

Exercise Is a Many-Splendored Thing, but for Some It Does Not Feel So Splendid: Staging a Resurgence of Hedonistic Ideas in the Quest to Understand Exercise Behavior

Panteleimon Ekkekakis and Manolis Dafermos

Abstract

Contemporary theories of exercise behavior have been the products of the so-called cognitive revolution, which has shaped the dominant paradigm in psychology over the past several decades. Cognitive theories rely on the assumption that, in making behavioral decisions, humans collect relevant information and make their selections on the basis of a more-or-less rational analysis of this information. Although the dominance of cognitive theories in the field of exercise psychology is unquestionable, evidence suggests that they leave most of the variance in exercise behavior unaccounted and interventions based on them are of limited effectiveness in changing exercise behavior. This chapter reviews the history and evaluates the potential of an alternative approach, namely the hedonic theory of motivation. This idea, long neglected due the fascination of psychologists with information-processing models of the mind, attributes a substantial portion of the variance in decision-making to affective processes. Modern iterations of the idea emerging from the fields of neurology and behavioral economics reaffirm the ancient thesis that, in the long run, humans tend to repeat what makes them feel better and tend to avoid what makes them feel worse. Evidence from studies in the context of exercise suggests that affective responses to exercise vary greatly between individuals. Furthermore, despite a still-evolving methodological platform, preliminary studies show that affective responses to exercise predict subsequent exercise behavior. This line of research and theorizing offers a novel and intriguing perspective on the mechanisms underlying behavioral decision-making in the context of exercise. The literature reviewed in this chapter highlights the need for further research on the motivational implications of affective processes and lays the foundation for the development of a hedonic theory of exercise behavior.

Key Words: hedonic theory, affect heuristic, information processing, rationality assumption, epistemology

Ah, the truth about exercise? ... The real value of it is not in terms of abstract health benefits like longevity—an extra few hours or maybe months—but because it feels good when you do it or when it's over. To hell with Hygeia, the truth lies in the pleasure.

—Excerpt from a letter by Drs. Richard A, Friedman and Fred Charatan to the *British Medical Journal* (Vol. 328, p. 1315, 2004)

For my sixty-fifth birthday this year, my wife purchased a week of personal training at the local health club for me. Although I am still in great shape since playing on my college tennis team 45 years ago, I decided it would be a good idea to go ahead and give it a try. . . . [After two workouts] The only way I can brush my teeth is by laying on the toothbrush on the counter and moving my mouth back and forth over it. . . . My chest hurt when I got on the treadmill, so Belinda put me on the stair monster. . . . Belinda told me it would help me get in shape and enjoy life. She said some other [expletive deleted] too. [After four workouts] I hate that witch Belinda more than any human being has ever hated any other human being in the history of the world. . . . If there was a part of my body I could move without unbearable pain, I would beat her with it. [At the end of the first week] I'm having the church van pick me up for services today so I can go and thank God that this week is over. I will also pray that next year my wife will choose a gift for me that is fun—like a root canal or a vasectomy.

—Excerpt from a widely circulated e-mail message, forwarded to one of the authors (P.E.) by a former student

Exercise psychology is a scientific field in the midst of a Kuhnian crisis. An old paradigm, according to which behavioral decisions (such as the decision to engage in, adhere to, or disengage from physical activity) are guided by the rational cognitive analysis of available information, has started to show its weaknesses. Over the past 20 years, a period during which more information about the health benefits of physical activity has become available than ever before, the percentage of people engaging in regular physical activity has remained stagnant. Cognitive models typically account for less than 25% of the variation in physical activity behavior. It would be hard to deny that there must be additional sources of variance and that these should be explored. This chapter is about the untapped potential represented by one such variable—namely, affect.

On the Brink of a Kuhnian Revolution?

To place the current situation in exercise psychology in historical context and to better understand the underlying intellectual conflict between the old and new paradigm, it is useful to revisit some of Thomas Kuhn's timeless insights about the emergence of scientific revolutions. According to Kuhn (1962/1996), "normal science" is a label

that describes "research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice" (p. 10). Normal science operates on the basis of "paradigms." A paradigm is a combination of theory, practice, and instrumentation that acts as an accepted example of scientific practice. Paradigms serve a crucial function in the scientific enterprise because they "provide models from which spring particular coherent traditions of scientific research" (p. 10).

