the OECD and the application of strong and appropriate statistical techniques. Because many inappropriate sources of apparent difference (comparability of samples, materials, etc.) were carefully controlled, the remaining differences appropriately attributable to cultural or national differences were much smaller than would otherwise be the case if such differences had existed and had inappropriately been interpreted as a lack of cross-cultural generalizability. If a narrowly based, null hypothesis testing approach had been used with such a large *N*, it would have found highly significant differences from a statistical perspective. However, taking a construct validity approach based on CFA/SEM tests of invariance of results across the different countries, they demonstrated that support for cross-cultural invariance of relations among SAL factors, and between SAL factors and criterion variables, was much stronger than cross-cultural differences.

Mean Differences: Invariance of Measured Variable Intercepts and the Multiple Indicator and Multiple Causes Model

In CFA/SEM studies of invariance across multiple groups it is also possible to extend tests of invariance to include measured variable intercepts (Byrne, 1998; Byrne, Shavelson, & Muthén, 1989; Kaplan, 2000; Marsh & Grayson, 1994; Thompson, 2006). Adapting terminology from item response theory (see Marsh & Grayson, 1994), each measured variable (t) is related to the latent construct (T) by the equation $t = a + bT$, where b is the slope (or discrimination) parameter that reflects how changes in the observed variable are related to changes in the latent construct and a is the intercept (or difficulty) parameter that reflects the ease or difficulty in getting high manifest scores for a particular measured variable. Unless there is complete or at least partial invariance of both the *a* and *b* parameters across the multiple groups, the comparison of mean differences across the groups may be unwarranted. However, there are important disadvantages to this traditional multiple-group approach to mean differences, particularly when *N*s are modest. Using this approach to evaluating latent mean differences in responses to the PSDQ based on matched samples of Spanish and Australian high school students, Tomás-Marco, González-Romá, and Marsh (2005) demonstrated support for strict factor invariance—invariance of item factor loadings, intercepts, and uniquenesses. Their results demonstrated that there was no differential item functioning across the two Spanish and Australian versions of the PSDQ and justify comparisons of Spanish and Australian adolescents on latent mean differences on multiple dimensions of physical self-concept.

Whereas the multiple group approach is reasonable when there is one contrast (or grouping) variable with a small number of discrete groups (e.g., male/female, experimental/control), it is not practical for variables that are continuous or have many categories (e.g., age), nor for studies that simultaneously evaluate many different contrast variables (age, gender, experimental/control) and their interactions. Kaplan (2000; also see Jöreskog & Sörbom, 1988; Marsh, Ellis, Parada, et al., 2005; Thompson, 2006) described a multiple indiator and multiple causes (MIMIC) model, which is like a multivariate regression model in which latent variables (e.g., multiple dimensions of self-concept) are caused by discrete contrast or grouping variables that are each represented by a single indicator. This approach is clearly stronger than a traditional analysis of variance or multivariate analysis of variance (MANOVA) approach that is based on manifest variables (i.e., scale scores) that are assumed to be measured without error, rather than latent variables arising from the CFA. Indeed, a strong argument could be made for eliminating ANVOVA models altogether and replacing them with SEMs like the MIMIC model. The MIMIC approach is also much more flexible than the traditional ANOVA approach in allowing a mixture of continuous and discrete independent variables (i.e., contrast, background or grouping variables) and their interactions. Although it is more like a multiple regression approach to ANOVA (e.g., Aiken & West, 1991), the MIMIC model has the important advantage that the dependent variables are latent variables based on multiple indicators corrected for measurement error. Whereas interaction terms can easily be included in a MIMIC model if both the interacting variables are single-indicator variables, more complicated models are required to model interactions between latent constructs based on multiple indicators (see Marsh, Wen, & Hau, 2004; Marsh, Wen, & Hau, 2006).

Marsh, Tracey, and Craven (in press) demonstrated the usefulness of this approach in a study of young children with mild intellectual disabilities (MID). They began by showing support for the invariance of all parameter estimates—including measured variable intercepts—in separate analyses of groups defined in terms of gender, age (younger versus older), and placement (MID students in regular mixed-ability class with non-MID students versus MID students in special education classes with other MID students). They then constructed MIMIC models in which multiple dimensions of self-concept factors were related to four single-degree-of-freedom contrast variables: linear effects of age, gender (1 = male, 2 = female), age × gender interaction, and educational placement (1 = mixed ability, 2 = special education). In support of the construct validity of the multidimensional self-concept responses and a priori predictions based on theory and previous research, differences associated with placing preadolescents with MIDs in regular classrooms—compared to preadolescents with MIDs in special classes—were significantly negative for the three academic self-concept scales (support of the discriminant validity of the self-concept responses, a priori predictions) and a construct validity approach. There were no significant placement effects for nonacademic (physical ability, appearance, parent relationships) components of self-concept.

The Causal Ordering of Self-Concept and Performance

Do changes in self-concept lead to changes in subsequent performance? This is one of the most vexing questions in self-concept research. It has important theoretical and practical implications and has been the focus of considerable research, particularly in educational settings. Calsyn and Kenny (1977) contrasted the self-enhancement model that posits self-concept as a primary determinant of subsequent performance (i.e., self-concept → performance) with the skill development model that implies that self-concept emerges principally as a consequence of prior performance (i.e., performance → self-concept).

Based on more advanced statistical tools, empirical results, and self-concept theory, Marsh (1990; Marsh et al., 1999) argued that a more realistic compromise between the self-enhancement and skill-development models was a *reciprocal effects model* in which prior self-concept affects subsequent achievement and prior achievement affects subsequent self-concept. The prototypical model for testing the reciprocal effects model (Figure 35.2) is a "full-forward" multiwave-multivariable model in which multiple indicators of self-concept and performance are collected in three successive waves (T1, T2, and T3). A reciprocal effects model is supported when both the self-enhancement (e.g., T1Self → T2Performance) and skill development (e.g., T1Performance → T2Self) paths are significant. A growing body of research (Marsh et al., 1999; Marsh & Craven, 2006; Valentine, DuBois, & Cooper, 2004) supports the reciprocal effects model of relations between academic self-concept and academic achievement. Here I briefly consider recent extensions of the reciprocal effects mode in the physical arena.

Gymnastics Self-Concept and Achievement in Physical Education Classes

Marsh, Chanal, Sarrazin, and Bois (2006) pursued tests of the reciprocal effects, self-enhancement, and skill development models in relation to physical self-concept and performance skills in physical education classes (see Figure 35.1b). More specifically, they evaluated predictions about the effects of T1 gymnastics self-concept and T1 gymnastics performance skills collected at the start of a gymnastics training program on T2 gymnastics self-concept and T2 gymnastics performance skills collected at the end of a 10-week program. Performance was based on videotapes of each student's performance on a standardized gymnastics performance test that was evaluated by three independent expert judges. Consistent with a priori predictions in support of the reciprocal effects model, the effect of T1 gymnastics self-concept on T2 gymnastics performance (.20) and the effect of T1 gymnastics performance on T2 gymnastics self-concept (.14) were both highly significant. Consistent with the reciprocal effects model, gymnastics self-concept and gymnastics performance were both determinants and consequences of each other.

Physical Self-Concept and Physical Activity

Marsh, Papaioannou, and Theodorakis (2006) adapted the reciprocal effects model in a study of the causal ordering of physical self-concept and exercise behavior. Based on a large sample of Greek physical education students ($N =$ 2,786 students) collected early (T1) and late (T2) in the school year, analyses supported a reciprocal effects model in which prior (T1) physical self-concept and exercise behavior both influence subsequent (T2) physical self-concept and exercise behavior. Consistently with the predictions from the reciprocal effects model, both the effect of T1 physical self-concept on T2 exercise behavior (.17) and the effect of T1 exercise behavior on T2 physical self-concept paths (.10) were highly significant. In subsequent analyses, key constructs from the theory of planned behavior (behavioral intentions, perceived behavioral control, exercise attitudes) also contributed to the prediction of subsequent exercise behavior. However, the effect of physical self-concept was significant even after controlling for these additional variables, suggesting that self-concept should be used to supplement the theory of planned behavior. In further discussion, the authors compared how SEM had been used in typical tests of the reciprocal effects model in self-concept research and models based on the theory of planned behavior.

Generalizability to Championship Performances in Elite Swimming

Marsh and Perry (2005) tested predictions from a reciprocal effects model based on a large sample of many of the best swimmers in the world competing at the Pan Pacific Swimming Championships in Australia and the World Short Course Championships in Greece. Top swimmers from 30 countries completed the 29-item Elite Swimmer Self-Description Questionnaire (ESSDQ) instrument on the 1st day for each of these championships, prior to actually competing in any events. Also available for all participants were previous personal best performances (PPBs) in each of their events and, subsequently, actual championship performance. The strongest predictor of championship performance was PPB (path coefficient = .88; Model A, Figure 35.3), also demonstrating the importance of controlling for prior performance. In support of the reciprocal effects model, the ESSDQ factors contributed significantly to the prediction of championship performance, even after controlling for PPB. Due in part to multicollinearity associated with the six self-concept factors, only the contribution of overall performance self-concept was statistically significant (standardized beta = .12).

Next we evaluated a higher-order factor model in which the six ESSDQ factors are posited to reflect one (global) higher-order factor (Model B in Figure 35.3). Factor loadings relating the 6 first-order factors to the higher-order factor were all substantial (.58 to .89). The goodness of fit and paths from the PPB (.87) and global self-concept (.12) factors to subsequent performance for this higher-order model were similar to those in the first-order model. These results are consistent with both the design of the ESSDQ and the global nature of the outcome variable

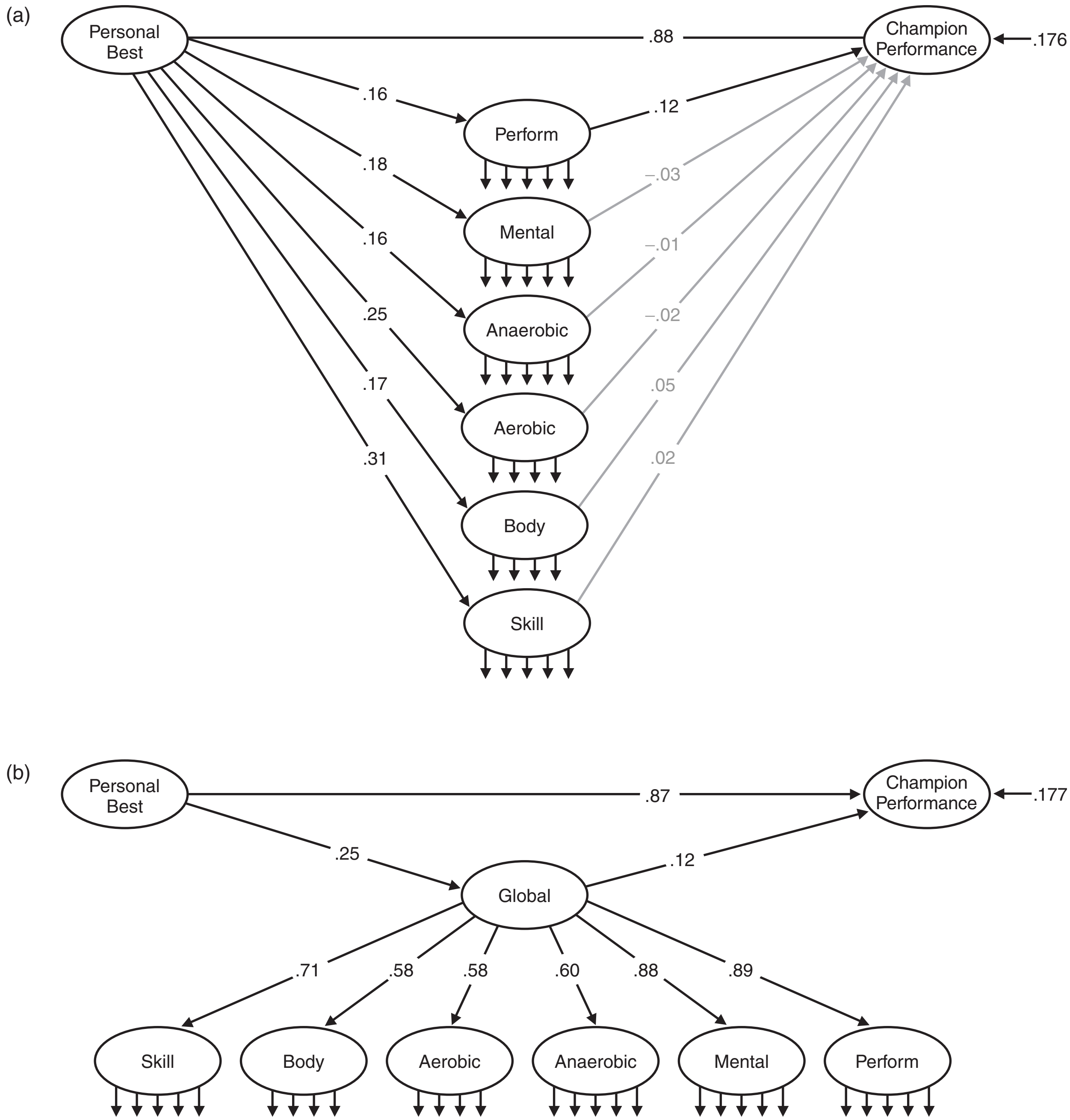

Figure 35.3 Summary of structural equation models predicting subsequent championship performance on the basis of prior personal best and self-concept responses from Marsh and Perry (2005). Self-concept responses are represented as six first-order factors (a) or a single higher-order global factor (b). In (c), results from two different events by the same swimmer are included in the same model.

(continued)

(championship performance), as well as the reciprocal effects model.

Because most swimmers competed in at least two events, we compared results based on their first two events (Model C in Figure 35.3). The effect of global swimmer self-concept on championship performance was highly significant and approximately the same for both events (.13 and .12, respectively). Adapting traditional tests of factorial invariance to this within-swimmer design, we evaluated the replicability of the results across the two events by systematically evaluating the invariance of matching pairs of parameters. There was good support for the invariance of

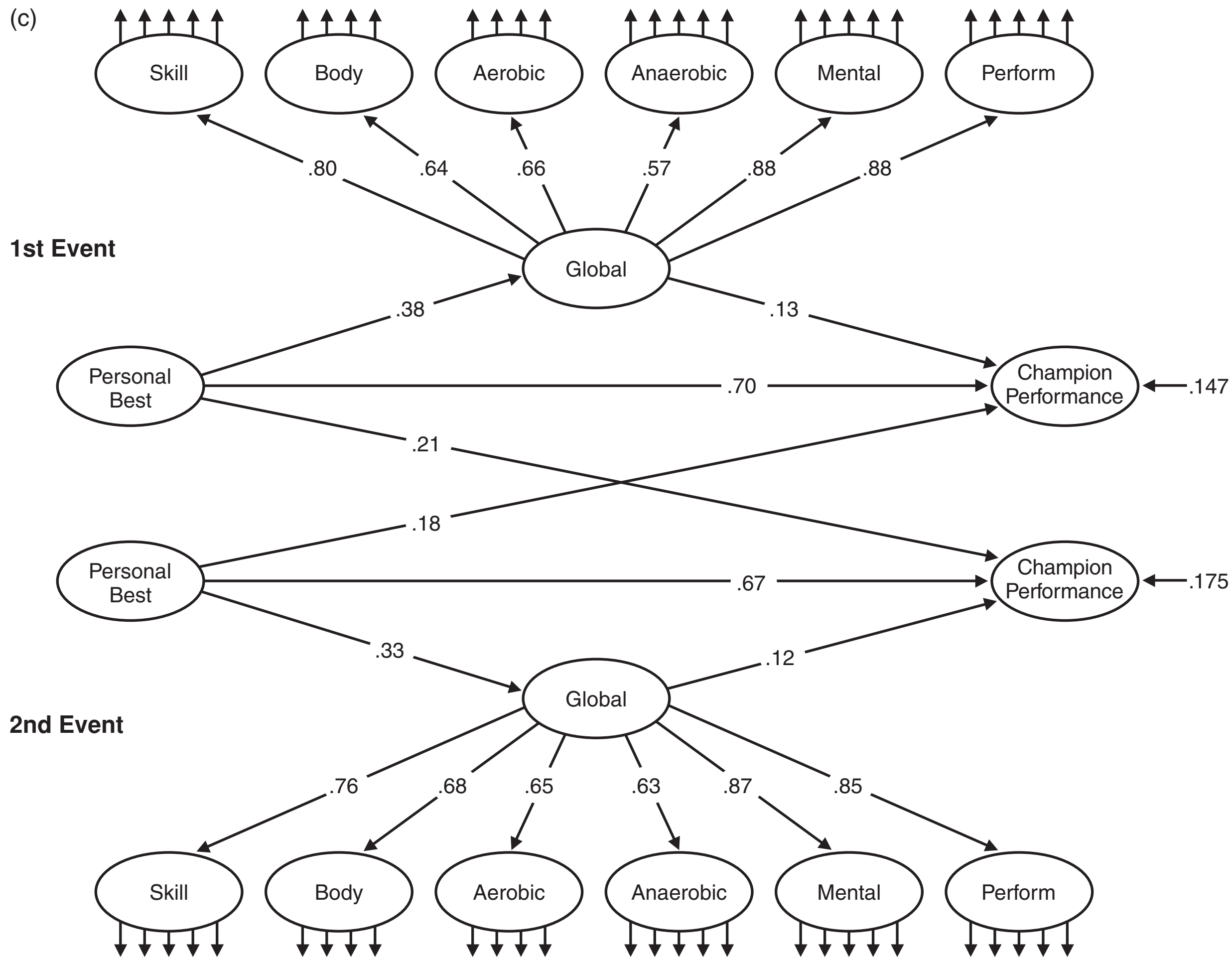

Figure 35.3 *(Continued)*

all parameter estimates. In summary, elite athlete self-concepts have an effect on the subsequent championship performances of elite swimmers beyond that which can be explained in terms of PPBs, and these results were replicated across different events swum by each swimmer.

CONCLUSION

Little more than a decade ago, CFA/SEM statistical techniques were rarely used in sport and exercise psychology research. Today they are widely used, as evidenced by publications in the leading sport and exercise journals. In years to come, they will become a standard tool in the repertoire of quantitative sport and exercise research. In this chapter, I hope to have provided a sufficiently rich array of exciting research applications that will motivate researchers to pursue these analyses, provide new and interesting ways to address existing issues, and stimulate exciting new substantive questions that are uniquely suited to these multivariate techniques. The good news is that SEM technology is more accessible than ever to applied researchers via modern software programs, rapidly expanding experience in how to apply these techniques, and the growing body of expertise acquired by sport and exercise psychologists. I predict that in the next decade applications of CFA/SEM and related techniques in sport and exercise psychology will experience even more growth than that of the past decade.

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CHAPTER 36

From Self-Efficacy to Collective Efficacy in Sport

Transitional Methodological Issues

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In this chapter, we focus on transitional methodological issues that have emerged as sport psychologists have widened the study of efficacy beliefs in sport to include collective efficacy. It is noted that some of this research is better categorized as having occurred with exercise tasks as opposed to sport tasks, but the majority of the work has occurred with sport tasks. For textual parsimony, we use the term *sport* for tasks in both exercise and sport.

Spink (1990a) and Feltz (1992) implored the field of sport psychology to expand the study of self-efficacy beliefs to include the study of collective efficacy in sport. Neither of these scholars predicted the absence of transitional methodological issues. The phrase "transitional methodological issues" is meant to encompass several methodological issues encountered during the past 2 decades as the field responded to the challenge put forth by both Spink and Feltz. Currently there is considerable within group agreement among researchers who contribute in this area of inquiry regarding the importance of collective efficacy in sport. There is also, however, clearly a significant level of within group variance in this same cluster of scholars on some specific methodological issues (e.g., measuring collective efficacy, role of interrater agreement). Regarding these latter areas, we make what we believe to be reasonable recommendations in this chapter. Given the relative infancy of this line of research, it is understandable that there is considerable disagreement in some areas; however, we hope that the recommendations put forth will increase the cohesiveness and quality of subsequent research.

We would like to acknowledge Ahnalee Brincks, MA, for her work on editing this chapter.

All of the studies we review, even those for which we offered targeted and limited critiques (including our own), are to be recognized as having played a role in developing knowledge in this relatively new area.

GENERAL OVERVIEW

The role of efficacy beliefs in human behavior spans many areas of psychology, with sport psychology being only one area (Bandura, 1997). In this chapter, our primary interest was collective efficacy in sport psychology and not other related subareas, such as collective efficacy in industrial and organizational psychology. Therefore, our review of published work (unpublished manuscripts, theses and dissertations, and presentations and abstracts were cited sparingly) should be viewed as relatively exhaustive within sport psychology only. We included literature outside the sport domain only when it was deemed appropriate to make a point within sport psychology; the coverage of relevant literature outside sport psychology was not exhaustive.

The role of efficacy beliefs in sport has proven to be a rich focus area in sport psychology. Because so much related work has been done, a book has been commissioned to chronicle the current knowledge base (see Feltz, Short, & Sullivan, in press). Chapters from other books, including a previous edition of the *Handbook of Sport Psychology* (Feltz & Lirgg, 2001), also provide quality reviews of subareas within this field of study. The focus of this chapter, transitional methodological issues in collective efficacy research, is unique and has yet to receive extensive attention. Specific issues that are intended to be the primary contribution of this chapter include:

- Defining collective efficacy
- Measuring collective efficacy
- Outlining expectations for multilevel modeling in collective efficacy research
- Proposing possible roles for interrater agreement on indicators of collective efficacy
- Providing a foundation for a multilevel model of collective efficacy in sport

To provide a context for these transitional methodological issues, a brief summary of how collective efficacy differs from self-efficacy is provided.

Collective Efficacy and Self-Efficacy in Sport

Both self- and collective efficacy beliefs are "can do," not "will do," perceptions that reside within individuals (Bandura, 1997). However, self-efficacy and collective efficacy differ in the unit of agency. Self-efficacy is an individual phenomenon regarding the belief one has in one's ability to execute a specific task successfully; collective efficacy is focused at the group level. Thus, an athlete can have beliefs about his or her own abilities (i.e., self-efficacy) that may differ from his or her beliefs in the team's ability (i.e., collective efficacy). Individual athletes can differ in their own beliefs about the team's ability (i.e., variance within teams), though an aggregated estimate may be used to represent collective efficacy at the team level when variance between team level estimates is of interest. However, Bandura also theorized that collective efficacy is rooted in self-efficacy. Both constructs are hypothesized as cognitive mediators of performance and probably operate through similar processes. Thus, both are purported to influence behavioral choices, effort exerted on the task, and persistence in the face of difficulties. All of these proposed outcomes can influence team performance in sport.

DEFINING COLLECTIVE EFFICACY

As the field has transitioned to include the study of collective efficacy in sport, two similar definitions of the concept have been used. Bandura (1986a, 1986b) proposed that collective efficacy referred to people's judgments of group capabilities. He defined collective efficacy as "a group's shared belief in their conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1997, p. 476). Zaccaro, Blair, Peterson, and Zazanis (1995) were more explicit than Bandura was in incorporating the coordinative and integrative aspects of collective efficacy in their definition of the concept. They defined it as "a sense of collective competence shared among members when allocating, coordinating, and integrating their resources as a successful, concerted response to specific situational demands" (p. 309). The term *collective efficacy* has been used in the majority of relevant research in sport (see Table 36.1). To achieve greater consistency in both sport psychology and psychology in general, we advocate that future researchers refer to this construct as collective efficacy and not team efficacy.

The subtle differences in Bandura's (1997) and Zaccaro et al.'s (1995) definitions have contributed to impassioned writing about the need for a true definition and theory-based measurement of collective efficacy in sport (Paskevich, Brawley, Dorsch, & Widmeyer, 1999). As Maddux (1999, pp. 223–224) noted:

> The search for the real definition or the true nature of a psychological concept is wrongheaded and ultimately fruitless because there is nothing real or true to discover. . . . The problem is that we have not yet agreed on what we want the term collective efficacy to mean and how we want to measure it.

Several years later, consensus on what is meant by the term collective efficacy exists within groups of researchers (e.g., Paskevich and his colleagues tend to emphasize components of Zaccaro's definition, and Feltz and her colleagues tend to emphasize components of Bandura's definition), yet remains elusive between these groups. This elusiveness unnecessarily bogs down the processing of related manuscripts, and therefore knowledge development, too frequently. Given that neither definition can be "right" if a construct does not truly exist, a more important question is "which definition of collective efficacy leads to the development of measurements that most accurately predict what we want to predict about group behavior" (Maddux, 1999, p. 225).

MEASURING COLLECTIVE EFFICACY

Before reviewing the relationship between various measures of collective efficacy, and other theoretically relevant external variables, an in-depth examination of how these measures have been constructed is warranted.

Assessment Methods

As the field has transitioned to include the study of collective efficacy in sport, multiple methods to assess collective

Table 36.1 Select Characteristics of the Measurement of Collective Efficacy in Relevant Empirical Studies: A Chronological Review

Authors	Term	Item Stem	Sample Item(s)	Number of Items	Setting	Conceptual Analysis	Number of Categories
Spink (1990b)	Collective efficacy	Your confidence	What placing do you expect to attain in Supervolley? How confident are you that your team will attain this placing?	2	Field	No	7
Hodges and Carron (1992)	Collective efficacy	Your confidence	What do you think your group's chances are of winning? How confident are you in your prediction?	2	Lab	No	11*
Lichacz and Partington (1996)	Collective efficacy	Your confidence	Do you think that your group will achieve a better pull than the normative group?	1	Lab	No	11
Feltz and Lirgg (1998)	Team efficacy	Your confidence	Rate your confidence right now that your team can outskate your upcoming opponent team	3 and 8	Field	Yes	11
Greenlees, Graydon, and Maynard (1999)	Collective efficacy	Your confidence	What do you think your group's chances are of winning the first prize?	1	Lab	No	11*
Greenlees, Nunn, Graydon, and Maynard (1999)	Collective efficacy	Your confidence	What are your team's chances of winning the match?	1	Field	No	11* and 10
Paskevich, Brawley, Dorsch, and Widmeyer (1999)	Collective efficacy	Your team's confidence	Our team's confidence that we can spike from the left side of the court is . . .	58	Field	Yes	11*
Greenlees, Graydon, and Maynard (2000)	Collective efficacy	Your confidence	What do you think your group's chances are of winning the first prize?	1	Lab	No	11*
Kozub and McDonnell (2000)	Collective efficacy	Your confidence	How confident are you that your team will retain possession of the ball in a line out?	7	Field	Yes	11*
Watson, Chemers, and Preiser (2001)	Collective efficacy	Not applicable	This team's confidence helps it to perform at its best. This team is poor compared to other teams we compete with. This team is a very effective team.	7	Field	No	5
Vargas-Tonsing, Warners, and Feltz (2003)	Team efficacy	Your confidence	How confident are you that your team will block well?	10	Field	Yes	11
Chase, Feltz, and Lirgg (2003)	Collective efficacy	Your confidence	How confident are you that your team will play well?	1	Field	No	11
Magyar, Feltz, and Simpson (2004)	Collective efficacy	Your confidence	How confident are you that your crew can effectively settle into the race?	22 and 22	Field	Yes	11
Bray (2004)	Collective efficacy	Your team's confidence	Our team's confidence in its ability to hold the medicine ball for 15 seconds . . .	20	Lab	No	11*
Myers, Feltz, and Short (2004)	Collective efficacy	Your confidence	Rate your confidence at this point in the season that your team can outhit tomorrow's opponent.	4 and 9	Field	Yes	11

(continued)

Table 36.1 (Continued)

Authors	Term	Item Stem	Sample Item(s)	Number of Items	Setting	Conceptual Analysis	Number of Categories
Myers, Payment, and Feltz (2004)	Collective efficacy	Your confidence	Rate your confidence right now that your team can beat your upcoming opponent.	7	Field	Yes	11
Hueze, Raimbault, and Fontayne (2006)	Collective efficacy	Your team's confidence	Our team's confidence in our ability to handle the ball against defensive pressure is . . .	27	Field	Yes	11

[*] Assumed that the rating scale used provided 11 categories that were equally spaced, beginning at 0% and ending at 100%.

efficacy have been developed. These assessment methods are interrelated with how collective efficacy has been defined. There are at least four methods that have been used to assess collective efficacy in sport (CE-): (1) aggregating team members' individual responses to *self-efficacy* items (CE-SE); (2) aggregating team members' individual responses to collective efficacy items that are preceded by a stem, which asks an individual to assess *his or her own confidence* in the team's capabilities (CE-CEI, where I is meant to stand for individual); (3) aggregating team members' individual responses to collective efficacy items that are preceded by a stem, which asks an individual to assess *his or her team's confidence* in its capabilities (CE-CET, where T is meant to stand for team); and (4) using a group discussion method to obtain a single, *group-level* estimate (CE-GCE, where G is meant to stand for group).

Comparing the CE-SE Method and the CE-CEI Method

Bandura (1997) suggested that collective efficacy may be represented through the CE-SE method for tasks that are additive or do not require a high degree of interdependent effort, such as the performance of a cross-country team. On highly interactive tasks or in situations where there is a high degree of interdependent effort required to achieve success, measures based on the CE-CEI method are believed to be a better predictor of group performance because members' beliefs about the group encompass the coordinative and interactive dynamics that operate within the group.

Feltz and Lirgg (1998) and Myers, Feltz, and Short (2004) compared the CE-SE method and the CE-CEI method in examining relations between collective efficacy and group performance on interdependent field tasks in hockey and football, respectively. In both studies, and as predicted by Bandura (1997), CE-CEI outperformed CE-SE as a predictor of group performance. Neither study, however, reported a statistically significant difference in the predictive power of CE-CEI over CE-SE. That is, the difference between the coefficient that estimated the relationship between collective efficacy (as measured by CE-SE) and group performance versus the parallel coefficient based on the CE-CEI measures was not reported as statistically significant. Congruent with Bandura, however, we believe that there are sufficient conceptual reasons to caution against using the CE-SE method when assessing collective efficacy for an interdependent task.

Comparing the CE-CEI Method and the CE-CET Method

To date, a primary difference between how collective efficacy has been measured is observed in the stem of the items that athletes have been asked to respond to (see Table 36.1). Researchers who tend to emphasize components of Zaccaro et al.'s (1995) definition have preferred a CE-CET-based stem such as "Our *team's confidence* that we can spike from the left side of the court is . . ." or some variant of this where each individual is asked to rate the team's confidence in its capabilities (see Hueze, Raimbault, & Fontayne, 2006; Paskevich et al., 1999). Researchers who tend to emphasize components of Bandura's (1997) definition have preferred a CE-CEI-based stem such as "Rate *your confidence in your team's ability* to bounce back from performing poorly" or some variant of this where each individual is asked to rate his or her confidence in the team's capabilities (see Chase, Feltz, & Lirgg, 2003; Feltz & Lirgg, 1998; Greenlees, Graydon, & Maynard, 1999, 2000; Greenlees, Nunn, Graydon, & Maynard, 1999; Hodges & Carron, 1992; Kozub & McDonell, 2000; Lichacz & Partington, 1996; Magyar, Feltz, & Simpson, 2004; Myers, Feltz, & Short, 2004; Myers, Payment, & Feltz, 2004; Spink, 1990b; Vargas-Tonsing, Warners, & Feltz, 2003). The majority of published work in sport psychology has employed the CE-CEI method as opposed to the CE-CET method.

