

# Analysis of the affect measurement conundrum in exercise psychology

## I. Fundamental issues<sup>☆</sup>

Panteleimon Ekkekakis<sup>a,\*</sup>, Steven J. Petruzzello<sup>b</sup>

<sup>a</sup> *Department of Health and Human Performance, Iowa State University, 253 Forker Building, Ames, IA 50011-1160, USA*

<sup>b</sup> *Department of Kinesiology, University of Illinois at Urbana-Champaign, USA*

Received 7 October 1999; received in revised form 22 May 2000; accepted 21 June 2000

---

### Abstract

**Background and purpose:** The measurement of affect in the context of exercise is a controversial issue. The purpose of this paper is to provide a critical review of the relevant literature and to outline a conceptual framework that will serve as the basis for subsequent analysis.

**Methods:** Four issues are discussed: (a) the distinctions between emotions, moods, and affect; (b) the strengths and weaknesses of categorical and dimensional models for conceptualizing affective phenomena; (c) the notion of ‘exercise-specific’ affect; and (d) whether measurement should be based on a deductive or an inductive approach.

**Results and conclusions:** Arguments are presented in favor of (a) targeting basic affect as the appropriate object of assessment at the present stage of knowledge development; (b) adopting dimensional models because of their broad and balanced scope; (c) critically reconsidering the notion of ‘exercise-specific’ affect; and (d) using deductive methods for measuring affect. © 2000 Elsevier Science Ltd. All rights reserved.

*Keywords:* Exercise; Affect; Dimensional models; Deductive approach to measurement

---

A large and continuously growing body of research has documented that single bouts of physical activity are associated with significant affective changes (Ekkekakis & Petruzzello, 1999; Gauvin & Spence, 1996; Scully, Kremer, Meade, Graham, & Dudgeon, 1998; Tuson & Sinyor, 1993; Yeung, 1996). However, the validity of much of this research is often called into question

---

<sup>☆</sup> This is the first part of a 4-part series (see Editorial) on the measurement of affect in exercise psychology.

\* Corresponding author.

due to a number of conceptual and methodological problems. Among these problems, the measurement of affect has probably received the majority of critical attention (Byrne & Byrne, 1993; Dishman, 1995; Ekkekakis, Hall, & Petruzzello, 1999; Gauvin & Brawley, 1993; McAuley & Rudolph, 1995; Mutrie & Biddle, 1995; Rejeski, Hardy, & Shaw, 1991; Steptoe, 1992; Tuson & Sinyor, 1993). The knowledge development process depends directly upon the measurement technology used. Therefore, problems associated with measurement warrant close scrutiny and rapid resolution. To paraphrase Bernard Bass (1974), unsound measurement “can send science on false leads and wasteful detours into fads and fancies” (p. 870).

### **An evolving crisis?**

Even a cursory glance at the contemporary research literature on the effects of exercise on affect reveals that the measurement of affect is a highly controversial issue. During the last decade, at least five new self-report measures of affect have been developed in the domain of exercise psychology, each proposing a different structural model of affect (Gauvin & Rejeski, 1993; Hardy & Rejeski, 1989; Lox, Jackson, Tuholski, Wasley, & Treasure, 2000; McAuley & Courneya, 1994; Rejeski, Reboussin, Dunn, King, & Sallis, 1999). Yet, in none of these cases was the adoption of a structural model based on a prior comparative analysis of the relevant theories. The structure of new measures appears to have been the result of induction, not deduction. In most cases, confirmatory factor analyses and associated indices of ‘goodness of fit’ were used as evidence of the validity of the structures. This, however, is a misapplication of statistical methods. Whether a structural model ‘fits’ a certain data set has no bearing on whether the model itself is meaningful from a theoretical standpoint. The conceptual merit of the model must be evaluated independently and prior to any psychometric assessments. According to Cole (1987), “one can fail to reject a model on statistical grounds, but to truly accept the model, one must go beyond statistics to theory” (p. 593).

The situation in applied research is also troubling. Despite the significant differences in the conceptual underpinnings of the available measures, applied researchers seldom present any arguments for selecting one measure instead of another. Overall, these phenomena can be interpreted as symptoms of a growing crisis. This statement is not intended to curtail the enthusiasm for the study of the affective changes associated with exercise, but rather to provide a warning for potential weaknesses, eminent obstacles, and interpretational perils. The challenge lies in the successful transformation of past mistakes into future solutions. In this light, the purpose of the present project is to draw lessons from the distant and recent past and to integrate this experience into proposed remedies.

### **A short retrospective**

As a first step, we provide an historical overview. This should help underscore the fact that the theoretical groundwork with regard to the measurement of affect in the context of exercise has been deficient. Three periods, distinct in terms of their prevailing trends but temporally over-

lapping, are identified: (a) the descriptive era, (b) the era of frustration, and (c) the era of exercise-specificity.

### *The descriptive era*

The initial period of study of the effects of acute exercise on the affective domain was primarily characterized by the urge to replicate findings that demonstrated the affective *benefits* of exercise. Although the pioneering studies of that era were undoubtedly instrumental in sensitizing the scientific community and the public at large to the potential affective benefits of exercise, a critical appraisal of their attributes reveals a lack of theoretical and methodological sophistication. The measurement of affect during that period relied on self-report instruments that were developed in general psychology in the late 1960s and early 1970s and were becoming increasingly popular at the time. Prominent examples are the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971), the Multiple Affect Adjective Check List (MAACL; Zuckerman & Lubin, 1965), and the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970). These instruments were selected for use in the emerging study of the exercise–affect relationship mainly because they were the only self-report measures of affective variables available at the time that could be used with nonclinical populations. Thus, in essence, the measures dictated the dependent variables of interest, effectively making this line of research ‘measure-centric’ rather than ‘construct-centric’. The following excerpt by Morgan (1985) is illustrative of this approach:

Under normal circumstances, most individuals report that they “feel good” or “feel better” following vigorous exercise. These subjective reports have been quantified with various psychometric instruments designed to measure constructs such as anxiety, depression, and self-esteem (p. 94).

This passage suggests that the use of measures of anxiety, depression, and self-esteem was not motivated by a conceptually driven interest in these particular emotional variables. Instead, the availability of standardized measures of these variables simply provided a convenient means of ‘quantifying’ and, thus, documenting the exercise-associated ‘feel good’ or ‘feel better’ phenomenon, which was the genuine target of investigation. Of course, there were exceptions to this rule, perhaps the most prominent being Sonstroem’s (1997) systematic and theory-driven research on self-esteem and Martinsen’s studies of depression and anxiety in clinical samples (e.g. Martinsen, 1995; Martinsen & Morgan, 1997; Martinsen, Raglin, Hoffart, & Friis, 1998).