Once a paradigm is established, the main function of "normal-scientific" research is "the articulation of those phenomena and theories that the paradigm already supplies" (Kuhn, 1962/1996, p. 24). What normal science does not do is to observe and consider new phenomena ("indeed those that will not fit the box are often not seen at all," p. 24) and to develop new theories (scientists are even "often intolerant of those invented by others," p. 24). According to Kuhn, "normal science does not aim at novelties of fact or theory and, when successful, finds none" (p. 52). In the process of articulating the components of the paradigm, scientists develop increasingly elaborate instruments,

an increasingly esoteric vocabulary, an increasingly complex skill set, and increasingly refined concepts. The unintended consequences of these developments are the "immense restriction of the scientist's vision" and a "considerable resistance to paradigm change." In essence, science becomes "increasingly rigid" (p. 64).

How, then, does progress occur? According to Kuhn, a mature paradigm, despite its rigidity and resistance to change, is a prerequisite for change. The reason is that a paradigm precisely specifies what is anticipated. For example, it leads to the development of instruments specifically engineered to find the "anticipated" result and trains researchers to detect even the most intricate matches between paradigm-based predictions and observations. This situation creates the conditions for the observation of "anomalies," the engine of scientific progress. Kuhn (1962) defined an "anomaly" as "nature's failure to conform entirely to expectation" (p. 762). Anomalies appear "only against the background provided by the paradigm," and in fact, "the more precise and far-reaching that paradigm is, the more sensitive an indicator it provides of anomaly and hence of an occasion for paradigm change" (Kuhn, 1962/1996, p. 65).

Clearly, not all anomalies result in progress. The vast majority are ignored. When an anomaly persists over an extended period of time, the most common effect is that scientists will attempt to alter their instrumentation in a way that makes the anomaly disappear or they will try to make the anomaly fit within the paradigm (i.e., modify the expectation and thus make the former anomaly seem expected). According to Kuhn (1962/1996), "they will devise numerous articulations and ad hoc modifications of their theory in order to eliminate any apparent conflict" (p. 78). In general, "when confronted by even severe and prolonged anomalies" that make them "begin to lose faith [and] consider alternatives," scientists "do not renounce the paradigm that has led them into crisis" (p. 77). The main reason is that "as in manufacture so in science—retooling is an extravagance to be reserved for the occasion that demands it. The significance of crises is the indication they provide that an occasion for retooling has arrived" (p. 76).

In rare cases, an anomaly results in a "crisis." The forces that can convert an anomaly to a crisis are many, and usually several of them must co-occur. For example, a persistent anomaly may call into question some of the most fundamental tenets of the paradigm. In other cases, the paradigm predicts that

an application should be ineffective when long practice has clearly established its utility (or conversely, the paradigm predicts that an application should be effective when practice reliably demonstrates its failure). As a result of such discrepancies, the anomaly becomes more widely recognized (e.g., replicated and confirmed by a broader circle of scientists) and even catches the attention of prominent figures in the field. The anomaly then becomes "the new fixation point of scientific scrutiny" (Kuhn, 1962/1996, p. 83) and its resolution becomes a shared goal. One of the defining features of a field in crisis is the emergence of multiple and divergent attempts to resolve the anomaly. As these attempts multiply, they also become more diversified. Although early attempts may follow the rules of the paradigm closely, the persistence of the anomaly begs "ad hoc adjustments" (p. 83) of the paradigm that are increasingly bold and unruly. Thus "the rules of normal science become increasingly blurred. Though there still is a paradigm, few practitioners prove to be entirely agreed about what it is. Even formerly standard solutions of solved problems are called in question" (p. 83).

A crisis is a powerful transformative force, because it brings forth critical thinking and creativity. According to Kuhn (1962/1996), "the transition from a paradigm in crisis to a new one from which a new tradition of normal science can emerge is far from a cumulative process, one achieved by an articulation or extension of the old paradigm" (pp. 84–85). Instead, a crisis forces "a reconstruction of the field from new fundamentals, a reconstruction that changes some of the field's most elementary theoretical generalizations as well as many of its paradigm methods and applications" (p. 85). Such "reconstructions" progress slowly and usually against considerable resistance. Formerly dominant paradigms do not just collapse or disappear overnight:

Once it has achieved the status of paradigm, a scientific theory is declared invalid only if an alternate candidate is available to take its place. . . . The act of judgment that leads scientists to reject a previously accepted theory is always based upon more than a comparison of that theory with the world. The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other. (Kuhn, 1962/1996, p. 77).