Researchers who use some variant of the CE-CET-based stem "Rate *your team's confidence* in its capabilities" often justify this decision based on theory (see Paskevich et al., 1999, for an example). Proponents of this method stress that collective efficacy is a shared, group-level, emergent belief, and that these team-based beliefs arise from an individual's ability to cognitively consider social entities larger than oneself. Therefore, they reason, collective efficacy should be measured by asking individual group members to assess the group's confidence as an informant of the group. These researchers often stress the work of Earley (1993), Lindsley, Brass, and Thomas (1995), Moritz and Watson (1998), and Zaccaro et al. (1995), to name a few. A footnote in the Moritz and Watson paper provides an example of the relevant logic that is typically espoused:

> When a researcher is interested in assessing collective efficacy, we believe that the measures should be constructed so that individuals rate their team's ability to accomplish a specific task (i.e., "Rate your team's confidence that *they* [italics added] can score a power-play goal while playing with an advantage in ice hockey"). In Chan's (1998) collective efficacy example, he uses the following collective efficacy item: "I am confident that my team can perform this task." The wording of these items is very different. Chan's example reflects individuals' perceptions of their group's capability rather than a *group's efficacy per se* [italics added] (Earley, 1993). That is, a respondent is asked to give his or her individual perception of the collective efficacy of the team (Lindsley et al., 1995). Our example uses individuals as informants to estimate the team's collective efficacy. When items are phrased this way, the focus is on the *group's* [italics added] belief rather than on *individual-level* [italics added] beliefs (for a more detailed explanation of these assessment methods, see Lindsley et al., 1995). (p. 286)

As Maddux (1999, p. 225) noted, however:

> Asking me what I believe about what my group believes about its abilities is not the same as asking the group what it believes about its abilities. Therefore, Paskevich et al. did not measure collective efficacy as defined by either Bandura or Zaccaro.

Moreover, the parts of the previous footnotes where we added italics reveal other problems: (a) If a single group entity existed, presumably it would be singular (i.e., it), not plural (i.e., they), and (b) even when items are phrased to focus on individuals' beliefs about the team's beliefs, the focus is still on individual-level beliefs about the team, not the team's beliefs about its capabilities.

Researchers who use a CE-CEI-based stem "Your confidence in your team's capabilities . . ." often justify this decision based on theory (see Myers, Feltz, et al., 2004). They stress that even though collective efficacy is defined as a shared, group-level, emergent belief, it still reflects individuals' perceptions of the team's capabilities, and therefore should be measured by asking athletes to assess their own confidence in the team's capabilities, individually. These researchers often suggest that this mode of assessment is congruent with Bandura's (1997) conceptualization. When referring to the assessment of collective efficacy, Bandura (2001, p. 7) stated: "The second method aggregates members' appraisals of their group's capability as a whole." Members are not asked to assess the group's beliefs of its capabilities (e.g., "Rate your team's confidence in its ability to . . .").

If one applies Maddux's (1999) logic to the CE-CEI method, one would probably conclude that asking team members what they, individually, believe about their team's capabilities is not the same as asking the team what it believes about its capabilities, and therefore, those who use this method are not measuring collective efficacy as defined by either Bandura (1997) or Zaccaro et al. (1995). An examination of Bandura's (2001, p. 23) guidelines for constructing self-efficacy scales, however, provides the following example of instructions for children, in schools, who are to respond to efficacy items regarding the school's capabilities on criterion-referenced tests (CRTs): "Please indicate your confidence level that your school as a whole can attain the different average levels of the CRT scores by the end of the school year."

We prefer the CE-CEI based stem "Your confidence in your team's capabilities. . ." due to accessibility. People have better access to their own beliefs about a group's capabilities than they do to a group's beliefs about its capabilities. Beliefs, even those about a group's capabilities, reside in human beings and not in inanimate social systems. Groups are not alive in the same way that human beings are alive. If a group were alive in the same way, then we could ask it, directly, about its efficacy beliefs or take its blood pressure. There would be no need for informants. We cannot ask a group about its efficacy beliefs because groups are not alive in the same way that human beings are alive. Even when a collection of people who define what we believe to be a group at some point in time are gathered together for the purpose of forming a single, group-level estimate of collective efficacy, questions about the validity of these measures arise because of social persuasion and conformity (Bandura, 1997; Paskevich et al., 1999). If a singular group entity existed and held a set of beliefs, there would be nothing for it to conform those beliefs to in this setting because it would be the only entity being prodded on this measurement occasion. This is not to say that groups of people cannot have similar, or even the same beliefs. Rather, it is to say that even when beliefs are shared within a group they are shared because they reside in the people who compose the group. Or, as Bandura (2001, p. 7) states when referring to the assessment of collective efficacy, "There is no emergent entity that operates independently of the beliefs and actions of the individuals who make up a social system."

The CE-GCE Method

Paskevich et al. (1999) questioned the utility of the CE-GCE method for at least two reasons. First, "it does not detect the nature of the variability that exists when beliefs are shared" (p. 213). And second, "social persuasion and conformity mask within-group variability" (p. 213). These critiques of the CE-GCE method are consistent with concerns expressed by Bandura (1997, 2001). Myers, Feltz, et al. (2004) questioned the utility of the CE-GCE method for reasons similar to those previously stated, as well as the impracticality of implementing this method in a longitudinal field study: evidence for a nonstatistically significant difference between coefficients summarizing relations between collective efficacy and group outcomes where collective efficacy was measured by both the CE-GCE method and by the CE-CET method (Gibson, Randel, & Earley, 2000). Bray (2004) employed the CE-GCE method in assessing collective efficacy for a muscular endurance group task in a lab setting. None of the aforementioned problems with this method were reported. Groups in this lab study were defined by three members, which may have minimized the opportunity for social persuasion and conformity.

Summary

There is insufficient evidence that any of the assessment methods employed to assess collective efficacy produces measures that relate to theoretically relevant external variables (e.g., team performance) significantly better than the measures produced by the other methods. For this reason, any of the methods employed to assess collective efficacy, except for the CE-SE method for highly interdependent team tasks, should be judged acceptable on the continuum of valid measurement. That said, we prefer the CE-CEI method.

Future studies that compare the predictive power of measures derived from these assessment methods should meet at least two criteria to claim evidence for the superiority of a particular method. First, the difference between the coefficients that are being compared should probably be statistically significant—that one coefficient is larger than the other is a necessary but insufficient condition. Second, the magnitude of the said difference, that is, the effect size, should be nontrivial.

BEYOND THE STEM: ADDITIONAL ASSESSMENT ISSUES

As the field has transitioned to include the study of collective efficacy in sport, shared standards for how to create valid indicators (i.e., items) of collective efficacy, the need to provide evidence for an imposed dimensionality on a set of indicators, and how and when to pair collective efficacy measures and performance measures have been elusive. A paragraph from Bandura (2001, p. 1) provides a general context for the structure, and therefore guidance on the creation of indicators of self-efficacy beliefs:

> There is no all-purpose measure of perceived self-efficacy. The "one-measure-fits-all" approach usually has limited explanatory and predictive value because most of the items in an all-purpose measure may have little or no relevance to the selected domain of functioning. Moreover, in an effort to serve all purposes, items in a global measure are usually cast in a general, decontextualized form leaving much ambiguity about exactly what is being measured, and the level of task and situational demands that must be managed. Scales of perceived self-efficacy must be tailored to the particular domains of functioning that are the object of interest.

Certainly the tenants of task-relevant and tailor-made self-efficacy scales are germane to the construction of indicators of collective efficacy.

Feltz and Chase (1998) provided a chapter on the measurement of self-efficacy in sport where some recommendations for assessing collective efficacy were advanced. General recommendations and statements included (a) caution against measures derived from a single item focused on competitive or comparative efficacy; (b) that an a priori conceptual analysis to determine the skills needed to perform in the domain(s) of interest should guide the construction of task-specific and tailor-made scales; (c) optimal categorization of rating scales; (d) that the dimensionality of efficacy scales are typically determined conceptually, not empirically (this is not stated directly, but it is implied on p. 71); and (e) concordance between the efficacy of interest and the external variable one wishes to relate collective efficacy to. We provide a review of how well each of these recommendations has been implemented in the relevant research. We note that some of the relevant studies were completed prior to these recommendations being put forth. We include these studies in our review to provide a fuller history of the relevant research.

Competitive or Comparative Efficacy

It is important to distinguish between competitive or comparative efficacy and outcome expectations. As we have stated in other publications (Feltz & Lirgg, 2001; Feltz et al., in press; Myers, Payment, et al., 2004), judgments about winning an event or placing second or third are not outcome expectations; they are expectations about the performance. As Bandura (1997, pp. 22–23) clearly articulates, "A performance is an accomplishment; an outcome is something that flows from it. In short, an outcome is the consequence of a performance, not the performance itself." Performance accomplishments can take the form of letter grades in academia or a final game score in sports. A trophy, praise from the coach, or self-satisfaction are examples of outcomes that might flow from a performance accomplishment.

Feltz and Lirgg (1998) labeled efficacy beliefs about winning or performing better than an opponent "competitive" or "comparative" efficacy. Collective efficacy measures derived from items of this type are appropriate in a competitive environment, but construction of such measures based on a single item or two similarly focused items is problematic. As can be seen in Table 36.1, measures derived from a single item or two similarly focused items that ask an athlete to report his or her confidence in the team's ability to compete (e.g., achieve a particular placing, or perform better than a normative group) have a history in the research on collective efficacy in sport (see Greenlees, Graydon, et al., 1999, 2000; Greenlees, Nunn, et al., 1999; Hodges & Carron, 1992; Lichacz & Partington, 1996; Spink, 1990b). We recommend against constructing measures of collective efficacy from either a single item or two similarly focused items for three reasons. First, this approach is unlikely to adequately represent collective efficacy as defined by either Bandura (1997) or Zacarro et al. (1995). Second, and probably a by-product of the first reason, there is evidence that measures of efficacy beliefs derived from multiple items may be somewhat more predictive of relevant external variables than are measures derived from a single item (Lee & Bobko, 1994). Third, these types of measures are quite likely to have unidentifiable and or dubious psychometric qualities.

We note that measures of this type have most frequently been imposed in a lab setting and that all of the relevant studies that were conducted in a lab, except one (Bray, 2004), employed this type of measure (see Table 36.1). Lab studies, because of the degree of control that this type of a design allows for (e.g., holding a group performance task constant across teams), may be a necessary condition for advancement of knowledge in collective efficacy in sport. That a study occurs in a lab, however, is not a sufficient condition for inadequately representing the construct of interest. Similarly, employing a single item that is more mastery-oriented (e.g., one's belief that one's team would play well; Chase et al., 2003) in a field study is also likely to inadequately represent the construct of interest, and we caution against it.

Conceptual Analysis

Feltz and Chase (1998) recommend an a priori conceptual analysis, with the active input of at least one content expert, to determine the skills needed to perform in the domain of interest. These skills should be reflected in both the efficacy measure and the external measure of interest. That is, the efficacy measure and the external measure should be reasonably concordant, an issue that is explored in a subsequent section. Here, however, the focus is on the construction of indicators of collective efficacy, not relevant external variables.

As can be seen in Table 36.1, the occurrence of an a priori conceptual analysis to guide the construction of indicators of collective efficacy has become more frequent across time. The most rigorous example of such an analysis is provided by Paskevich et al. (1999). These scholars put forth an eight-dimensional factor model that was defined by 56 items. Other studies that have employed a conceptual analysis have typically specified a unidimensional factor model defined by fewer items (range = 4 to 27). We recommend that the domain of interest, the external variable(s) one wishes to relate collective efficacy to, and the amount of time participants are expected to have to respond to items should determine the scope of the conceptual analysis.

An often-cited study on collective efficacy in sport was provided by Watson, Chemers, and Preiser (2001). Although this study advanced the literature in many ways, it suffers from questionable measurement of collective efficacy. First, there is no evidence that a conceptual analysis of the skill necessary to perform in the domain of interest, high school basketball, in this case, was performed. Second, the items that were used were adapted from a scale by Riggs and Knight (1994) that was developed for use in organizational psychology. The content of the original items is problematic and reads as follows: (a) *The department that I work with has above average ability,* (b) *This department is poor compared to other departments doing similar work,* (c) *This department is not able to perform as well as it should,* (d) *The members of this department have excellent job skills,* (e) *Some members of this department should be fired due to lack of ability,* (f) *This department is not very effective,* (g) *Some members of this department cannot do their jobs well.* Adaptations made by Watson et al. for three of the items are provided in Table 36.1. Adaptations for the other items were not provided in the manuscript. Many, if not all of these items, do not tap "can do" beliefs in the team's capability that Bandura (2001) advocates when assessing collective efficacy. Therefore, the collective efficacy measures and the subsequent relations with theoretically relevant external variables reported by Watson et al. are of questionable validity.

Optimal Categorization of Rating Scales

Bandura (2001) and Feltz and Chase (1998) advocated for rating scale structures of approximately 11 categories (i.e., either 0% to 100% in equally spaced intervals of 10%, or 0% to 10% in equally spaced intervals of 1). In both cases, the low end point is "certain cannot do," the midpoint is "moderately certain can do," and the top end point is "completely certain can do." Typically, none of the other categories are given labels. As can be viewed in Table 36.1, most of the relevant research on collective efficacy in sport has adopted an 11-category rating scale structure.

Maurer and Pierce (1998) argue that a 5-point Likert scale is more practical than the response structures that are typically advocated. Further, they provided evidence that measures derived from responses to the said Likert scale have similar psychometric properties and provide equivalent levels of prediction of theoretically relevant external variables as do measures derived from responses to the rating scale structures typically advocated. Pajares, Hartley, and Valiante (2001) also compared responses to rating scale structures that are typically advocated to a 6-point Likert scale. They concluded that the former structure produced measures with greater prediction of theoretically relevant external variables, primarily because the latter structure produces measures that are less sensitive. Both studies can be classified as employing classical test theory (CTT) methodology.

Item response theory (IRT) is a preferred alternative to CTT in many instances in psychology (Embretson & Reise, 2000). Rasch (1960) models are a family of 1-parameter IRT measurement models (see Tenenbaum & Fogarty, 1998, for an introduction to applying these models to data in sport psychology). These models are well-suited to both analyze rating scale data in general (Wright & Masters, 1982) and to determine the optimal rating scale in particular (Linacre, 2002). The goals of rating scale analyses are to determine whether the original rating scale structure produced estimates with acceptable psychometric characteristics, and if not, then to determine a post hoc rating structure that is defensible conceptually and produces estimates with improved psychometric characteristics. Imposing a rating scale that produces estimates with acceptable psychometric characteristics increases the likelihood of measure stability, measure accuracy, and related inferences for future samples (Linacre, 2002).

There is evidence that efficacy scales in sport employ too many categories (Myers, Feltz, & Wolfe, 2006; Myers, Wolfe, & Feltz, 2005; Zhu & Kang, 1998; Zhu, Updyke, & Lewandowski, 1997). Zhu et al. and Zhu and Kang both found that the functioning of a five-category self-efficacy scale could be improved if collapsed to a three-category structure. Myers, Wolfe, et al. reported that the functioning of a 10-category coaching efficacy scale could be improved if collapsed to a four-category structure. Myers, Feltz, et al. provided confirmatory, cross-validation evidence for the reduced four-category structure. In all three cases (excluding Myers, Feltz, et al., 2006), the respondents were unable to systematically employ, at least in a similar manner across respondents, the original rating scale structure because there were too many categories to successfully distinguish between. It is very likely that rating scale analyses on the traditional 11-category collective efficacy scales would provide evidence for considerable reduction in the structures. Reductions in these rating scale structures would be consistent with long-standing recommendations (Likert, 1932). A concern with such reduction would likely be that these scales would be less sensitive because raw scores would be bunched together. This concern can be allayed in IRT, where raw scores are typically stretched further apart by undergoing a nonlinear transformation onto a logit scale (Smith, 2000).

We recommend empirical study within the IRT framework to determine optimal rating scale structure(s) for scales intended to measure collective efficacy in sport. We hypothesize that the optimal rating scale structure(s) (there may be more than one depending on characteristics of the population of interest) will include considerably fewer categories than are typically used. These studies are important because optimal rating scale structures are more likely to produce psychometrically sound estimates of collective efficacy, assuming that, among other things, the items are good indicators of collective efficacy and that a good-fitting dimensional structure is specified.

Dimensionality

As illustrated in Table 36.2, researchers in this area almost always assume that the collective efficacy of interest is unidimensional and almost never provide empirical evidence to support this assumption. These items are generally nonhierarchical in nature, meaning that they are not the same question repeated at different levels of difficulty (e.g., "How confident are you that your team can win against the opposing team 1 in 10 times?" ". . . 2 in 10 times?"). Instead, they ask about different aspects of the task or performance. Providing evidence for an acceptable level of internal consistency for a collection of items on such a nonhierarchical questionnaire does not confirm that items are homogeneous, and therefore fails to rationalize the imposition of a unidimensional factor model to construct scores (Schutz & Gessaroli, 1993).

That empirical evidence is seldom provided for the assumed dimensionality of a set of collective efficacy items can probably be traced to previous conceptual rationales. For example, Feltz and Chase (1998, p. 71) write:

> Bandura (1978) has rejected criticism that efficacy judgments should be subjected to construct, trait, convergent, and discriminant validation of trait methodology, especially when used with a microanalytic approach. Thus, the validity of self-efficacy measures is typically inferred from how well they predict the behaviors hypothesized in the study.

Whatever the reason, it appears that most researchers in this area see no compelling reason to, nor are they asked by reviewers to, provide empirical justification for imposing a predetermined measurement model on a set of indicators of collective efficacy (see Magyar et al., 2004; Myers, Feltz, et al., 2004; Paskevich et al., 1999; Vargas-Tonsing et al., 2003).

That measures of a construct of interest relate in expected ways to theoretically relevant external variables is but one facet of validity evidence (Messick, 1989). This facet of validity evidence is not the optimum way to determine a reasonable dimensionality for a collection of items. Another equally important facet of validity evidence is to demonstrate that the proposed component(s) of the construct exert influence on responses to the specified indicators of this construct in ways that are predicted by the measurement model (Messick, 1989). This is the optimal way to determine a reasonable dimensionality for a collection of items. Similarly, Bandura (2001, p. 6) recently stated:

> The items tapping the same domain of efficacy should be correlated with each other and with the total score. Factor analyses verify the homogeneity of the items. Different domains of efficacy require different sets of scales with item homogeneity within each of the domain-relevant scales.

Bandura (1997, p. 45) also stated, "Guided by a sound conceptual scheme in the construction of efficacy items, factor analysis can help verify the multifaceted structure of efficacy beliefs." Therefore, we now believe that a thorough conceptual analysis that guides item construction of nonhierarchical questionnaires should embolden researchers to, not excuse researchers from, providing empirical evidence for the imposed measurement model.

A measurement model is imposed whenever responses from multiple items are collapsed into a composite score of some form. We recommend that evidence for the imposed measurement model (e.g., factor analysis) be reported from this point forward. Providing results from this type of analysis is important because it can provide insight into the degree of concordance between the collective efficacy measures produced and the external variable(s) one wishes to relate collective efficacy to (see Myers, Payment, et al., 2004). The external variable(s) one wishes to relate collective efficacy to should be exposed to the same level of scrutiny to provide confidence that the indicators of this external variable relate to each other in ways that are assumed by the measurement model that is imposed. We recommend that empirical evidence is provided for the dimensional structure(s) that is/are assumed in collective efficacy research.

Concordance and Temporal Disparity

Bandura (1997) outlined several design flaws that can obscure the relationship between efficacy judgments and subsequent action. The two design flaws that are the focus of this section are discordance between efficacy judgments and subsequent actions, and temporal disparities between measurements of efficacy and subsequent actions. Both of these design flaws were observed in the literature on collective efficacy and team performance in sport. Before reviewing that relevant literature, both design characteristics are more fully introduced.

There should be a reasonable level of concordance between the efficacy of interest and the subsequent action one wishes to relate the efficacy of interest to (Bandura, 1997). Assessments of collective efficacy and a subsequent

Table 36.2 Select Characteristics of Empirical Studies on Collective Efficacy in Sport: A Chronological Review

Authors	Assumed Dimensionality and Evidence for It	Efficacy and Performance Concordance	Efficacy and Performance Proximity	Level of Analysis	*n*, *g* *n* per *g*	Consensus
Spink (1990b)	Unidimensional Not applicable	Not applicable	Not applicable	Athlete	$n = 92$ g = Not available	No
Hodges and Carron (1992)	Unidimensional Not applicable	Yes	Yes	Team	$n = 163$, $g = 51$ n per $g = 3$	No
Lichacz and Partington (1996)	Unidimensional Not applicable	Yes	No	Athlete	$n = 8$, $g = 25$ n per g = 2 to 4	No
Feltz and Lirgg (1998)	Unidimensional No	Yes	Yes	Within teams	$n = 159$, $g = 6$ n per g = Not available	r_{wg} = .93 to .96
Greenlees, Graydon, and Maynard (1999)	Unidimensional Not applicable	Not applicable	Not applicable	Athlete	$n = 22$, $g = 22$ n per $g = 3$	No
Greenlees, Nunn, Graydon, and Maynard (1999)	Unidimensional Not applicable	Not applicable	Not applicable	Athlete	$n = 66$, $g = 6$ n per $g = 11$	No
Paskevich, Brawley, Dorsch, and Widmeyer (1999)	Multidimensional No	Not applicable	Not applicable	Athlete	$n = 70$, $g = 7$ n per g = Not available	No
Greenlees, Graydon, and Maynard (2000)	Unidimensional Not applicable	Not applicable	Not applicable	Athlete	$n = 26$, $g = 26$ n per $g = 3$	No
Kozub and McDonnell (2000)	Unidimensional No	Not applicable	Not applicable	Athlete	$n = 96$, $g = 7$ n per g = Not available	No
Watson, Chemers, and Preiser (2001)	Unidimensional No	No	No	Multilevel	$n = 315$, $g = 28$ n per g = Not available	r_{wg} = .88 to .98
Time 2	Unidimensional No	No	No	Multilevel	$n = 275$, $g = 26$ n per g = Not available	
Vargas-Tonsing, Warners, and Feltz (2003)	Unidimensional No	Not applicable	Not applicable	Team	$n = 133$, $g = 12$ n per g = 7 to 15	$M\ r_{wg} = .79$ $SD\ r_{wg} = .11$
Chase, Feltz, and Lirgg (2003)	Unidimensional Not applicable	Not applicable	Not applicable	Athlete	$n = 34$, $g = 3$ n per g = Not available	No
Magyar, Feltz, and Simpson (2004)	Unidimensional No	Not applicable	Not applicable	Multilevel	$n = 154$, $g = 33$ n per g = Not available	r_{wg} = .55 to .99
Bray (2004)	Unidimensional No	Yes	Yes	Team	$n = 111$, $g = 37$ n per $g = 3$	Not applicable
Myers, Feltz, and Short (2004)	Unidimensional No	Yes	Yes	Within teams	$n = 180$, $g = 9$ n per g = Not available	r_{wg} = .93 to .96
Myers, Payment, and Feltz (2004)	Unidimensional Yes	Yes	Yes	Multilevel	$n = 243$, $g = 12$ n per g = 15 to 24	$M\ r_{wg} = .87$ $SD\ r_{wg} = .13$
Hueze, Raimbault, and Fontayne (2006)	Unidimensional No	No	No	Athlete	$n = 149$, $g = 17$ n per g = Not available	No

Note: n = Number of subjects; g = Number of teams.

action are concordant when both tap similar capabilities within the domain of interest (e.g., when collective efficacy judgments are based on summative team capabilities, and team performance indicators are indicative of overall team performance). Achieving an acceptable level of concordance does not require a one-to-one correspondence between the items that define the collective efficacy measure and the indicators that define the measure of the subsequent performance of interest. Rather, as Bandura (1986a, 1986b, p. 372) explained, "Items are constructed at an intermediate level of generality representing a generic level of competence at each aspect of a domain." Indicators of the performance of interest should be measured at a commensurate level of specificity. This intermediate and shared level of generality between the efficacy measure and the subsequent performance measure served as the basis for judgment of adequate concordance in our review of the related literature.

"The relation between efficacy beliefs and action is revealed most accurately when they are measured in close temporal proximity" (Bandura, 1997, p. 67). The primary problem with a time lapse between the measurements has to do with the possibility of intervening experiences, which could alter efficacy beliefs, which are not fixed traits. The best way to minimize this potential problem is to measure the beliefs immediately prior to, or during, if possible, performance. In field studies, where access to athletes is often limited, Feltz and Lirgg (2001) recommended that measures be taken at least within 24 hours of performance. Myers, Paiement, and Feltz (in press) provide empirical evidence for this recommendation, and therefore, this recommendation served as the basis for judgment of adequate temporal proximity in our review of the related literature. Research designs that allow for proximal and concordant measures of collective efficacy and subsequent performance are well situated to provide maximal information about this relationship, assuming other design flaws are not present.

Illustrated in Table 36.2, not all of the relevant studies were judged to have an acceptable level of both collective efficacy and team performance concordance, and collective efficacy and team performance proximity. About half of the studies were judged to meet both criteria to a reasonable degree (i.e., Bray, 2004; Feltz & Lirgg, 1998; Hodges & Carron, 1992; Myers, Feltz, et al., 2004; Myers, Payment, et al., 2004). In all of these studies, the expected relation between collective efficacy and subsequent team performance was observed. As predicted by Bandura (1997), studies that maximize both measure concordance and temporal proximity of the measures are quite likely to demonstrate the expected relationships. Subsequent studies should work toward such designs.

The Lichacz and Partington (1996) study was judged to not meet the temporal proximity condition. In this study, collective efficacy appears to have been measured after performance. The order of these measurements would not have been judged to be problematic if the goal was to predict subsequent collective efficacy with a relevant prior team performance. Unfortunately, the authors appeared to express a different focus when interpreting a related correlation matrix:

> This finding suggests that perceiving a task as interesting and involving one's group members may be important for enhancing collective performance efficiency, while perceiving one's group as being likely to achieve a better pull than the normative pull may not be important. (p. 151)

It is difficult to support the conclusion that collective efficacy may not be important for enhancing performance efficiency when it is measured after performance efficiency.

Two of the other relevant studies, Hueze et al. (2006) and Watson et al. (2001), were judged to fail to meet either of the stated criteria to a reasonable degree. In the Hueze et al. study, the collective efficacy and performance measures were judged to be unreasonably discordant because the collective efficacy measure was derived via the CE-CET method and was paired with a measure of *individual* performance. Why an individual performance would be affected by an athlete's judgments of the team's belief in its capabilities was not made clear. Second, the measures were judged to lack a reasonable degree of temporal proximity because the subsequent individual performance measure, which was paired with prior collective efficacy, was an aggregate from the individual's performance from the subsequent 8 games. A nonsignificant correlation was reported between collective efficacy and subsequent performance. Design limitations severely limit confidence in this finding. Subsequent studies should avoid such design flaws. If multiple performances across time are to be regressed on collective efficacy, then multiple and proximal collective efficacy measures should be paired with these performance measures.

The Watson et al. (2001) study also was judged as failing to meet both of the stated criteria when examining the relation between collective efficacy and subsequent team performance. The study gathered collective efficacy data at two time points: once before the beginning of the competitive season (Time 1), and again near the end of the season (Time 2). The collective efficacy and performance measures were judged to be unreasonably discordant for two reasons: Collective efficacy was measured in a way that was not consistent with either Zacarro et al.'s (1995) or Bandura's (1997) conceptualization of collective efficacy, and the collective efficacy measure at Time 1 was derived via the CE-CET method and was modeled as a predictor of *individual* performance (which was the average number of points an athlete scored per game across the season). Why an averaged individual performance across the season would be predicted by an athlete's judgments of the team's belief in its capabilities at the beginning of the season was not made clear. Not surprisingly, collective efficacy at Time 1 was reported as a nonsignificant predictor of the individual performance measure. The collective efficacy and performance measures were judged to lack a reasonable degree of temporal proximity because aggregate measures of points scored (across the season), points allowed (across the season), and final team rank were regressed on "average collective efficacy," which was the average of the observations at Time 1 and Time 2. Average collective efficacy was not a statistically significant predictor of average team points scored or average team points allowed. Average collective efficacy was a statistically significant predictor of team rank. Design limitations lessen confidence in these findings. Subsequent studies should avoid such design flaws. Collective efficacy should be measured in a way that is consistent with at least one of the two common conceptualizations of the construct. And, again, if multiple performances across time are to be regressed on collective efficacy, then multiple and proximal collective efficacy measures should be paired with these performance measures.

MULTILEVEL MODELING

In most instances, multilevel modeling is likely to be the optimal framework for analyzing collective efficacy data. Unfortunately, as can be viewed in Table 36.2, a multilevel framework has rarely been applied to the study of collective efficacy. Common rationales for not implementing this framework with observed data (ignoring models with latent variables) typically are that the research question was at one level of analysis only, or that data were collected from a small number of teams. These rationales to impose single-level models should be judged insufficient in most instances in the future. A full discussion of why these rationales should be judged insufficient in most instances, and how multilevel models should be implemented, is beyond the scope of this chapter but is among the subjects of a similarly focused book by Raudenbush and Bryk (2002). A synopsis of why the first rationale should be considered insufficient, however, is provided in subsequent paragraphs because of its prevalence. As for the insufficiency of the latter rationale, it is incumbent upon researchers to design a study that collects enough data to examine the question(s) of interest with an acceptable level of precision. Of course, both the size of and the accessibility of the population of interest also may influence the sample size. As can be viewed in Table 36.2, the number of teams from which data have been collected has typically ranged from small to moderate.

In most instances, there are serious problems with specifying a single level of analysis when there is a significant proportion of between-group variance in the dependant variable of interest (Raudenbush & Bryk, 2002). In the case of collective efficacy research, specifying a single level of analysis requires one to either ignore the groupings of the data (i.e., analyzing data at the athlete level only) or to ignore the within-team variability (i.e., analyzing aggregated data at the team level only) of the data. When a significant proportion of between-team variance exists, a major problem with analyzing the data at only the athlete level is that the standard errors are likely to be underestimated. Hypothesis tests that utilize these underestimated standard errors are likely to be overly optimistic (Raudenbush & Bryk, 2002). Raudenbush and Bryk summarize the likely and major problems with analyzing data at only the team level as (a) a loss of information and power, (b) inefficient estimation of fixed effects when sample size is unequal within teams, and (c) difficulty in interpreting the amount of variance explained by team-level predictors. Submitting meaningfully nested observed data to multilevel modeling is the most efficient, most unbiased, and most appropriate way to analyze this type of data in most instances (Raudenbush & Bryk, 2002). Completing a quality empirical study with collective efficacy as the dependent variable does not require one to attempt explaining variance in collective efficacy at both the within-team level and the between-team level, but it most likely does require one to at least partition the variance in collective efficacy at both levels before trying to model the variance(s) of interest.

As can be viewed in Table 36.2, imposing multilevel models has become more common in the relevant research over the past several years (see Magyar et al., 2004; Myers, Payment, et al., 2004; Watson et al., 2001). We recommend that subsequent studies in this area should employ similar data analytic frameworks, or at least provide a compelling rationale for the reasons the framework is inappropriate. Early research in collective efficacy focused almost exclusively on single-level analyses at either the athlete level (see Chase et al., 2003; Greenlees, Graydon, et al., 1999, 2000; Greenlees, Nunn, et al., 1999; Hueze et al., 2006; Kozub & McDonnell, 2000; Lichacz & Partington, 1996; Paskevich et al., 1999; Spink, 1990b) or the team level (see Hodges & Carron, 1992; Vargas-Tonsing et al., 2003). Confidence in the results from all of these studies is limited because of the problems associated with the specific data analytic framework that was imposed. Bray (2004) analyzed his data at the team level only, because collective efficacy was measured with the CE-GCE method, and performance was measured at the team level only. Feltz and Lirgg (1998) and Myers, Feltz, et al. (2004) utilized a meta-analytic framework, where the relationships of interest were modeled within teams and an aggregate of this relationship was provided when the specified relationship within teams was sufficiently similar across teams. In most instances, this type of framework is superior to a single-level analysis that ignores the groupings but is inferior to multilevel modeling, which allows one to try to explain the variation around the average effect. In multilevel modeling, the average effect is typically provided regardless of whether there is significant variation around it.