### *The era of frustration*

Despite the fact that the extensive use of the STAI, POMS, and MAACL was accompanied by claims of ‘demonstrated reliability and validity’, these instruments never underwent formal psychometric evaluations in the context of exercise. Over time, concerns about floor effects (Dishman, 1995), the mostly unilateral focus on negative affectivity (Byrne & Byrne, 1993; Gauvin & Brawley, 1993; Mutrie & Biddle, 1995), and the possible lack of validity (Ekkekakis et al., 1999; Rejeski et al., 1991) began to emerge. This escalating dissatisfaction led some researchers to adopt alternative approaches, thus ushering in a new period of ‘exploration’ or ‘experimentation’

with respect to the measurement of affect. The most notable trend during this period was the use of self-report measures assessing not distinct affective states, such as anxiety or depression, but rather broad affective dimensions. These measures were the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the Activation Deactivation Adjective Check List (AD ACL; Thayer 1978, 1986, 1989). Both the PANAS (Hobson & Rejeski, 1993; Petruzzello & Landers, 1994) and the AD ACL (Tate & Petruzzello, 1995) were adopted by exercise psychology researchers several years after both the former (McIntyre, Watson, & Cunningham, 1990; Watson, 1988) and the latter (Thayer, 1987) were first introduced in the context of physical activity by their developers. Although the emergence of this trend could arguably be interpreted as a promising development, the adoption of these measures seems to have been motivated mainly by the intention to seek alternatives to the ‘traditional’ measures (such as the STAI and the POMS) rather than by the contemplation of the underlying conceptual models and their relevance to the context of exercise.

A parallel trend, which also appears to have evolved out of frustration and should, therefore, be classified in the same era, involves using multiple measures within a single study. Various combinations have appeared, such as the PANAS and the STAI (Bartholomew, 1999; Petruzzello & Landers, 1994), the PANAS and the Exercise-induced Feeling Inventory (Rejeski, Gauvin, Hobson, & Norris, 1995), the AD ACL and the STAI (Tate & Petruzzello, 1995), or the POMS with the addition of measures of exhilaration (Steptoe & Bolton, 1988; Steptoe & Cox, 1988) or self-esteem (Pronk, Crouse, & Rohack, 1995; Pronk, Jawad, Crouse, & Rohack, 1994). Again, in most cases, the rationale for selecting a particular combination of measures (and constructs) was not stated.

### *The era of exercise-specificity*

Another notable trend that was fueled by the discontent with the traditional measures was the development of measures that were specifically tailored for use in the context of exercise. These measures were the Exercise-induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993; Rejeski et al., 1999), the Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994), and the Physical Activity Affect Scale (PAAS; Lox et al., 2000). The development of exercise-specific instruments has been hailed as representing ‘auspicious beginnings to a solution’ (McAuley & Rudolph, 1995, p. 90; also see Gauvin & Spence, 1998). Despite their differences in terms of format, content, and structure, all these attempts were motivated by the common desire to provide a measure that taps the ‘stimulus properties’ of exercise, thus being more sensitive to exercise treatments compared to general measures. However, the concept of ‘domain-specific affect’ and the related development of ‘idiosyncratic’ scales has its critics. Stone (1995) warned that increasing the ‘relevance’ and ‘responsiveness’ to a particular treatment does not generally constitute a sufficient rationale for developing a new measure. Instead, one must convincingly demonstrate that the content and structure of the affective domain is somehow uniquely transformed due to the properties of the treatment or the context in question. In this light, it is noteworthy that these theoretical considerations were not addressed in the development of the exercise-specific instruments. Instead, in the cases of the EFI and SEES (and the PAAS, which was derived by merging subscales from the EFI and the SEES), the only criterion that was used to guide the process of item selection was the presumed relevance and responsiveness to exercise. Not having

a clearly delineated theoretical foundation, establishing the validity of these measures is a challenging undertaking. These issues will be dealt with in detail in subsequent papers in this series.

The development of exercise-specific measures also prompted an increase in the number of studies examining the psychometric properties of self-report scales of affect within the context of exercise (Crocker, 1997; Lox & Rudolph, 1994; Markland, Emberton, & Tallon, 1997; Vlachopoulos, Biddle, & Fox, 1996). As welcome as any such development might seem at first, close examination reveals that, once again, relatively little attention was given to theoretical issues. These studies examined how well the proposed models fit the data (through the use of confirmatory factor analysis), but failed to consider whether the models were properly conceptualized in the first place. However, as we noted earlier, examining statistical fit without having addressed fundamental theoretical issues makes little sense. Thus, although the attention to the issue of measurement could be perceived as a promising sign, it would be imprudent to infer that the challenge of measuring affect in the context of exercise in a conceptually and psychometrically sound manner has been met.

### **Three decades later and still at the crossroads: time to find a map?**

Arguably, in the study of affective responses to exercise, the natural progression from deciding which variables should be assessed to selecting or devising appropriate measures for assessing them has been violated. In the following sections, we pose and attempt to answer four crucial questions regarding the measurement of affect. The arguments we present will be used to guide the remainder of our analysis in this and the subsequent papers in the present series. First, we will attempt to elucidate the distinctions between the various constructs in the ‘emotional’ domain and will seek to identify the appropriate target for assessment in the context of exercise. Second, we will discuss the issues surrounding the distinction between *categorical* and *dimensional* measures. Third, we will examine the implications of developing measures that are tailored to assess only those affective states that are likely to arise during and following exercise. And, fourth, we will consider the advantages and disadvantages of employing an *inductive* as opposed to a *deductive* strategy for devising a measurement model for the study of affect.

#### *Emotions, moods, affect: conceptual hair-splitting or substantive distinctions?*

One of the most troubling symptoms of deficient theoretical groundwork has been the reduced sensitivity to the important distinctions between affective constructs. For many years, reviews of the psychological benefits of exercise were characterized by an overly broad perspective. It was not uncommon for a single paper to cover such diverse areas as states and traits, clinical and non-clinical issues, cognitive function and performance, stress reactivity, self-image, sleep, and eating disorders. The documentation of wide-ranging benefits may have been successful in igniting an interest in the healthful effects of exercise but also contributed to the blurring of important conceptual distinctions. Affective constructs were subsumed under various rather abstract umbrella terms, such as ‘mental health’ (Brown, 1990; Dishman, 1995; Folkins & Sime, 1981; Morgan, 1997; Morgan & Goldston, 1987; Raglin, 1990), ‘psychosocial health’ (Biddle, 1995), ‘psychological health’ (McAuley, 1994; Plante & Rodin, 1990; Weyerer & Kupfer, 1994), ‘psychological



well-being' (Brown & Wang, 1992; Gauvin & Spence, 1996; McAuley & Rudolph, 1995; Scully et al., 1998; Steptoe, 1992), or 'psychological stress indices' (Berger, 1994).

One of the most problematic side-effects of this broad perspective has been the equating of the concepts of emotion, mood, and affect (Gauvin & Spence, 1998; Tuson & Sinyor, 1993). For example, Boutcher (1993) introduced a review on 'emotion and aerobic exercise' stating that "this chapter... views affect and mood as being synonymous with emotion" (p. 800). Plante and Rodin (1990) referred to "negative mood states such as tension and anxiety" (p. 6), although anxiety is generally regarded as an emotion, not a mood state. Similarly, Brown and Wang (1992) stated that their review focused on "affect or mood, especially on the relationship between exercise and anxiety or depression" (p. 126), thus treating *affect* and *mood* as synonymous and classifying the *emotions* of anxiety and depression under this category. Contrary to this liberal use of terminology, theorists caution that the distinctions between affective constructs, although admittedly not perfectly precise and not unanimously agreed upon, are important and should be taken into serious consideration. Particularly since the Zajonc–Lazarus debate (Lazarus 1982, 1984; Zajonc 1980, 1984) and the subsequent discussions attributing the dispute mainly to semantics (Buck, 1993; Leventhal & Scherer, 1987), the calls for tighter definitions and more prudent use of terminology have intensified (Alpert & Rosen, 1990; Batson, Shaw, & Oleson, 1992; Davidson, 1994; Frijda 1993, 1994; Lazarus 1991a, 1994; Ortony, Clore, & Collins, 1988).