Much like political revolutions, scientific revolutions “are inaugurated by a growing sense, . . . often restricted to a narrow subdivision of the scientific community, that an existing paradigm has ceased to function adequately in the exploration of an aspect of nature to which that paradigm itself had previously led the way” (p. 92). Scientific revolutions, therefore, are “those non-cumulative developmental episodes in which an older paradigm is replaced in whole or in part by an incompatible new one” (p. 92).

What Is the Dominant Paradigm in Exercise Psychology?

All currently prominent models of physical activity or exercise behavior are exemplars of the same paradigm. The health belief model (Rosenstock, Strecher, & Becker, 1988), the theory of planned behavior (Ajzen, 1991), the social cognitive theory (Bandura, 1986), and (to a large extent) the transtheoretical model (Prochaska & DiClemente, 1982) are all products of the so-called cognitive revolution. As such, they all rely on the fundamental assumption that in making behavioral decisions, people collect and analyze the relevant information that is available to them, rationally weigh pros and cons, and make complicated probabilistic predictions about the future consequences of their actions.

For example, according to the theories of reasoned action and planned behavior, “people think and act in more or less logical ways” (Ajzen, 2005, p. 29). Human behavior “can be described as reasoned” (Ajzen & Fishbein, 2005, p. 203) in the sense that the decision to act “rests ultimately on the information people have relevant to the behavior” (Ajzen & Fishbein, 2005, p. 195). In social cognitive theory, cognitive processing also plays the central role in decision making. People are described as data processors, constantly engaged in collecting and analyzing information:

Many activities involve inferential judgments about conditional relations between events in probabilistic environments. Discernment of predictive rules requires cognitive processing of multidimensional information that contains many ambiguities and uncertainties. In ferreting out predictive rules, people must draw on their state of knowledge to generate hypotheses about predictive factors, to weight and integrate them into composite rules, to test their judgments against outcome information, and to

remember which notions they had tested and how well they had worked.

(Bandura, 1989, p. 1176)

Similarly, according to the transtheoretical model, in approaching the decision to change their behavior, people are constantly engaged in analyzing and comparing pros and cons and make decisions on that basis: “for most problem behaviors people will decide that the pros of changing the behavior outweigh the cons before they take action to modify their behavior” (Prochaska et al., 1994, p. 44).

It is also striking that within the framework of these popular theories, all of which have been adopted from social and health psychology to account for exercise behavior, exercise is considered just another variant of health behavior (similar to practicing safe sex, brushing one’s teeth, or eating fruits and vegetables). Yet exercise appears to have near-zero correlations with other health behaviors, suggesting that its underlying regulatory mechanisms are, at least in part, distinct (Newsom, McFarland, Kaplan, Huguet, & Zani, 2005). Nevertheless, popular broad-scope theories do not take this uniqueness of exercise into consideration. Acknowledging this point, Rhodes and Nigg (2011) write that “there is adequate, if not overwhelming, evidence to suggest that unique theories of [physical activity] should be pursued” (p. 114).

Anomalies in the Paradigm

The “physical activity paradox” is one of the most frustrating phenomena in public health. On the one hand, physical activity is arguably, as the late Jeremy Morris (1994) famously put it, “today’s best buy in public health.” This characterization is convincingly supported by compelling epidemiologic and experimental evidence across a broad range of conditions (Miles, 2007; Pedersen & Saltin, 2006; Warburton, Katzmarzyk, Rhodes, & Shephard, 2007). On the other hand, promoting physical activity to the public has proven a very “tough sell” (Dishman, 2001). This situation challenges the notion that human beings make decisions on the basis of rational information processing. However, that idea is a core assumption of most contemporary theories of health (and physical activity) behavior. Such theories are built on the belief that when presented with a behavioral option that can credibly lower the risk of an important negative outcome (e.g., death), most people, thinking and acting rationally, will select that option.