To date, every study in this area that aggregated athlete-level collective efficacy estimates to the team level did so without providing any empirical evidence for the assumed multilevel measurement model (see the chapter by Marsh in this text for a review). That is, the process of taking athlete-level responses to a set of collective efficacy items and forming a unidimensional measure for each athlete, and then aggregating these measures to form a single team-level estimate assumes a unidimensional measurement model both within teams and between teams. Muthén (1989) and Muthén and Satorra (1989) provided an approach to latent variable modeling when the data are meaningfully nested (i.e., all or most items have a significant proportion of between-group variance). Their approach is a large sample technique, where the number of level 2 units, G, should be ~ 100 (Hox & Maas, 2001). When the number of teams is considerably less than 100, and the data are meaningfully nested, analyzing the pooled within-cluster covariance matrix instead of the total variance covariance matrix effectively controls for biases resulting from the multilevel structure of the data with an effective sample size of $N - G$ (Hox & Maas, 2001; Muthén, 1989). We recommend that subsequent studies in this area should consider both approaches, as dictated by sample size at both levels, when providing evidence for the assumed dimensionality of responses to the items. See Myers, Feltz, Maier, Wolfe, and Reckase (2006) for both a conceptual review of confirmatory factor analysis on the pooled within-cluster covariance matrix and an application with real data.

INTERRATER AGREEMENT

Interrater agreement, or consensus, as it is also referred to in sport, has become an unnecessarily thorny issue when athlete-level responses to collective efficacy items are aggregated to form a single estimate of collective efficacy at the team level. We believe that the thorniness is due in large part to the convergence of strongly voiced beliefs that an "adequate" level of consensus *must* be observed within teams before athlete-level observations can be aggregated to the team level, with no clear criteria as to what constitutes an adequate level of consensus. We propose a way around this conundrum. But first, we provide introductions to pertinent background issues associated with interrater agreement: its recent history, how to assess it, how to summarize an assessment of it in a manuscript, and what to do with estimates of it.

Recent History of the Assessment of Interrater Agreement

Conway and Schaller (1998) reviewed various methods for the measurement of consensual beliefs within groups. They described the within-group agreement index, r_{wg}, as put forth by James, Demaree, and Wolfe (1984), as a measure of dispersion that is highly intuitive, moderately difficult to compute, and difficult to compare across studies. All of these characteristics are more fully elaborated on in the subsection on how to assess r_{wg}. For now, it is important to note that in sport, when the degree of interrater agreement is assessed, r_{wg} is typically employed to estimate it. Accordingly, justification for using this index has typically been provided by citing related work by James and his colleagues or citing related work by others who responded to the relevant work of James and his colleagues.

The main focus of James (1982) was that upwardly biased estimates of the consensus of individuals within groups were appearing in the literature because some researchers were mistaking the proportion of variance in *mean* workgroup scores, accounted for by organizations, for the proportion of variance of in *individuals'* perceptions, accounted for by organizations. Why it was important to determine the degree of consensus prior to aggregating scores, however, is of primary interest in this section of our chapter. To understand why consensus was important, James provided some relevant background information in two areas: unit of theory for climate and composition theory for climate. The former area refers to "the appropriate level for operationalizing a construct (e.g., individual *or* organization [italics added to highlight the dichotomy])" (p. 219). The latter refers to "how a construct operationalized at one level of analysis (e.g., psychological climate) is related to another form of the construct at a different level of analysis (e.g., organizational climate)" (p. 219). James contended, among other things, that in most instances, the unit of theory for climate is the individual; consensus must be demonstrated within groups to aggregate individual measures to the group level; adequate consensus within groups may imply that the disaggregated and aggregated measures have a similar interpretation (e.g., psychological *climate* at the individual level and organizational *climate* at the group level) at both levels. James argued that in many instances where there are multiple targets (climates, in this case), correctly specified applications of an index designed to measure interrater reliability, *ICC(1),* was an appropriate index to estimate consensus. He did not offer empirical guidelines for what constituted a sufficient level of consensus for the purpose of aggregating scores to the group level.

James et al. (1984, p. 85) proposed "methods for assessing agreement among the judgments made by a single group of judges on a single variable in regard to a single target." Their methods applied the work of Finn (1970). The product of their application was abbreviated as either $r_{wg(1)}$ (estimate of consensus on a single item) or $r_{wg(J)}$ (estimate of consensus on multiple items). They made clear that in most instances, r_{wg} was not intended to be an alternative to *ICC(1)* because of the single target focus of r_{wg}. That is, r_{wg} was designed to provide an estimate of consensus or interrater reliability (i.e., the degree to which judges are interchangeable) within each group. Presumably, the value in estimating the degree of consensus within each group was tied to James's (1982, p. 220) belief that there are "criteria to be met before aggregating scores on a variable for which the unit of the theory is the individual." James et al. did not offer empirical guidelines for what constituted a sufficient level of consensus to meet these criteria, as measured by r_{wg}, for the purpose of aggregating scores to the group level.

Schmidt and Hunter (1989) provided a cogent argument for why r_{wg}, based on a single stimulus, cannot reasonably be interpreted as a measure of interrater reliability within classical measurement theory. Alternatively, they proposed that when multiple raters respond to a single stimulus, interrater agreement "can and should be indexed by the standard deviation of ratings across the raters (SD_x), and the standard error of the mean rating (SE_M), and its associated confidence intervals" (p. 370). In response to Schmidt and Hunter, Kozlowski and Hattrup (1992) acknowledged that r_{wg} should not be referred to as a measure of interrater reliability. They did, however, conclude that in most instances, r_{wg} does a better job of assessing interrater agreement in regard to the purposes for which it was developed than does either SD_x or SE_M. James, Demaree, and Wolfe (1993) also acknowledged that interpreting r_{wg} as a measure of interrater reliability in classical measurement theory could be viewed as problematic; however, like Kozlowski and Hattrup, they reiterated their belief that the index provides a legitimate estimate of interrater agreement. We interpret r_{wg} as an estimate of interrater agreement or consensus from this point forward and recommend that future research adopt this interpretation.

How to Assess Interrater Agreement with r_{wg}

As can be viewed in Table 36.2, most of the relevant studies have not assessed interrater agreement. This may be partially due to the fact that there is much confusion and misinformation about how to assess r_{wg} in related research. This opinion was formed from reviewing the studies that did assess interrater agreement (including our own), reviewing relevant unpublished manuscripts, and correcting recurring errors in our own research group.

Before we introduce the mechanics of assessing r_{wg} it is important to review some of the assumptions embedded in such an assessment. First, the collection of items has adequate psychometric characteristics, individually and collectively. Such characteristics would include evidence for the dimensional structure of the set of items and adequate internal reliability for the set of items. This assumption reinforces some of our recommendations in our section on dimensionality. Second, the set of items employ the same rating scale. Third, the shared rating scale contains a reasonable number of categories. This assumption reinforces recommendations in our section on optimal rating scales. As James et al. (1984, p. 96) state:

> It is possible to manipulate estimates of $r_{wg(1)}$ and $r_{wg(J)}$ by constructing artificial and unrealistic measurement scales. Adding a spurious number of alternatives to a scale merely to inflate the size of an *EV* [expected variance], and therefore the estimate of IRR [r_{wg}] is poor research practice at best.

Because it is likely that too many categories have been employed in most of the studies that estimated consensus, the r_{wg} estimates reported were probably inflated. Determining optimal rating scale structure for collective efficacy scales is important for a number of reasons, including accurate estimation of the degree of consensus within teams.

For reasons already introduced in our section on competitive efficacy and comparative efficacy, collective efficacy measures based on multiple indicators are preferred; therefore, we review how to derive the corresponding index, $r_{wg(J)}$ (see James et al., 1984, for a fuller introduction). Prior to introducing this equation, we note that it assumes that the items are essentially parallel, an assumption that is rarely met in nonstandardized small-scale assessments. James et al. state that by essentially parallel, they mean "the variances of, and the covariances among, the items are approximately equal, respectively, in the underlying domain of interest" (p. 88). It is our belief, however, that in many cases, the collective efficacy items will be parallel enough to proceed with this analysis. The equation for $r_{wg(J)}$ is

$$r_{wg(J)} = \frac{J\left[1-\left(\frac{\overline{s}_{xj}}{\sigma_E^2}\right)\right]}{J\left[1-\left(\frac{\overline{s}_{xj}}{\sigma_E^2}\right)\right]+\left(\frac{\overline{s}_{xj}}{\sigma_E^2}\right)}$$

where $r_{wg(J)}$ is the within-team interrater agreement for athletes' mean scores based on J essentially parallel items; J is the number of items; $\overline{s^2_{xj}}$ is the mean of the observed variances on the J items; and σ^2_E is the expected variance if all of the responses were random.

In plain language, when the average observed variance is small relative to the expected variance, $r_{wg(J)}$ estimates will approach 1; when the average observed variance is similar to the expected variance, $r_{wg(J)}$ estimates will approach 0. In most situations, $r_{wg(J)}$ estimates should range from 0 to 1. Clearly, this index has some intuitive appeal despite being moderately difficult to compute.

Determining a Value for the Expected Variance

Providing a value for the expected variance σ^2_E requires judgment because it is not provided by the sample data. James et al. (1984) proposed substituting the variance for a uniform rectangular distribution, σ^2_{EU} where $\sigma^2_{EU} = (A^2 - 1)/12$, and A is the number of categories on a *discrete* rating scale (see Mood, Graybill, & Boes, 1974, for a technical explanation of the equation). We highlight *discrete* because by this they meant, among other things, that the rating scale would contain a reasonable number of categories that respondents could employ systematically. In most instances, they assert that a reasonable number of categories will be approximately 7 ± 2. As reviewed earlier, there is accumulating evidence that optimal rating scales for measuring efficacy in sport are likely to contain 5 or fewer categories. As can be viewed in Table 36.1, the number of categories typically employed in sport is greater than 9. In instances where more than 9 categories are employed, we propose that σ^2_{EU} be determined assuming a continuous, not discrete, rating scale: $\sigma^2_{EU} = (A - 1)^2/12$. This would likely minimize the inflation of $r_{wg(J)}$ due to an unreasonably high number of categories. Because the value of $r_{wg(J)}$ estimates is partially dependent on the expected variance that is assumed by the researcher, $r_{wg(J)}$ estimates across studies can only be compared when the expected variance is the same.

Assuming a uniform rectangular distribution for σ^2_E is but one option, albeit our preferred option in many cases. A major contribution of James et al. (1984) was discussing the possibility of assuming nonuniform distributions when an absence of any true consensus exists among group members and a response bias is expected. Common types of response bias that they discussed are central tendency, leniency, and social desirability. Possible corrections for each type of response bias were forwarded. Social desirability is probably the most likely response bias, if a bias exists, in collective efficacy research. It is important to note, however, that observing negatively skewed distributions of responses to collective efficacy items does not guarantee that a response bias is responsible for the shapes of the observed distributions. The expected distribution of collective efficacy prior to a performance is negatively skewed for reasons other than response bias (Feltz & Chase, 1998). Therefore, a negatively skewed distribution can be interpreted in a number of ways: as reflecting true, high collective efficacy; as the result of social desirability; or as some combination of these. Authors who believe that the expected skewness is due, at least in part, to social desirability should apply an appropriate correction. In this case, a correction would likely lower the value of σ_E^2 which, in turn, would lower $r_{wg(J)}$ estimates.

How to Summarize an Assessment of r_{wg} in a Manuscript

To date, summaries of how r_{wg} was assessed in a study have been inadequate. In our experience, this inadequacy often masks inappropriate estimation of r_{wg}. Therefore, we propose a number of suggestions to make the estimation of r_{wg} more transparent. First, tell the reader if r_{wg} was assessed for a single item or for multiple items, by using a more informative abbreviation: $r_{wg(1)}$ or $r_{wg(J)}$, respectively. In our experience, some researchers have summed responses to the collective efficacy items and estimated consensus on this variable as if it were a single item (i.e., $r_{wg(1)}$); we do not advocate this approach. We suggest estimating consensus based on multiple items (i.e., $r_{wg(J)}$) when, in fact, multiple items were used. Second, tell the reader what value for σ_E^2 was utilized. In our experience, some researchers have used the number of categories on the rating scale as the estimate of σ^2_E; we do not advocate this approach. The approach that we do advocate was already outlined in our section on determining a value for the expected variance. Third, tell the reader if a discrete or continuous rating scale was assumed. In our experience, most researchers have assumed a discrete rating scale. Given the number of categories that are typically employed (~ 11), we advocate using a continuous rating scale approach. Fourth, summarize for the reader what the observed distributions were for the set of responses to each item. If the majority of the distributions are negatively skewed, tell the reader if you believe a response bias was at least partially responsible for the observed skewness. If you believe that a response bias was at least partially responsible for the observed skewness, tell the reader how the chosen value of σ^2_E accounted for this bias. If you believe that the observed skewness was not due to any response bias and σ^2_{EU} was used as the estimate for σ^2_E, tell the reader this. None of the studies that we reviewed adequately addressed all four suggestions. The Myers, Payment, et al. (2004) study provides an example to build on, although it does not address the first or second suggestion.

What to Do with Estimates of r_{wg}

Some researchers believe that there needs to be an acceptable level of consensus, as measured by r_{wg}, within a team before athlete-level collective efficacy estimates can be aggregated to the team level. This belief is articulated by Moritz and Watson (1998, p. 287):

> A researcher needs to provide evidence that the group members' judgment of their group's capabilities are shared by the group. Only with such evidence do aggregated collective efficacy judgments represent an emergent group-level attribute. If individual perceptions of the group's capabilities are not shared, then there is no collective efficacy for that group.

We note, however, that multilevel software programs generally do not require that a certain r_{wg} estimate exist before computing a weighted average of the individual-level responses within each cluster.

What constitutes an adequate level of consensus is unclear. To their credit, Moritz and Watson (1998, p. 291) provided a heuristic:

> If one adopts the James et al. (1984) approach, in which group members are viewed as multiple judges rating the same stimulus, then guidelines from classical test theory can be applied to inform the judgment of whether an observed level of interrater agreement is sufficient. Nunnally (1978) stated that the sufficiency of a measure's reliability depends on the use to which the measure is put and that, generally, reliabilities of .50 to .80 can be quite sufficient for research purposes.

If r_{wg} cannot reasonably be considered as an estimate of interrater reliability in classical test theory, then applying guidelines for adequate levels of reliability from classical test theory for the interpretation of adequate levels of r_{wg} is probably unreasonable, too. The lack of a clear cut-off for acceptable r_{wg} values for the purpose of aggregation has contributed to the appearance of a proposed cut-off that has an unknown empirical basis. This proposed cut-off appears even in our own work, in Magyar et al. (2004, p. 151): "James et al. (1984) recommend a mean cutoff of .7 to justify aggregation of individual scores." We no longer believe that such a recommendation was provided by James et al.

We do not support using r_{wg} estimates to discard teams that fail to show an adequate level of consensus, whatever that adequate level may be. We believe that doing so would limit the population of teams that we wish to generalize to, to only those teams that consist of athletes who have some level of agreement on what the team's capabilities are. In short, unlike Moritz and Watson (1998), we have come to believe that even when team members disagree to a significant extent on what the team's capabilities are for a given task, a reasonable estimate of collective efficacy at the team level still exists. In most cases, this estimate would be some version of the mean. The only difference would be that there would be more within-team variance around this team mean, which can be partitioned and explained in multilevel modeling. There can be two units of analysis when a significant proportion of variance exists between teams.

We do support using r_{wg} estimates in at least two ways. First, we believe that r_{wg} estimates should be reported for descriptive purposes. Second, we believe that r_{wg} estimates should be considered a team-level variable in multilevel models. It may be that r_{wg} values explain variance around an average team-level effect. For instance, the average influence of proximal collective efficacy on subsequent performance may be moderate across teams, but there may be a significant level of variance around this average. It may be that teams that consist of athletes who have a low degree of consensus on collective efficacy demonstrate a negligible relationship between collective efficacy and subsequent performance because there is so much within-team variance around the mean collective efficacy for these teams. At this point, we do not believe that there needs to be an acceptable level of consensus, as measured

Table 36.3 Select Characteristics of Empirical Studies on Collective Efficacy in Sport: A Chronological Review

Authors	Correlates ↔	Predictors → CE	CE → Outcomes	Measurement Occasions[a]
Spink (1990b) Elite		Attraction to group: social Attraction to group: task[b] Group integration: social[b] Group integration: task		1
Recreational		Attraction to group: social Attraction to group: task Group integration: social Group integration: task		
Hodges and Carron (1992)		Verbal persuasion (team)[b]	Performance (team)[b]	2
Lichacz and Partington (1996)	Performance efficiency	Verbal persuasion[b]	Performance efficiency (team)[b]	1
Feltz and Lirgg (1998)		Performance (team)[b]	Performance (team)[b]	10 to 32
Greenlees, Graydon, and Maynard (1999)		Verbal persuasion[b]	Effort[b] Persistence	3
Greenlees, Nunn, Graydon, and Maynard (1999)	Positive affect[b] Negative affect Cognitive anxiety intensity[b, c] Cognitive anxiety direction Somatic anxiety intensity Somatic anxiety direction		Positive affect Cognitive anxiety intensity[b, c]	1
Paskevich, Brawley, Dorsch, and Widmeyer (1999)	Attraction to group: social[d] Attraction to group: task[b] Group integration: social[d] Group integration: task[b]	Attraction to group: social Attraction to group: task[b] Group integration: social Group integration: task[b]	Group integration: task[b]	1
Greenlees, Graydon, and Maynard (2000)		Verbal persuasion[b]	Goal selection[b] Commitment[b]	1
Kozub and McDonnell (2000)	Attraction to group: social[b] Attraction to group: task[b] Group integration: social[b] Group integration: task[b]	Attraction to group: social[b] Attraction to group: task[b] Group integration: social[b] Group integration: task[b]		1
Watson, Chemers, and Preiser (2001) Time 1		Self-efficacy[b, c] Optimism[b] Team size (team) Previous performance (team) Confident leadership (team)[b] Self-efficacy (team)[b]		Time 1 = Before beginning of season
Watson, Chemers, and Preiser (2001) Time 2		Self-efficacy[b] Optimism Perception of performance[b] Captain's leadership[b] Collective efficacy time 1[b] Team size (team)[b, c] Previous performance (team)[b] Confident leadership (team) Average points scored (team)[b] Average points allowed (team)	Offensive performance (team) Defensive performance (team) Rank (team)[b]	Time 2 = Near the end of season

(continued)

Table 36.3 (Continued)

Authors	Correlates ↔	Predictors → CE	CE → Outcomes	Measurement Occasions[a]
Vargas-Tonsing, Warners, and Feltz (2003)		Coaching efficacy[b]		1
Chase, Feltz, and Lirgg (2003)		Performance[e] Physiological/emotional state[e] Vicarious experience[e] Outside sources[e] Verbal persuasion[e]		12
Magyar, Feltz, and Simpson (2004)		Experience Task self-efficacy[b] Task orientation Ego orientation Mastery climate (team)[b] Performance climate (team) Team size (team)		1
Bray (2004)	Goals (team)[b] Performance (team)[b]		Performance (team)[b] Goals (team)[b]	1
Myers, Feltz, and Short (2004)		Performance (team)[b, c]	Performance (team)[b]	5 to 8
Myers, Payment, and Feltz (2004)		Performance (team)[b]	Performance (team)[b]	14 to 24
Hueze, Raimbault, and Fontayne (2006)	Attraction to group: task[b] Group integration: social[b] Group integration: task[b]	Group integration: task[b] Performance[b]	Group integration: task[b] Performance	1

[a] Number of times collective efficacy was measured across time.

[b] A statistically significant relationship.

[c] A negative relationship.

[d] Unclear from information provided in paper.

[e] Qualitative study.

by r_{wg}, within a team before athlete-level collective efficacy estimates can be aggregated to the team level.

CONCEPTUAL MULTILEVEL MODEL OF COLLECTIVE EFFICACY IN SPORT

Feltz and Lirgg (2001) proposed that the sources and outcomes of collective efficacy in sport are probably similar to those specified in conceptual models of self-efficacy in sport. The multilevel nature of collective efficacy data probably precludes complete adoption of conceptual models of self-efficacy in sport. That is, sources of collective efficacy at the athlete level may not be the same as sources of collective efficacy at the team level, and so forth. Given the limited number of studies that have adequately handled the multilevel nature of collective efficacy data, confidently proposing a multilevel conceptual model of collective efficacy in sport, buttressed by adequate empirical backing, is beyond our means at this time. That is the work of a future chapter that we hope will be made easier by subsequent adoption of the recommendations forwarded in this chapter. We do, however, provide an up-to-date review of empirical research that has looked at the relationship(s) of external variables with collective efficacy in Table 36.3 as a basis on which future work can be built.

CONCLUSION

A number of recommendations regarding specific methodological issues in collective efficacy research were put forth in this chapter. The purpose of these recommendations was to move this important area of inquiry forward. To make these recommendations more accessible, we summarize some of the general recommendations in Table 36.4. For a fuller account of all the recommendations put forth in this chapter, readers are referred to the relevant subsections in this chapter.

Table 36.4 General Recommendations for Future Research on Collective Efficacy in Sport

I. Defining collective efficacy:
- The term *collective efficacy,* not team efficacy, should be employed.
- Zaccaro et al.'s (1995) or Bandura's (1997) definition of collective efficacy can be employed.

II. Measuring collective efficacy:
- Any of the proposed methods for assessing collective efficacy, except for the CE-SE method for highly interdependent tasks, should be judged acceptable.
- Measures of collective efficacy based on single-items, or two similarly focused items are cautioned against.
- A priori conceptual analysis of the collective efficacy of interest should be performed.
- The domain of interest, the external variable(s) one wishes to relate collective efficacy to, and the amount of time participants are expected to have to respond to items should influence the scope of the conceptual analysis.
- The instrument used to assess collective efficacy should be included as an appendix.
- Research on the optimal rating scale structure(s) for the assessment of collective efficacy should be available.
- Empirical evidence should be provided for the dimensional structure(s) that is/are assumed.
- A reasonable level of concordance should exist between collective efficacy and the external variable(s).
- Reasonable temporal proximity should exist between collective efficacy and the external variable(s).

III. Multilevel modeling:
- The multilevel framework likely is the most appropriate framework in many instances with observed data.
- The multilevel framework likely is the most appropriate framework in many instances with latent variables.

IV. Interrater agreement:
- r_{wg} is interpreted as an estimate of interrater agreement or consensus.
- Summaries of how r_{wg} was assessed in a study should contain more information.
- r_{wg} estimates are not used to discard teams.
- r_{wg} estimates are reported for descriptive purposes and are considered level-2 predictors.

V. Multilevel Conceptual Model of Collective Efficacy:
- A multilevel conceptual model of collective efficacy in sport should be built and tested.

Note: r_{wg} = Within-group interrater as put forth by James et al. (1984).

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PART VIII

Special Topics

CHAPTER 37

Gender and Cultural Diversity

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Why include gender and cultural diversity in this sport psychology handbook? This chapter is included because gender and cultural diversity are integral parts of sport. Participants are diverse, and sport takes place in a culturally diverse world. However, gender and cultural diversity issues are rarely addressed in sport psychology. Sport psychology research is dominated by Western perspectives, and professional practice reflects the cultural boundaries of elite sport. Reviewing sport psychology from a multicultural perspective challenges our worldview, enriches our scholarship and practice, and advances sport psychology in the public interest.

Although titled "Gender and Cultural Diversity," this chapter takes a multicultural perspective, emphasizing the intertwined nature of gender and multiple cultural diversity issues. The growing multicultural psychology scholarship is the primary base, but the framework is also informed by feminist and sport studies scholarship. These scholarly perspectives converge on common themes that form the *multicultural framework* for this chapter. All emphasize multiple, intersecting cultural identities, highlight power relations in the cultural context, and call for social action and advocacy:

- *Multiple, intersecting cultural identities:* We all have gender, race/ethnicity, and multiple intersecting identities, with the mix varying across individuals, time, and contexts. Gender and culture relations are complex and dynamic.
- *Power relations:* Gender and culture relations involve power and privilege—Who makes the rules? Who plays? Who is left out?
- *Action and advocacy:* Multicultural perspectives demand action for social justice. Psychologists, including sport psychologists, develop multicultural competencies and advance psychology in the public interest.

These key themes run through this chapter. After expanding on this multicultural framework and describing the status of cultural diversity in sport psychology, the chapter covers related scholarship and promising directions for enhancing multicultural competencies in sport psychology.

A MULTICULTURAL SPORT PSYCHOLOGY FRAMEWORK

Multicultural psychology may be defined as the "systematic study of behavior, cognition and affect in many cultures" (Mio, Barker-Hackett, & Tumambing, 2006, p. 3). *Culture,* however, is complex and not easily defined. Narrow definitions of culture emphasize ethnicity, but multicultural psychologists typically broaden the definition to include *shared values, beliefs, and practices of an identifiable group of people.* Culture includes race/ethnicity, language, spirituality, sexuality, and, of particular relevance for sport psychology, physical abilities. Cultural diversity encompasses the wide range of differences, and multicultural psychology further emphasizes intersections of identities and the totality of experiences and contexts.

Although culture is broadly defined, culture is often used interchangeably with *race* and *ethnicity.* Race is assumed to have a biological base, but research indicates that physiologically and genetically, humans are far more similar than different. Multicultural psychology takes a critical view of race and racialized science, noting that racial groups are not genetically discrete, reliably measured, or scientifically meaningful (Smedley & Smedley, 2005). Multicultural psychologists argue that race is an unacceptable proxy for social-environmental factors that disproportionately affect minorities, and advocate replacing racial categories with ethnicity, which combines race and culture, and more relevant cultural concepts (Helms, Jernigan, & Mascher, 2005; Shields et al., 2005; Wang & Sue, 2005). In the American Psychological Association (APA) Division 45, the Society for the Psychology of Ethnic Minority Issues, is the base, but multicultural psychology involves intersections, with gender psychology particularly in line with multicultural frameworks.

Gender is highlighted in the chapter title because gender scholarship is more developed and influential in sport psychology than other cultural diversity issues, and because feminist sport studies scholarship provides a useful guide for a more multicultural sport psychology. Sport studies scholars have also addressed race/ethnicity in sport. Sport studies scholarship is the primary source for the race/ethnicity scholarship in this chapter, as the sport psychology literature is virtually silent on cultural diversity issues other than gender.

Feminist and Sport Studies Frameworks

The multicultural framework for this chapter draws from feminist and sport studies scholarship. For example, bell hooks (2000) and M. Ann Hall (1996) provide readable works that emphasize multiple, intersecting cultural relations and call for moving from scholarship to social action. hooks's writings on feminism provide a good starting point, as she invites everybody to understand that "feminism is a movement to end sexism, sexist exploitation, and oppression" (p. viii). The definition is inclusive rather than exclusive, and focuses on action to end oppression. Men have power, but men are also restricted by sexism, and men can be part of the movement. hooks also emphasizes the need to incorporate race and class into a true feminist (and multicultural) perspective.

Sport studies scholar M. A. Hall (1996) describes advances from earlier feminist models to cultural relations in sport studies that fit the chapter framework. Gender influences everyone, and simple, dichotomous categories cannot explain real-world behavior. We all have multiple, intersecting identities, with the mix of identities and power relations varying with time and context. Hall also calls for moves from theory into real-world action. Feminism and multiculturalism demand action to end oppression through professional work and social action.

Multicultural Psychology Perspectives

Psychology has moved beyond its decidedly nonmulticultural past, described in Robert Guthrie's (1998) aptly titled, *Even the Rat Was White.* D. W. Sue, Bingham, Porche-Burke, and Vasquez (1999) provided an overview of APA's first multicultural summit, which met its stated purposes of (a) examining state-of-the-art issues in ethnic minority psychology, (b) identifying barriers to becoming a multicultural profession, and (c) forging alliances for political action and advocacy. In a keynote address, Stanley Sue (1999) argued that traditional psychological research models overemphasize internal validity and hinder ethnic minority research. To move forward, S. Sue advocates that (a) all research studies address external validity and specify populations to which findings are applicable; (b) different research approaches, including qualitative and ethnographic methods, be appreciated; and (c) the psychological meaning of ethnicity or race be examined in ethnic comparison. The first summit gave impetus to new multicultural scholarship. The National Multicultural Conference and Summit II included keynote addresses on gender, race/ethnicity, sexual orientation, and physical disabilities; the overall program highlighted intersections and overlapping of these cultural identities.

Garnets (2001) noted that minority groups share common elements in that all experience identity development and group solidarity and face stereotypes, discrimination, hostility, and violence. As Garnets further noted, minority groups also differ from each other. For example, racial and ethnic minorities typically develop in families and communities with shared identity, whereas sexual minorities and people with disabilities typically grow up without such community. As multicultural psychology scholars emphasize, we all have multiple cultural identities that intersect in many ways.

As well as recognizing cultural diversity in scholarly research and professional practice, multicultural scholars have challenged psychology's foundations. By definition, psychology focuses on individual behavior, thoughts, and feelings, but we cannot fully understand the individual without considering the larger world. Trickett, Watts, and Birman (1994) argue that psychology needs new ways of thinking to understand diversity. They advocate moving from the dominant psychology view, which emphasizes biology, isolating basic processes, rigorous experimental designs, and a critical-realist philosophy of science, to an emphasis on *people in context.*

Derald Wing Sue (2004), who has written extensively on multicultural issues in psychology, described invisible Whiteness and ethnocentric monoculturalism as a deeply entrenched worldview in society and psychology (and certainly including sport psychology). As Sue noted, privileged people are often unaware of power relations that oppress others. Most readers of this chapter are in privileged positions, but we seldom recognize our own privilege. "Color blindness" denies differences and existing power relations, and "standard operating procedures" often deny opportunity to others. Sue argues that psychology must make the invisible visible—recognize White privilege and the culture-bound nature of our scholarship and practice—to advance psychology's mission and enhance the health and well-being of all people. Sport psychology must join in this effort.

Multiculturalism incorporates multiple, intersecting cultural identities—race/ethnicity, multiple cultures, socioeconomic class, sexuality, religion, language, and physical attributes. Disability has been highlighted in APA's multicultural summits, calling attention to disability as a cultural and not simply a physical characteristic accommodated by modification in sport equipment and facilities. Olkin and Pledger (2003) argue that disabled persons are marginalized even as psychology incorporates diversity. They call for disability studies, paralleling the critical studies of gender and race/ethnicity, to emphasize empowerment and social context for disability. Certainly disabled persons are marginalized and among the "left-outs" in sport.

Physical attributes are particularly exclusionary in sport and exercise settings. We unquestioningly refer to elite sport, and elite necessarily implies physically elite. Sport opportunity is limited by physical abilities, physical skills, physical size, physical fitness, and physical appearance. Opportunities are limited not simply by physical barriers, but by our sport culture, which is particularly harsh on those who are not physically elite. The increasing public attention on obesity has created a negative culture for overweight and obese persons, and sport settings are particularly hostile environments. The exclusion of people with disabilities from sport and physical activity is a public health issue. From a multicultural perspective, sport psychology could take the lead in promoting more inclusive and welcoming sport for all, to advance psychology in the public interest.

Multiculturalism calls for expanding research and practice by expanding limited worldviews. First, we must recognize the cultural limits of dominant worldviews and acknowledge multiple perspectives. Moving beyond cultural boundaries and traditional approaches is no easy task. Sport psychology is explicitly context-dependent, and sport is a unique context with cultural boundaries and limits. Sport encompasses diverse participants in varied physical activity contexts. As Parham (2005) states, *context is everything* for effective sport psychology practice. We must consider people in context to understand their behavior.

Like feminist and sport studies scholars, multicultural psychologists call for attention to multiple power relations and social context, but psychologists also retain concern for the individual. The combined focus on the individual and cultural relations may seem paradoxical, but that combination is the essence of a useful multicultural sport psychology. The goal is to understand behavior and apply our understanding to help individuals in the real world. Worell and Johnson's (1997) edited volume on feminist psychology provides guidelines for sport psychologists who wish to be more inclusive, empowering, and effective in their research and practice. We not only put our theories and research into action for individuals, but also work for social change. To meet the challenge, we must incorporate cultural relations and value diversity in all areas of professional practice.

DIVERSITY IN SPORT AND SPORT PSYCHOLOGY

Sport is diverse, but opportunities and access are not evenly distributed among participants. Moreover, sport psychology does not reflect that diversity in research or practice.