As stated earlier, the definitions of *emotion*, *mood*, and *affect* are not precise or universally accepted. To use the words of Smith and Lazarus (1990), these constructs make up an "inherently fuzzy set" (p. 611) and exact lines of demarcation are almost impossible to draw. Therefore, to be realistic, the purpose here is not to provide authoritative definitions or to enumerate the distinctions. Instead, a more viable approach is to examine expert opinions in search of points of convergence or consensus. This is done with the understanding that definitions are conventions. As such, they are not invariant across time or theoretical orientations, but rather a reflection of the zeitgeist. Thus, the perspective taken in this analysis is consistent with the prevailing cognitive approach to the study of affective phenomena, and it is not necessarily shared by researchers in other domains (e.g. psychobiology).

Among cognitively oriented theorists, there seems to be an emerging consensus that the term *emotion* should be reserved for those affective states that are elicited following an appraisal process during which a specific object is recognized as having the potential to either promote or endanger the survival or the well-being of the individual. According to Ortony et al. (1988), "emotions arise as a result of certain types of cognitions... the physiological, behavioral, and expressive aspects of emotions seem to us to presuppose that this first, cognitive, step has already taken place" (p. 2). Similarly, according to Lazarus (1991a), "emotions are generated and controlled by the personal implications for well-being conveyed by relationships with the environment (typically social) and comprehended through an appraisal process that... draws heavily on evolved intelligence and knowledge" (p. 55). Lazarus (1991b) has gone further, arguing that emotion "is *always* a response to cognitive activity, which generates meaning" (emphasis added) and, therefore, cognition is both a necessary and sufficient condition for the genesis of emotion: "*Sufficient* means that thoughts are capable of producing emotions; *necessary* means that emotions cannot occur without some kind of thought" (p. 353). Emotions are immediate responses to specific stimuli (i.e. are directed at a specific object). They are also typically characterized by a relatively short duration and high intensity.

*Moods* are also theorized to have a cognitive origin. In contrast to emotions, however, moods are considered as lacking a specific target (Frijda 1993, 1994). They are thus characterized as ‘diffuse’ and, contrary to emotions, they are typically associated with low or no action tendencies (i.e. the inclination to ‘do something about it’). Moods are also thought to be less intense and generally longer lasting compared to emotions (Alpert & Rosen, 1990; Parkinson, Totterdell, Briner, & Reynolds, 1996; Watson & Clark, 1994), although some authors believe that duration is a superficial and inessential distinguishing characteristic (Frijda, 1994; Lazarus, 1994). What is perhaps a more essential difference is what is being appraised in the case of an emotion as opposed to a mood. Although both emotions and moods stem from appraisals of the individual’s relationship with the environment, such as perceptions of control (Price, 1998) and the availability of coping resources (Morris, 1992), according to Lazarus (1991a) “moods refer to the larger, pervasive, existential issues of one’s life, whereas acute emotions refer to an immediate piece of business, a specific and relatively narrow goal in an adaptational encounter with the environment” (p. 48). The ‘existential issues’ that may give rise to moods are related to “who we are, now and in the long run, and how we are doing in life overall” (Lazarus, 1994, p. 84). In a sense, moods are not responses to how we view a specific event, but rather responses to how we see the world as a whole and our place in it at a particular point in time (Frijda 1993, 1994). Moods are also characterized as ‘appraisal propensities’ (Frijda, 1993) or *temporal* or *contextual* dispositions (in contradistinction to personality dispositions; Lazarus 1991a, 1994). This is because, while in a given mood, an individual may have an increased tendency to appraise situations in a way that is consonant to that mood. Therefore, moods may also lower the threshold for the induction of consonant emotions. Furthermore, it is noteworthy that, although perceptions of physical energy (or lack thereof) are considered an essential experiential component of moods (Morris, 1992; Thayer, 1989), according to cognitive conceptualizations, these perceptions are not part of the cause but rather part of the outcome of the mood process.

Finally, *affect* refers to the experiential component of all valenced (i.e., ‘good’ or ‘bad’) responses, including emotions and moods (Frijda, 1993; Gross 1998, 1999; Lazarus, 1991a; Scherer, 1984). This component is ‘irreducible’ and is what gives valenced responses their distinct ‘noncognitive character’ (Frijda, 1993, p. 383). Therefore, according to Batson and his associates (1992), “of affect, mood, and emotion, affect is the most general” (p. 298). A similar conceptualization is presented by Russell and Feldman-Barrett (1999): “We use the term *core affect* to refer to the most elementary consciously accessible affective feelings” (p. 806). Likewise, according to Ortony, Clore, and Foss (1987):

...although the terms “affect” and “emotion” are often used synonymously in the psychological literature, we think it important to make a distinction between them. Affect is a broader construct than emotion. Any valenced judgement or condition implicates affect, whereas emotions are more specific. Consequently, our use of the word “affect” entails that all emotions are affective conditions, but not that all affective conditions are emotions (p. 343).

The requisite cognitive substrates of emotions and moods restrict their applicability as relevant constructs to the most advanced species. To experience a mood, ‘the organism must have some sense of the future and of what it will bring’; to experience an emotion, “the organism must be able to imagine possible states that do not currently exist, to compare these states with existing

states to determine goals, to conceive behavioral routes for obtaining these goals, and to assess the probability of these behaviors being effective in obtaining the goals” (Batson et al., 1992, p. 309). This implies that “if an organism lacks the cognitive capacity to make a particular appraisal, it will not feel emotions that depend on that appraisal. A newborn can feel a generalized distress (positive–negative appraisal), but cannot feel anger or sadness, which depend upon more sophisticated appraisals of agency” (Ellsworth, 1991, pp. 157–158). On the other hand, affect is “phylogenetically and ontogenetically the most primitive. Affect is present in the yelp of a dog and in the coo or cry of an infant” (Batson et al., 1992, p. 298).

Perhaps the most effective way to conceptualize the relationships between emotion and affect is to examine these constructs from a functionalist perspective. Both emotion and affect are *functional* because they promote and facilitate the individual’s adaptation to the demands of the physical and social environment by pairing the detection of survival- or well-being-relevant stimuli with the production of survival- or well-being-enhancing behavior (Keltner & Gross, 1999; Smith & Lazarus, 1990). However, they represent different evolutionary stages and they achieve the ultimate goal of adaptation via different routes. A basic affective response can be elicited through a hard-wired mechanism, which affords very limited or no response flexibility, as in the case of the unpleasantness associated with pain. On the other hand, the evolution of emotions represents a move toward greater flexibility and variability, and perhaps accuracy and effectiveness, as a result of knowledge and judgement. As Smith and Lazarus (1990) put it, “innate reflexes [of pleasure and displeasure] were once the simplest solution to the adaptational problem of getting along in the world, but in more complex creatures these evolved into emotional patterns” (p. 612). Thus, while humans maintained the capacity to experience simple pleasure and displeasure (since these responses still serve an adaptational function in certain survival-critical situations), the evolution of cognitive capabilities brought about the capacity for complex emotions like pride and shame (since these responses provide solutions to *new* adaptational problems that emerged over evolutionary time, in parallel with the evolution of social structures).