For example, according to the theory of planned behavior, "attitude toward a behavior is determined by accessible beliefs about the consequences of the behavior, termed *behavioral beliefs*. Each behavioral belief links the behavior to a certain outcome. The attitude toward the behavior is determined by the person's evaluation of the outcomes associated with the behavior and by the strength of these associations" (Ajzen, 2005, p. 123). Thus recognizing that physical activity can be beneficial in lowering the risk of cardiovascular disease is expected to improve the attitude toward physical activity. In turn, this should lead to the formation of an intention to be physically active. Similarly, in social cognitive theory, realizing that physical activity can bring about the important outcome of maintaining cardiovascular health should increase the chance of someone's becoming physically active. According to Bandura (2001), "people ... anticipate the likely consequences of prospective actions, and select and create courses of action likely to produce desired outcomes and avoid detrimental ones. Through the exercise of forethought, people motivate themselves and guide their actions in anticipation of future events" (p. 7). In the transtheoretical model, increasing the perceived pros (such as recognizing that exercise can lower the risk of death from cardiovascular disease) is a prerequisite for moving from "precontemplation" to later stages of change. Furthermore, "to move to action, pros should be higher than cons" (Prochaska, Redding, & Evers, 2008, p. 104). From a rational standpoint, it would be hard to imagine a "con" that could outweigh the "pro" of staying alive.

If these assumptions are correct, it follows that in societies inundated with messages about the health benefits of physical activity, the population should be, for the most part, physically active. In the United States, a country in which the population is routinely exposed to media messages about the health benefits of physical activity. Morrow, Jackson, Bazzarre, Milne, and Blair (1999) surveyed 2,002 adults representing the 48 contiguous states and the District of Columbia. Of them, 84% knew that physical inactivity was related to the development of heart disease. In another analysis of the same data set, Martin, Morrow, Jackson, and Dunn (2000) reported that of the 2,002 respondents, 97% identified physical inactivity as a health risk factor (52% as "very important," 37% as "important," and 8% as "somewhat important"). Nevertheless, 68.1% did not meet the minimum physical activity guidelines

(Pate et al., 1995). Even of those who rated physical inactivity as a "very important" health risk factor, about two-thirds (64.2%) did not engage in the minimum recommended levels of activity.

In other words, despite the fact that "message penetration" about the health benefits of physical activity in U.S. society seems excellent (at rates of 85–95%), participation in physical activity remains low. Just how low became evident with the publication of results from the first nationwide study of accelerometry-based activity monitoring. Troiano et al. (2008) reported that among adults between the ages of 20 and 59 years, only 3.5% (3.8% of men, 3.2% of women) participated in bouts of at least moderate-intensity physical activity totaling at least 30 minutes per day on at least 5 days per week. For those over the age of 60 years, the percentage was even lower, at 2.4% (2.5% of men, 2.3% of women). A latent class analysis of the same data set showed that when every minute of activity was considered, 78.7% of the population was included in the two least active classes (33.6% averaging 5.3 minutes and 45.1% averaging 21.0 minutes of moderate-to-vigorous physical activity per day). When only activity performed in bouts of at least 10 minutes was considered (during which at least 70% of the accelerometer counts were above the threshold for moderate-to-vigorous activity), 93.5% of the population was included in the two least active classes (56.1% averaging nearly zero and 37.4% averaging 10.3 minutes of moderate-to-vigorous physical activity per day). The data for vigorous activity are even more disconcerting. On 91.1% of all days, participants accumulated less than 1 minute of vigorous physical activity on average. Of 3,462 participants who provided valid data for at least three days, only 23 (0.66%) registered 20 minutes of vigorous physical activity on at least three days per week (Metzger et al., 2008).

In Australia, another country with social marketing campaigns promoting the health benefits of physical activity, the results have been similar. According to data from the National Physical Activity Survey, nearly all adults (92%) said that they knew they would get health benefits if they did at least 30 minutes of moderate physical activity per day (Armstrong, Bauman, & Davies, 2000). Nevertheless, over 50% did not reach this criterion (15% reported no leisure-time physical activity during the previous week, and another 40% accumulated fewer than 150 minutes of activity). From 1997 to 1999, knowledge about the health

benefits of physical activity increased nationwide, but the percentage of people satisfying the guidelines decreased (Bauman et al., 2003). Specifically, the percentage of people who knew that being more active is good for health increased from 85.0% to 88.1%, and those who knew that brisk walking for half an hour daily is good for health increased from 90.3% to 92.1%. At the same time, the percentage who reported at least 150 minutes of physical activity on at least five days per week decreased from 50.9% to 45.2%.