Diversity in Sport

Sport participants are diverse, but the sport population does not exactly mirror the broader population. The United States, the primary reference for this chapter, is moving toward increased cultural diversity and in the near future will no longer have one majority racial/ethnic group. The increased diversity is particularly evident in the youth population. In my home community, our public schools have no majority cultural group, and with a large immigrant population, students have over 70 different primary languages. School physical education and community youth programs may reflect community diversity, but elite sport programs often reflect cultural restrictions.

In considering cultural diversity, it is important to go beyond participation numbers to consider power and privilege; that is, *who makes the rules.* In the larger society and in sport, White males hold the power positions. D. W. Sue (2004) illustrates the power differential in noting that although White males make up just 33% of the U.S. population, they hold 80% of tenured faculty positions, 92% of Forbes 400 CEO-level positions, 80% of the House of Representatives and 84% of the Senate, and, of special interest here, *99% of athletic team ownerships.*

Richard Lapchick has been monitoring gender and racial diversity in sport for several years, and the most recent *Racial and Gender Report Card* (Lapchick, 2005) clearly shows racial and gender inequities in collegiate sport, with little progress. The 2004 report card indicates that African Americans are 24.6% of the male athletes and 14.8% of the female athletes in Division I, a higher percentage than in the overall U.S. population. Latino athletes are around 3% for both males and females, far less than their population percentage, with Asian American and Native American athletes at even lower percentages. Interestingly, nonresident aliens make up a higher percentage (around 4.5%) than any racial/ethnic minority group other than African Americans. When we consider the power in college athletics, coaching and administrative positions, diversity is nonexistent. White men dominate coaching, even of women's teams. African American men coach 7.2% of men's teams and 3.4% of women's teams, but African American women coach only 1.6% of women's teams. Coaches of other racial/ethnic identities hardly can be counted, with only Latino men coaches over 1%. Administration remains solidly White male; in 2004, people of color held 5% and women 7.3% of these positions. Clearly, elite sport is elite and not culturally diverse.

What about exercise? The typical exerciser in research and in the fitness club is a young, White, fit, middle-class male. Physical activity, a more inclusive term, suggests diversity, but census data and public health reports indicate that physical activity is not equal across cultural groups. These disparities are particularly relevant in considering sport psychology's role in promoting health and well-being. Research confirms the health benefits of physical activity, cited as the leading public health indicator in *Healthy People 2010* (U.S. Department of Health and Human Services [USDHHS], 2000), but participation is limited by gender, race, class, and especially by physical attributes. Physical activity generally decreases across the adult life span, and the decreases (and increasing inactivity) interact with gender, race, and class. Generally, men are more active than women, racial/ethnic minorities are less active across all age groups, and young adult women (particularly African American women) are one of the most inactive populations in the United States (Kimm et al., 2002; Pratt, Macera, & Blanton, 1999; USDHHS, 2000). Public health initiatives and research efforts often target women and minorities, but programs and measures are seldom adapted to culturally diverse groups.

Crespo, Ainsworth, Keteyian, Heath, and Smit (1999), in one of the few studies to specifically look at social class, used a national database and a multiple measure of social class (education, income, employment status); they found inactivity more common in less privileged social classes, and females more inactive in all social class groups. Crespo (2005) cites the health disparities and low activity levels for minority groups and argues that the potential public health benefit of a physically active lifestyle for racial/ethnic minorities cannot be ignored. Crespo outlines the cultural barriers and calls for professionals to consider the unique needs and cultural constraints when giving advice on exercise. He cites the Robert Wood Johnson (2004) report *Active Living Diversity Project* as a promising resource. Sport psychologists can use such resources and also become key resources for other sport and exercise professionals.

Sport and exercise settings, educational programs, and professional practice are culturally elite. Sport psychology could play a unique role in advancing psychology in the public interest by applying our expertise to promote *sport for all,* so that the benefits of physical activity for health and well-being are not limited to the elite. To do that, sport psychology must expand the research base on gender and cultural diversity and develop multicultural competencies for professional practice.

Diversity in Sport Psychology

Despite the diversity and need for cultural competence in the sport world, sport psychology has not adopted multicultural perspectives. Sport and exercise psychology research does not address diversity issues, professional practice focuses on elite sport, educational programs do not incorporate multicultural competencies, and we have not advanced sport psychology in the public interest. Duda and Allison (1990) identified the lack of research on race/ethnicity, reporting that only 1 of 13 published theoretical papers and 7 of 186 empirical papers (less than 4%) considered race/ethnicity, and most of those were sample descriptions. Ram, Starek, and Johnson (2004) updated the report by reviewing articles in sport psychology research journals between 1987 and 2000 for both race/ethnicity and sexual orientation content and confirmed the persistent void in the scholarly literature. Ram et al. found that 20% of the articles made reference to race/ethnicity and 1.2% to sexual orientation. More important, those few articles provided little analysis and few insights but, as with the earlier literature, were descriptive. Ram et al. concluded that there is no systematic attempt to include the experiences of marginalized groups. Sport psychology has no conceptual models, no empirical research, and no scholarship on cultural diversity in sport.

Cindra Kamphoff and colleagues (Kamphoff, Araki, & Gill, 2004) surveyed the Association for the Advancement of Applied Sport Psychology (AAASP) conference programs from the first conference in 1986 to 2003 to investigate the extent to which AAASP, the primary sport psychology professional organization, included cultural diversity content. Kamphoff et al. coded abstracts "diverse sample" if they included nonmajority participants (females, non-European/Caucasians, youth under 18, adults over 50, etc.), and "diversity issue" if they addressed a diversity issue (gender roles/differences, ethnic identity, stereotypes, etc.). Although increases were seen for both diverse samples, from 10 (19.2%) in 1986 to 126 (36%) in 2003, and diversity issues, from 2 (4%) in 1986 to 54 (15.4%) in 2003, closer examination revealed little attention to multicultural issues. Most of the "diverse" samples were women or youth under age 18, with few samples that were diverse in any other way. Moreover, few abstracts examined diversity issues, with those few focused on gender differences. Although conference programs might be expected to include more diversity issues in professional workshops and presentations, that was not the case. Multicultural perspectives are missing, and cultural diversity is marginalized in sport psychology.

MULTICULTURAL SCHOLARSHIP IN SPORT PSYCHOLOGY

Although sport psychology does not yet have a true multicultural scholarly base, we have related scholarship to draw from. Gender scholarship is established and addresses multicultural issues. This section focuses first on the gender scholarship, moves to the more limited scholarship on race/ethnicity, and then incorporates related scholarship on sexuality, physicality, and multiple cultural diversity issues.

Gender Scholarship

Despite the pervasiveness and power of gender in sport, sport psychology research on gender is limited and focuses on differences while neglecting complex gender issues and relations. Gender scholarship in sport psychology follows psychology; it has progressed from sex differences to an emphasis on gender role as personality, to more current social psychology models that emphasize social context and processes. As Basow and Rubin (1999) explain, gender refers to the meaning attached to being female or male in a particular culture, and gender-role expectations also vary with ethnicity, social class, and sexual orientation. The following highlights gender scholarship that has most influenced sport psychology (see Gill, 2002, for extended discussion).

The Social Context of Gender and Sport

Multicultural sport psychology demands recognition of the social and historical context. Our physical education roots give sport psychology a unique gender context. Strong women leaders developed *women's* physical education as an alternative, separate from men's physical education programs, and provided a women-oriented environment long before the women's movement of the 1970s. At a 1923 conference, key physical education leaders set guidelines that included putting athletes first, preventing exploitation, downplaying competition while emphasizing enjoyment and sportsmanship, promoting activity for all rather than an elite few, and developing women as sports leaders. A related clarifying statement (National Amateur Athletic Federation, 1930, p. 41) concluded with the classic "A game for every girl and every girl in a game." The 1972 passage of Title IX of the Educational Amendments Act marked the beginning of the move away from the early women's physical education model toward today's competitive women's sport programs. Although women have taken giant steps into the competitive sport world, sport remains male-dominated, with a clear hierarchical structure that is widely accepted and communicated in so many ways that we seldom notice.

Sex Differences

Maccoby and Jacklin's (1974) classic review exemplifies the sex differences in psychology research. Their main finding, which often is ignored, was that few conclusions could be drawn from the diverse literature on sex differences. Similarly, Ashmore (1990) later concluded that sex differences are relatively large for certain physical abilities (i.e., throwing velocity) and body use/posturing, more modest for other abilities and social behaviors (e.g., math, aggression), and negligible for all other domains. Average differences are elusive, and the evidence does not support biological dichotomous sex-linked connections. Hyde (2005) recently reviewed 46 meta-analyses of the extensive sex differences literature and concluded that results support the *gender similarities hypothesis:* Males and females are more alike than different on psychological variables, and overstated claims of gender differences cause harm and limit opportunities.

Personality and Gender-Role Orientation

Psychologists and sport psychologists interested in gender issues emphasize personality, following Bem's (1978) lead and using her Bem Sex Role Inventory (BSRI). Both males and females can have a masculine or a feminine personality; and androgyny (high levels of both) is best. More recently, the masculine and feminine categories and measures have fallen out of favor, and even Bem (1993) has progressed to a more encompassing gender perspective. Still, most sport psychology gender research is based on that early work.

Spence and Helmreich (1978) reported that most female collegiate athletes were either androgynous or masculine, in contrast to nonathlete college females, who were most often classified as feminine. Several studies in the sport psychology literature yielded similar findings (e.g., D. V. Harris & Jennings, 1977), but that extensive research provides little insight into gender and sport. One recent study following this model does expand our cultural perspective by surveying Turkish women. Koca and Asci (2005) used the BSRI with a large sample of female elite athletes from feminine, masculine, and neutral sports, as well as nonathletes. Their results paralleled the findings from earlier Western samples, in that Turkish female athletes scored higher on masculinity and were more likely to be classified as androgynous, whereas nonathletes were most often classified as feminine. Koca and Asci cited Choi (2000) in acknowledging that athletics, like other male-dominated occupations, is highly competitive and individual, and both females and males must be competitive, assertive, independent, and willing to take risks—all characteristics classified as masculine.

Overall, this research suggests that female athletes possess more masculine personality characteristics than do female nonathletes, but this is not particularly enlightening. The higher masculine scores of female athletes probably reflect an overlap with competitiveness, but competitive orientation can be measured directly (e.g., Gill & Deeter, 1988); we do not need to invoke more indirect, controversial measures that do not add any information.

Today, most psychologists look beyond the male-female and masculine-feminine dichotomies to developmental and social cognitive models. That is, how people *think* males and females differ is more important than how they actually differ. Although actual differences between females and males are small and inconsistent, gender stereotypes are pervasive (e.g., Deaux, 1984; Deaux & Kite, 1993). We exaggerate minimal differences into larger perceived differences, and these perceptions exert a strong influence that may elicit further gender differences. This cycle reflects the feminist position that gender is socially constructed and highlights social context.

Gender stereotypes certainly exist in sport. In her classic analysis, Eleanor Metheny (1965) identified gender stereotypes and concluded that it is *not socially appropriate* for women to engage in contests in which:

- The resistance of the *opponent* is overcome by bodily contact.
- The resistance of a *heavy object* is overcome by direct application of bodily force.
- The body is projected into or through space over long distances or for extended periods of time.

Gender stereotypes did not fade away with the implementation of Title IX. Kane and Snyder (1989) confirmed gender stereotyping of sports, and more explicitly identified physicality and the emphasis on male physical muscularity, strength, and power as the key feature.

Competitive Orientation

The topic of competitive achievement illustrates the shift from sex differences and gender roles to more complex social models. The early achievement research (McClelland, Atkinson, Clark, & Lowell, 1953) took male behavior as the norm until Horner (1972) focused attention on gender and fear of success. Horner's work faded quickly, and McElroy and Willis (1979), who specifically considered women's achievement conflicts in sport contexts, concluded that no evidence supports a fear of success in female athletes. Global achievement motives have been replaced by multidimensional constructs and social cognitive models, as in my work (Gill, 1993) on competitive sport orientation. Using the Sport Orientation Questionnaire (Gill & Deeter, 1988) with three dimensions of competitiveness, win orientation, and goal orientation, we found athletes were higher on all measures, with competitiveness the primary discriminator between athletes and nonathletes (Gill, 1993). We also found that males consistently scored higher than females on competitiveness and win orientation. However, females were just as high or higher on goal orientation and just as likely as males to participate in noncompetitive sport and nonsport achievement activities (Gill, 1993). In all of our research, gender differences have been minimal and not particularly interesting. With international and university athletes and nonathletes from Taiwan (Kang, Gill, Acevedo, & Deeter, 1990), we found strong differences between athletes and nonathletes but minimal gender differences. With one unique sample of ultramarathoners, we found low win orientations but very high goal orientations and no gender differences (Gill, 1993).

The competitiveness research helps put the gender "differences" into perspective. Generally, males are more competitive than females, but overlap and *similarity* are the rule. Moreover, differences between athletes and nonathletes, and within athlete samples, typically are stronger than gender differences. Overall, gender differences in competitiveness are limited and do not reflect either global achievement orientation or inherent interest in sport activities. Instead, competitiveness seems to reflect opportunity and experience in competitive sport, and gender influence is most evident when there is an emphasis on social comparison and winning in sport (context).

Other researchers report similar gender influences on reactions to competitive sport. When McNally and Orlick (1975) introduced a cooperative broomball game to children in urban Canada and the northern territories, they found that girls were more receptive than boys; they also noted cultural differences, with northern children more receptive. Duda (1986) reported similar gender and cultural influences on competitiveness with Anglo and Navajo children in the southwestern United States. Male Anglo children were the most win-oriented and placed the most emphasis on athletic ability. Weinberg and colleagues (2000) in Australia and New Zealand found similar gender differences across the three cultures, with males higher on competitive, extrinsic, and social recognition motives and females higher on fitness, fun, and teamwork motives.

Gender and Self-Perceptions in Sport

The continuing research of Eccles and her colleagues is particularly relevant to sport psychology. Eccles's (1985; Eccles, Barber, Jozefowicz, Malenchuk, & Vida, 1999) model incorporates sociocultural factors along with achievement cognitions, with both expectations and value as determinants of achievement behaviors. Gender is related to both expectations and value, and expectations and value are influenced by gender-role socialization, stereotyped expectations of others, and sociocultural norms, as well as individual characteristics and experiences. Eccles and Harold (1991) confirmed that the model holds for sport achievement, that gender influences children's sport-achievement perceptions and behaviors at a very young age, and that these gender differences seem to be the product of gender-role socialization.

Eccles is one of the few developmental psychologists to specifically address sport competence, and she consistently finds larger gender differences in sport competence than in other domains. Moreover, even in sport, the gender differences in perceptions are much larger than the gender differences in actual sport-related skills.

Fredricks and Eccles's (2004) review of the literature on parental influence and youth sport involvement revealed that parents held gender-stereotyped beliefs about athletics and were gender-typed in their behaviors, providing more opportunities and encouragement to sons than to daughters. Fredricks and Eccles (2005) tested these hypotheses with three cohorts of children from a larger longitudinal study. They found that mothers and fathers were gender-stereotyped in beliefs and practices, and the parents' perception of the child's ability had the strongest relationship to the child's beliefs and participation. Their results confirmed that boys had higher perceived competence, value, and participation, despite the absence of gender differences in motor proficiency, and suggested that the full set of parent socialization factors influenced children's outcomes.

With the gender issues in perceived sport competence and body image, physical activity has a tremendous potential to enhance girls' and women's sense of competence and control. Many women in physical activity programs report enhanced self-esteem and a sense of physical competence that often carries over into other aspects of their lives. Some research supports these testimonials (Brown & Harrison, 1986; Choi, 2000; Holloway, Beuter, & Duda, 1988; Krane et al., 2004), confirming that exercise programs, particularly weight and strength training, enhance self-perceptions of women participants. Tiggemann and Williamson (2000), in one of the few studies including both women and men and a wide age range (16 to 60 years), found a negative relationship between exercise and self-perceptions for the younger women, but a positive relationship for mature women and both young and mature men. The results suggest developmental changes and also different social processes operating for the young women.

Physical Activity and Body Image

Body perceptions are particularly relevant to sport psychology. Clearly, most women recognize and strive for the ideal, which is much less than ideal in terms of physical and mental health. Boys and men also have body image concerns, but the literature indicates that girls and women are much more negative and concerns are gender-related. Girls are particularly concerned with physical beauty and maintaining the ideal thin shape, whereas boys are more concerned with size, strength, and power. Sanchez and Crocker (2005) focused on *investment in gender ideal* (importance of conforming to the ideal) and its role in well-being with a culturally diverse sample of women and men. They found a negative relationship between investment in gender ideal and well-being, which was mediated through externally contingent self-worth. The model held for African American, Asian, and White men and women. Those who buy into the unrealistic gender ideal pay the price in health and well-being.

Research on body image and gender in sport psychology focuses on societal pressures, gender ideals, and unhealthy eating behaviors with female participants. Some researchers find positive relationships between participation in sport and physical activity and body perceptions (Hausenblas & Mack, 1999), but others find negative relationships (Davis, 1992). Justine Reel and colleagues examined body image, eating disorders, and unique pressures in cheerleading and dance, activities likely to emphasize body issues. Reel and Gill (1996) found strong relationships between body dissatisfaction and eating disorders in cheerleaders, and also found that although high school cheerleaders reported fewer pressures than their college counterparts, they exhibited greater body dissatisfaction and disordered eating. More recently, Reel and colleagues (Reel, SooHoo, Jamieson, & Gill, 2005) explored body image concerns in college female dancers and found that although social physique anxiety and eating disorder scores were moderate, the dancers overwhelmingly reported pressures to lose weight, with unique pressures related to mirrors, performance advantages, and landing roles.

Krane, Waldron, Michalenok, and Stiles-Shipley (2001) held focus groups with athletes and recreational exercisers and found that athletes reported positive affect and body image when considering themselves in the athletic context, but more negative body image as well as maladaptive behaviors (disordered eating) in other social contexts. Cox and Thompson (2000) similarly reported that elite female soccer players were confident in their athletic body, but experienced dissatisfaction and anxiety related to their body. Greenleaf (2002) explored body image issues with competitive female athletes and found that they recognized conflict between their athletic body and social ideals, but the incongruence did not seem problematic.

Fewer studies have examined self-perceptions and body image with the wider range of physical activity settings, but research suggests that exercise is associated with stronger self-perceptions (Caruso & Gill, 1992; McAuley, Bane, & Mihalko, 1995). Hausenblas and Fallon (2002) found that exercise behavior was the strongest predictor of body satisfaction for men, but it was not a predictor for females. Berman, DeSouza, and Kerr (2005) extended that line with recreational exercisers and found that all women cited numerous benefits of physical activity, but weight and appearance were the key motivators for exercise. They further explored the direction of the relationship and reported that weight and appearance concerns prompted physical activity, with no evidence for reverse effects. Daubenmier (2005) investigated self-perceptions with women participants in yoga, aerobics, and nonyoga and nonaerobic activities and found yoga participants more positive, with higher body satisfaction and less disordered eating.

Conception and Ebbeck (2005) explored the role of physical activity with domestic abuse survivors—women who clearly can benefit from programs that foster empowerment and competence. The participants reported that physical activity provided a sense of accomplishment, enhanced mental and physical states, and more of a sense of being "normal." Although the study was limited in scope, it offers promising directions for using physical activity to enhance the well-being of women in a particular cultural context. Clearly, gender, race, and class issues are ever-present in these programs, and feminist and cultural relations perspectives are particularly relevant. Sport psychologists could contribute to this work and could gain greatly from collaboration in these action-oriented, real-life programs.

Overall, research on body perceptions and physical activity suggests that body image concerns are powerful and gender-related and that relationships vary with the sport and cultural context. Sport psychologists who understand the role of gender and culture in body perceptions can help themselves and other sport professionals promote healthy sport and exercise behaviors.

Physical Activity and Adolescent Development

Several researchers and community service professionals have promoted sport and activity programs for youth development. Research supports benefits for both girls and boys, and recent work explores intersections of gender, race, and class. The President's Council on Physical Fitness and Sports (1997) report, *Physical Activity and Sport in the Lives of Girls: Physical and Mental Health Dimensions from an Interdisciplinary Approach,* notes the physical benefits of sport and physical activity (motor skill development, fitness, reproductive function, body density, immune function), gives special attention to the psychosocial benefits (self-concept, emotional well-being, social competence), and concludes with a call for activity programs for girls.

Richman and Shaffer (2000) found a positive relationship between precollege sport participation and self-esteem with college females. They further reported that sport participation led to more positive body image, physical competencies, and gender flexibility; those intervening variables led to greater self-esteem. This retrospective study was predominantly limited to White college students, but other recent work is more inclusive. Pedersen and Seidman (2004) investigated team sport participation and self-esteem with a large sample of adolescent girls from diverse racial/ethnic backgrounds and found team sport participants higher than nonparticipants on self-esteem and athletic self-evaluation.

Miller, Sabo, Farrell, Barnes, and Melnick (1999) used data from the Centers for Disease Control national 1995 *Youth Risk Behavior Survey* of high school students to explore gender and sexuality in the sport context and to address the practical question: Does sport reduce the risk of teen pregnancy? The survey sample is purposely culturally diverse, with similar numbers of Black/African American, Hispanic/Latino, and White youth. After controlling for race/ethnicity, age, and mother's education, results indicated that girls who participated in sport were indeed at lower risk for teen pregnancy. Girls in sport (compared to girls not in sport) reported lower rates of sexual experience, fewer partners, later age of first intercourse, higher rates of contraception use, and lower rates of past pregnancies. Boys in sport also reported higher contraceptive use, but on other measures reported more sexual experience. Miller and colleagues, following cultural resource theory, suggested that athletic participation for girls leads to less adherence to conventional cultural scripts and more social and personal resources in sexual bargaining. Sport for boys provides similar resources, while strengthening their commitment to traditional masculine scripts.

Notably, Miller and colleagues (1999) included a racially/ethnically diverse sample of both males and females. In addition to the main results on sport and sexual behaviors, Miller et al. reported that males had higher sport participation rates than did females, and Whites had the highest participation of the three race/ethnic groups, with Hispanic youth reporting the lowest rates. To date, few studies in sport psychology have incorporated such diverse samples, but the growing work on adolescent development, often focused on underserved youth, necessarily brings that perspective and offers insights into the role of physical activity. Hellison and his colleagues (2000) are operating physical activity programs for underserved youth that focus on adolescent development and promote resiliency and responsibility. Few sport psychology scholars are working on these important issues, with the exception of Steve Danish (Danish, Fazio, Nellen, & Owens, 2002), who has extended his counseling psychology work into community youth development programs and has provided a model for sport psychologists to advance sport psychology in the public interest.

Urban Youth: Intersections of Gender, Race/Ethnicity, and Class

In one particularly relevant report, Erkut, Fields, Sing, and Marx (1996) describe experiences (including sport experiences) that influence diverse urban girls, taking a feminist, cultural relations approach. They noted that gender is a risk factor for eating disorders, depression, and suicide for adolescents, but cautioned that most of the research involves White, privileged girls and describes risk and resilience in White, middle-class models. Erkut and colleagues focused on the intersections of gender, race/ethnicity, and social class to explore differences within as well as across groups.

Erkut et al. (1996) sampled girls from across the United States representing five ethnic backgrounds (Native American, African American, Anglo-European American, Asian Pacific Islander, Latina) and asked the girls, "What activities make you feel good about yourself?" Athletics was the most common response, mentioned by nearly half (46%) of the girls. When asked what about the activity made them feel good, the most common response was mastery or competence (e.g., "I'm good at it"), followed by enjoyment. Erkut et al. also found ethnic and socioeconomic status influences and variations in patterns. Native American and Asian Pacific Islander girls were most likely to cite athletics as the activity that made them feel good. Also, girls with high socioeconomic status were less likely to cite athletics and more likely to cite art activities. Erkut et al. expressed surprise at the prominence of athletics and suggested that the findings called attention to the importance of historical context (post-Title IX for these girls). Erkut et al.'s large, diverse sample and the many variations in findings highlight the importance of cultural contexts in the lives of these girls and suggest exciting directions for sport psychology.

Weis and Fine have been engaged in this work for some time, and their recent collaborative effort (Weis & Fine, 2000) focuses on the intersections of gender, race/ethnicity, and class in urban youth, with contributions from both scholars and community activists. Weis and Fine take a feminist, action-oriented approach; two chapters in their edited book specifically address sport and exercise in the lives of adolescent girls.

Carney (2000) draws on her experience as a figure-skating coach as well as focus group and interview data to investigate sport as a site that enables girls to rework their physical selves as functioning, beautiful, and strong. Her results suggest that these girls do not question traditional femininity, which emphasizes being thin, feminine, and delicate. The girls do see possibilities for skating as empowerment, but they also see limits and constraints. The girls expressed dissatisfaction with their body but also appreciation for their physicalness.

In the same volume, Webster (2000) used interviews to explore girls' identity development through sport and the arts. Sport participants discussed individual success and the excitement of sport, they recognized that they were resisting stereotypes, and the reported athletic success carried over into academics. Girls in the arts discussed the opportunity for reflection, freedom, and release from stress. The girls recognized that the arts discriminate against men, and they cited gay stereotypes and homophobia. Webster concluded that the arts and sports provide space for diverse expressions of gender, which are important for overall identity development and academic work.

Gender affects men as well as women in sport, and gender interacts with other cultural identities. Sport is not only male, but White, young, middle-class, heterosexual male. Still, sport psychology focuses on individuals and has not incorporated multicultural diversity. To move toward a more inclusive and useful sport psychology we must consider the many intersections of gender, race/ethnicity, class, and other power relations.

Gender and Sexuality

Feminist scholarship extends gender analyses to sexuality, as reviewed next. Afterward, the focus is more directly on the emerging multicultural scholarship and intersections of race/ethnicity, social class, and gender.

Heterosexism and Homophobia

Messner, a sport studies scholar who gave a wonderful keynote address at the 1999 AAASP conference, describes sport as a powerful force that socializes boys and men into a restricted masculine identity. Messner (1992) emphasizes the social context and relational analyses as he describes the intersecting influences of gender and homophobia on sport behavior. He argues that homophobia leads all boys and men (gay and straight) to conform to a narrow definition of masculinity. Real men compete and avoid anything feminine that might lead them to be branded a sissy. One successful elite athlete interviewed by Messner noted that he was interested in dance as a child, but instead threw himself into athletics as a football and track jock. He reflected that he probably would have been a dancer but wanted the macho image of the athlete. Messner links homophobia with misogyny: Sport bonds men together as superior to women. We expect to see men dominate women, and we are uncomfortable with bigger, stronger women who take active, dominant roles expected of athletes.

Homophobia in sport has been discussed most often as a problem for lesbians. Despite the visibility of a few prominent lesbian athletes, most remain closeted, and those involved with women's athletics often go out of their way to avoid any appearance of lesbianism. We stereotypically assume that sport attracts lesbians (of course, not gay men), but there is no inherent relationship between sexual orientation and sport (no gay gene will turn an individual into a softball player or figure skater). No doubt, homophobia has kept more heterosexual women than lesbians out of sports, and homophobia restricts the behavior of all women in sport. Moreover, as Messner (1992) suggests, homophobia probably restricts men in sport even more than it restricts women. Men who deviate from the heterosexual norm in the homophobic athletic culture often face ridicule, harassment, or physical violence. Few men, especially adolescents who are concerned about fitting in, step outside the boundaries.

Pat Griffin (1998) has written extensively on homophobia in sport, focusing on connections among sexism, heterosexism, and sport, and Broad (2001) argued that women's sport participation may be interpreted as queer resistance and a "gendered unapologetic." Vikki Krane (2001; Krane & Barber, 2003) is the most active sport psychology scholar addressing issues of sexuality and heterosexism. Krane and colleagues draw connections among gender, sexism, and heterosexism and have applied social identity as a theoretical framework for their work (e.g., Krane & Barber, 2003). Barber and Krane (2005) have taken the feminist and cultural studies approach of moving to action and advocacy and offer suggestions for considering gender and sexuality in sport psychology practice.

Sexual Prejudice in Sport and Physical Activity

Most sport psychology scholarship on sexism and heterosexism focuses on women in competitive athletics, with few scholars examining sexual prejudice in wider physical activity settings. Discrimination and prejudice on the basis of sexual orientation is often described as homophobia, but Herek (2000), a leading psychology scholar on lesbian/gay/bisexual (LGB) issues, prefers *sexual prejudice.* As Herek notes, sexual prejudice is an attitude (evaluation), directed at a social group, involving hostility or dislike. Considerable psychological research confirms persistent sexual prejudice and hostile climates faced by LGB individuals in our society (e.g., Herek, 2000; Rivers & D'Augelli, 2001). Although scholarly research in sport and physical activity settings is limited, national reports from the National Gay and Lesbian Task Force Policy Institute (Rankin, 2003) and Human Rights Watch (2001), as well as observations and anecdotal evidence, suggest that organized sport is a particularly hostile environment for LGB youth, and fitness clubs, sports medicine facilities, and recreational physical activity programs do not welcome gay men and lesbians.

In one of the few empirical studies, Morrow and Gill (2003) reported that both physical education teachers and students witnessed high levels of homophobic and heterosexist behaviors in public schools, but teachers failed to confront those behaviors. Over 60% of the teachers and students see homophobia, and over 50% of gay and lesbian youth experience homophobia. The good news is that over 75% of the teachers say that they want safe, inclusive PE; on the bad news side, over 50% of those teachers themselves report that they *never* confront homophobia.

In our research, we examined the climate for cultural minority groups, focusing on sexual prejudice. The initial study (Gill, Morrow, Collins, Lucey, & Schultz, in press) examined attitudes toward racial/ethnic minorities, older adults, and persons with disabilities, as well as perceptions of sexual minorities. Overall, attitudes of our preprofessional students toward gay men and lesbians were similar to attitudes reported in other samples and reflect the sexual prejudice in society. Evaluation scores were generally positive but markedly lower and more negative for both gay men and lesbians than for other minority groups, with males especially negative toward gay men. Interestingly, on our demographic page, many students went out of their way to indicate that they were exclusively heterosexual, further confirming the stigma of gay/lesbian identity and social acceptance of sexual prejudice.

Sexual Harassment

Sexual harassment has clear gender connotations and relevance to sport psychology. Given the prevalence of sexual harassment and sexual assault, female athletes are much more likely to present problems related to these issues than eating disorders or other potentially clinical issues. Considerable psychological research (e.g., Koss, 1990) and public attention demonstrate the prevalence of sexual harassment, and sport studies scholars have addressed the issue in sport. The sport psychology literature, however, is silent on this topic.

Lenskyj (1992) discussed sexual harassment in sport, drawing ties to power relations and ideology of male sports and noting unique concerns for female athletes. Sport (as a nonfeminine activity) may elicit derisive comments; clothes are revealing; male coaches are often fit and conventionally attractive; female athletes spend much time training and less in general social activity; coaches are authoritarian; and for some sports, merit is equated with heterosexual attractiveness.

Interestingly, sexual harassment and abuse are receiving attention at the international level. At the 2001 International Society of Sport Psychology Congress, Kari Fasting of Norway and Celia Brackenridge of the United Kingdom (2001) organized a symposium on sexual harassment and abuse with colleagues from around the world. These scholars, from varying perspectives and different countries, converged on common feminist themes and clearly showed the prevalence of sexual harassment and abuse throughout the sport world. Their collective works indicate that the sport climate fosters sexual harassment and abuse; that young, elite female athletes are particularly vulnerable; that neither athletes nor coaches have education or training about the issues; and that both research and professional development are needed in sport psychology to address issues of sexual harassment and abuse (Brackenridge, 1997; Brackenridge & Kirby, 1997; Bringer, Brackenridge, & Johnston, 2001; Kirby & Wintrup, 2001; Leahy, Pretty, & Tenenbaum, 2001; Volkwein, 2001; Volkwein, Schnell, Sherwood, & Livezey, 1997).