This functionalist–evolutionary view of affective phenomena is shared by several theorists (Berntson, Boysen, & Cacioppo, 1993; Izard 1993, 1994; Leventhal & Scherer, 1987; van Reekum & Scherer, 1997). For example, Leventhal and Scherer (1987) proposed three levels of affective stimulus processing. At the *sensory–motor* level, the evaluation of events involves mostly hard-wired feature detectors. The *schematic* level involves solidified memory-based associations between specific stimuli on the one hand and perceptual, behavioral, autonomic, and experiential responses on the other. Finally, the *conceptual* level involves abstract, complex, intentional, and reflective modes of processing. Similarly, Izard (1993, 1994) has proposed four types of affective information processing (cellular, organismic, biopsychological, and cognitive).

A fundamental tenet of the present account is that exercise is a multifaceted stimulus. As such, it has the capacity to induce affective responses emerging from any level of affective processing, from basic affect to specific emotions. For instance, intense physiologic responses elicited during strenuous exercise may be automatically experienced as unpleasant. This would involve Leventhal and Scherer’s (1987) *sensory–motor* mode of affect induction. At the same time, the positive evaluation of one’s own physique may elicit emotional responses, such as pride and improved self-esteem, whereas a negative evaluation may elicit shame and anxiety. Likewise, the interpretation of symptoms of exertion as signs of compromised health may elicit an emotional response such as fear, whereas the interpretation of these symptoms as signs of effort, commitment, and



improving fitness may elicit satisfaction. These emotional responses involve complex cognitive processes such as ego representations and future projections. In Leventhal and Scherer's terms, these responses originate at the *conceptual* level.

With these considerations as a backdrop, a reasonable question to ponder is whether, at the present stage of knowledge development, researchers interested in the affective changes associated with exercise should target basic affect or specific emotions. Some researchers may approach this issue by considering which construct is a more 'relevant' topic for psychological research. In this view, basic affective responses that originate in the body are characterized as 'reflexes' (such as the pleasure of physical rest or the displeasure of pain) or 'physiological drives' associated with periodic and, thus, predictable 'homeostatic needs' (such as the pleasure of eating after being hungry or the displeasure of starvation). These responses are shared between humans and lower animals and are common to all neurologically intact individuals (see Lazarus, 1991a). These features may be viewed as grounds for disqualifying such responses as relevant or important topics for psychological investigation in favor of the more advanced, more complex, more individualized and human-specific emotions.

Our perspective is different. We believe that the decision on which construct to study depends on (a) the purpose of the investigation and (b) the extant knowledge base. In exercise psychology, if the goal is to examine the link between exercise-associated affect and exercise adherence (i.e. the hypothesis that people are likely to do what makes them feel good and avoid doing what makes them feel bad), the appropriate target should be affect (i.e. the 'goodness' or 'badness' of what people feel). Regardless of whether the affective responses are cognitively mediated (i.e. as when they are part of a certain emotion) or not, it is the quality of the subjective experience (i.e. the basic affect itself) that would be of interest in this context. On the other hand, if the goal is to examine the effects of the social environment on how people feel during exercise, the targets of the investigation should be those emotions that are theoretically more likely to be influenced by a manipulation of the social environment (such as self-esteem or social physique anxiety).

One must also take into account the stage of knowledge development in exercise psychology. An examination of the literature shows that the majority of the studies are conducted with the purpose of *describing* how people feel when exercising (Ekkekakis & Petruzzello, 1999). The role of cognitive mediators is rarely considered. As a result, with the exception of self-efficacy (Bozoian, Rejeski, & McAuley, 1994; McAuley & Courneya, 1992; McAuley, Talbot, & Martinez, 1999), cognitive appraisals that could underlie the generation of specific emotions in the context of exercise have not been studied systematically and are poorly understood. Given these constraints, in studies with a descriptive purpose (i.e. the majority of research conducted at the present juncture), the logical choice would be to focus on basic affect. In the preceding analysis, basic affect was characterized as the most general and perhaps the least complex of the affective constructs (Alpert & Rosen, 1990; Batson et al., 1992; Gross, 1998, 1999; Scherer, 1984). Initially focusing on the most general of concepts should allow researchers to gain some understanding, even in basic and rudimentary terms, of how people feel during and following exercise under various conditions. This empirical foundation could subsequently be used to guide research on specific affective states and, eventually, perhaps on specific emotions. This notion resembles McAuley and Courneya's (1994) idea of a "hierarchy of [affective] responses to exercise participation" (p. 173) which may ultimately lead to the study of "particularized emotional states" (p. 173).

### *Affective categories or affective dimensions?*

An important dilemma facing researchers interested in affective phenomena is whether they should adopt a *categorical* or a *dimensional* perspective. From the *categorical* perspective, affective states are organized in distinct categories comprising states that bear resemblance to prototypical exemplars, such as anger, fear, sadness, disgust, happiness, love, pride, etc. (Ekman, 1992; Lazarus, 1991a; Ortony et al., 1988; Shaver, Schwartz, Kirson, & O'Connor, 1987). Alternatively, from the *dimensional* perspective, affective states are considered systematically inter-related and their relationships can be modeled by a parsimonious set of dimensions (as few as 2 or 3; see Larsen & Diener, 1992; Russell 1989, 1997; Tellegen, 1985, for reviews).

It is widely recognized that both categorical and dimensional conceptualizations have relative advantages and limitations, depending on the specific research objectives (Lazarus, 1991a; Stone, 1995). Categorical conceptualizations are recognized for offering the advantage of specificity and the potential for finer discriminations of psychological meanings. Dimensional approaches, on the other hand, offer a wide, theoretically unrestricted scope and, thus, the potential for a parsimonious representation of the global affective space. Consequently, researchers interested in deciphering the distinct (cognitive) antecedents of specific emotions have traditionally opted for categorical approaches, whereas researchers aiming to explore the general nature and the dynamics of affective responses to environmental stimuli have opted for dimensional models (see Russell & Feldman-Barrett, 1999 on this topic). Thus, essentially the 'categorical versus dimensional' dilemma can be resolved by answering the previous question, namely whether one is interested in studying distinct emotions or basic affect.

Acknowledging that both the categorical and the dimensional perspective have relative advantages and limitations, several authors have presented hierarchical models in which a dimensional representation accounts for the commonalities between affective states at a macro-level and categorical models account for the specificity at a micro-level (Diener, Smith, & Fujita, 1995; Haslam, 1995; Russell, 1997; Tellegen, Watson, & Clark, 1999a,b; Watson & Clark 1992, 1997). The important point is that the categorical and dimensional perspectives "are not incompatible or mutually exclusive; rather, they essentially reflect different levels of a single, integrated hierarchical structure" (Watson & Clark, 1997, p. 269). Therefore, in the context of exercise, the question reverts to which perspective can be more beneficial at the present stage of knowledge development. Given the currently limited understanding of the experiential nature of the affective changes associated with exercise, what is mostly needed is a template or 'map' of affective space that affords a broad and balanced investigative scope. This 'map' must be as encompassing and as balanced between different variants of affective experience as possible to allow the detection of changes in any direction. Then, empirical research can begin the systematic process of charting of the effects of exercise stimuli of different physiological, cognitive, or social attributes. A dimensional model of affect, by virtue of its breadth and parsimony, could provide an ideal template for the systematic charting of exercise effects. Gauvin and Brawley (1993) have presented similar arguments in favor of adopting a dimensional perspective for the study of affect in the context of exercise:

Because the affective experience that accompanies exercise has not been thoroughly described, a model of affect that has a wider breadth is more likely to capture the essence of exercise-

induced affect than a model that, at the outset, limits the focus of investigation to specific emotions (p. 152).