Within specific studies, the results have been similarly discordant with rationality assumptions. For example, patients in cardiac rehabilitation ($N = 353$) were asked questions related to their perceived risk (e.g., "If I keep my lifestyle the way it was prior to the acute treatment, I will suffer from coronary health problems") (Schwarzer, Luszczynska, Ziegelmann, Scholz, & Lippke, 2008). Their answers indicated that they were well aware of their elevated level of risk ($M = 3.10$ out of 4.00). However, the correlation of risk perception to the intention to be physically active (e.g., "I intend to become physically active on a regular basis") was only $r = .09$. Outcome expectancy (e.g., "If I would exercise on a regular basis, then I would feel balanced in my daily life"; $M = 3.60$ out of 4.00) was also weakly related to intention ($r = .29$). Similarly, patients in orthopedic rehabilitation ($N = 368$) reported high risk perception (e.g., "likelihood that you will ever suffer from chronic pain"; $M = 2.96$ out of 5.00) and outcome expectancy (e.g., "If I would engage in physical exercise on 2 or more days per week, for at least 20 minutes each time, then I would be doing something good for my health"; $M = 3.19$ out of 4.00). However, neither variable correlated with intention ($r = .03$ and $.11$, respectively).

These and numerous other studies with similar results suggest that it might be erroneous to assume that the decision to engage in or adhere to an exercise program depends solely on the rational analysis and evaluation of information. The corollary is that appealing to the public's knowledge and rational reasoning as the cornerstone of intervention efforts, as is commonly the case (e.g., enumerating the health benefits of activity and the risks of inactivity), is unlikely to be very effective (e.g., Dishman & Buckworth, 1996).

In fact, a growing number of theorists have questioned the ability of human beings to collect, process, and apply information in the manner

described by cognitive models of health behavior. Herbert Simon, the 1978 Nobel laureate in economics ("for his pioneering research into the decision-making process within economic organizations"), argued that "human beings have neither the facts nor the consistent structure of values nor the reasoning power at their disposal that would be required" to perform the kinds of computations that cognitive models entail (Simon, 1983, p. 17). Instead, Simon suggested that "human rationality is very limited, very much bounded by the situation and by human computational powers" (p. 34), a notion now referred to as "bounded rationality." Other researchers have also criticized the assumptions of cognitive theories, focusing on the substantial deviations that human judgments and behavioral choices often exhibit compared with standard models of rationality (e.g., Stanovich & West, 2000). These researchers have proposed that rather than being determined by a thorough and truly reasoned analysis, human decisions are aided by a set of "heuristics" (shortcuts or simplified rules) that, although frequently flawed and biased, bring the complexity of problems down to the scale of human reasoning abilities and ultimately help people navigate their world.

The Hedonic Perspective as an Emerging Alternative

Many authors who question the exclusive reliance of decision making on cognitive analysis tend to assign an important role to affective influences, reminding us that people generally tend to do what makes them feel better and tend to avoid what makes them feel worse. For example, following his strong argument for bounded rationality, Simon (1983) suggested that "in order to have anything like a complete theory of human rationality, we have to understand what role emotion plays in it" (p. 29). Before him, Young (1959) had argued that "any theory of behavior which ignores the concept of affectivity will be found inadequate as an explanation of the total facts" (p. 106). Along the same lines, in a thought-provoking and highly influential article that ignited a famous debate with Richard Lazarus, Robert Zajonc (1980) wrote: "We sometimes delude ourselves that we proceed in a rational manner and weigh all the pros and cons of the various alternatives. But this is probably seldom the actual case. Quite often 'I decided in favor of X' is no more than 'I liked X'" (p. 155). Similarly, in the introduction of his landmark book *Descartes'*

Error: Emotion, Reason, and the Human Brain, Damasio (1994) wrote:

I began writing this book to propose that reason may not be as pure as most of us think it is or wish it were, that emotions and feelings may not be intruders in the bastion of reason at all: they may be enmeshed in its networks, for worse *and* for better. The strategies of human reason probably did not develop, in either evolution or any single individual, without the guiding force of the mechanisms of biological regulation, of which emotion and feeling are notable expressions. Moreover, even after reasoning strategies become established in the formative years, their effective deployment probably depends, to a considerable extent, on a continued ability to experience feelings.

(p. xii)

In the view of these prominent theorists, models of decision making based exclusively on information processing are bound to be deficient. To quote Bettman (1993), such models “are overbearingly cognitive; like the tin man in the Wizard of Oz, these models have no heart” (p. 8).