Sexual harassment and assault probably occur much more often than we recognize. Consultants who are aware of gender and cultural dynamics might be quicker to recognize such issues and help athletes deal with the situation. Both female and male athletes must be aware of issues, and the cooperation of male and female administrators can be enlisted to support educational efforts and promote social action.

Gender and sexuality are a particularly salient part of a complex, dynamic, ever-changing cultural context in sport and exercise settings. We now turn to race and ethnicity and explore the intersections of race/ethnicity with gender, as well as look for guidance for sport psychology work on cultural diversity.

Race/Ethnicity Scholarship

As Ram et al. (2004) reported, the striking void in sport psychology on race and ethnicity persists despite the increased multicultural diversity in society and in sport. Sport psychology research rarely includes ethnically diverse participants and does not even have the limited work on racial/ethnic stereotypes and self-perceptions to parallel the gender research. Sport studies scholar Yevonne Smith (1992, p. 224), in her review of the research (or lack of it) on women of color, called for “more relational analyses of and by diverse women of color and to understand how collective personal experiences and processes are informed by race, gender, and class power relations.” As Smith suggests, a more critical analysis of race/ethnicity is a good starting point for a more insightful approach to cultural diversity in sport psychology.

Critical Perspectives on Race/Ethnicity

Marable (2000), a noted historian and African American studies scholar, called for a new, critical study of race and ethnicity that recognizes the intersections of gender and cultural identity in a dynamic social context. Marable stated, "A new racial formation is evolving rapidly in the United States, with a new configuration of racialized ethnicity, class and gender stratification and divisions" (p. B7). Both Y. R. Smith's (1992) and Marable's statements reflect Trickett et al.'s (1994) call for a new paradigm in psychology that emphasizes multiple cultures and people in context.

For example, the experiences of a Black female tennis player are not simply a combination of the experiences of White female and Black male players. Althea Gibson's (1979) personal account highlights complex interactions of race and gender and illustrates influences of historical and immediate cultural contexts in her development as a tennis player and as a person. Serena Williams grew up in a different world. Certainly race, gender, and cultural context have tremendous impact, from the playground to Wimbledon, but society has changed, and cultural relations have changed from Gibson's day.

Social class often is conflated with race/ethnicity in public discussion and professional work, but social class is qualitatively different from race/ethnicity. Class operates in all racial/ethnic groups and also interacts with gender, but there is little research on social class in psychology and none in sport psychology. C. Smith (2005) states that the poor are not served by psychology, despite many calls to address the needs of poor people. Moreover, C. Smith describes problems in defining and assessing social class and takes a critical multicultural perspective arguing that focusing on class (or any social identity) does not represent the complex interactions among class, race/ethnicity, and gender that people experience.

Most of the limited research covered in this section focuses on race/ethnicity, and almost none incorporates class. As discussed earlier, intersections of gender, race/ethnicity, and class are inevitable in sport and have psychological implications. Psychology has begun to address race/ethnicity, increasingly from a multicultural perspective. Sport psychology has not addressed race/ethnicity, but again, sport studies scholars provide some directions.

Sport Studies Scholarship on Race/Ethnicity

Sport studies scholars note that significant numbers of athletes are not White and middle class, yet power remains solidly White and middle and upper class. The popular media and some scholars have discussed such practices as "stacking" (i.e., assigning African Americans to positions such as football running back or baseball outfield but not in central quarterback or pitching roles) and the White male dominance of coaching and management positions. More recent reports include critical analysis of race or class in sport.

E. Smith and Henderson (2000) referred to stacking as the longest thread in sport sociology research. As they noted, most of that research focuses on professional male sports and confirms that White players tend to hold central, controlling positions, whereas African Americans tend to hold peripheral positions. E. Smith and Henderson argued that the interrelated phenomena captured by the term stacking are primarily characteristics of social isolation, marginalization, and systematic discrimination against African Americans. Jamieson, Reel, and Gill (2002) extended the stacking research to women's sports and collegiate softball, finding patterns differing from those in professional male sports. White women, as in previous studies, predominated in the most central position of catcher. As expected, African American women were stacked in the peripheral outfield positions, and so were Asian American women, in contrast to typical stereotypes. Latina players were stacked in the central positions of pitcher and infield, challenging the notion that all minority players are stacked in noncentral positions and calling for more complex cultural analyses.

Brooks and Althouse's (2000) edited volume on racism in college athletics includes a welcome section on gender and race. Y. R. Smith (2000) opens that section with a discussion of the sociohistorical influences on African American elite sportswomen. African American women are necessarily at the intersections of race, gender, and class, facing both sexist and racist oppression. Y. R. Smith gives voice to some of the outstanding women athletes who achieved success despite the oppressive cultural context, including Louise Stokes and Tydie Pickett, the first African American women to participate in the Olympics, in 1936 (the year of Jessie Owens's outstanding performances). Tuskegee Institute and Tennessee State, both historically Black colleges, offered unique cultural settings and opportunities for African American women track athletes before the civil rights and women's rights movements. Several African American women Olympians trained at Tuskegee, and from 1956 to 1977 the Tennessee State Tigerbelles were widely known as the training base for outstanding African American women track athletes, including Willye White, Madaline Manning, Wyomia Tyus, and Wilma Rudolf.

The civil rights movement, though facilitating integration and opportunities, did not open all doors, as private clubs and many sport facilities held to racist and classist policies, and public programs often were slow to progress. As Y. R. Smith (2000) notes, YWCAs, Historically Black Colleges and Universities [HBCUs], public schools, and other community-based educational and sports structures became the dominant support networks for African American female athletes. Taking a more critical analysis, Y. R. Smith notes that the tradition of athleticism for women comes out of social acceptance of physicality and recognition of the inner strength of women. She concludes, "Thus, educational and sport structures within the African American community, as well as gendered and racial ideology in American society, have significantly influenced the social history of women of color in sports" (p. 194).

Corbett and Johnson (2000) similarly focus on the cultural context for African American women in collegiate sport, calling attention to the overlooked heroines and continuing nonrepresentative media coverage. Like Y. R. Smith (2000), they note the pioneering African American sportswomen, and specifically highlight women's basketball coaches as overlooked stars. Women are underrepresented in collegiate coaching and administration, and African American women are barely included at all. Corbett and Johnson cited the 1997 *Racial Report Card,* (see Lapchick, 2005, for current report data) noting that Black women held 2.1% of the Division I head coaching positions for *women's* teams (compared to 40.3% for White women, 52.1% for White men) and only 1% of college athletic director positions (6.3% for White women, 82.2% for White men). In the 2004 *Racial Report Card* (Lapchick, 2005), the numbers have actually dropped, with only 1.6% of the women's head coaching positions and no athletic director positions held by African American women. Corbett and Johnson noted that the Black community has been instrumental in supporting African American women and buffering negative societal influence, that African American sportswomen are becoming more vocal, and that networks of professionals are providing a supportive sport environment. However, the barriers persist and the cultural context in sport continues to exclude women of color.

Psychology Scholarship on Race/Ethnicity

The psychology scholarship on race/ethnicity is growing and beginning to take a multicultural perspective. Like the gender scholarship, the psychology research on race/ethnicity emphasizes stereotypes and social cognition, and much of that work addresses health disparities, which is particularly relevant for sport psychology.

Health disparities, and particularly racial/ethnic and socioeconomic disparities, are well-documented (USDHHS, 2003) and key topics in public health and health psychology. Adler and colleagues (1994) reported on the social gradient in health, calling attention to the role of social class in health risk, health behaviors, and health care. Contrada et al. (2000) summarized research on ethnicity-related stress, noting that evidence indicates racial/ethnic minorities face stress based on discrimination, stereotypes, and conformity pressures within groups and that these stresses affect health and well-being. As Yali and Revenson (2004) suggest, with the changing population demographics, socioeconomic disparities are likely to have an even greater impact on health and mental health in the near future. Health disparities are relevant to sport psychology in that physical activity is a key health behavior, and sport psychologists are in a position to provide guidance on promoting physical activity for health and well-being.

Steele (1997) has done extensive research on gender and racial/ethnic stereotypes and stereotype threat—the influence of negative stereotypes on performance (Steele, Spencer, & Aronson, 2002). Steele's research indicates that stereotypes affect all of us, and the most devastating effects are on those minority group members who have abilities and are motivated to succeed. Steele's research also suggests that even simple manipulations that take away the stereotype threat (e.g., telling students the test does not show race differences) negate the stereotype effects. Stereotype threat has been widely researched and extended to sport. Beilock and McConnell (2004) reviewed the stereotype threat literature, concluding that negative stereotypes are common in sport and lead to performance decrements, especially when the performers are capable and motivated.

Stereotypes are common is sport, for example, "White men can't jump"; "throw like a girl," and "Blacks can't swim." The prevalence of negative stereotypes for racial/ethnic minorities, particularly African American athletes, is documented in the psychology and sport studies literature. Devine and Baker (1991) found "unintelligent" and "ostentatious" associated with the category "Black athlete," and Krueger (1996) found both Black and White participants perceived Black men to be more athletic than White men. Johnson, Hallinan, and Westerfield (1999) used photos of a Black, a White, a Hispanic, and a composite male athlete and asked participants to rate attributes of success. Results conformed to stereotype as success for the Black athlete was attributed to innate abilities, whereas success was attributed to hard work and leadership ability for the White athlete. Interestingly, no stereotyping was evident for the Hispanic athlete. This nonresult may reflect the lower visibility of Hispanics in sport. There is little research on racial/ethnic minorities other than African Americans; scholarship and views seem limited to Black and White. Both O. Harris (2000) and Sailes (2000) document persistent stereotypes and report that African American athletes are more likely than White athletes to have higher aspirations for professional sports and see sports as a route to social mobility. These views may reflect stereotypes or barriers in other areas, but certainly suggest cultural influences and power relations in sport.

More important, stereotypes affect performance and relationships in sport. Stone, Perry, and Darley (1997) had individuals listen to a college basketball game and evaluate players; they were told that the player they were evaluating was Black or White. Black players were rated more athletic, whereas White players were perceived as having more basketball intelligence by both White and Black students. After confirming those stereotypes, Stone and colleagues (Stone, Lynch, Sjomeling, & Darley, 1999) had African Americans and Caucasians perform a golf task framed as a test of "sports intelligence" or "natural ability." Stereotype threat was confirmed as Black participants did worse when told the test was of sports intelligence, and White participants performed worse when told the test was of natural ability. Stone (2002) continued his line of research with a study demonstrating that White athletes faced with stereotype threat were prompted to use self-handicapping behaviors.

Beilock and McConnell (2004) linked the stereotype threat phenomenon to attention and cognitive strategies in sport. One explanation for stereotype threat is that threat reduces memory capacity, but in sport, skills are performed best when proceduralized and run without conscious control. Beilock and Carr (2001) suggest that calling attention to skills can lead to performance decrements, or "choking under pressure." Beilock and colleagues' research with golfers suggested that stereotype threat leads to poorer performance by increasing attention to monitoring, which disrupts proceduralized performance. Beilock and McConnell suggest that stereotype threat both fills working memory and entices the performer to pay more attention to step-by-step control. They further suggested that positive stereotypes might enhance performance if they increase self-efficacy and attention to relevant tasks. Beilock and McConnell also pointed out that people are members of multiple groups, and how they think about their group membership is critical. Different aspects of cultural identity may be more or less salient to an individual, or in differing situations, and salience is a critical mediator of stereotype threat effects. As Beilock and McConnell conclude, we know less about stereotype threat in sport and motor domains than in cognitive areas. The processes may well differ, but with the abundance of stereotypes in sport, their influence is clearly a relevant issue for sport psychology.

Social psychology research suggests that stereotypes are common and influential, that social cognitive processes are important, and that minority group members are active agents in the process. Sport psychologists can take direction from the psychology research on race/ethnicity. Clearly, racial/ethnic minorities face similar stresses in sport and exercise settings, and stereotypes influence behaviors and relations in sport.

Sport psychology research on race/ethnicity that reflects multicultural analysis is nonexistent, and we have few models. Barnes, Zieff, and Anderson (1999), in a critical review of the motor development research on Black and White infants from the 1930s through 1992, described how power relations and historical context, including dominant views on race relations, influence our presumably objective science, research methods, and interpretations. McGraw's (1931) classic research reflects the prevailing biology-based notions of racial superiority. As with gender research, motor development research on race favored biological explanations and categorical analyses until the 1980s, but current research follows more complex, dynamical systems models.

In one of the few studies to look at race/ethnicity, physical activity, and aging, Heesch, Brown, and Blanton (2000) examined the exercise barriers for adult women over age 40. Their large sample (nearly 3,000) included similar numbers of African American, Hispanic, Native American, and White women, and they compared perceived barriers across the stages of precontemplation, contemplation, and preparation/action. They found several common barriers across racial/ethnic groups within stages. For example, being tired was a barrier for all precontemplators, and lack of time was a barrier for most contemplators. However, they also reported differences between stages that varied by racial/ethnic group. In offering suggestions for interventions, the authors noted some consistent barriers, but cautioned that their reported differences and specific community needs preclude definitive guidelines. They called for continued qualitative as well as quantitative research to more appropriately design interventions to increase exercise.

Extending Multicultural Scholarship in Sport Psychology

Sport psychology can adopt similar complex, dynamic models of gender and cultural relations to advance our work on race/ethnicity. Moreover, a true multicultural framework recognizing multiple, intersecting identities and power relations includes diverse racial/ethnic groups, social class, and particularly physical attributes.

In sport psychology, the person who has most eloquently addressed the intersections of gender, race, and sexuality is Ruth Hall. Hall brings a clear and strong feminist and multicultural perspective, whether drawing on her clinical experiences to discuss the role of exercise in therapy with African American women (Hall, 1998) or more explicitly trying to "shake the foundation" of sport psychology in discussing the marginalization of women of color in sport (Hall, 2001).

Physicality

Sport psychologists deal with physical activities, and physical abilities and characteristics are prominent. Within multicultural frameworks, disability is a cultural issue (Olkin & Pledger, 2003) and particularly relevant for sport psychology given that exclusion on the basis of physicality is nearly universal in sport. Physical activity professionals address physical disabilities with adapted activities, but seldom address physicality as a cultural diversity issue. In discussing the role of physical activity in the health and well-being of those with disabilities, Rimmer (2005) notes that people with physical disabilities are one of the most inactive segments of the population. Rimmer cites the physical barriers but argues that organizational policies, discrimination, and social attitudes are the real barriers.

As part of the larger study on sexual prejudice cited earlier, we (Gill, Morrow, Collins, Lucey, & Schultz, 2005) examined the climate for minority groups (racial/ethnic minorities, LGB people, older adults, and those with disabilities) in organized sport, exercise settings, and recreational settings. Overall, the ratings were in the midrange, indicating neither inclusive nor exclusive climates, but notably, the climate was rated as most exclusionary for those with disabilities. Although earlier results revealed positive attitudes toward all minority groups, with somewhat lower ratings only for gay men and lesbians, the climate results indicate that these students recognize the exclusion of minority groups, particularly those with disabilities, in exercise and sport.

Several sport studies scholars have addressed physicality as a cultural diversity issue, and DePauw (1997) specifically addresses the intersections of gender and disability from a cultural relations perspective. Henderson and Bedini (1995) also explored gender and disability issues, noting that women with disabilities report leisure, therapeutic, and health values, but some see little value for physical activity in their lives. Blinde and McCallister (1999) interviewed women ages 19 to 54 who had varied physical disabilities and found that these women participated in more fitness than sport activities, participated to maintain functional capabilities, valued intrinsic gains (perceived competence, enhanced body image, control), and perceived differences in the activity experiences of men and women with disabilities.

Physical diversity is more than ability and disability, and physicality is particularly relevant to sport psychology. Physical skill, strength, and fitness are key sources of restrictions and stereotyping in sport. Physical appearance, particularly obesity, is a prominent source of social stigma and oppression in sport contexts. Multicultural sport psychology must highlight physicality as a cultural diversity issue.

FROM MULTICULTURAL SCHOLARSHIP TO PROFESSIONAL PRACTICE

Moving from scholarship to professional practice highlights the theme of action and advocacy. Not only must sport psychology professionals understand multicultural relationships, but culturally competent professionals must act to empower participants and challenge restrictive social structures.

Multicultural Competencies

Multicultural competence refers to *the ability to work effectively with individuals who are of a different culture.* Multicultural competencies are most often cited in clinical and counseling psychology practice, as well as in human services and health care professions, but multicultural competencies are essential for anyone working with others, and certainly for sport psychologists in all professional roles. Multicultural competencies generally encompass (a) awareness of one's own cultural values and biases, (b) understanding of the client's worldview (in all its multicultural complexity), and (c) development of culturally appropriate intervention strategies (Mio et al., 2006). Multicultural competency is about applying multicultural knowledge and understanding in life, work, and interactions. For professionals, multicultural competencies increase effectiveness and lead to mutually enriching interactions.

Sport psychologists can look to the American Psychological Association, which has recognized the key role of multicultural competencies in fulfilling psychology's mission to promote health and well-being. The APA's multicultural guidelines, in line with this chapter framework, call for moving to action for social justice. Psychology and sport psychology can advance the public interest by following those guidelines.

American Psychological Association Multicultural Guidelines

Guideline 1: Psychologists are encouraged to recognize that, as cultural beings, they may hold attitudes and beliefs that can detrimentally influence their perceptions of and interactions with individuals who are ethnically and racially different from themselves.

Guideline 2: Psychologists are encouraged to recognize the importance of multicultural sensitivity/responsiveness, knowledge, and understanding about ethnically and racially different individuals.

Guideline 3: As educators, psychologists are encouraged to employ the constructs of multiculturalism and diversity in psychological education.

Guideline 4: Culturally sensitive psychological researchers are encouraged to recognize the importance of conducting cultural-centered and ethical psychological research among persons from ethnic, linguistic, and racial minority backgrounds.

Guideline 5: Psychologists strive to apply culturally appropriate skills in clinical and other applied psychological practices.

Guideline 6: Psychologists are encouraged to use organizational change processes to support culturally informed organizational (policy) development and practices (APA, 2003).

Cogan and Petrie (2002), in a review of diversity in sport, offer intervention strategies for sport psychologists working with diverse racial/ethnic minorities that reflect the multicultural guidelines of APA: (a) Acknowledge bias and racism, and extend beyond traditional views; (b) recognize within-group differences; (c) develop multicultural skills and knowledge (e.g., learn different worldviews, models of acculturation, communication styles, family systems); and (d) address societal racism and promote institutional change.

William Parham (2005), a leader in APA's multicultural programming as well as an active member of the sport psychology community, provides an overview of psychology's legacy with respect to culturally, ethnically, and racially diverse people and offers useful guidelines based on his professional practice. Parham's first guiding premise, *Context is everything,* is key when providing consultation services to diverse athletes. When working with diverse individuals (and that includes all individuals), history, economics, family, and social context are all relevant. Parham's second premise, *Culture, race, and ethnicity as separate indices do little to inform us,* reminds us that cultural groups are not homogeneous and that every individual has a unique cultural identity. A sport psychology consultant must consider the unique individual, including the unique cultural characteristics, setting, and time. Parham's third guiding premise underscores the importance of *using paradigms reflecting differing world views.* People from culturally diverse backgrounds are survivors of oppression and may have developed sources of resiliency and strength in dealing with power relations. Our sport worldview is culturally limited, typically emphasizing independence, competitiveness, and individual striving. Emphasis on connectedness rather than separation, deference to a higher power, mind-body interrelatedness rather than control, and a sense of "spirit-driven energy" may be more prominent in another's worldview.

In a commentary, Gridley (2005) affirms much of Parham's (2005) advice, but adds more emphasis on the persistent homophobia in sport, and with her more community-oriented approach and Australian base, moves outside Western-based psychology. Gridley compares the Western emphasis on the goals of winning and performance enhancement with the Eastern martial arts emphasis on mastery and discipline. She also points to the Canadian Psychological Association's (1996) *Guidelines for Non-Discriminatory Practice* as a model for practitioners seeking to incorporate diversity issues.

Like Parham (2005), Michael D'Andrea has been involved with APA's multicultural programs for some time. Recently, D'Andrea and Daniels (2005) applied his multidimensional-multicultural competency model to sport psychology and challenged sport psychologists to think about what it means to be culturally competent in the twenty-first century. They noted that multicultural psychology has expanded beyond the early focus on strengths, challenges, and concerns of non-White racial groups in the United States, to include other marginalized and devalued cultural groups. D'Andrea and Daniels refer to the APA multicultural guidelines in describing a culturally competent sport psychologist. Their model of RESPECTFUL sport psychology includes 10 factors to think about in dealing with individuals whose psychological development, athletic performance, and team membership is impacted by different cultural-contextual variables that have been previously underestimated or ignored in professional practice.

RESPECTFUL Sport Psychology: A Multidimensional-Multicultural Competency Model

R—Religious/spiritual identity
E—Economic class identity
S—Sexual identity
P—Psychological maturity
E—Ethnic/racial identity
C—Chronological challenges
T—Trauma and threats to well-being (injury, abuse)
F—Family history
U—Unique physical characteristics
L—Language, location of residence

Krane (2004), in discussing fair treatment in sport, argues that sport psychologists are in an ideal position to challenge unfair treatment and promote sport practices that encourage social justice. Unfair treatment may be challenged at the societal level, as in APA's recent stand against Native American mascots for athletic teams and lobbying for boycotts of sporting goods companies with exploitive practices. Sport psychologists can challenge unfair practices in athletic and exercise programs, in their consulting work, and in our educational programs.

Cultural Competence for Physical Activity Professionals

As part of an ongoing project funded by the American Association of University Women, Katherine Jamieson and I have been examining the cultural climate in physical activity settings and professionals' cultural competencies. Our long-term goal is to develop programs and resources for professionals so that physical activity will be inclusive and welcoming for all participants. *Physical activity for all* fits the action and advocacy theme of this chapter. We have incorporated multicultural psychology models and found helpful resources in public health and community service programs that emphasize the central role of cultural competence in effective practice. *Cultural competence* has been defined many ways; for our project with physical activity professionals, we adopted the following definition:

> The ability of physical activity professionals and their agencies to develop, implement, and evaluate physical activity programs that reflect, value, and promote varied culturally relevant forms of physical activity. Key to this comprehensive capacity is the ability to evaluate and understand the cultural values for physical activity held by oneself, one's agency, and one's clients.

The preliminary results (Gill, Jamieson, & Kamphoff, 2005) suggest that professionals and participants see the need for cultural competence resources and programs, but the work has barely begun. By taking multicultural perspectives to advance scholarship and adapting multicultural competencies for professional practice, sport psychology professionals could contribute greatly to this effort.

CONCLUSION

Sport psychology has begun to follow sport studies and psychology scholars in developing multicultural frameworks and addressing multicultural issues. To date, those efforts are limited, with most scholarship focused on gender issues and few truly multicultural frameworks. Multicultural perspectives are especially needed for sport psychology in the real world. If we are to advance sport psychology in the public interest, we must develop our multicultural competencies, expand our reach to the marginalized "left-outs," and promote sport and physical activity for all.

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CHAPTER 38

Athletes with Disabilities

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In the late 1980s, researchers and practitioners argued that athletes with disabilities had been virtually neglected by sport psychology research and interventions (e.g., Asken & Goodling, 1986). Since then, research involving athletes with disabilities has steadily grown. These studies have predominantly focused on those with physical disabilities (e.g., amputations, cerebral palsy, and spinal cord injuries), although there also has been research with those with sensory impairments (e.g., blindness and deafness) and intellectual disabilities. For the purposes of this chapter, psychiatric disorders have not been included, as they are rarely considered by sporting organizations or competitions for people with disabilities.

Research largely began with isolated studies testing the psychometrics of questionnaires with this population and comparing athletes with and without disabilities on various psychological instruments. Numerous descriptive studies followed that tended to replicate previous research using samples with, instead of without, disabilities, covering topics such as motives, affect, athletic identity, and social physique anxiety. In addition, there has been research specific to individuals with disabilities on issues such as coping with disability, the influence of physical activity on disability, and integration and segregation. Only in the past decade have sport psychologists published information about psychological skills training for athletes with disabilities and how consultants may work with these athletes (e.g., Hanrahan, 1998; Martin, 1999a).

VALIDITY AND RELIABILITY OF ASSESSMENT INSTRUMENTS USED WITH ATHLETES WITH DISABILITIES

A number of studies have evaluated existing instruments for validity and reliability when used with athletes with disabilities. For example, the State Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) was found to be reliable when administered verbally to elite female athletes with visual impairments (Mastro, French, Henschen, & Horvat, 1985), and the multidimensionality of the Athlete Identity Measurement Scale (Brewer, Van Raalte, & Linder, 1993) was confirmed when used with athletes with disabilities (Martin, Eklund, & Mushett, 1997). The factor structure of the Sport Orientation Questionnaire (Gill & Deeter, 1988) was tested with wheelchair athletes and found to contain five factors rather than the typical three, but with poor results in a confirmatory factor analysis (Skordilis, Sherrill, Yilla, Koutsouki, & Stavrou, 2002).

Measurement instruments have also been tested in areas not directly related to sport but relevant to physical activity or coping with disabilities, both issues that may influence athletes with disabilities. Two systematic observation instruments for measuring physical activity levels were tested with children with intellectual disabilities (Taylor, 2003). Although both instruments were found to be reliable, their validity was weak, perhaps due to the instruments' inability to differentiate between the relatively low activity levels of the sample. In terms of measuring emotional distress following amputation, the General Health Questionnaire has been shown to validly measure levels of emotional distress reported in the early weeks after amputation and also some months after amputation (Fisher & Price, 2003).

COMPARISONS OF ATHLETES WITH AND WITHOUT DISABILITIES

Related to the assessment of athletes with disabilities, there has been some interest in comparing athletes with and without disabilities on a number of psychological variables. The most common comparison has been between wheelchair and able-bodied basketball players. In relatively early studies, wheelchair basketball players had significantly healthier mood state profiles when compared to intercollegiate basketball players and normative data from college men (Paulsen, French, & Sherrill, 1991), and wheelchair athletes scored lower on depression than wheelchair nonathletes (Paulsen, French, & Sherrill, 1990). These results suggest that wheelchair athletes are mentally healthier than either able-bodied athletes or wheelchair nonathletes, but the researchers did not consider possible confounding variables.

Using the Sport Orientation Questionnaire (SOQ), Skordilis, Koutsouki, Asonitou, Evans, and Jensen (2002) found no significant differences in goal orientation, but that wheelchair athletes scored significantly higher on competitiveness and win orientation than able-bodied basketball players. Another study using the SOQ, however, found no significant differences in competitiveness or goal orientation, but that professional able-bodied basketball players scored higher on win orientation than wheelchair basketball players and amateur able-bodied players (Skordilis, Gavrilidis, Charitou, & Asonitou, 2003). These inconsistent findings may be due to the failure to control for potential confounding variables such as skill level or years of experience.

Fliess-Douer, Hutzler, and Vanlandewijck (2003) found that wheelchair basketball players scored similarly to able-bodied basketball players on the Task and Ego Orientation in Sport Questionnaire (TEOSQ; Duda, 1989). Although they also failed to control for skill level and experience, their research was unique in that they examined TEOSQ scores by functional classification or degree of disability. No significant differences were found between those with low and high degrees of disability on either task or ego orientation (Fliess-Douer et al., 2003).

Some of the significant differences found between athletes with and without disabilities are due to differences in skill level. Mendoza, del-Valle, Ruiz, and Sanchez (2003) found that the principal differences in psychological variables between expert and novice basketball players were irrespective of disability. Controlling for competitive level by comparing Olympic and Paralympic winter sport athletes, Pensgaard, Roberts, and Ursin (1999) found Paralympians perceived a more mastery-oriented climate and were more satisfied with their effort and results than Olympians. However, both groups had similar motivational profiles and coping strategies. Although Pensgaard et al. controlled for competitive level, they did not control for the type of sport. Many of the sports in which winter Olympians and Paralympians compete are not the same.

Dattilo and Guadagnolo (1988) controlled for the type of sport by comparing athletes with and without disabilities on their perceptions of a 10K road race. The two groups were similar on their importance ratings of 27 of 31 attributes associated with a 10K race (e.g., preregistration procedures, challenging course, crowd control). The only attributes for which the groups significantly differed related to prizes and awards, timing of results, running surface, and packet pick-up at the race site; these were rated as more important by those with a disability. For individuals with mobility aids (e.g., wheelchairs), road surface is an obvious concern, as is the need to travel to a different location to pick up the registration packet if it was not available at the race (Dattilo & Guadagnolo, 1988). Those with a disability also placed greater importance on receiving rewards and obtaining immediate knowledge of their results.

Although most research comparing athletes with and without disabilities has focused on wheelchair athletes (particularly wheelchair basketball players), research also has been conducted to compare those with and without cerebral palsy. Cerebral palsy is a group of neuromuscular conditions caused by damage to a part of the brain that controls and coordinates muscle tone, reflexes, and action. Elite athletes both with and without cerebral palsy were found to have positive attitudes toward physical activity. Athletes with this disability, however, were less likely to perceive physical activity as a thrill or to enjoy long and hard training (Cooper, Sherrill, & Marshall, 1986). Instead, athletes with cerebral palsy were more likely to perceive physical activity in terms of social experience, health and fitness, beauty, and tension release (Cooper et al., 1986). Within the sample of elite athletes with cerebral palsy, there were no differences in attitudes toward physical activity due to gender or ambulatory status.

Sherrill and Rainbolt (1988) compared elite athletes with cerebral palsy with college able-bodied athletes on self-actualization, which is the desire for self-fulfillment. The two groups were found to have similar self-actualization profiles. Again, as with other studies involving disabled athletes during this time period, the presence or absence of the disability was confounded with level of competition. Focusing on recreation rather than competitive sport, Magill-Evans, Darrah, and Adkins (2003) found that youth with cerebral palsy and their parents were less satisfied with recreational services than able-bodied youth and their parents. Although both groups had issues with program costs and transportation, those in the group with cerebral palsy also identified issues with inclusion, access to information, and disability awareness. These differences, however, have more to do with environmental than psychological factors.

The majority of comparison research has focused on those with physical disabilities; however, there have been a couple of studies comparing those with and without sensory or intellectual disabilities. Bressan and Rossouw (2002) found that the sources of enjoyment in competitive sport for athletes with visual impairments were consistent with those identified through research on sighted athletes. Minimal differences have also been found between physical education students with and without intellectual disabilities (Kozub, 2002). Children with intellectual disabilities did not differ from children without intellectual disabilities on expectations or attributions, although they were less persistent. Overall, comparison studies have found many more similarities than differences in psychological variables between those with and without disabilities, particularly when the confounding variables of competition level or experience are considered. Similarly, there do not appear to be any notable differences in these psychological variables as a result of the degree of disability (e.g., different classifications in wheelchair basketball or ambulatory versus nonambulatory athletes with cerebral palsy).

DESCRIPTIVE STUDIES ON ATHLETES WITH DISABILITIES

Although some of the studies just mentioned included comparisons between degrees of disability when studying differences between athletes with and without disabilities, none of them considered whether the disability was acquired or congenital. People with congenital disabilities have had the disability since birth and have never experienced life without it. By contrast, those with acquired disabilities have had to cope with a significant change in their lives upon acquiring a disability. These different histories may affect psychological well-being or other psychological variables. Campbell (1995) reported that athletes with acquired physical disabilities tend to have more positive psychological well-being than those with congenital disabilities. Campbell found that those with acquired disabilities tend to have more positive mood, higher self-esteem, and lower trait anxiety than did those with congenital disabilities.

When considering the competitive orientations of athletes, however, Page, O'Connor, and Wayda (2000) found no differences between those with congenital and those with acquired disabilities. Their sample was taken from individuals competing at the elite level in track and field, so it may be that those who make it to the elite level have similar competitive orientations.