### *On the notion of 'exercise-specific' affect*

As noted earlier, one of the main arguments in the development of the EFI (Gauvin & Rejeski, 1993) and the SEES (McAuley & Courneya, 1994) was that a measure of affect that is to be used in the context of exercise should be specifically tailored to reflect the 'stimulus properties' of exercise. In practice, this notion led to the exclusion from further consideration of items that young, healthy, and physically active college students did not consider representative of their affective experiences during or following bouts of exercise. The idea of *domain specificity* is not new. It is, however, a controversial one. As noted previously, according to Stone (1995), the decision to develop an 'idiosyncratic' measure of affect must be based on a convincing demonstration that, for some reason, affect within the domain of interest assumes unique characteristics (i.e. content or structure), not captured by existing measurement models. The desire to increase the 'relevance' or 'responsiveness' of measurement to a particular treatment cannot be construed as an adequate rationale.

In the domain of exercise, we see two additional problems. First, the reference to a single set of 'stimulus properties of exercise' seems to imply that there is a global 'phenomenology' of exercise, common to all people and types of exercise. This idea bears directly upon one of the oldest and most acrimonious debates in the history of psychology, namely the debate on nomothesis versus idiography. The notion of a global phenomenology of exercise implies that, regardless of variable biological and psychological constitutions and regardless of variable physical and social conditions, the phenomenology of people's affective responses to exercise will be uniform. We are not alone in believing that this assumption is false (see Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000, for a more detailed discussion and empirical demonstration). Many authors, including the developers of the EFI and the SEES, have noted that affective responses to exercise are characterized by large inter- and intra-individual variability (Gauvin & Brawley, 1993) and that, because people respond to exercise 'actively' rather than 'passively,' individuals are likely to respond in varied ways to an identical exercise stimulus (McAuley & Courneya, 1992; Rejeski, 1994; Rejeski & Thompson, 1993). If that is the case, the proposition that exercise has a unique and uniform set of perceived properties that can be captured by a small and invariant set of psychometric scales is seriously challenged. The proposition becomes particularly troubling when the attempts to delineate the global phenomenology of exercise are based on the experiences of only one, highly homogeneous demographic group. In the development of the EFI and the SEES, the experiences of young, healthy, and physically active individuals were used as the basis for deciding which affective states do and which do not occur during and following exercise. If extant research findings are any indication, it should be evident that, had elderly, injured, diseased, sedentary, unfit, obese, or otherwise physically limited individuals been surveyed instead, the emergent phenomenology would have been different. We will discuss the implications of this issue in more detail in subsequent papers in this series.

Second, the notion of a measure of affect specifically tailored to assess only those aspects of affective experience that are relevant to exercise leads to some perplexing logical and practical

problems. A typical experimental protocol is likely to involve assessments of affect not only during and after exercise, but also before the exercise session, as well as before, during, and after various control conditions, usually sedentary ones. If one imposes an a priori restriction of the investigative scope to include only those affective states that arise during and following exercise and to exclude all other variants of affective experience, then how meaningful would any comparisons be between exercise and all the non-exercise conditions where the measure of affect is likely to be employed? For example, let us assume that the item ‘revitalized’ was selected for inclusion in a measure of ‘exercise-specific’ affect, because it was found that ‘revitalization’ is a state that is likely to occur during or following a bout of exercise (at least among young, healthy, and physically active people). However, people in a waiting list control condition or people who have not yet started their exercise session are probably unlikely to feel ‘revitalized’. Instead, they are likely to experience other affective states that were selectively eliminated from the item pool. This makes an increase in ‘revitalization’ during or following exercise compared to preexercise conditions an almost trivial finding. In a sense, that ‘revitalization’ would increase was already known, since the item ‘revitalized’ was specifically selected *because* it increases with exercise (at least among young, healthy, and physically active people) and it is unlikely to be elevated during resting conditions.

Besides the question of meaningfulness, when an item is irrelevant to a given situation, a host of measurement problems are likely to arise. The range of scores on this item will probably be diminished (what is called a ‘floor effect’ in psychometrics). Low item variance also means low item covariance, which, in turn, entails the potential for decreased internal consistency and a disintegration of factor structure.

For these reasons, we would argue that a critical reevaluation of the concept of ‘exercise-specific’ affect is in order. To our knowledge, at present, there is no evidence that the content and structure of the affective domain is somehow uniquely transformed in the context of exercise. In the absence of such a demonstration, the arguments for the necessity to devise measures that are uniquely tailored to assess affect in the context of exercise are not compelling.

#### *Formulating a measurement model of affect: inductive or deductive strategy?*

When deriving a measurement model or developing a self-report measure of a psychological construct, one is faced with yet another important dilemma: Should an inductive or a deductive approach be used? In a typical *inductive* scenario, the researcher precisely defines the construct of interest and demarcates the domain of content, but the absence of previous theoretical or empirical groundwork precludes the enunciation of specific postulates about the dimensionality and the internal structure of the construct. In this case, “one starts with a collection of individual items, lets the data ‘speak for themselves’, and ends up with scales at a higher level of abstraction” (Burisch, 1984, p. 215). Exemplars of this approach are the POMS (McNair et al., 1971) and the original version of the AD ACL (Thayer, 1967), whose structure was determined by exploratory factor analyses. The alternative scenario is characterized as *deductive*, because researchers, besides the precise delineation of the domain of content, also have an adequately developed theoretical basis for postulating the number of components, their nature, and their inter-relationships. Thus, in the deductive approach, the “choice and definition of constructs precede and govern the formulation of items” (Burisch, 1984, p. 215). Exemplars of this approach are the STAI, which was

based on Spielberger's (Spielberger et al., 1970) state-trait theory of anxiety, and the PANAS, which was based on Tellegen and Watson's (Watson et al., 1988) two-dimensional (Positive Affect–Negative Affect) model of mood. Inductive and deductive approaches carry with them distinct sets of methodological and analytical tools and different sets of assumptions and criteria. However, if properly implemented, both can produce useful outcomes. In fact, as Burisch (1984) has argued, the two approaches can be combined in effective ways. The evolution of the structure of the AD ACL, guided by the evolution of Thayer's (1967, 1978, 1986, 1989) conceptualization of mood and arousal, is an illustrative example of such a fruitful merger.

As a way of rectifying previous mistakes and making the study of affect in the context of exercise construct-centric rather than measure-centric, we submit that a deductive rather than an inductive strategy is most appropriate. First, the most fundamental question is 'Do we know enough about affective phenomena to form a sound conceptual basis for a deductively derived measurement model?'. We believe that the answer is affirmative. There are perhaps few domains of psychological investigation with a longer history and more extensive accumulated experience than the area of affect. Given this knowledge base, not only are we able to derive measurement models from existing conceptualizations, but we can also select among alternative options to fit specific needs. Second, a deductive approach can help avoid methodological errors that may eventually lead to misrepresentations of the intended domain of content. This is because a well-specified conceptual model can safely guide methodological decisions. Critical issues like the type of structural analysis to be used, the content and the number of components to be retained, and the direction and magnitude of the relationships between components can be resolved in a non-arbitrary manner on the basis of theory and, thus, need not rely on subjective judgement or speculation. In conclusion, a deductive approach seems to offer several important advantages over the inductive alternative and no apparent disadvantages.