Heeding such calls, authors have proposed that one of the heuristics that people use to facilitate decision making is the “affect heuristic” (e.g., Kahneman, 1999; Slovic, Finucane, Peters, & MacGregor, 2002; 2007). The basic tenet of the affect heuristic, heralded as “probably the most important development in the study of judgment heuristics in the past few decades” (Kahneman, 2003, p. 710), is that “positive and negative affective feelings . . . guide and direct judgments and decisions” (Finucane, Peters, & Slovic, 2003, pp.340–341). Specifically, affect “facilitates information integration in judgments and decisions, guides reason, . . . gives priorities among multiple goals,” and is “a powerful motivator of behavior” (p. 341). As explained in the next section, this idea is certainly not new, since its historic origins can be traced to Epicurean philosophy, and well-known revivals can be found in Bentham’s “hedonic calculus” and Freud’s “pleasure principle.” Recently, the idea has reappeared in diverse scientific fields, including social psychology (Baumeister, Vohs, DeWall, & Zhang, 2007; Emmons & Diener, 1986), behavioral economics (Kahneman, 1999; Loewenstein & Lerner, 2003; Mellers, 2004), affective neuroscience (Bechara, Damasio, & Damasio, 2000; Damasio, 1996; Naqvi, Shiv, & Bechara, 2006), and experimental physiology (Cabanac, 1992).

It is noteworthy that the idea that affect can be “a powerful motivator of behavior” seems to be much more influential in fundamentally interdisciplinary research fields than those that adhere closely to paradigms dictated by “mainstream” psychology. In effect, interdisciplinary fields have operated unrestrained by the influence of the cognitive tradition, which within psychology proper seems to have imposed an “immense restriction of the scientist’s vision,” to use Kuhn’s (1962/1996, p. 64) words. For example, that eating behavior and food choices are driven at least in part by the rewarding effects of food (Lutter & Nestler, 2009; Moore & O’Donohue, 2008; Stroebe, Papies, & Aarts, 2008) has come to be regarded as almost self-evident. By extension, we readily accept that the pleasure associated with eating has contributed to the problem of obesity (Kishi & Elmquist, 2005; Rolls, 2007). Similarly, few would question that the addictive effects of drugs of abuse are mediated by pleasurable feelings (Bechara, 2005; Koob, 2008; Robinson & Berridge, 2008).

In decision research, although most researchers still subscribe to information processing models, the role of affect has been gaining considerable ground. In a major review, Weber and Johnson (2009) noted the following: “Though successful in many ways, the cognitive revolution may have been too focused on analytic and computational processes. The emotions revolution of the past decade or so has tried to correct this overemphasis by documenting the prevalence of affective processes, depicting them as automatic and essentially effort-free inputs that orient and motivate adaptive behavior” (p. 65). Nevertheless, within the core of psychology, as acknowledged by Ajzen and Fishbein (2005), “much of the research [stemming from cognitive theories of motivation and behavior] has devoted little attention to the role of emotion in the prediction of intentions and actions” (p. 203).

Overview of the Long History of Psychological Hedonism

The present generation of researchers in exercise psychology has been educated in an academic culture that is almost entirely devoid of information about the role of affect as a motivating force in human behavior. Tracing the historical origins and subsequent evolution and refinement of the idea of “psychological hedonism” by relying solely on the contemporary literature. However, the value of having this type of historical perspective cannot

be overemphasized. First, it is crucial for researchers to appreciate that this is an idea that, despite ups and downs, has remained alive amid radical and tumultuous changes in philosophical and metatheoretical currents over the past 25 centuries. Second, it is important, as the phoenix of affect in psychological thought rises from the ashes once again, to avoid the pitfall of rediscovering the wheel by reigniting debates that have already taken place. Third, a solid understanding of the historical journey of the idea of psychological hedonism will inevitably reveal both its limitations and its strengths and will thus help contemporary researchers formulate modern iterations of the essential themes that are more robust and more relevant to today's psychology. For these reasons, in this section, we trace the time line of this idea over the course of the past 25 centuries by concentrating on select works of figures whose views have proven to be of landmark significance from a historical perspective.

