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
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.
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 satisfying 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 envi-
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 underlying 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, Niura, & 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 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 (Marsh & 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 (Marsh & 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>
<thead>
<tr>
<th>Stage</th>
<th>Meeting Criterion Level of Physical Activity?</th>
<th>Current Behavior</th>
<th>Intention to Meet Criterion Level of Physical Activity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>No</td>
<td>Little or no physical activity</td>
<td>No</td>
</tr>
<tr>
<td>Contemplation</td>
<td>No</td>
<td>Little or no physical activity</td>
<td>Yes</td>
</tr>
<tr>
<td>Preparation</td>
<td>No</td>
<td>Small changes in physical activity</td>
<td>Yes</td>
</tr>
<tr>
<td>Action</td>
<td>Yes</td>
<td>Physically active for less than 6 months</td>
<td>Yes</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Yes</td>
<td>Physically active for more than 6 months</td>
<td>Yes</td>
</tr>
</tbody>
</table>
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.

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.
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 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 support-

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ed 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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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.
Perceptions 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

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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 underestimates 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/under-estimation 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 result 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 VO2 max). They found that participants reported lower RPE when cycling at 25% and 50%, but not 75% of VO2 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 motiva-
tion 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% VO₂ 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% VO₂ 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.
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% VO2 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% VO2 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. . . .
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% VO2 max for 30 min. After controlling for VO2 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% VO2 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 VO2 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-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

**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.
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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.

REFERENCES