### **Objectives of the present project**

As we noted from the beginning, the knowledge development process depends directly upon the measurement technology used and, consequently, problems associated with measurement warrant close scrutiny and rapid resolution. Some researchers might interpret the recent development of multiple measures of affect and the flurry of psychometric investigations in the area of exercise psychology as a sign of progress. In the present series of papers, we attempt a critical dissection of this trend, concentrating on the EFI (Gauvin & Rejeski, 1993) and the SEES (McAuley & Courneya, 1994). The conclusions that emerge from this analysis are in contrast to the prevalent optimistic sentiment, as we were unable to detect signs of 'auspicious beginnings to a solution' (cf. Gauvin & Spence, 1998; McAuley & Rudolph, 1995). On the contrary, we identified problems that would indicate that the affect measurement conundrum in exercise psychology is far from being solved. This critical outlook is not intended to curtail the newly found enthusiasm for the study of affect. Instead, the goal is to inspire further progress by clarifying several important points, alerting researchers to potential pitfalls, and hopefully planting seeds of critical thought.

The project would be incomplete, even arguably futile, if we did not attempt to draw lessons from past mistakes and integrate this experience into a potentially viable solution. That is the, admittedly ambitious, role of the final paper in the series. Considering the fundamental questions



we outlined above (i.e., whether emotion, mood, or affect should be the target of assessment at the current stage; whether a categorical or a dimensional model is more appropriate; whether or not a measure should be tailored to assess ‘exercise-specific’ affect; and whether an inductive or a deductive strategy should be used in devising a measurement model for the study of affect), we present a conceptual case for the affect circumplex (Russell 1978, 1980). This is accompanied by a review of available measurement options and a discussion of related challenges and prospects. Finally, we delineate some findings from preliminary applications of the circumplex model in the context of exercise.

The ultimate objective of the project is to inject the elements of theoretical reasoning in the ongoing discourse on the measurement of affect in the context of exercise. We will consider this project successful when extensive theoretical discussions start to complement — in fact, *precede* — reports of psychometric indices and when researchers in exercise psychology begin to present theory-grounded rationales for selecting a particular measure of affect in their studies.

## References

- Alpert, M., & Rosen, A. (1990). A semantic analysis of the various ways that the terms ‘affect,’ ‘emotion,’ and ‘mood’ are used. *Journal of Communication Disorders*, 23, 237–246.
- Bartholomew, J. B. (1999). The effect of resistance exercise on manipulated preexercise mood states for male exercisers. *Journal of Sport and Exercise Psychology*, 21, 39–51.
- Bass, B. M. (1974). The substance and the shadow. *American Psychologist*, 29, 870–886.
- Batson, C. S., Shaw, L. L., & Oleson, K. C. (1992). Differentiating affect, mood, and emotion: toward functionally based conceptual distinctions. In M. S. Clark, *Review of personality and social psychology* (Vol. 13), (pp. 294–326). Newbury Park (CA): Sage.
- Berger, B. G. (1994). Coping with stress: the effectiveness of exercise and other techniques. *Quest*, 46, 100–119.
- Berntson, G. G., Boysen, S. T., & Cacioppo, J. T. (1993). Neurobehavioral organization and the cardinal principle of evaluative bivalence. *Annals of the New York Academy of Sciences*, 702, 75–102.
- Biddle, S. J. H. (1995). Exercise and psychosocial health. *Research Quarterly for Exercise and Sport*, 66, 292–297.
- Boutcher, S. H. (1993). Emotion and aerobic exercise. In R. N. Singer, M. Murphey, & L. K. Tennant, *Handbook of research on sport psychology* (pp. 799–814). New York: Macmillan.
- Bozoian, S., Rejeski, W. J., & McAuley, E. (1994). Self-efficacy influences feeling states associated with acute exercise. *Journal of Sport and Exercise Psychology*, 16, 326–333.
- Brown, D. R. (1990). Exercise, fitness, and mental health. In C. Bouchard, R. J. Shephard, T. Stephens, J. R. Sutton, & B. D. McPherson, *Exercise, fitness, and health: a consensus of current knowledge* (pp. 607–626). Champaign (IL): Human Kinetics.
- Brown, D. R., & Wang, Y. (1992). The relationships among exercise training, aerobic capacity, and psychological well-being in the general population. *Medicine, Exercise, Nutrition, and Health*, 1, 125–142.
- Buck, R. (1993). What is this thing called subjective experience? Reflections on the neuropsychology of qualia. *Neuropsychology*, 7, 490–499.
- Burisch, M. (1984). Approaches to personality inventory construction: a comparison of merits. *American Psychologist*, 39, 214–227.
- Byrne, A., & Byrne, D. G. (1993). The effect of exercise on depression, anxiety, and other mood states: a review. *Journal of Psychosomatic Research*, 37, 565–574.
- Cole, D. A. (1987). Utility of confirmatory factor analysis in test validation research. *Journal of Consulting and Clinical Psychology*, 55, 584–594.
- Crocker, P. R. E. (1997). A confirmatory factor analysis of the Positive Affect Negative Affect Schedule (PANAS) with a youth sport sample. *Journal of Sport and Exercise Psychology*, 19, 91–97.