A large number of additional studies has been conducted to investigate the motives of athletes with disabilities for sport participation. Qualitative studies have explored the motives paraplegics have for competing in power lifting (Piletic, 1998), the reasons elite athletes with disabilities give for participating in sport (Page, O'Connor, & Peterson, 2001), and why children and adolescents with physical disabilities participate in a sports program (Kristen, Patriksson, & Fridlund, 2002). The 10 themes that emerged in the power lifting study were physical self, self-presentation, masculinity, stigma, compensation, empowerment, camaraderie, physical appearance, independence, and victimization (Piletic, 1998). The themes that emerged in the Page et al. (2000) study were affirming competence, being considered a serious competitor, providing a common social outlet, promoting fitness, and delaying the effects of disability. The themes that emerged in the interviews with children were getting new friends, learning, strengthening one's physique, becoming someone, experiencing nature, and having a good time (Kristen et al., 2002). Although the studies targeted different samples and used different interview protocols, some commonalities are apparent. All three studies indicated issues related to social opportunities, empowerment, and independence among the motives to compete in sport.

The motives of athletes with disabilities also have been examined in quantitative studies. Participants with spinal cord injuries cited fitness, fun, health, competition, social opportunities, and rehabilitation as reasons for participating in wheelchair sports (Wu & Williams, 2001). Special Olympians reported participating to win ribbons and medals, play with other people, get exercise, do something they are good at, and have fun as reasons for participating in sport (Shapiro, 2003). The results from simple descriptive, quantitative studies are in part determined by the questionnaires used, making meaningful comparison across studies difficult.

A number of psychological variables other than motives have been described in various studies. Players selected for a Paralympic wheelchair basketball team reported being less tense and angry than those not selected, and they became less anxious and self-critical the closer they came to the Paralympics (Henschen, Horvat, & Roswal, 1992). Martin and Adams-Mushett (1995) found that international swimmers with disabilities had a strong athletic identity and felt that sport was important to them. Elite wheelchair basketball players revealed sources of stress that included preevent concerns, negative match preparation, on-court concerns, postmatch performance concerns, negative aspects of major events, poor group interaction and communication, negative coaching style behavior, relationship issues, demands and costs of wheelchair basketball, and lack of disability awareness (Campbell & Jones, 2002). Adults with physical disabilities participating in a challenging physical activity reported that perceived challenge was associated with higher levels of positive than negative affect (Crocker, 1992). And finally, stress measured through daily life demands was found not to be related to performance in alpine Paralympic skiers (Boundy, 2002). Generally speaking these results do not appear to be different from what might be expected in similar research with able-bodied athletes (e.g., Noblet & Gifford, 2002; Schmid & Seiler, 2003).

Other descriptive studies have focused on issues specifically relevant to the topic of disability (e.g., Martin, 1999b; Stewart, Robinson, & McCarthy, 1991; Wu & Williams, 2001). Appearing in front of others in a bathing suit can be anxiety-provoking for many people. Being an adolescent with a physical disability could potentially exacerbate this anxiety. Martin examined the predictors of social physique anxiety in adolescent swimmers with physical disabilities and found that although self-esteem and self-identity predicted social physique anxiety, the type of physical disability did not.

Another issue is that people with disabilities rarely have the same opportunities to participate in competitive sport as their able-bodied counterparts. As there may be barriers to the participation of people with disabilities, how do they become socialized into competitive sport? Elite deaf athletes reported that hearing coaches were the primary forces for introducing them to deaf sport (Stewart et al., 1991). For people with spinal cord injuries, rehabilitation programs and specialized sports clubs for people with disabilities were important contexts for introducing these individuals to sport postinjury; however, friends and peers with disabilities were more influential than rehabilitation therapists in the initiation and continuation of involvement in sport (Wu & Williams, 2001).

Both sport-related and non-sport-related forms of social support from parents, coaches, and friends are perceived as important by athletes with disabilities (Martin & Mushett, 1996). In their correlational study, Martin and Mushett reported that the more athletes received encouragement to achieve and develop, and perceived that others genuinely cared about their opinions, the stronger their self-efficacy. The authors, however, indicated that social support was not related to athletic satisfaction.

COPING WITH DISABILITY

In addition to dealing with unequal opportunities and inaccessible venues, athletes with disabilities have to cope with the disability itself. This chapter does not pretend to cover the issues of post traumatic stress or rehabilitation, but gives examples of specific studies related to coping that may be unique to those with disabilities.

Common sense would suggest that those with more severe disabilities would have greater psychological distress, but this is not always the case. Padua et al. (2002) found that, for individuals with congenital spina bifida, less disability was associated with greater psychological distress and more emotional problems. These results suggest that those with mild disabilities need as much psychological support as those with severe disabilities.

Emotional distress also may not follow expected predictions in those with acquired disabilities. The old adage that time heals all wounds suggests that emotional distress would decrease as time passes. This was not the case in a relatively short-term study of patients with recent amputations. Fisher and Price (2003) reported that the emotional distress of these individuals was greater at 4 to 6 months postamputation than it was a few weeks postamputation. Whether this increase in emotional distress is due to rehabilitation plateaus, delayed reactions, or some other cause, support needs to be available to those who may previously have been determined to be effectively coping. Coaches and sport psychologists should be aware that individuals who quickly return to (or initiate involvement in) sport postamputation may experience delayed psychological reactions. The cause for the amputation also may influence how individuals adapt. For example, an amputation resulting from a traumatic accident most likely would induce a different psychological experience than an amputation resulting from cancer. The cause of the amputation can also affect factors relevant to mobility (and hence sport). For example, people with a lower limb amputated for vascular reasons have poorer balance confidence than those who had the same type of amputation for nonvascular reasons (Miller, Speechley, & Deathe, 2002).

Social support can help individuals cope with a disability. However, not all social support is beneficial. In a study of rugby union players who acquired a disability as a result of a spinal cord injury, social support was perceived to be very important and was critical in their being able to enhance the quality of their lives (Rees, Smith, & Sparkes, 2003). Rather than being fussed over, however, these individuals wanted to be proactive in seeking support and to know that it was available if they needed it. Although well-intended, social support in the forms of minimizing the importance of the event, encouraging quicker coping, avoiding open communication about the event, and giving inappropriate advice are negatively experienced and unhelpful (Rees et al., 2003).

Social integration, mobility, and perceived health are significant predictors of life satisfaction for people with spinal cord injuries (Putzke, Richards, Hicken, & Devivo, 2002). Therefore, encouraging the social integration of these individuals and providing opportunities for mobility may enhance their quality of life. In a study of the transition of individuals into university life, support services, opportunities for leisure, and peer support were integral to the successful transition into the university community (Gillies & Pedlar, 2003). Participation in accessible physical activity programs can enhance health (and possibly mobility) and be a source of leisure, social integration, and peer support.

EFFECTS OF PARTICIPATING IN SPORT AND PHYSICAL ACTIVITY

As mentioned, physical activity can help individuals cope with disabilities. Physical activity can contribute to physical well-being, perceptions of health and independence, pain control, the prevention of illness and secondary disability, and the maintenance of function (Goodwin & Compton, 2004). Being physically active can have numerous psychological benefits in addition to the better-known physical benefits. Rather than focusing on the influence of physical activity on psychological factors such as depression and anxiety (covered in Part V of this *Handbook*), studies that specifically focus on people with disabilities are introduced in this section.

Participating in sport and exercise can be empowering, as sometimes people with disabilities face limited achievement opportunities. In male college students with physical or sensory disabilities, participation in sport and physical fitness activities provided opportunities for three types of empowerment: perceived competence as a social actor, facilitation of goal attainment, and social integration (Blinde & Taub, 1999). Participation in elite sport can be empowering both physically and mentally. Wheelchair basketball Paralympians revealed that competing in high-level sport helped them to regain control over their bodies and to establish an identity as an athlete rather than a "disabled person" (Ashton-Shaeffer, Gibson, Holt, & Williming, 2001). Adolescents participating in an adapted sports program have also reported these empowering effects. Participation in adapted sports provided these adolescents with a heightened sense of competence and opportunities to express themselves and led to decreased awareness of their disabilities (Groff & Kleiber, 2001). This decreased awareness of disability could be perceived as having a normalizing effect. Taub and Greer (2000) concluded that physical activity is a normalizing experience for children with physical disabilities because it provides a setting in which social networks of peers are enhanced and facilitates their perceptions of social identity as children.

Results of interviews with 23 adults with physical disabilities support this suggestion that both physical and social aspects of the self are enhanced through physical activity programs (Blinde & McClung, 1997). Participation in activity programs expanded social interactions and experiences and redefined physical capabilities.

Participation in physical activity and sport can contribute to the well-being of individuals with disabilities. Participation in a recreational sport program increased the physical and mental fitness, the social integration, and the confidence of children with disabilities (Kinkade, 1998). Campbell and Jones (1994) reported that the psychological well-being of wheelchair athletes was significantly greater than that of wheelchair nonathletes. Furthermore, those who were competing at the international level scored higher on psychological well-being than did those participating at the national, regional, or recreational level (Campbell & Jones, 1994). This idea that "more is better" is also partially supported by Goldberg and Shephard (1982), who found that those who were paraplegic and highly active reported enhanced mood, attitude, and body image compared to those who were paraplegic and moderately active. The relationship between physical activity and body image also has been found in adults with a lower-limb amputation (Wetterhahn, Hanson, & Levy, 2002).

The research reported thus far has focused primarily on individuals with physical disabilities. Participation in physical activity also has been found to have psychological benefits for people with intellectual disabilities. Using a randomized control trial, Mactavish and Searle (1992) assigned adults with intellectual disabilities to either a 5-week physical activity program or a control group. Those in the activity program increased their perceptions of competence, internal locus of control, and self-esteem. Similarly, participation in a Special Olympics swim training program increased the self-concept of children with intellectual disabilities (Wright & Cowden, 1986). Nevertheless, the effectiveness of sport or exercise programs in providing psychological benefits to the participants is dependent on the quality of the program. A study of Polish Special Olympians found that some coaches blocked the participants' aspirations for autonomy (Dluzewska-Martyniec, 2002). This failure of coaches to allow participants to develop independence may be related to the tendency for coaches and parents to overprotect participants with disabilities (Nixon, 1988). Protecting these individuals from failure also keeps them from experiencing meaningful success. A question that has not been conclusively answered is whether an integrated or a segregated environment is best for enhancing the psychological well-being of people with disabilities. This issue is discussed briefly in the next section.

INTEGRATION OR SEGREGATION

Individuals with disabilities noted that an inclusive leisure program could be either freeing or constraining (Devine, 2003). The context and the role of the social group appeared to determine the meaning of inclusive leisure to the participants. Perhaps it can be freeing when the environment (both physical and social) allows individuals to engage on an equal footing with people without disabilities or provides opportunities for social integration and achievement. An integrated setting, however, could be constraining if individuals feel they are excluded from the group for either social or ability reasons. When even minor accommodations to an impairment are not made (e.g., using a bright ball when a visually impaired athlete is on an integrated soccer team), the experience will most probably be constraining rather than freeing (Nixon, 1988).

The social experiences of children (both with and without disabilities) in integrated physical education classes have been found to be determined by the physical education teachers, the social substance of the activities, cultural backgrounds, and the social skills of the students (Suomi, Collier, & Brown, 2003). The physical education teacher was the only factor that positively influenced the social experiences of all students, indicating that the impact of a physical activity environment, whether integrated or segregated, can largely be determined by the quality of the leadership. This contention is supported somewhat by the finding that physical education classes that emphasize a mastery motivational climate may result in higher perceived competence in children with movement difficulties (Dunn, 2000). In physical education classes, the teacher controls many of the elements that facilitate the development of a mastery motivational climate (Chi, 2004).

The impact of integrated programs on those without disabilities also needs to be considered in terms of their costs and benefits. Students in two fourth-grade physical education classes doing a 2-week module on volleyball participated in a study investigating the effects of the presence of a student in a wheelchair with no direct support in the class (Obrusnikova, Valkova, & Block, 2003). There were no significant class differences in the acquisition of volleyball skills and knowledge. In addition, the attitudes toward including a student with a disability tended to be positive. Although Obrusnikova et al. found no detrimental effects to able-bodied students when a student in a wheelchair was included in the class, they did not investigate possible positive effects for children without disabilities being in an integrated environment. It would not be expected that an integrated environment would enhance the sporting skills of able-bodied participants, but the experience could potentially develop capacities for tolerance, acceptance, and open-mindedness.

Integration may be mandated in schools, but physical activity instructors in the community often can determine for themselves whether their classes are more or less open to participants with disabilities. In a study of swim instructors, Conatser, Block, and Gansneder (2002) found that perceived behavioral control and attitudes significantly predicted intention, and intention predicted instructors' inclusion of participants with disabilities. Overall, however, the instructors were more favorable toward the inclusion of those with mild disabilities than of individuals with severe disabilities. Perhaps if education about the practical concerns related to working with people with disabilities was readably available, more coaches and instructors would be open to the inclusion of people with disabilities in their programs.

FACTORS AFFECTING EXERCISE BEHAVIOR

Whether in an integrated or a segregated format, physical activity programs can be beneficial only when individuals regularly attend. Although information about predictors of and barriers to exercise behavior are covered elsewhere in this book, this chapter presents two studies specific to people with disabilities.

As mentioned in the previous section, perceived behavioral control and attitudes predicted intention and behavior in terms of swim instructors including individuals with disabilities in their programs. These variables, as part of the theory of planned behavior, frequently have been found to predict intentions and behavior in other contexts, including exercise. In a study testing the theory of planned behavior, perceived behavioral control was the only variable that predicted exercise intentions and behavior in individuals with tetraplegia (Latimer, Martin Ginis, & Craven, 2004). The same study, however, indicated that none of the constructs in the theory of planned behavior predicted exercise intentions or behavior for people with paraplegia.

Perhaps one of the reasons the results in the Latimer et al. (2004) study were not those predicted by previous research with able-bodied exercisers is that people with disabilities are confronted with additional barriers to exercise. Able-bodied women frequently cite lack of time, lack of financial resources, and lack of energy and motivation as perceived barriers to exercise. In a study of women with disabilities, Rauzon (2002) found that social support, confidence in the ability to exercise, environmental barriers, financial resources, time, energy, and health limitations were perceived as barriers to exercise. The environmental barriers included accessible facilities, transportation, personnel trained about disabilities and exercise, and adapted equipment. It is doubtful that these environmental barriers would be ordinary barriers for able-bodied individuals.

MENTAL SKILLS TRAINING

Psychological skills training programs are applicable to athletes with disabilities (Hanrahan, 1998). Prior to the 1990s, there was little, if any, evidence of research on mental skills training for athletes with disabilities. In the past 15 years, however, studies investigating the implementation of psychological skills for athletes with intellectual, sensory, and physical disabilities have been published.

Imagery has been demonstrated to be effective in enhancing performance in both a cognitively oriented task (i.e., peg board) and a motorically oriented task (i.e., pursuit rotor) in students with mild mental disabilities (Screws & Surburg, 1997). This conclusion was drawn after students were randomly assigned to the standard groups used in much of imagery research: a physical practice group, an imagery practice group, and a no-practice control group. In a study more directly relevant to sport, Surburg, Porretta, and Sutlive (1995) found that participants with intellectual disabilities had significantly better performances when they used imagery in conjunction with physical practice compared to physical practice alone.

A few studies have reported on the implementation of psychological skills training programs with athletes with disabilities. Travis and Sachs (1991) revealed that a swimmer participating in the Special Olympics was able to differentiate between tension and relaxation after a psychological skills training program focusing on managing competitive anxiety and learning to relax. Travis and Sachs were not able to work on transferring the skills to the sporting environment, as the swimmer in this single case study withdrew from the program. Gorely, Jobling, Lewis, and Bruce (2002) administered a psychological skills training program focusing on cue words, breathing techniques, and positive thinking to members of men's and women's state basketball teams for athletes with intellectual disabilities. Although there were no measures of mental skills or basketball skills to determine the effectiveness of the program, in telephone interviews the participants indicated that the program was appropriate and worthwhile. More recently, Gregg, Hrycaiko, Mactavish, and Martin (2004) used a multiple baseline design across individuals to test the effects of a mental skills training package on off-task behaviors, work outputs, and competition results for three track and field athletes with intellectual disabilities. The intervention was clearly effective across all measures for two of the participants and decreased off-task behaviors and increased the percentage of laps completed for the third participant. Every indication from the published studies on the topic is that psychological skills training is beneficial for athletes with intellectual disabilities.

Mental skills training is also useful for athletes who are blind or visually impaired. In determining the needs of these athletes, Hanrahan, Grove, and Lockwood (1990) reported that the participants had high levels of motivation and positive energy, with the two weakest areas being negative energy and attention control. Interestingly, in only one case was visual and imagery control one of the weakest skills, and this was for an athlete with the classification representing the least amount of impairment. The athletes then participated in a 5-week psychological skills training program that included relaxation, goal setting, performance checklists, self-talk, and imagery. The participants reported that the program was beneficial, although they suggested that it would have been better to spend more time on fewer topics. One observation that Hanrahan et al. made was that the majority of the participants reported it was difficult to "shut their brains off" during relaxation. It may be that self-talk is a greater distraction during relaxation sessions for people who are blind. They do not have the cue of shutting out regular distractions by closing their eyes as may occur with sighted individuals. On the other hand, athletes who are blind may be superior to sighted athletes on skills that primarily require proprioceptive performance, such as reproducing a movement (Warren, 1978).

The mental skill that probably has received the most attention in research for people who cannot see is imagery. Visual imagery is possible for people who are blind. People who have been blind from birth can activate processes that might be considered functionally equivalent to visuospatial imagery processes activated by individuals who can see (Vecchi, Monticellai, & Cornoldi, 1995). For those who have acquired their blindness after birth, primary visual cortices are not essential for visual imagery (Chatterjee & Southwood, 1995; Goldenberg, Mullbacher, & Nowak, 1995). In a study of five athletes who were blind or visually impaired, Hanrahan (1996) reported that after imagery training, all five were capable of creating reasonably vivid movement images, and that four of the five could create reasonably vivid visual images. The beneficial use of imagery by athletes with visual impairments is also supported by Eddy and Mellalieu (2003), who interviewed six elite goalball players. These athletes indicated that they used imagery for cognitive and motivational purposes in both training and competition. In summary, athletes who are blind and visually impaired can benefit from the learning and practice of mental skills, including imagery.

In a study of wheelchair road racers, those with high training self-efficacy tended to report strong performance efficacy, outcome confidence, and positive affect leading up to the race (Martin, 2002). These findings suggest that interventions focusing on improving training efficacy in these athletes may have positive flow-on effects. Similar results were reported in a study of athletes competing in the Amputee Soccer World Cup (Lowther, Lane, & Lane, 2002). Self-efficacy showed reciprocal relationships with performance. In addition, the psychological skills of activation and relaxation influenced self-efficacy and performance (Lowther et al., 2002). Encouragingly, in a study of 53 wheelchair basketball players, many of them reported that they were open to consulting a sport psychologist (Page, Martin, & Wayda, 2001).

In a study of psychological skills training for competitive wheelchair and amputee athletes, Hanrahan (1995) noted a number of issues relevant to specific psychological skills for athletes with physical disabilities. One issue was which body parts to include in a progressive muscular relaxation script. When athletes either do not have (e.g., amputees) or do not have control over (e.g., those with spinal cord injuries) particular body parts, should these be included or excluded? Hanrahan indicated that it is best to go with personal preference. Some athletes liked a tailor-made script because they got frustrated when trying to tense and relax certain parts of the body, whereas others preferred a standard script because they still perceived benefits in terms of body awareness and relaxation when focusing on parts of the body excluded from the individualized scripts. One quadriplegic pointed out that he preferred the standard version because the individualized script was too short! Future research may consider controlling for length of scripts while varying the content. Also related to relaxation, the Hanrahan study found that even those without use of abdominal muscles still reported both concentration and relaxation benefits from abdominal breathing exercises.

Hanrahan (1995) also reported a number of issues related to body awareness and imagery for athletes with physical disabilities. One issue is determining what is and what is not part of the athlete's physical self. For amputees, prostheses often take the place of missing arms or legs, and wheelchair athletes obviously use chairs in place of legs. The general rule of thumb is that the prosthesis or chair can be considered part of the athlete if it is required for participation in the sport (Hanrahan, 1998). For example, swimmers do not use prostheses or chairs during their events, but many track athletes do. If athletes use prostheses or chairs during competition, then they should be worn or sat in when doing body awareness exercises or imagery. Body awareness exercises can help athletes with cerebral palsy or spinal cord lesions to improve their understanding of which muscles they can use and control. After increased awareness, some athletes have reported being able to modify technique because they discovered they were able to incorporate into the activity a part of the body that had previously been idle (Hanrahan, 1995). In addition, enhanced awareness may help athletes distinguish between pain from their disability, pain or discomfort from fatigue, and pain from a sport injury (Martin, 1999a). For athletes who have acquired physical disabilities (as opposed to having congenital disabilities), greater effort may be needed in learning to control images. As imagery is based on memory, these athletes may tend to image themselves performing in their bodies as they were before the disability. Imagery that includes limbs that currently do not exist or cannot be controlled tends to lead to feelings of anger and frustration and can be counterproductive in terms of learning skills, improving technique, and developing confidence.

In summary, psychological skills can effectively be developed and used by athletes with physical, sensory, and intellectual disabilities. Although sometimes the presence of a disability introduces unique concerns when teaching or implementing a psychological skill (e.g., whether a prosthesis should be worn during body awareness and imagery exercises), the majority of psychological skills can be taught and practiced without major modification.

PRACTICAL CONSIDERATIONS

Aside from the specific issues related to the development or use of psychological skills, there are a number of practical considerations that practitioners should be aware of when working with athletes with disabilities. First of all, assuming you are a sport psychologist or a coach rather than a person working in rehabilitation, you would be working with these individuals because they are athletes, not because they have disabilities. The basic guideline to be followed is to focus on ability rather than disability (Hanrahan, 2004). The focus, therefore, is on them as athletes, not as people with disabilities. Often there is no need to directly address the disability. If the disability does not affect communication or skill acquisition, or the athlete does not bring up issues related to the disability, then there is rarely a need to discuss it (Hanrahan, 1998). However, if the disability is influencing the situation, then it should be discussed openly. Feeling awkward and avoiding the issue when it is relevant limits effective communication and can inhibit the development of rapport. Individuals tend to be experts on their disabilities. After all, they have lived with the specific nuances of their disabilities longer than anyone else. Use the athletes as a source of information. In addition, feel free to explore new territory with the athletes through trial and error. For example, if you want to use concentration exercises with an athlete and your normal repertoire of activities is not adequate due to the disability, establish your objective, clearly explain it to the athlete, brainstorm, and then experiment.

A common issue for parents, coaches, and perhaps sport psychologists is the tendency to want to protect athletes with disabilities from failure (Nixon, 1988). If athletes are not provided the opportunity to fail, however, they also miss out on the experience of meaningful success. Without failure, the process of learning is severely curtailed, as we learn from mistakes. Failure is okay when it is balanced with the opportunity of success. If athletes are protected from failure, they do not get the chance to attempt or overcome challenges. The basic guideline to be followed is to focus on ability rather than disability (Hanrahan, 2004). To be able to be a competitive athlete, individuals need to develop the capacity to handle both success and failure.

In addition to these general issues related to disability, some considerations are relevant to specific disabilities. See Table 38.1 for considerations for working with athletes with vision or hearing impairments, intellectual disabilities, and physical disabilities.

CONCLUSION

Research on topics related to sport psychology and athletes with disabilities did not exist until the 1980s, and then it was only sparse. Initial research tended to focus on descriptive studies of athletes with disabilities, comparisons of athletes with and without disabilities, and the psychometric testing of instruments for use with athletes with disabilities. Research on disability and coping, although not directly in the field of sport psychology, is relevant to those who want to help individuals maximize their sporting and physical activity experiences. It is worth noting the potentially different experiences of those with congenital versus acquired disabilities.

Participation in sport and physical activity can be empowering and can contribute to the psychological well-being of individuals with disabilities. However, some individuals with disabilities may have greater barriers to overcome than able-bodied individuals when it comes to accessing physical activity programs and venues. There are no consistent findings in answer to the dilemma of whether integrated or segregated environments are best. Ideally, both options can be provided so that individuals can choose the one that best suits their needs.

Psychological skills can be developed and effectively used by athletes with disabilities. Although many skills can be taught without any notable modifications, sport psychologists should be aware of some disability-specific issues (e.g., people with an acquired disability potentially having the tendency to image themselves performing

Table 38.1 Considerations for Working with Athletes with Specific Disabilities

Disability	Consideration
Visual impairment	If holding sessions at a venue that is not familiar to the athletes, allow time for the room to be explored and avoid major changes in furniture arrangement.
	Assure that all participants have access to information. This may require a variety of communication methods (e.g., large type, cassette recordings, Braille). When administering questionnaires, translate them into Braille, read them aloud, and devise an answer sheet for the blind, or schedule times for athletes to complete the questionnaires with the consultant on an individual basis (Hanrahan et al., 1990). (Try to avoid having athletes complete inventories with the aid of coaches, other athletes, or family members.) Provisions should be made for athletes to record their goals onto cassettes or CDs.
	Provide athletes with access to personal cassette or CD players.
Hearing impairment	Have eye contact and attention of deaf athletes when communicating. The method of communication will vary with the athlete. Deaf athletes may communicate through sign language (which is not a single universal language), gestures, lip reading, speech, writing, or a combination of methods (Clark & Sachs, 1991).
	When speaking to deaf individuals, use facial expressions, body language, and other visual means of communication, such as videotape, slides, and demonstrations.
	When verbalizing, speak clearly and slowly, but avoid overenunciating and exaggerating words.
	Keep in mind that even athletes who have lived in an English speaking country their entire lives may not have English as a first language. Pencil-and-paper tests and inventories are not appropriate for use with deaf athletes whose first language may be American Sign Language or another version of signing. If a great deal of work with deaf athletes is foreseen, learning the suitable sign language would be appropriate (Clark & Sachs, 1991).
Intellectual	The development of trust and rapport is critical (Travis & Sachs, 1991).
	The sport psychologist must work at the individual's level of understanding.
	Overcome any limiting preconceptions of the capabilities of the athletes (Gorely et al., 2002).
	Solicitation of help from relatives, case managers, or residential staff is important (Travis & Sachs, 1991).
	An athlete with an intellectual disability may be unable to think in abstract terms, lack the ability to make decisions, have poor short-term memory, have limited literacy or numeracy skills, and have inconsistent concentration spans (Hanrahan, 1990).
	Instructions should be kept simple. Skills should be broken down into smaller teaching components.
	Sessions should be fun and enjoyable, with practice times on specific activities kept short.
	Continual repetition of skills with variety enhances success (Gorely et al., 2002).
Physical	Ensure that venues are accessible.
	If working with a group of athletes in wheelchairs, communication can be improved by being on their level (i.e., sit in a chair).
	If the physical disability affects the control of muscles required for speech, be patient with verbal communication. Do not finish sentences for the athlete. If a carer or parent is present, allow that person to interpret, but be sure to speak directly to the athlete.
	Be aware of the temperature of the venue. Spinal lesions can involve the loss of autonomic control, limiting vasodilatation, sweating, and vasoconstriction (Shephard, 1994).
	Extra time may be required for athletes to transfer from their chairs to the floor for relaxation sessions. Alternatively, some athletes may prefer to stay in their chairs.

Adapted from "Sport Psychology and Athletes with Disabilities" (pp. 572–583), by S. J. Hanrahan, in *Sport Psychology: Theory, Applications, and Issues,* second edition, T. Morris and J. Summers (Eds.), 2004, Milton, Queensland, Australia: Wiley. Adapted with permission.

with full use of their bodies). Whether working as a psychologist, trainer, or coach, considerations may need to be made for specific types of disabilities. The bottom line, however, is that the athlete comes first, before the disability.

Although the amount of research related to sport psychology and athletes with disabilities has dramatically increased in the past decade, more research is needed. The majority of studies have been descriptive in nature and involved small sample sizes. Ideally, randomized controlled trials should be instigated to scientifically test interventions to enhance performance, increase persistence, and boost enjoyment of participation. Additional research on how to best structure facilitative environments for participation and skill acquisition may address the question of integration versus segregation and perhaps increase the percentage of people with disabilities who are physically active on a regular basis. Overall, the focus should always be on enhancing abilities and quality of life.

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CHAPTER 39

Alcohol and Drug Use among Athletes

Prevalence, Etiology, and Interventions

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The 1980s were marked by a number of high-profile events involving athletes and alcohol or recreational drugs, including deaths from cocaine overdose (e.g., All-American college basketball player Len Bias) and drunk driving (e.g., Philadelphia Flyers goaltender Pelle Lindbergh) and other revelations of drug use among well-known athletes (Creamer, 1985; Johnson, 1983; Kirshenbaum, 1983; MacCallum, 1986; Wolff, 1985). Additionally, there were numerous incidents involving performance-enhancing drugs in this era. Several Olympic athletes tested positive for banned performance-enhancing substances at the 1984 and 1988 Olympic Games, including Canadian sprinter Ben Johnson, who was stripped of his 100-meter gold medal (Axthelm, 1988; Wulf, 1988). Steroid use was also believed to be increasingly pervasive in the National Football League (NFL) during the 1980s, leading, in part, to the League's instituting a stringent drug-testing policy in the later part of the decade (Johnson, 1985, 1988).

These incidents helped raise public awareness regarding the use of drugs in athletics and presented clear examples of the dangers of drug use overall. Drug use among athletes, however, was not a phenomenon that began in the 1980s. Tobacco and alcohol companies have served as sponsors and team owners for a variety of sports in the United States since the beginning of the twentieth century (Crompton, 1993), and a formal relationship between the alcohol industry and athletics in Europe dates to at least the seventeenth century (Collins & Vamplew, 2002). Amphetamine abuse has been documented among NFL players in the 1940s (Mandell, 1979; Marshall, 1979), and college athletes in the United States were using amphetamines and steroids to help improve their performance in the 1970s (Toohey, 1978).

Many hoped that the higher-profile cases of the 1980s would warn future generations of athletes about the dangers and consequences of drug and alcohol use (e.g., N. Cooper, 1986; "9 Days in June," 1987). Yet, high-profile incidents involving drugs and athletes have continued into the twentieth century, such as the death of hockey player Steve Chiasson in a car accident in 1999 while driving under the influence, the conviction of NFL player Leonard Little for involuntary manslaughter while driving under the influence in 1998, and the death of former Major League Baseball (MLB) MVP Ken Caminiti due to a cocaine overdose in 2004 (Bryan, 1998; Fidlin, 1999; Ginnetti, 2004). In 2005, concerns about the use of performance-enhancing substances among professional athletes led to legal and congressional involvement, as representatives of MLB and the NFL testified before Congress regarding steroids in their sports (Hohler, 2005; Smith, 2005).

Although substance abuse and athletics has received much publicity in the popular press over the past 20 years, there are a number of questions that have not been answered or only partially explored. The present chapter addresses three such areas of investigation: (1) the prevalence rates of alcohol and drug use among athletes, and how these rates compare to those for nonathletes; (2) the reasons for alcohol and drug use (or lack of use) among athletes, especially any motivating factors that might be related to sport itself; and (3) possible alcohol/drug abuse prevention and treatment strategies that can be implemented with athletes. We first address prevalence rates and reasons for alcohol use, recreational drug use, and ergogenic drug use among athletes, followed by a discussion of prevention and treatment strategies for all substances.

ALCOHOL

Epidemiological data suggest that excessive alcohol consumption and its subsequent problems affect a considerable number of individuals, with recent data suggesting that approximately 9% of the U.S. population will meet *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) diagnostic criteria for either alcohol abuse or dependence in a 12-month period (Grant, Dawson, et al., 2004). These rates are higher among younger individuals, with epidemiological data among college students indicating prevalence rates of 8% for alcohol abuse and 11% for alcohol dependence (Dawson, Grant, Stimson, & Chou, 2004). Studies have also shown that excessive alcohol consumption can result in significant negative consequences even among individuals who may not qualify for a *DSM* diagnosis (e.g., Wechsler, Lee, Kuo, & Lee, 2000).

One might assume that the physical demands of sport participation, and the importance of successful performance to most individuals involved in athletics, would serve as a deterrent to heavy alcohol consumption among athletes. However, there is evidence to suggest that some groups of athletes may be more at risk for heavy alcohol consumption and negative alcohol-related consequences than their nonathlete counterparts.