- Davidson, R. J. (1994). On emotion, mood, and related affective constructs. In P. Ekman, & R. J. Davidson, *The nature of emotion: fundamental questions* (pp. 51–55). New York: Oxford University Press.
- Diener, E., Smith, H., & Fujita, F. (1995). The personality structure of affect. *Journal of Personality and Social Psychology*, *69*, 130–141.
- Dishman, R. K. (1995). Physical activity and public health: mental health. *Quest*, *47*, 362–385.
- Ekkekakis, P., & Petruzzello, S. J. (1999). Acute aerobic exercise and affect: current status, problems, and prospects regarding dose–response. *Sports Medicine*, *28*, 337–374.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (1999). Measuring state anxiety in the context of acute exercise using the State Anxiety Inventory (SAI): an attempt to resolve the brouhaha. *Journal of Sport and Exercise Psychology*, *21*, 205–229.
- Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion*, *6*, 169–200.
- Ellsworth, P. C. (1991). Some implications of cognitive appraisal theories of emotion. In K. T. Strongman, *International review of studies on emotion (Vol. 1)*, (pp. 143–161). New York: John Wiley and Sons.
- Folkens, C. H., & Sime, W. E. (1981). Physical fitness training and mental health. *American Psychologist*, *36*, 373–389.
- Frijda, N. H. (1993). Moods, emotion episodes, and emotions. In M. Lewis, & J. M. Haviland, *Handbook of emotions* (pp. 381–403). New York: Guilford.
- Frijda, N. H. (1994). Varieties of affect: emotions and episodes, moods and sentiments. In P. Ekman, & R. J. Davidson, *The nature of emotion: fundamental questions* (pp. 59–67). New York: Oxford University Press.
- Gauvin, L., & Brawley, L. R. (1993). Alternative psychological models and methodologies for the study of exercise and affect. In P. Seragianian, *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 146–171). New York: John Wiley and Sons.
- Gauvin, L., & Rejeski, W. J. (1993). The Exercise-Induced Feeling Inventory: development and initial validation. *Journal of Sport and Exercise Psychology*, *15*, 403–423.
- Gauvin, L., & Spence, J. C. (1996). Physical activity and psychological well-being: knowledge base, current issues, and caveats. *Nutrition Reviews*, *54*, S53–S65.
- Gauvin, L., & Spence, J. C. (1998). Measurement of exercise-induced changes in feeling states, affect, mood, and emotions. In J. L. Duda, *Advances in sport and exercise psychology measurement* (pp. 325–336). Morgantown (WV): Fitness Information Technology.
- Gross, J. J. (1998). The emerging field of emotion regulation: an integrative review. *Review of General Psychology*, *2*, 271–299.
- Gross, J. J. (1999). Emotion regulation: past, present, future. *Cognition and Emotion*, *13*, 551–573.
- Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: the measurement of affect during exercise. *Journal of Sport and Exercise Psychology*, *11*, 304–317.
- Haslam, N. (1995). The discreteness of emotion concepts: categorical structure in the affective circumplex. *Personality and Social Psychology Bulletin*, *21*, 1012–1019.
- Hobson, M. L., & Rejeski, W. J. (1993). Does the dose of acute exercise mediate psychophysiological responses to mental stress? *Journal of Sport and Exercise Psychology*, *15*, 77–87.
- Izard, C. E. (1993). Four systems for emotion activation: cognitive and noncognitive processes. *Psychological Review*, *100*, 68–90.
- Izard, C. E. (1994). Cognition is one of four types of emotion-activating systems. In P. Ekman, & R. J. Davidson, *The nature of emotion: fundamental questions* (pp. 203–207). New York: Oxford University Press.
- Keltner, D., & Gross, J. J. (1999). Functional accounts of emotions. *Cognition and Emotion*, *13*, 467–480.
- Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M. S. Clark, *Review of personality and social psychology (Vol. 13)*, (pp. 25–59). Newbury Park (CA): Sage.
- Lazarus, R. S. (1982). Thoughts on the relations between emotion and cognition. *American Psychologist*, *37*, 1019–1024.
- Lazarus, R. S. (1984). On the primacy of cognition. *American Psychologist*, *39*, 124–129.
- Lazarus, R. S. (1991a). *Emotion and adaptation*. New York: Oxford University Press.
- Lazarus, R. S. (1991b). Cognition and motivation in emotion. *American Psychologist*, *46*, 352–367.
- Lazarus, R. S. (1994). The stable and unstable in emotion. In P. Ekman, & R. J. Davidson, *The nature of emotion: fundamental questions* (pp. 79–85). New York: Oxford University Press.
- Leventhal, H., & Scherer, K. (1987). The relationship of emotion to cognition: a functional approach to a semantic controversy. *Cognition and Emotion*, *1*, 3–28.

- Lox, C. L., & Rudolph, D. L. (1994). The Subjective Exercise Experiences Scale (SEES): factorial validity and effects of acute exercise. *Journal of Social Behavior and Personality*, 9, 837–844.
- Lox, C. L., Jackson, S., Tuholski, S. W., Wasley, D., & Treasure, D. C. (2000). Revisiting the measurement of exercise-induced feeling states: the Physical Activity Affect Scale (PAAS). *Measurement in Physical Education and Exercise Science*, 4, 79–95.
- Markland, D., Emberton, M., & Tallon, R. (1997). Confirmatory factor analysis of the Subjective Exercise Experiences Scale among children. *Journal of Sport and Exercise Psychology*, 19, 418–433.
- Martinsen, E. W. (1995). The effects of exercise on mental health in clinical populations. In S. J. H. Biddle, *European perspectives on exercise and sport psychology* (pp. 71–84). Champaign (IL): Human Kinetics.
- Martinsen, E. W., & Morgan, W. P. (1997). Antidepressant effects of physical activity. In P. Morgan, *Physical activity and mental health* (pp. 93–106). Washington DC: Taylor and Francis.
- Martinsen, E. W., Raglin, J. S., Hoffart, A., & Friis, S. (1998). Tolerance to intensive exercise and high levels of lactate in panic disorder. *Journal of Anxiety Disorders*, 12, 333–342.
- McAuley, E. (1994). Physical activity and psychosocial outcomes. In C. Bouchard, R. J. Shephard, & T. Stephens, *Physical activity, fitness, and health: international proceedings and consensus statement* (pp. 551–568). Champaign (IL): Human Kinetics.
- McAuley, E., & Courneya, K. S. (1992). Self-efficacy relationships with affective and exertion responses to exercise. *Journal of Applied Social Psychology*, 22, 312–326.
- McAuley, E., & Courneya, K. S. (1994). The Subjective Exercise Experiences Scale (SEES): development and preliminary validation. *Journal of Sport and Exercise Psychology*, 16, 163–177.
- McAuley, E., & Rudolph, D. (1995). Physical activity, aging, and psychological well-being. *Journal of Aging and Physical Activity*, 3, 67–96.
- McAuley, E., Talbot, H. M., & Martinez, S. (1999). Manipulating self-efficacy in the exercise environment in women: influences on affective responses. *Health Psychology*, 18, 288–294.
- McIntyre, C. W., Watson, D., & Cunningham, A. C. (1990). The effects of social interaction, exercise, and test stress on positive and negative affect. *Bulletin of the Psychonomic Society*, 28, 141–143.
- McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the profile of mood states*. San Diego: Educational and Industrial Testing Service.
- Morgan, W. P. (1985). Affective beneficence of vigorous physical activity. *Medicine and Science in Sports and Exercise*, 17, 94–100.
- Morgan, W. P. (1997). *Physical activity and mental health*. Washington DC: Taylor and Francis.
- Morgan, W. P., & Goldston, S. E. (1987). *Exercise and mental health*. Washington DC: Hemisphere.
- Morris, W. M. (1992). A functional analysis of the role of mood in affective systems. In M. S. Clark, *Review of personality and social psychology* (pp. 256–293). Newbury Park (CA): Sage.
- Mutrie, N., & Biddle, S. J. H. (1995). The effects of exercise on mental health in nonclinical populations. In S. J. H. Biddle, *European perspectives on exercise and sport psychology* (pp. 50–70). Champaign (IL): Human Kinetics.
- Ortony, A., Clore, G. L., & Foss, M. A. (1987). The referential structure of the affective lexicon. *Cognitive Science*, 11, 341–364.
- Ortony, A., Clore, G. L., & Collins, A. (1988). *The cognitive structure of emotion*. New York: Cambridge University Press.
- Parkinson, B., Totterdell, P., Briner, R. B., & Reynolds, S. (1996). *Changing moods: the psychology of mood and mood regulation*. London: Longman.
- Petruzzello, S. J., & Landers, D. M. (1994). Varying the duration of acute exercise: implications for changes in affect. *Anxiety, Stress, and Coping*, 6, 301–310.
- Plante, T. G., & Rodin, J. (1990). Physical fitness and enhanced psychological health. *Current Psychology: Research and Reviews*, 9, 3–24.
- Price, J. (1998). The adaptive function of mood change. *British Journal of Medical Psychology*, 71, 465–477.
- Pronk, N. P., Crouse, S. F., & Rohack, J. J. (1995). Maximal exercise and acute mood response in women. *Physiology and Behavior*, 57, 1–4.
- Pronk, N. P., Jawad, A. F., Crouse, S. F., & Rohack, J. J. (1994). Acute effects of walking on mood profiles in women: preliminary findings in postmenopausal women. *Medicine, Exercise, Nutrition, and Health*, 3, 148–155.
- Raglin, J. S. (1990). Exercise and mental health: beneficial and detrimental effects. *Sports Medicine*, 9, 323–329.