Prevalence of Alcohol Use among Athletes

A number of studies have assessed alcohol consumption rates among various athletic populations, especially collegiate and youth athletes. This body of research is reviewed below.

Alcohol Use and College Athletes

The most comprehensive data regarding alcohol consumption among athletes comes from the U.S. college athlete population. There have been several large-scale national studies that have compared the alcohol use habits of collegiate athletes to nonathletes. These studies have consistently found that college athletes tend to consume more alcohol than their nonathlete counterparts (Leichliter, Meilman, Presley, & Cashin, 1998; Nelson & Wechsler, 2001; Wechsler, Davenport, Dowdall, Grossman, & Zanakos, 1997). Two of the studies (Nelson & Wechsler, 2001; Wechsler et al., 1997) found that 83% to 87% of college athletes and 81% to 84% of college nonathletes reported consuming alcohol at least once in the past 12 months. However, considerable differences emerge when one examines actual rates of alcohol consumption between athletes and nonathletes. The findings from the studies indicate that athletes were significantly more likely than nonathletes to report heavy episodic drinking (defined as at least four or five drinks in one setting) one or more times in the preceding 2 weeks, with estimates ranging from 53% to 57% for athletes and 36% to 43% for nonathletes. A greater percentage of athletes than nonathletes reported engaging in frequent heavy episodic drinking in the preceding 2 weeks (defined as three or more episodes). Finally, Leichliter et al. found that athletes reported consuming significantly more drinks per week than nonathletes (7.57 versus 4.12). Although, for both groups, males reported consuming more alcohol than females in the same category, the athlete-nonathlete differences were consistent between genders. Not surprisingly, these studies also found that college athletes were more likely than nonathletes to experience a host of negative alcohol-related consequences, such as driving under the influence, getting hurt or injured, and doing something later regretted. A summary of the overall athlete-nonathlete differences in alcohol consumption is provided in Table 39.1.

There is also some evidence to suggest that differences in alcohol use exist based on the level of one's involvement in athletics. The Leichliter et al. (1998) survey indicated that athletes in positions of leadership (e.g., team captains) averaged significantly more drinks per week (8.25 versus 7.34) and were more likely to report heavy episodic drinking at least once in the past 2 weeks (58.0% versus 54.4%)

Table 39.1 U.S. College Athlete-Nonathlete Differences in Alcohol Consumption

	Heavy Episodic Drinking		Frequent Heavy Episodic Drinking		Drinks per Week	
Source	Athletes (%)	Nonathletes (%)	Athletes (%)	Nonathletes (%)	Athletes (%)	Nonathletes (%)
Wechsler et al. (1997)	56.8	38.1	27.1	16.0	N/A	N/A
Leichliter et al. (1998)	55.3	36.3	N/A	N/A	7.57	4.12
Nelson & Wechsler (2001)	52.9	43.4	28.0	21.4	N/A	N/A

Note: N/A = Data were not available. Percentages for heavy episodic drinking refer to the proportion of students who reported engaging in the behavior in the past 2 weeks. Sample sizes for the studies ranged from 2,088 to 8,749 athletes and 11,122 to 42,734 nonathletes. In the Weschsler et al. (1997) and Nelson and Weschsler (2001) studies, heavy episodic drinking was defined as five or more drinks in one sitting for males and four or more drinks for females. In the Leichliter et al. (1998) study, it was defined as five or more drinks in one sitting for both males and females. Frequent heavy episodic drinking was defined as three or more heavy drinking episodes in the past 2 weeks.

than athletes not in positions of leadership. In another study, Hildebrand, Johnson, and Bogle (2001) found that a greater proportion of students from one university who were college athletes (28.5%) were classified as "heavy drinkers" than students who had been athletes only in high school (22.2%). The lowest frequency of heavy drinkers was found among individuals who had not been involved in athletics at all (13.8%). Similarly, more college athletes (53.0%) reported at least "a few" heavy episodic drinking episodes per month than high school-only athletes (49.1%), who in turn were more likely to report such behavior than nonathletes (31.7%). These findings seem to suggest that the level of one's involvement in athletics, in addition to simply being an athlete, is positively related to alcohol consumption among college students.

Alcohol Use and Youth Athletes

Athletics has long been conceptualized as a means for reducing deviant behavior among youths, a phenomenon that has been labeled "the deterrence hypothesis" (Eitle, Turner, & Eitle, 2003; Leonard, 1998). No comprehensive, national studies have provided an in-depth examination of alcohol use among youth athletes, but several smaller studies do not provide strong support for this hypothesis.

Although some studies have in fact reported that youth athletes may be less likely to consume alcohol than nonathletes, the results from these studies are tempered by methodological limitations. For example, Forman, Dekker, Javors, and Davison (1996) found that the prevalence rates for any alcohol consumption among male high school athletes were considerably lower than for nonathletes. The results from this study are limited, however, in that the actual amount of alcohol consumed when drinking was not assessed and the nonathlete control group consisted of an archival database. Other studies conducted on this population also report lower levels of alcohol use among athletes, but the results are not compelling. Harrison and Narayan (2003) found that ninth graders who participated in sports (and not any other extracurricular activity) were less likely to report binge drinking over the past 2 weeks than those who did not participate in any extracurricular activity. Nonetheless, they were more likely to report binge drinking than those who participated in other activities only or a combination of sports and other activities. Vicary, Smith, Caldwell, and Swisher (1998) found that ceasing involvement in sports between 11th and 12th grade was associated with an increased likelihood in regular drinking among females (defined as drinking on at least a monthly basis). However, no such relationship was found for males, nor among females transitioning between other grade levels. Finally, Thorlindsson (1989) reported a negative relationship between sport participation and alcohol use among Icelandic youth (12 to 15 years of age), although the magnitude of the effects was small.

In contrast, other studies have found either no differences in rates of alcohol consumption between youth athletes and nonathletes, or that athletes in fact consume more alcohol than nonathletes. For example, Lorente, Souville, Griffet, and Grélot (2004) found that 70.4% of French high school students involved in sport reported drinking alcohol at least once in the past 15 days, compared to 60.0% of those who did not participate in sport. K. E. Miller et al. (2003) found a relationship between identifying oneself as a "jock" and incidence of heavy drinking, binge drinking, and alcohol-related social problems, even after controlling for demographic variables associated with heavy alcohol consumption. Leonard (1998) reported a minimal relationship between physical activity and alcohol use. In this study, "physical activity" was measured such that the vast majority of athletes would score high on the measure. In one of the only longitudinal studies in the area, Eitle et al. (2003) found no overall relationship between participation in high school sports and subsequent alcohol use as a young adult (age 18 to 23). In fact, among White males, those who participated in high school sports consumed more alcohol as young adults than those who did not participate in sports. Finally, Moore and Werch (2005), using a sample of junior high school students, found more positive than negative relationships between participation in a variety of school-sponsored and out-of-school sports and alcohol use. Taken together, the results from studies among youth athletes do not seem to support the deterrence hypothesis, as the majority of studies among this population have showed no differences in alcohol use between athletes and nonathletes or heavier consumption among athletes.

Alcohol Use and Other Athletes

The few existing studies on alcohol use among athletes who may be considered elite (e.g., competing at the national level) have provided inconsistent findings. Peretti-Watel et al. (2003) compared alcohol use among a sample of French elite sport athletes ages 16 to 24 to population age group norms. Significantly fewer numbers of athletes reported regular alcohol use compared to the nonelite athlete comparison group. In contrast, results from a study conducted in New Zealand found that those who competed in sport, at either the provincial or national level, scored significantly higher on a measure of high-risk drinking than those who participated in nonelite sport or no sport (O'Brien, Blackie, & Hunter, 2005). Some research also suggests that professional athletes in North America frequently use alcohol (Gallmeier, 1988; Malone, 1991, as cited in Stainback, 1997), but these studies are tempered by considerable methodological limitations. Therefore, more definitive conclusions regarding alcohol consumption among elite athletes await further study.

Several studies have examined adults who actively participate in sport but do not train or compete at the professional or elite level. These studies, from different population groups, indicate that athletes consume more alcohol than nonathletes. For example, Black, Lawson, and Fleishman (1999) reported that 35% of a sample of nonelite Australian athletes met a medical definition for "excessive drinking," compared to population norms of 29%. Kunz (1997), using a large sample of Canadian adults, found a curvilinear relationship between engaging in physical activities (many of which were organized sports) and frequency of drinking. High scores on their physical activity index were associated with drinking between 1 and 4 to 6 times per week, and low scores were associated with drinking either every day or less than once per month. In another study involving nonelite athletes, Gutgesell, Timmerman, and Keller (1996) compared alcohol consumption between "serious recreational" U.S. runners and age- and gender-matched controls. They found that male runners averaged more drinks per week and felt guiltier about their drinking than the male control group. Also, both male and female runners reported drinking on more occasions than their respective control groups. In general, results from these studies on both elite and recreational athletes again suggest that athletes are more at risk for heavy alcohol use than their nonathlete counterparts.

Etiology of Heavy Alcohol Consumption among College Athletes

Researchers have identified a host of factors associated with excessive alcohol use, such as parental alcoholism (e.g., Sher, Walitzer, Wood, & Brent, 1991), demographic characteristics (e.g., being male, being White; Wechsler et al., 2000), personality characteristics such as impulsivity and neuroticism (e.g., Fischer, Anderson, & Smith, 2004), perceptions of drinking among others (e.g., Perkins, 2002), and one's level of drinking motives (e.g., M. L. Cooper, 1994). We presume that most of these factors that are related to alcohol use in the general population will also be related to use among athletes. Research on some of these factors has, in fact, suggested that this is the case (e.g., Leichliter et al., 1998; Martens, Cox, Beck, & Heppner, 2003; Nelson & Wechsler, 2001). For the purposes of this chapter, we focus on the relationship between factors that may be unique to athletics, which we broadly term *sport-specific* factors, and personal alcohol consumption.

Impulsivity

Studies have consistently shown that higher levels of the personality characteristic of impulsivity are associated with greater alcohol consumption (e.g., Fischer et al., 2004; Sher et al., 1991). Some research suggests that athletes may possess higher levels of impulsivity than nonathletes, which may also partially explain the elevated drinking rates among athletes. For example, research by Nattiv and his colleagues (Nattiv & Puffer, 1991; Nattiv, Puffer, & Green, 1997) found that college athletes were more likely than nonathletes to engage in a host of risky behaviors, such as getting into physical fights, not using helmets on a motorcycle or bicycle, and having more sexual partners. One interpretation for engaging in such behaviors is that the individual has a higher need for sensation seeking, which has been conceptualized as an important component of impulsivity (Whiteside & Lynam, 2001).

Sport-Related Pressures

Over the past 20 years, a number of theoretical articles have been published relative to factors intrinsically related to sport that may motivate or encourage alcohol use (e.g., Damm & Murray, 1996; Tricker, Cook, & McGuire, 1989). These authors have speculated that factors such as excessive pressure and anxiety related to being an athlete and a student (for college athletes), dealing with injury, adjusting to athletic retirement, and managing performance-related pressures may cause athletes to be particularly susceptible to using alcohol as a coping strategy. It is also possible that peer influences on alcohol use (Perkins, 2002) from one's teammates are more powerful in the athletic environment, perhaps because of a "work hard, play hard" mentality. A final sport-specific factor that has been hypothesized to be related to excessive alcohol consumption is the privileged social status athletes are often afforded (Tricker et al., 1989). It is possible that this status provides athletes with more social opportunities than other individuals, which results in greater alcohol consumption. Recent research has in fact suggested that college athletes may be more likely to report drinking for social reasons than their nonathlete counterparts (Wilson, Pritchard, & Schaffer, 2004).

Despite these theoretical writings, only a few studies have attempted to address the relationship between sport-specific motivators and alcohol consumption among athletes. In many of these studies, reasons for alcohol use was assessed via simple, single-item measures (e.g., Evans, Weinberg, & Jackson, 1992; Martin, 1998). Martens, Watson, Royland, and Beck (2005) found that scores on a measure designed to assess athlete-specific reasons for alcohol use predicted alcohol consumption among college athletes, even after controlling for demographic factors and general drinking motives. Sport-related coping, however, was not a strong unique predictor of alcohol consumption, but was associated with alcohol-related problems. These findings are consistent with other research suggesting that athletes generally do not use alcohol for coping-related purposes (Bower & Martin, 1999; Evans et al., 1992; Martin, 1998; National Collegiate Athletic Association [NCAA], 2001), and contradicts earlier writings on this topic.

In another study (Martens, Dams-O'Connor, Duffy-Paiement, & Gibson, in press), the researchers found that perception of alcohol use among friends who are athletes had a strong relationship with personal alcohol consumption for both male and female athletes. For female athletes, the perception of alcohol use among friends who were not athletes was also related to personal alcohol consumption, but this was not the case for male athletes. These findings lend preliminary support to the notion that the implicit or explicit pressure from peers, especially the perception of alcohol use among one's peers who are also athletes, may in fact partially explain heavy drinking among athletes.

Seasonal Factors

It is possible that the cycle of an athlete's competitive season and off-season is also a factor in excessive alcohol use among athletes. No well-controlled longitudinal studies have addressed this question, but cross-sectional research suggests that athletes generally do not drink as much during their competitive season as in the off-season, and that drinking rates during the season are often quite low (Bower & Martin, 1999; Martin, 1998; Selby, Weinstein, & Bird, 1990; Thombs, 2000). Yet, we know that, in general, many groups of athletes report consuming more alcohol than do nonathletes (e.g., Nelson & Wechsler, 2001). It is possible that athletes are more likely to engage in heavy episodic drinking than nonathletes because they perceive that they have only 1 or 2 days per week when they have permission (either implicit or explicit) to drink alcohol, or they may perceive that there are only certain times during the year (e.g., the off-season) when they can drink alcohol. For example, football players who play games on Saturday and have Sunday off may perceive that they can consume alcohol on Saturday nights only. These athletes may therefore choose to drink heavily on their 1 night out per week. Longitudinal, well-controlled studies that analyze seasonal patterns in athlete alcohol use are warranted to provide clearer answers in this area.

Cultural Factors

A final sport-specific factor that might in some way be related to athlete alcohol consumption is the overall cultural link between athletics and alcohol. The relationship between alcohol and athletics is embedded in both the North American and the European athletic culture, and has been for some time (Collins & Vamplew, 2002; Crompton, 1993). An organized link between pub owners and sport goes back to the 1600s in Great Britain (Collins & Vamplew, 2002). In North America the link between sport and athletics has been solidified via factors such as sponsorship of athletic teams and stadiums by alcohol companies (e.g., Coors Field in Denver, Colorado; the Molson Center in Montreal, Quebec), as well as comprehensive television and other media sponsorships (Crompton, 1993; Madden & Grube, 1994). Further evidence of the sport-alcohol cultural link has been provided by national data suggesting that, among college students, those who report being a sports fan also report higher levels of alcohol consumption (Nelson & Wechsler, 2003).

Although the role of this cultural link in explaining alcohol consumption among athletes themselves has not been directly investigated, there are several speculative mechanisms of influence. It is possible, for example, that individuals who are interested in sport are inundated with associations between alcohol and sport from a young age, which causes a type of conditioned effect that allows them to identify athletic participation with alcohol consumption. In addition, because alcohol is often advertised as a means of celebration, and athletic contests often provide occasions for celebration, the athletes themselves may be particularly vulnerable to becoming conditioned to the notion that they need to consume alcohol to enjoy themselves.

RECREATIONAL DRUGS

Epidemiological data suggest that approximately 12% of the population experiences problems related to the abuse of drugs besides alcohol at some point, and approximately 2% to 4% of the population experiences drug abuse or dependence in a given 12-month period (Grant, Stinson, et al., 2004; Kessler et al., 1994). Athletes are certainly not immune to such problems associated with the use of drugs, although, in contrast to research on alcohol use, studies suggest that athletes may be less likely than nonathletes to report using a number of "recreational" drugs.

Prevalence Rates

A number of studies have compared recreational drug use among athletes to that of nonathletes drawn from the same sample. Additionally, other comprehensive data exist that has documented recreational drug use among certain subgroups of athletes (e.g., U.S. college athletes), and these data can be compared to larger databases. Despite some limitations (e.g., studying only a small number of recreational drugs), these studies provide a fairly comprehensive picture of the overall prevalence of recreational drug use among athletes.

Recreational Drug Use and College Athletes

Only one large-scale published study has directly compared prevalence rates of drug use between college athletes and nonathletes. Wechsler et al. (1997) found that a larger percentage of males who were not involved in athletics reported using marijuana at least once in the past 30 days as compared to males who were involved in athletics (16% versus 12%); rates were similar for female nonathletes versus athletes (11% versus 10%). The researchers indicated that little drug use was reported in other substance categories, and therefore did not provide specific comparisons for other substances. Other studies have not made direct athlete-nonathlete comparisons in terms of drug use but provide relevant data nonetheless. Perhaps the most comprehensive source of recreational drug use prevalence rates among any group of athletes comes from the NCAA (2001). Results from a sample of more than 21,000 college athletes indicated that 27.3% reported using marijuana, 4.5% psychedelics or hallucinogens, and 1.7% cocaine or crack at least once in the past year. These rates (see Table 39.2) are either similar to or lower than national data from general college student databases (Gledhill-Hoyt, Lee, Strote, & Wechsler, 2000; Johnston, O'Malley, Bachman, & Schulenberg, 2004). These athlete-nonathlete comparisons should be interpreted cautiously because data were drawn from different samples and assessed specific substance use differently. Nonetheless, comparisons of these databases suggest that intercollegiate athlete recreational drug use is at least similar to the general college student population, and may actually be less for certain substances.

Recreational Drug Use and Youth Athletes

Most studies on substance use among younger athletes indicate that this group is generally less likely to use recreational drugs than nonathletes. For example, a study of 12-month drug use prevalence rates found that high school students who had participated in a sport in the past year were significantly less likely to report using cocaine (3.1% versus 7.2%) and psychedelics (9.8% versus 18.1%) than those who had not participated in sport (Naylor, Gardner, & Zaichkowsky, 2001). Athletes were also less likely to use marijuana and barbiturates, but these differences were not statistically significant. Two studies conducted on a large sample of French youth (Peretti-Watel, Beck, & Legleye, 2002; Peretti-Watel & Lorent, 2004) showed that those who participated in sport were less likely to use cannabis than those who did not participate. Finally, two large studies of Swiss adolescents (Ferron, Narring, Cauderay, & Michaud, 1999; Stronski, Ireland, Michaud, Narring, & Resnick, 2000) found that participation in sport was associated with less likelihood of lifetime marijuana use, and, among boys, participating in a sports club was associated with use of marijuana only rather than marijuana plus other illicit drugs. However, one recent study conducted on a sample of U.S. junior high school students found no relationship between school-sponsored sport participation and

Table 39.2 Intercollegiate Athlete 12-Month Recreational Drug Use Prevalence Rates Compared to General College Student Rates

	Substances Used (%)						
Source	Marijuana	Psychedelics/ Hallucinogens	LSD	PCP	Crack/ Cocaine	Other Cocaine	Crack Cocaine
NCAA (2001)	27.3	4.5	N/A	N/A	1.7	N/A	N/A
Gledhill-Hoyt et al. (2000)	27.4	N/A	3.7	5.7	N/A	3.6	0.9
Johnston et al. (2004)	33.7	7.4	1.9	N/A	N/A	8.8	1.8

Note: $N = 21{,}225$ for the athlete-only sample (NCAA, 2001); $N = 13{,}958$ for one overall student sample (Gledhill-Hoyt et al., 2000); $N = 1{,}240$ for the other overall student sample (Johnston et al., 2004). In the Johnston et al. sample, results were presented separately for full-time versus other college students, so data reflect full-time students only.

marijuana use when the total sample was analyzed, and a positive relationship between participation in school-sponsored football or swimming and marijuana use (Moore & Werch, 2005). Therefore, although most results seem to indicate that youth sport participation serves as a protective factor against recreational drug use, this may not be the case for individuals across all types of sports.

Recreational Drug Use and Other Athletes

No known studies have assessed for recreational drug use prevalence rates among Olympic-caliber athletes, and only one known study (Malone, 1991, as cited in Stainback, 1997) queried males in a professional sport league. This study found very low rates of recreational drug use, including marijuana, hashish, and cocaine, and that these rates were much lower than age-matched males in the general population. Another study (Peretti-Watel et al., 2003) found that marijuana use among French athletes participating in regional training centers was lower than comparable population norms, providing additional support for the notion that elite athletes may report less drug use than the general population. Further, because most professional sport leagues and international amateur organizations routinely test for a variety of drugs, one can speculate that recreational drug use will be limited among athletes competing at that level. Nonetheless, the lack of detailed information regarding drug use among these types of athletes remains a void in the literature.

Explaining Less Recreational Drug Use among Athletes

Because studies that examine athlete-nonathlete differences indicate that athletes seem to be less likely to use recreational drugs than nonathletes, it is possible that participating in sports may serve as a type of protective factor against heavy recreational drug use. We presume that athletes will be subject to the same risk factors that predict drug use in the general population and generally use recreational drugs for similar purposes as nonathletes (enjoying a party, tension reduction, feeling high; e.g., Simmons, Correia, Carey, & Borsari, 1998). It is certainly possible that some athletes use recreational drugs as a means of coping with sport-specific stress, or that the social status afforded some athletes (Tricker et al., 1989) provides more opportunities for recreational drug use. Nonetheless, because the prevalence data indicate that athletes are not a particularly at-risk group for heavy recreational drug use, it is unlikely that sport-related factors contribute to recreational drug use among athletes in general. In fact, it is more likely that factors directly or indirectly related to sport serve to minimize recreational drug use among athletes. Two such factors include drug testing by sporting organizations and the health-related consequences associated with recreational drug use.

Drug Testing

Most professional sport organizations routinely test for recreational drug use among their members, as do other major organizations such as the NCAA and the World Anti-Doping Agency. Although punitive sanctions vary across levels, competitions, and sports, athletes who test positive for a banned recreational drug typically face a penalty of some kind. One study conducted on athletes from a single university found that those who were regularly tested were less likely to use drugs than those who were not tested (Coombs & Ryan, 1990), and another small study found that drug testing was associated with less drug use among high school athletes (Goldberg et al., 2003). Although comprehensive, well-controlled studies have not yet unequivocally shown that drug testing reduces the incidence of use among athletes, one can presume that possible sanctions such as loss of eligibility, suspension, and erasure of performance records will serve as a deterrent. Further, some data indicate that most athletes are in favor of drug testing (Diacin, Parks, & Allison, 2003; NCAA, 2001), which suggests that athletes generally support official policies designed to limit recreational drug use.

Health Consequences

A second potential reason for reduced rates of recreational drug use among athletes compared to nonathletes is that athletes are more concerned about the negative impact such use would have on their overall health and athletic performance. Research from the NCAA (2001) indicated that the most frequently cited reason for not using cocaine, marijuana, or hallucinogens, after "no desire for the effect," was concern about one's health. These results are consistent with other research on smaller samples of athletes (e.g., Evans et al., 1992). Although athletes also indicate that health-related concerns are primary reasons for not using alcohol (NCAA, 2001), the prevalence rates of alcohol use among athletes suggests that these concerns do not serve as strong deterrents for a large percentage of athletes. In contrast, given the relatively low prevalence rates of recreational drug use among athletes, perhaps such concerns are more salient deterrents for recreational drug use. At this point, we can only speculate as to why this might be the case, but it is possible that athletes perceive the health risks of most recreational drugs to be more severe, thus limiting their use.

ERGOGENIC DRUGS

The use of performance-enhancing substances in sport dates back almost as far as athletic competitions themselves. Soon after the first Olympiad, the ancient Greeks began using mushrooms to gain a competitive edge, and Roman gladiators discovered the benefits of stimulants around 600 B.C. (Jones & Pichot, 1998). Much later, soldiers in World War II recognized that using the amphetamines from their survival kits (which were intended to reduce fatigue in combat) improved their performance in armed services football games (Mandell, 1979). The performance-enhancing effects of various substances, from steroids to stimulants, became an attractive option for athletes at all levels of competition. Whereas alcohol and recreational drugs are generally recognized as being detrimental to athletic performance (NCAA, 2001), the use of performance-enhancing substances may not be so readily stigmatized by some in the athletic community due to its apparent consistency with many athletes' larger goals: to reach one's maximum potential and win at all costs. We next address the prevalence rates, reasons for use, and potential health risks of three main categories of performance-enhancing substances: steroids, painkillers, and stimulants.

Steroids

As a result of several high-profile media cases, legal and ethical contention at all levels of athletic competition, and increased use of steroids among nonathletes, the use of anabolic-androgenic steroids has received a great deal of attention in recent decades. Throughout the 1970s, when instances of steroid use among professional athletes were receiving heightened media attention, researchers initially found little or no steroid use among nonathletes (e.g., Toohey, 1978). However, despite the passage of the Anabolic Steroid Control Act of 1990, which made nonprescription use of steroids illegal in the United States, steroids are increasingly being used in the general population. Data from the 1991 National Household Survey on Drug Abuse indicated that 0.5% of Americans age 12 and older reported having used anabolic steroids at some point in their life (Yesalis, Kennedy, Kopstein, & Bahrke, 1993). By 1999, a study funded by the National Institute on Drug Abuse (NIDA; 2000) on adolescent drug abuse estimated that 2.7% of 8th and 10th graders and 2.9% of 12th graders had used anabolic steroids at least once, which represented a significant increase in rates of use across all three grade levels since 1991. Finally, 1.4% of males ages 19 to 30 reported steroid use in the previous year (Johnston et al., 2004).

Although most athletes believe that ergogenic drug use is unacceptable, research indicates that such drug use has increased more than social drug use among collegiate athletes in recent years (NCAA, 2001). Multiple factors, including gender, sport type, and level of competition, have been examined as risk factors for the use and abuse of steroids among athletes (for a review, see Bahrke, Yesalis, Kopstein, & Stephens, 2000). The motivational factors related to steroid use, many of which are intrinsic to athletics itself, are reviewed next.

Steroid Use and College Athletes

Evidence suggests that steroid use was more prevalent among college athletes in the 1970s and 1980s, before the advent of drug testing by the NCAA in 1986, although comprehensive national data from that time period are lacking. A survey study that was conducted at various intervals between 1970 and 1984 at five American universities reported that as many as 20% of intercollegiate athletes used steroids, and that this rate remained steady between 1976 and 1984 (Dezelsky, Toohey, & Shaw, 1985). More recently, the most comprehensive source of data on drug use among collegiate athletes comes from a series of studies conducted at 4-year intervals by or for the NCAA. Following the NCAA ban of anabolic steroids in 1986, usage rates dropped from 4.9% in 1989 to 1.1% in 1997. However, a trend toward an increase in steroid use among athletes has more recently emerged. In the 2001 NCAA study, anabolic steroids were the only ergogenic drug whose use had increased across all three divisions of NCAA competition since 1997. Specifically, 1.6%, 1.3%, and 1.4% of athletes competing in Divisions I, II, and III, respectively, reported using anabolic steroids in the previous 12 months, with the largest increase occurring among Division I athletes (NCAA, 2001).

Among college athletes, steroid use appears to vary greatly by sport type. The NCAA (2001) found that of the sports teams surveyed, anabolic steroid use was lowest among male and female tennis players (.06% and .00%, respectively), followed by female track and field athletes (.06%), and use was highest among men's water polo, rifle, football, and baseball teams (5.0%, 4.2%, 3.0%, and 2.3%, respectively) and women's lacrosse and swimming teams (1.6% and 1.3%, respectively). These data suggest that certain groups of athletes are more at risk for steroid use than others, which is logical given the varying physical demands of different types of sports.

Steroid Use and Youth Athletes

Only one survey has specifically focused on steroid use among adolescent students in the United States. Results from this study indicated that approximately 3% of those who participated on at least one sports team used anabolic steroids, and steroid use was relatively equally distributed between athletes (58.5% of all users) and nonathletes (K. E. Miller, Barnes, Sabo, Melnick, & Farrell, 2002b). High school steroid users were more likely to be male (71.4%), and male users were significantly more likely than female users to participate in interscholastic athletics (64.0% and 44.8%, respectively; Miller et al., 2002b). Although these data are drawn from only one study, results indicate that rates of steroid use may be relatively similar among athletes and nonathletes at the high school level.

Steroid Use and Professional and Elite Athletes

Possibly due to increasingly comprehensive bans of performance-enhancing drugs, stringent drug testing, and strict consequences associated with using steroids in elite and professional athletic competition, the prevalence of steroid use among this population of athletes has been poorly documented. Anecdotal evidence, as well as several cases of high-profile athletes testing positive for steroid use, suggests that some professional and elite athletes continue to use steroids despite the potential health and career consequences (e.g., Maske, 2005; McCarron, 2005). However, the paucity of nationally representative studies and the clear barriers to accurate self-reporting of steroid use preclude comprehensive statements about the true prevalence of steroid use among professional and elite athletes.

Reasons for Steroid Use among Athletes

Unlike the use of recreational drugs, which have clear ergolytic potential that makes their use inconsistent with the performance goals of athletes, the use of steroids and other performance-enhancing substances may actually be facilitated by factors that are intrinsic to sport itself. Forty-three percent of intercollegiate athlete steroid users reported that their primary motivation in using steroids was to improve athletic performance (NCAA, 2001), an incentive that is cited by athletes across multiple levels of competition, from high school (K. E. Miller, Barnes, Sabo, Melnick, & Farrell, 2002a) to Olympic athletes (Bamberger & Yaeger, 1997). Other reasons for steroid use among intercollegiate athlete users endorsed in an NCAA survey include improving one's appearance (19.8%), recovery from a sport injury (16.7%), recovery from a nonsport injury (11.5%), and preventing injury (6.3%; NCAA, 2001).

Additional sport-related factors for steroid use have emerged in smaller studies. Male bodybuilders reported that factors such as frustration over reaching a training plateau and witnessing the success of competitors who used steroids, in addition to gaining greater acceptance in groups of more "serious" bodybuilders, were primary motivators (Olrich & Ewing, 1999). Although the contribution of these factors to steroid use among athletes from sports outside of bodybuilding has not yet been explored, it is possible that they are salient motivators for other athletes as well. The influence of teammates and team leaders on steroid use, whether through explicit encouragement or vicarious reinforcement, has also been reported (Diacin et al., 2003). Finally, pressure from coaches and agents has been cited as a motivator for steroid use, even among athletes who disapprove of performance-enhancing drugs. This may be because they believe that playing time or maintenance of athletic scholarship is contingent upon acquiescing to a coach's recommendations (Diacin et al., 2003; Tricker & Connolly, 1997).

Research suggests that among steroid-using athletes, a subculture may be created in which steroid use may not be explicitly promoted, but also may not be discouraged (Olrich & Ewing, 1999). Athletes who are offered steroids by a trusted and knowledgeable person who has an investment in their athletic success, such as a team leader, coach, or athletic trainer, may be more likely to minimize the risks associated with steroid use due to its implicit acceptability when used in a context of health promotion and performance enhancement. This supports the previously discussed possibility that steroid use in some athletic subcultures is not considered a deviant behavior, but is rather a pragmatic measure that some athletes view as being consistent with goals of athletic success.

The win-at-all-costs ethic that is common among competitive athletes also appears to be a primary factor in the use of steroids (e.g., Tricker et al., 1989). An extreme example of this comes from a *Sports Illustrated* survey of American Olympic athletes in which 195 of 198 Olympians who were surveyed reported that they would use a banned performance-enhancing drug if it were guaranteed that they would not be caught and that they would win (Bamberger & Yaeger, 1997). Over half of the respondents indicated that they would still use such a drug under these conditions even if they knew they would die within 5 years from side effects of the drug. Although death from steroid use is relatively uncommon, the health consequences can be severe. These include hormonal disruptions (NIDA, 2000), aggressiveness and criminal activity (Brower, 1993), cardiovascular disease, increased LDL cholesterol (Dickey & Gavin, 2003), and a strong potential for addiction (Brower, Blow, Young, & Hill, 1991).