- Rejeski, W. J. (1994). Dose–response issues from a psychosocial perspective. In C. Bouchard, R. J. Shephard, & T. Stephens, *Physical activity, fitness, and health: international proceedings and consensus statement* (pp. 1040–1055). Champaign (IL): Human Kinetics.
- Rejeski, W. J., & Thompson, A. (1993). Historical and conceptual roots of exercise psychology. In P. Seraganian, *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 3–35). New York: John Wiley and Sons.
- Rejeski, W. J., Hardy, C. J., & Shaw, J. (1991). Psychometric confounds of assessing state anxiety in conjunction with acute bouts of vigorous exercise. *Journal of Sport and Exercise Psychology*, *13*, 65–74.
- Rejeski, W. J., Gauvin, L., Hobson, M. L., & Norris, J. L. (1995). Effects of baseline responses, in-task feelings, and duration of activity on exercise-induced feeling states in women. *Health Psychology*, *14*, 350–359.
- Rejeski, W. J., Reboussin, B. A., Dunn, A. L., King, A. C., & Sallis, J. F. (1999). A modified Exercise-induced Feeling Inventory for chronic training and baseline profiles of participants in the Activity Counseling Trial. *Journal of Health Psychology*, *4*, 97–108.
- Russell, J. A. (1978). Evidence of convergent validity on the dimensions of affect. *Journal of Personality and Social Psychology*, *36*, 1152–1168.
- Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*, 1161–1178.
- Russell, J. A. (1989). Measures of emotion. In R. Plutchik, & H. Kellerman, *Emotion: theory, research, and experience, vol. 4 (The measurement of emotions)*, (pp. 83–111). San Diego (CA): Academic Press.
- Russell, J. A. (1997). How shall an emotion be called? In R. Plutchik, & H. R. Conte, *Circumplex models of personality and emotions* (pp. 205–222). Washington DC: American Psychological Association.
- Russell, J. A., & Feldman-Barrett, L. (1999). Core affect, prototypical emotional episodes, and other things called emotion: dissecting the elephant. *Journal of Personality and Social Psychology*, *76*, 805–819.
- Scherer, K. R. (1984). On the nature and function of emotion: a component process approach. In K. R. Scherer, & P. Ekman, *Approaches to emotion* (pp. 293–317). Hillsdale (NJ): Lawrence Erlbaum.
- Scully, D., Kremer, J., Meade, M. M., Graham, R., & Dudgeon, K. (1998). Physical exercise and psychological well-being: a critical review. *British Journal of Sports Medicine*, *32*, 111–120.
- Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: further exploration of a prototype approach. *Journal of Personality and Social Psychology*, *52*, 1061–1086.
- Smith, C. A., & Lazarus, R. S. (1990). Emotion and adaptation. In L. A. Pervin, *Handbook of personality: theory and research* (pp. 609–637). New York: Guilford.
- Sonstroem, R. J. (1997). Physical activity and self-esteem. In W. P. Morgan, *Physical activity and mental health* (pp. 127–143). Washington DC: Taylor and Francis.
- Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto (CA): Consulting Psychologists Press.
- Steptoe, A. (1992). Physical activity and psychological well-being. In N. G. Norgan, *Physical activity and health* (pp. 207–229). Cambridge: Cambridge University Press.
- Steptoe, A., & Bolton, J. (1988). The short-term influence of high and low intensity physical exercise on mood. *Psychology and Health*, *2*, 91–106.
- Steptoe, A., & Cox, S. (1988). Acute effects of aerobic exercise on mood. *Health Psychology*, *7*, 329–340.
- Stone, A. A. (1995). Measurement of affective response. In S. Cohen, R. C. Kessler, & L. Underwood-Gordon, *Measuring stress: a guide for health and social scientists* (pp. 148–171). New York: Oxford University Press.
- Tate, A. K., & Petruzzello, S. J. (1995). Varying the intensity of acute exercise: implications for changes in affect. *Journal of Sports Medicine and Physical Fitness*, *35*, 295–302.
- Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma, & J. D. Maser, *Anxiety and anxiety disorders* (pp. 681–705). Hillsdale (NJ): Lawrence Erlbaum.
- Tellegen, A., Watson, D., & Clark, L. A. (1999a). On the dimensional and hierarchical structure of affect. *Psychological Science*, *10*, 297–303.
- Tellegen, A., Watson, D., & Clark, L. A. (1999b). Further support for a hierarchical model of affect: reply to Green and Salovey. *Psychological Science*, *10*, 307–309.
- Thayer, R. E. (1967). Measurement of activation through self-report. *Psychological Reports*, *20*, 663–678.



- Thayer, R. E. (1978). Factor analytic and reliability studies on the Activation–Deactivation Adjective Check List. *Psychological Reports*, 42, 747–756.
- Thayer, R. E. (1986). Activation–Deactivation Adjective Check List: current overview and structural analysis. *Psychological Reports*, 58, 607–614.
- Thayer, R. E. (1987). Energy, tiredness, and tension effects of a sugar snack versus moderate exercise. *Journal of Personality and Social Psychology*, 52, 119–125.
- Thayer, R. E. (1989). *The biopsychology of mood and arousal*. New York: Oxford University Press.
- Tuson, K. M., & Sinyor, D. (1993). On the affective benefits of acute aerobic exercise: taking stock after twenty years of research. In P. Seragianian, *Exercise psychology: the influence of physical exercise on psychological processes* (pp. 80–121). New York: John Wiley and Sons.
- Van Landuyt, L. M., Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2000). Throwing the mountains into the lakes: on the perils of nomothetic conceptions of the exercise–affect relationship. *Journal of Sport and Exercise Psychology*, 22, 208–234.
- van Reekum, C. M., & Scherer, K. R. (1997). Levels of processing in emotion-antecedent appraisal. In G. Matthews, *Cognitive science perspectives on personality and emotion* (pp. 259–300). Amsterdam: Elsevier.
- Vlachopoulos, S., Biddle, S., & Fox, K. (1996). A social-cognitive investigation into the mechanisms of affect generation in children's physical activity. *Journal of Sport and Exercise Psychology*, 18, 174–193.
- Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology*, 54, 1020–1030.
- Watson, D., & Clark, L. A. (1992). Affects separable and inseparable: on the hierarchical arrangement of the negative affects. *Journal of Personality and Social Psychology*, 62, 489–505.
- Watson, D., & Clark, L. A. (1994). Emotions, moods, traits, and temperaments: conceptual distinctions and empirical findings. In P. Ekman, & R. J. Davidson, *The nature of emotion: fundamental questions* (pp. 89–93). New York: Oxford University Press.
- Watson, D., & Clark, L. A. (1997). Measurement and mismeasurement of mood: recurrent and emergent issues. *Journal of Personality Assessment*, 68, 267–296.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063–1070.
- Weyerer, S., & Kupfer, B. (1994). Physical exercise and psychological health. *Sports Medicine*, 17, 108–116.
- Yeung, R. R. (1996). The acute effects of exercise on mood. *Journal of Psychosomatic Research*, 40, 123–141.
- Zajonc, R. B. (1980). Feeling and thinking: preferences need no inferences. *American Psychologist*, 35, 151–175.
- Zajonc, R. B. (1984). On the primacy of affect. *American Psychologist*, 39, 117–123.
- Zuckerman, M., & Lubin, B. (1965). *Manual for the Multiple Affect Adjective Check List*. San Diego (CA): Educational and Industrial Testing Service.