Other reasons for steroid use among athletes, especially younger individuals, may have little to do with athletic performance itself. Some researchers have demonstrated that steroid use is associated with other aberrant or unhealthy behaviors, such as using hard drugs and marijuana (DuRant, Escobedo, & Heath, 1995; Wichstrom & Pendersen, 2001), general risk taking (K. E. Miller et al., 2002b), and extreme weight loss (K. E. Miller et al., 2002a). As a result of these findings, steroid use has been included in models of health behavior such as problem behavior theory (Jessor & Jessor, 1977), which argues that substance abuse among adolescents often occurs alongside a host of other problem behaviors, including sexual precocity, risk taking, and general delinquency.

Nonetheless, it is our contention that performance-related considerations are the primary driving factor of steroid use among most athletes at all competitive levels. Among adolescents and young adults in particular, there appears to be a divergence in etiologies and motivations for use among athletes and nonathletes. As discussed earlier, steroid use may not be considered deviant by the athletes who are using it (Dunning & Waddington, 2003). In addition, athlete and nonathlete steroid users appear to have different health behavior and risk profiles, with athlete users reporting significantly less illicit drug use and suicidal ideation than nonathlete users (K. E. Miller et al., 2002b; Naylor et al., 2001). Stated motivations for use appear to vary as well: Although performance enhancement continues to be the primary reason for steroid use among athletes, many nonathlete users report weight loss or appearance augmentation as primary motivations for using steroids (e.g., Bahrke et al., 2000). Together, this suggests that athlete steroid users are attracted to the ergogenic properties of steroids but may avoid other drugs due to their ergolytic potential, and that factors such as body dissatisfaction, in addition to a propensity for engaging in risky health behaviors, may be salient motivators for steroid use in general but may be less relevant to athletes.

Painkillers

The drug problem in the United States is often characterized by a continuously changing scene in which the substance of choice is constantly shifting and new at-risk populations for popular substances are identified. One such trend was set in motion with the release of OxyContin into the market in 1996, resulting in widespread use and abuse of this highly addictive painkiller (Inciardi & Goode, 2003). OxyContin is just one of several widely used narcotics that provide pain relief from injuries, fractures, dislocations, and arthritis, yet at the risk of dependence or addiction. The 2003 National Household Survey on Drug Abuse (Substance Abuse and Mental Health Services Administration, 2004) found that 31.2 million Americans age 12 and over reported nonmedical use of prescription pain relievers, and that reported use of each of these drugs was significantly elevated since 2002. In addition, 4.7% of adults ages 18 to 25 reported nonmedical use of pain relievers in 2003, also reflecting a significant elevation since 2002.

Another index of the prevalence of painkiller abuse in the general population is the number of drug treatment admissions. Many states reported substantial increases in narcotics-related admissions that mirrored significant increases in opiate-based prescription drugs in the late 1990s (Inciardi & Goode, 2003). Despite a general decrease in illicit drug use among American 8th, 10th, and 12th graders from 2003 to 2004, abuse of OxyContin increased to 1.7%, 3.5%, and 5% in the three grade levels, respectively (Johnston, O'Malley, Bachman, & Schulenberg, 2005).

Prevalence of Painkiller Use among Athletes

Comprehensive data on painkiller use and abuse among athletes are lacking, largely due to the exclusion of painkillers from most nationally representative drug use studies. In addition, because painkillers are often appropriately prescribed and used legally, it is difficult to identify illicit use. In one small study, 5% of collegiate athletes reported daily painkiller use, and 26% reported using painkillers at least once a week (Selby et al., 1990). Many sources of anecdotal evidence suggest that the use of both prescription and nonprescription painkilling drugs is widespread among professional athletes (Freeman, 1997; Suggs, 2004), although comprehensive prevalence data among this group are lacking. However, it has been estimated that as many as 10% of NFL players have or have had addiction problems involving painkilling drugs (Freeman, 1997). The lack of data on rates of painkiller drug use, both legal and illegal, is a clear void in the research literature that warrants further investigation.

Reasons for Use of Painkilling Drugs among Athletes

Clearly, the primary reason for painkiller use among athletes is to treat or minimize an injury. One strong motivator that may put athletes at risk for painkiller overuse or abuse is what has been referred to as "the athletic mindset" (Tricker, 2000), which brings with it the attitude that one must continue to practice, play, and compete despite being injured. Indeed, many athletes believe that playing through pain is simply part of the game. In a survey of collegiate athletes, only 6% reported that they stopped training when they were injured, whereas 29% reported making no change in their training regimen (Selby et al., 1990). Evidence suggests that playing injury-free is hardly enough to gain attention; athletes must play through injuries to achieve respect and distinction (Freeman, 1997). Therefore, athletes may be motivated to do whatever it takes to continue sport participation, including overuse of painkilling medications.

Another motivating factor for painkiller use may be the stress associated with being injured. Approximately two-thirds of intercollegiate athletes report that a physical injury that impeded their ability to train or compete was a primary source of stress (Selby et al., 1990). Because severe or chronic injuries pose particular threats to an athlete's career and athletic identity, the resulting impatience, frustration, and depression may make injured athletes more vulnerable to painkiller abuse.

It is also possible that many athletes who illicitly use painkillers do so because they are not aware of the negative consequences associated with such use. For example, one study found that 25% of collegiate athletes had no knowledge of the side effects of painkilling drugs, 29% believed there was nothing wrong with using painkilling drugs on the day of competition to avoid competing in pain, and 58% reported that they used painkilling drugs regularly during the competitive season (Tricker, 2000). In addition, 58% of athletes reported obtaining painkilling drugs from teammates, and 60% obtained them from friends. In this same study, Tricker found that endorsement of the beliefs "Painkilling drugs are necessary to overcome any soreness," "Painkilling drugs are necessary to achieve success in sport," and "If injured I would take painkilling drugs so that I could continue to compete" was related to the attitude that there is nothing wrong with using painkilling drugs on competition days to allow an athlete to play through pain.

Unfortunately, the tendency of athletes to use painkilling drugs to mask the discomfort of injury puts them at risk of greater problems down the road if the injury worsens or recovery is prolonged (Thornton, 1997). In addition, overuse or overreliance on painkilling drugs may actually reinforce an athlete's dependency on painkillers by providing a more attractive option (at least in the short term) to dealing with injury more responsibly (Leadbetter, 1995). The risk of becoming addicted to painkilling drugs increases with such maladaptive attitudes (Tricker, 2000), and athletes who have abused other substances in the past or have an underlying vulnerability to effects of these substances may be at heightened risk (Meier, 2003).

Stimulants

Stimulants include a broad range of substances that have various effects on the body, including metabolic enhancement and weight loss, heightened mood, increased aggression, energy enhancement, improved speed, and belligerence (Bents, Tokish, & Goldberg, 2004; Jones & Pichot, 1998). These drug effects offer performance-enhancing, recreational, and appearance-augmenting properties that result in their use among both athletes and nonathletes. For example, one national study of high school students found that 7.6% of students in grades 9 through 12 (6.8% of females and 8.3% of males) used methamphetamines, and 9.2% of students (11.3% of females and 7.1% of males) used diet pills, powders, or liquids in the previous month without the advice of a physician (Grunbaum et al., 2004). Among college students, 5.8% reported using diet pills, many of which contain stimulants, to lose weight in the past 30 days (American College Health Association, 2005). It is difficult to determine from these data whether stimulants were used recreationally or as performance-enhancing agents, but as stimulants (including ephedrine as of 1997) are classified as ergogenic and therefore banned by many sporting organizations, we assume that much of its use among athletes is for the latter purpose.

Prevalence of Stimulants and Diet Drug Use among Athletes

A trend toward amphetamine use among professional football players began in the 1940s, when the performance-enhancing effects of these drugs were recognized (Mandell, 1979). In fact, stimulants were the most widely used and abused ergogenic substance among athletes before the onset of steroid use (Jones & Pichot, 1998). At least one source suggests that throughout the 1970s, football clubs at varying levels of competition commonly purchased amphetamines in bulk quantities, a practice that was sanctioned by many team physicians (Marshall, 1979). In fact, it has been speculated that monetary issues, rather than health concerns, led to the amphetamine ban by the NFL in 1971 (Marshall). However, high-profile cases of athletes who suffer health consequences related to amphetamine use, such as the 2003 death of Baltimore Orioles pitcher Steve Bechler after reported use of ephedra, suggest that stimulant use continues at this level of sport.

NCAA (2001) data suggest that rates of ergogenic amphetamine use have remained relatively stable since the late 1980s, with 3.3% of collegiate athletes reporting use in the previous 12 months. In some sports, such as football (4.2%), lacrosse (7%), and wrestling (6%), athletes reported greater use rates than athletes in other sports (e.g., track and field, 1.4%; men's basketball, 1.4%). However, one study of college hockey found that 58% of players reported current or past use of stimulants despite rather broad knowledge of potential side effects (Bents et al., 2004). The use of ephedrine among collegiate athletes was first included in NCAA studies in 1997, and use increased from 3.5% to 3.9% in 2001 (NCAA). Of particular importance, these rates reflect ephedrine use after the NCAA banned its use in 1997. In addition, it has been estimated that nearly 11% of female athletes report using a variety of nonprescription diet drugs (W. A. Anderson, Albrecht, McKeag, Hough, & McGrew, 1991). This rate appears to be higher among sports with strict weight and appearance expectations, such as gymnastics (Higher Education Center for Alcohol and Other Drug Prevention, 2002).

Reasons for Stimulant and Diet Drug Use among Athletes

Evidence suggests that the reasons for stimulant use vary somewhat by sport type and gender. It seems that performance enhancement is the primary reason for use among athletes who are involved in contact sports that require speed and aggression, such as football and hockey (e.g., Mandell, 1979; Marshall, 1979). In addition, a 1971 survey of professional football players found that 42% reported using or occasionally using amphetamines to combat pain and improve speed on game days (Johnson, 1972, as cited in Mandell, 1979).

However, many athletes report using amphetamines and diet drugs to enhance appearance or to meet a coach's weight requirements, with performance enhancement being only a secondary motivator (e.g., Bower & Martin, 1999). In addition, athletes who participated in track, cross-country, and wrestling were more likely to report using pathogenic weight control behaviors, such as diet pill use, than athletes participating in other sports (Nattiv et al., 1997). Female collegiate athletes are more likely to believe that weight is critical to athletic performance (22% as compared to 13% of males; Selby et al., 1990), which may also contribute to different etiologies for stimulant and diet drug use by gender. In addition, weight loss products may be used more frequently during the off-season among female athletes (Bower & Martin, 1999). This may suggest some awareness of the negative health and performance-related consequences of stimulant use, such as electrolyte imbalance, muscle loss, bone loss, and injury (Higher Education Center for Alcohol and Other Drug Prevention, 2002). Taken together, the literature suggests that stimulant use among athletes is driven by two main motivations: performance enhancement and weight loss. For athletes who compete in sports in which body weight and shape are important for athletic success, these two motivations may be one and the same.

PREVENTION AND TREATMENT OF ALCOHOL AND DRUG PROBLEMS AMONG ATHLETES

There is a growing body of literature documenting the overall efficacy of prevention and treatment programs in reducing alcohol use, other drug use, and consequences of such use, and many involve a brief intervention format (see Larimer & Cronce, 2002; Larimer, Kilmer, & Lee, 2005). Although prevention efforts that emphasize education, information, or knowledge-based content are commonly used, evidence suggests that, at least among college students, these have not been successful in changing behavior (Larimer & Cronce, 2002; National Institute of Alcohol Abuse and Alcoholism [NIAAA], 2002). Though the efficacy of different prevention and intervention approaches may vary according to the target populations, the scientific literature has yet to fully address the role and efficacy of prevention and treatment efforts that specifically or exclusively target athletes. However, a review of those studies that have included athletes allows us to make suggestions for athlete-specific prevention programs, intervention efforts, and future research.

Prevention Programs Targeted to Athletes

Research indicates that, at least in the collegiate population, many athletes are exposed to alcohol and drug education programs. For example, one study (Martin, 1998) found that 85% of NCAA Division I female athletes participated in some type of alcohol education program. Further, the majority of NCAA universities participate in the NCAA-sponsored Champs/Life Skills program, which has alcohol and drug education and prevention as one of its core program components (NCAA, n.d.). However, given the high rates of alcohol use among athletes (e.g., Nelson & Wechsler, 2001), as well as the literature on the general ineffectiveness of education-only programs (Larimer & Cronce, 2002), the efficacy of such education-based prevention programs with college athletes is questionable and would need to be studied in controlled trials.

There have been at least three studies (Marcello, Danish, & Stolberg, 1989; Thombs & Hamilton, 2002; Werch, Carlson, Pappas, Edgemon, & DiClemente, 2000) that have assessed the effectiveness of prevention programs among athletes that go beyond simply providing educational information. Werch et al., using a sample of youth athletes (seventh through ninth grade), tested the efficacy of a brief, individual consultation conducted by a nurse during sports physicals that focused on risk and protective factors related to alcohol use. They found that suburban and rural (but not urban) athletes who received the intervention were less likely than the control group to report alcohol use and intentions to drink, although differences were statistically significant on only two of eight measures. In contrast, Marcello et al. found that a prevention program designed specifically for college athletes, which included general information about alcohol and other drugs, skills for dealing with peer pressure, and peer refusal training, was not effective in reducing alcohol and drug use, and that participants in the treatment condition fared no better than those in the control group. Similarly, Thombs and Hamilton tested the impact of a social norms campaign (which is aimed at reeducating and correcting a misperceived norm regarding alcohol use; see Perkins, 2002) on the drinking behaviors of NCAA Division I athletes at three universities. They found that although "campaign-exposed" athletes estimated lower levels of alcohol consumption among various student groups (e.g., team members, the "typical" student), the intervention had no effect on personal alcohol consumption.

On the surface, the results of these studies are somewhat discouraging for those interested in effectively preventing heavy alcohol use among athletes, as only one study (Werch et al., 2000) demonstrated even moderate intervention effectiveness. However, there were a number of limitations to the two studies (Marcello et al., 1989; Thombs & Hamilton, 2002) that showed minimal or no intervention effectiveness. These limitations included very low response rates and number of participants (Marcello et al., 1989), no baseline assessment, no randomization, and large amounts of missing data (Thombs & Hamilton, 2002). We do believe that well-designed and properly administered programs targeted specifically to athletes have the potential to prevent or reduce high-risk alcohol use among this group, as prior studies that have assessed the effectiveness of alcohol intervention programs on samples that included large numbers of athletes (even though athletes were not specifically targeted) and preventive interventions targeted to athletes for other health-related behaviors (e.g., reducing chewing tobacco use) have been shown to be effective (e.g., Walsh et al., 2003; Werch et al., 2003). Further, there exists well-documented evidence in the general population for the efficacy of certain types of alcohol and other drug preventive interventions (e.g., Larimer & Cronce, 2002; Larimer et al., 2005; Stephens, Roffman, & Curtin, 2000).

Treatment Approaches

In the absence of studies focusing on treatment options with athletes who misuse or abuse different substances, approaches with demonstrated success among general populations that could likely be applied to athletes can be considered. Brief interventions, particularly those utilizing motivational interviewing techniques (W. R. Miller & Rollnick, 2002), have generated a great deal of enthusiasm because of the observed impact on behavior and data supporting their use. The NIAAA (2002) recognized brief motivational enhancement interventions as one of only three strategies with demonstrated evidence of effectiveness in reducing alcohol use by college students, as numerous studies have supported their effectiveness in reducing alcohol consumption and alcohol-related problems (see Larimer & Cronce, 2002). In addition to the clear success in reducing alcohol use and related consequences, motivational interviewing interventions have demonstrated effectiveness with use of marijuana (Stephens et al., 2000), cocaine (Stotts, Schmitz, Rhoades, & Grabowski, 2001), and other substances (Martino, Carroll, O'Malley, & Rounsaville, 2000).

The busy schedules of most athletes may make brief interventions more logistically feasible for this group. Further, because motivational interviewing focuses on eliciting personally relevant reasons for changing one's behavior, and because these reasons could differ so dramatically from person to person, any unique changes to content discussed during sessions with athletes could still fit within the framework of the intervention. The theory behind such approaches and a brief introduction to the strategies utilized therein are described in subsequent sections.

Motivational Enhancement Interventions: Motivational Interviewing

Motivation enhancement interventions, such as motivational interviewing, are person-centered, directive communication methods that are designed to enhance motivation to change by clarifying and resolving ambivalence (W. R. Miller & Rollnick, 2002). An important strength of motivational interviewing is that it caters to the client's level of readiness to hear the intervention's message about the impact of his or her behavior and the changes that may be needed because of this behavior. Prochaska and DiClemente's stages of change model (see Connors, Donovan, & DiClemente, 2001, for a recent review) can be used to inform and direct the delivery of motivational enhancement interventions. For the purposes of this chapter, a brief overview of the stages of change is provided.

The first stage of treatment is the *precontemplation* stage, during which an individual has no intention to change behavior, perhaps because he or she is unaware of any potential problem or is not concerned about any potential consequences that may seem alarming to others. Athletes who declare that they are there only to meet a coach's mandate or who believe they are immune from the potential harm caused by substance use may be in the precontemplation stage. Such athletes may even be surprised at the suggestion that substance use could be having a negative impact. A person in the *contemplation* stage has begun to notice possible reasons for change (e.g., connecting feeling dehydrated to days following excessive alcohol use). This person may even be weighing the pros and cons of change (e.g., fewer practices inhibited by a hangover versus perceived less enjoyable social gatherings). In the *preparation* or *determination* stage, a person has decided to make a change but has not yet begun taking steps to change behavior. For example, an athlete using a substance heavily in the off-season who describes a plan to stop once the start of the season arrives may be in this stage. In the *action* stage, an individual is actively making changes in his or her use, and in the *maintenance* stage a person is maintaining the behavior-related gains he or she has made.

Unlike many interventions that do not consider a person's readiness to change (e.g., targeting people with an action stage message such as "Just say no" when many participants may not have even begun thinking about changing their behavior), motivational interviewing recognizes the importance of meeting an individual where he or she is in terms of readiness to change. This method can also impact motivation to change by exploring and resolving ambivalence about change. Across the stages of change, motivational interviewing can be used to enhance motivation to prompt contemplation to change or to prompt initiation or maintenance of change. The basic principles of a motivational approach (also summarized by E. T. Miller, Kilmer, Kim, Weingardt, & Marlatt, 2001) are summarized next.

W. R. Miller and Rollnick (2002) explain that a client-centered, empathic style is utilized throughout motivational interviewing. Reflective listening is a key skill and strategy for expressing empathy and understanding a client's situation. Several authors (e.g., Ferrante, Etzel, & Lantz, 1996; Watson, 2002) describe unique challenges athletes may face in the college setting, such as balancing athletic and academic demands, managing athletic successes and failures, injury, termination of an athlete's sports-related career, and weight management issues. Being aware of, accepting, and communicating understanding of these issues (when discussed by the athlete), especially as they may relate to substance use, can be important to strengthening a therapeutic relationship when conducting an alcohol- or drug-related intervention (W. R. Miller & Rollnick, 2002). Being empathic also helps foster the process of challenging an individual by developing discrepancies. Developing discrepancies between a person's current behavior and his or her important goals can be important to eliciting personally relevant reasons for change. This can occur by providing information or feedback that helps the individual clarify goals, consider consequences or potential consequences of substance use, and allowing a client to present the reasons for change based on this consideration. For example, an athlete for whom reducing anxiety is very important may find that learning about alcohol- and marijuana-related REM sleep deprivation and the subsequent increases in anxiety, or the negative effects of alcohol use on athletic performance, could serve to prompt contemplation of change.

In considering the various components of providing information or feedback, providers often find that some particular topic serves as the hook that prompts an individual to think differently about his or her substance use. The hook may be different for athletes compared to nonathletes (e.g., weight gain, dehydration, muscle development). Although documenting any differences in what serves as the hook for an athlete is a matter that warrants empirical investigation, interventions could certainly begin to explore what is most important and relevant to the client involved in sports.

Even when providers are empathic and effective in developing discrepancies, clients are often resistant to change. This resistance is viewed as normal, and motivational interviewing does not advocate attempts to break it down. W. R. Miller and Rollnick (2002) describe the negative impact of nonempathic confrontation, which often results in patients or clients defending themselves or their current behavior. If an athlete, for example, disagrees that recreational prescription drug use can have risks associated with it, it is not the provider's job to convince him or her otherwise. Instead, because resistance to such information can be a typical component of the change process, the provider "rolls with resistance" through the use of various nonconfrontational strategies, such as reflective listening (e.g., slightly reframing a client's comment to show how it can actually support changing one's behaviors) and exploring ambivalence regarding change (e.g., addressing what the athlete may not like about changing his or her substance use habits). Both of these strategies allow the provider to roll with resistance and help the client explore new perspectives.

For individuals who are actually ready to change their behavior, supporting their self-efficacy for changing is very important. Many athletes are well aware of the importance of self-efficacy as it relates to performance. Similarly, a client's belief that change is possible can be an important motivator and predictor of the efficacy of substance use interventions (W. R. Miller & Rollnick, 2002). Understanding that there are a range of ways an individual can change his or her behavior can also enhance self-efficacy. Finally, if a client commits to making a change in behavior, various cognitive-behavioral strategies can be utilized to assist with this attempt. Once an individual pursues an initial change in behavior, the hope is that he or she can maintain this change (be it a reduction in use or total abstinence). For the athlete who is making or has made changes (i.e., a person who is in the action or maintenance stage), relapse prevention (Marlatt & Donovan, 2005) is another science-based approach with demonstrated success.

Relapse Prevention

For those individuals who have made efforts to significantly reduce or eliminate their use of alcohol or drugs, relapse prevention interventions may be useful. Marlatt and Witkiewitz (2005) explain that the two aims of relapse prevention are preventing an initial lapse and maintaining any goals (i.e., abstinence or reduced use) and providing coping strategies for managing a slip or lapse if it occurs. For clients using substances that are directly linked to athletic competition (e.g., steroids), relapse prevention has been suggested as a helpful and important strategy (Brower, 1993; Kilmer, Cronce, & Palmer, 2005). Relapse prevention strategies have also been successfully implemented with marijuana users (e.g., Stephens et al., 2000). Relapse prevention approaches primarily include strategies for coping with urges and cravings to use, recognizing high-risk situations, recognizing apparently irrelevant decisions that actually heighten the risk of relapse, stimulus control techniques that involve removing tempting stimuli and altering routines, and coping with upsetting thoughts that could lead to use. Given the many populations for which these strategies have been successfully implemented, a provider could utilize this clinical technique with an athlete who has recently changed behavior related to substance use.

CONCLUSION

The purpose of this chapter was threefold: (1) to review the prevalence rates of alcohol, recreational drug, and ergogenic drug use among athletes; (2) to discuss reasons for substance use among athletes, focusing on sport-specific reasons for use (or lack of use); and (3) to address alcohol/drug prevention and treatment strategies that may be effective with athletes. Of all the substances reviewed, athletes seem to be at most risk, in comparison to nonathletes, for heavy alcohol use. This is especially true of certain groups of athletes, such as college athletes in the United States. In contrast, and although the research in the area is not as comprehensive as that focusing on alcohol consumption, evidence does suggest that athletes may be less susceptible than nonathletes to recreational drug use. Research regarding ergogenic drugs suggests that overall rates for most substances are generally fairly low in comparison to other substances, although the health and other risks associated with such substances can be quite severe (Brower et al., 1991; NIDA, 2000).

Only a handful of theoretical articles and research studies have attempted to address sport-specific reasons for excessive alcohol use among athletes. These have identified factors (e.g., pressures associated with being an athlete, increased drinking opportunities due to elevated social status) that may partially explain excessive alcohol consumption among this group, but more comprehensive research is warranted. Similarly, few articles have addressed the reasons sport participation may serve as a protective factor against recreational drug use. Drug testing policies and perceived health risks are two possible deterrents, but additional research in this area would be welcomed. Finally, as one would expect, the most prevalent sport-specific reason for ergogenic drug use among athletes is improved performance. However, athletes may also use these substances due to a perceived permissive subculture and lack of knowledge regarding possible health risks.

Even though a large body of research has documented the overall effectiveness of alcohol and drug prevention and treatment programs, little research has focused on the effectiveness of such programs with athlete-specific populations. The existing research highlights the need to investigate the attributes of these programs that may be effective with various groups of athletes. Future research should also examine whether the timing for these interventions (e.g., during the off-season as compared to in-season) affects their outcome. In addition, the efficacy of drug policies and drug testing as a prevention strategy should be assessed.

Motivational interviewing and relapse prevention are empirically supported approaches for use with the general population, and research should evaluate the appropriateness and efficacy of extending these approaches to clinical work with athletes. Studies could also explore any differences in what serves as the hook to prompt contemplation or initiation of change or maintenance among this population. The client-centered nature of both of these strategies highlights the notion that what works with one client may not be applicable or helpful to another (i.e., one size does not fit all). Practitioners, providers, and researchers choosing to utilize these approaches with the athletes they are serving should consider opportunities to evaluate outcomes, using both large-scale treatment effectiveness designs and single-case designs or case studies. In doing so, treatment successes and lessons learned can be shared with others in the field and can serve as a foundation for subsequent treatment development.

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Afterword

ROBERT C. EKLUND and GERSHON TENENBAUM

There is always pleasure associated with putting the final flourish on the sort of accomplishment that the third edition of the *Handbook of Sport Psychology* represents. Previous editions of the *Handbook* have had a tremendous impact worldwide. Editing a worthy successor has been an invigorating challenge. In keeping with previous editions, we have sought to ensure that the *Handbook* serves as a forum for relaying the perspectives of experts intimately involved in advancing scholarship and knowledge in sport psychology. Our belief is that this edition has remained true to that spirit. It is a compendium that defines the present state of the art in sport and exercise psychology. Moreover, it is a document where existing gaps in present understandings and knowledge in each area are cogently detailed to provide a worthy basis for future development of theory, research, and practice in the field.

The third edition of the *Handbook of Sport Psychology* is deserving of being characterized as state of the art because its substance has been provided by 75 of the leading scholars in the field. Their generous investment of knowledge, insight, and enthusiasm in the 39 chapters of this edition is greatly appreciated. It was our good fortune as editors to work with these dedicated scholars on several accounts. It was, of course, a pleasure to be among the first to read the scholarly products included in this *Handbook*. That these products were provided for our consideration in a timely and efficient manner greatly eased our editorial burdens. It was also fascinating to have a small glimpse into the processes employed to produce chapters worthy of sharing with other interested scientists and practitioners. Finally, an uplifting sense of scholarly community was evident in the authors' efforts to provide constructive and insightful critiques to improve the quality of *each other's* chapters—and in the willingness to accept and utilize that feedback to the same end. As editors, there was much for us to appreciate about being privy to this process—on top of being associated with the resulting, and very satisfying, product.

Prior to the involvement of any of the authors contributing to the *Handbook,* we were faced with some daunting editorial tasks relative to content. There was some chimerical appeal for embarking on a quest to provide comprehensive representation of the areas of interest in sport psychology, as well as a full array of perspectives within each of those areas. Of course, that would have been an impossible errand, even in a document the size of this *Handbook*. Our brief flight of fancy on this account quickly gave way to more pragmatic considerations, and we settled on what we hope is a satisfying mix of topics. Certainly, additional worthy areas of research and practice in sport psychology could have been encompassed in the third edition. We could easily have sought exploration of less traveled corners of the field or more detailed consideration of specific issues within the present spectrum. Pragmatic matters such as page limitations, rather than interest, precluded these possibilities—at least for this edition.

Thirty-nine chapters are presented in the third edition of the *Handbook*. These chapters have been organized into eight topical sections. Earlier editions were also organized in this fashion. Specifically, the seminal edition of the *Handbook* contained 44 chapters organized in 11 sections, and the second edition contained 33 chapters organized in seven sections. Readers familiar with earlier editions will recognize substantial commonality across editions in the sections employed. Although dividing a compendium like the *Handbook* into coherent topical sections makes sense from an organizational standpoint, ultimately these sorts of divisions are always arbitrary in nature. Topical resonance can also be found in chapters cutting across the sectional distinctions employed. For example, the first section of the *Handbook* includes chapters dealing with motivation, emotion, and psychophysiology in sport psychology research. Subsequent sections also feature chapters providing very substantive commentaries on motivation, emotion, and psychophysiology, albeit relative to social perspectives (i.e., Part II), interventions and performance enhancement (i.e., Part IV), exercise and health psychology (i.e., Part V), and life span development (Part VI). Similar topical synergistic resonances are evident across other sections as well.

With regard to specific chapters in the third edition, some revisit and update topics from one or both of the earlier editions, whereas others focus on issues novel to both. The progression in the science and practice of sport and exercise psychology is evident in a variety of ways in all of the chapters in the third edition. Using Chapter 1 as an example, the sport psychology interest in goal achievement theory has been manifest in chapters in both of the previous editions. Roberts, Treasure, and Conroy's third edition commentary substantially updates, broadens, and extends the earlier perspectives. As well, some third edition chapters explore territories that are substantively novel. Among the many possible examples, commentary on self-presentation can be regularly encountered in the extant sport and exercise psychology literature but for the first time is substantially addressed in Martin Ginis, Lindwall, and Prapavessis's commentary in Chapter 6. Similarly, Eccles and Tenenbaum present the conceptual underpinning of team expertise in Chapter 12, and Eklund and Cresswell's treatise on athlete burnout in Chapter 28 provides conceptual detail on the rapidly increasing research base in this concerning area. Chapters in Part VII revisit and extend topics explored in the first edition (i.e., psychometrics and methodological issues) but on hiatus in the second edition. As a final observation, we have focused on sport expertise in the six chapters of Part III. Although novel as a section, the issues are not entirely new to the *Handbook*. Indeed, precursors of some chapters are evident in earlier editions in sections with titles such as "Skill Acquisition" and "Psychological Characteristics of High-Level Performance." Increasing interest in sport expertise, however, warranted this particular organizational addition and facilitated the development of a particularly coherent focal area.

As Tenenbaum and Bar-Eli (as cited in Singer, Murphey, & Tennant, 1993, p. 934) suggested in the epilogue of the first edition of the *Handbook,* "Future researchers will adopt a more integrative approach, in which individual (emotional, cognitive and biological) and social domains will interact." Overall, the chapters in this compendium provide strong and positive indications that more integrative approaches are being employed and about the growing maturity of the sport and exercise psychology research and practice. An increasing sensitivity to theoretical grounding and conceptual coherence is evident as well as methodological diversity and sophistication. This all bodes well for the field. Although sport and exercise psychology is fundamentally grounded in kinesiology and psychology, and although key background knowledge, ideas, and directions clearly emanate from both parent disciplines and professions, the chapters in this *Handbook* also serve to emphasize the uniqueness of sport and exercise psychology, both in its research foci and in its practice.

Finally, as editors, the satisfaction we experience from the third edition results from both the quality encapsulations of the state of the art provided by the contributing authors and their detailing of limitations and the future directions to be taken by scholars in the field. Indeed, we believe that this compendium goes well beyond simply describing the field's past. Instead, the contributing authors have also highlighted matters requiring further and more sophisticated evaluation to shore up our existing understanding and, particularly important, have peered into the future in describing where the field needs to go from here. Nonetheless, focusing solely within the field in looking for inspiration in the future, and especially within a single perspective, has stagnation as the most likely outcome. If sport and exercise psychology is to remain vibrant, it must continue to draw into research and practice the best ideas available from within the field and its parent disciplines *but also look beyond.* We encourage the formulation of brainstorming teams of scholars and thinkers with varied perspectives from both in and outside the field to formulate new and innovative ideas to further invigorate sport and exercise psychology scholarship. The future is bright for sport and exercise psychology, and we look forward to witnessing and contributing to its development.

REFERENCE

Singer, R. N., Murphey, M., & Tennant, L. K. (1993). Epilogue. In R. N. Singer, M. Murphey, & L. K. Tennant (Eds.), *Handbook of Research on Sport* (pp. 933–938). New York: Macmillan.

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