"Hedonism" is generally defined as the pursuit of pleasure. However, an important distinction must be drawn between hedonism as a doctrine in ethical philosophy and so-called psychological or motivational hedonism. Hedonism as an ethical philosophy advances the view that pleasure is the only ultimate good and that only pleasant states are desirable in themselves. This position can be taken as tantamount to the controversial claim that any pursuit of pleasure, from physical to spiritual and from individual to societal, must be condoned, regardless of the cost to others. Psychological or motivational hedonism, on the other hand, refers to the doctrine that behavior is motivated by the desire for pleasure and the avoidance of displeasure (Mees & Schmitt, 2008). Pleasure and displeasure may result immediately or in the long run (and may thus serve as either *proximal* or *distal* motives). Furthermore, as emphasized by Sober and Wilson (1998), pleasure and displeasure may range from purely corporeal sensations (e.g., the pleasure of quenching one's thirst or the pain of an injury) to feelings embedded within cognitively enriched states such as attitudes or emotions (e.g., the pleasure of pride or the displeasure of embarrassment). In its extreme version, this type of hedonism implies that *all* human behavior is carried out with the intent to either seek pleasure or avoid displeasure. In other words, according to this perspective, the pursuit of pleasure and the avoidance of displeasure are the *only* ultimate human motives.

Aristippus (435–366 BCE), the founder of the Cyrenaic school, proposed a body-centered, radical

version of hedonism. He taught that the goal of all human actions is to seek pleasure. According to Diogenes Laertius (trans. 1972), "he derived pleasure from what was present, and did not toil to procure the enjoyment of something not present" (*Lives of Eminent Philosophers*, Book II, Chapter 8, line 66). Aristippus and the other Cyrenaics held that there are two emotional states of the mind, pleasure and pain. Pleasure comes from bodily stimuli that are agreeable or attractive, whereas pain is associated with bodily symptoms that are aversive or repellent. Diogenes Laertius described the belief of the Cyrenaics in psychological hedonism in these words: "That pleasure is the end is proved by the fact that from our youth up we are instinctively attracted to it, and, when we obtain it, seek for nothing more, and shun nothing so much as its opposite, pain" (Book II, Chapter 8, line 88). Cyrenaics also believed that "bodily pleasures are far better than mental pleasures, and bodily pains far worse than mental pains" (Diogenes Laertius, *Lives of Eminent Philosophers*, Book II, Chapter 8, line 90). So a crucial characteristic of the Cyrenaic school is that it elevated rather than suppressed the pleasures of the body over those of the mind.

Plato's (428–348 BCE) view of pleasure is complex. In *Protagoras*, Plato defended a prohedonistic position. On the other hand, in *Gorgias*, *Phaedo*, and *The Republic*, he introduced a contrast between reason and bodily pleasure. The antihedonistic ideas of the Pythagoreans may have influenced Plato's soul-body dualism and his treatment of desires as irrational, dark forces of the soul (Gosling & Taylor, 1982). According to Plato (trans. 1997), "there is a dangerous, wild and lawless form of desire in everyone, even in those of us who seem to be entirely moderate or measured" (*Republic*, IX, 572b). In *Philebus*, Plato presented a discussion between Rotarchus and Socrates about the nature of the supreme good. The conclusion was that the life that combines wisdom and pleasure is better than the life that excludes one or the other. A life of pleasure would not be desirable without wisdom, nor could a life of wisdom exist without pleasure. Plato divided pleasures into various types, such as the intellectual pleasure of learning, the pleasure of honor and dignity, and the bodily pleasures, such as food, drink, and sex (*Republic*, XI, 580e–581a). There is a correspondence between these types of pleasure and parts of the soul (i.e., the rational, emotional, and appetitive). Although Plato is often thought of as a dualist, he believed that it was necessary to keep harmony and integration between

the parts of the human soul. However, Plato also held that there could be internal conflict between different sorts of desires and pleasures: "Some of our unnecessary pleasures and desires seem to me to be lawless. They are probably present in everyone, but they are held in check by the laws and by the better desires in alliance with reason. In a few people, they have been eliminated entirely or only a few weak ones remain, while in others they are stronger and more numerous" (*Republic*, IX, 571b). Plato's views on the tensions between different kinds of pleasures is important in the history of hedonistic ideas because it foreshadows the notion of internal conflicts in later psychodynamic theories in psychology.

Aristotle (384–322 BCE) accepted that "people who fall short with regard to pleasures and delight in them less than they should are hardly found; for such insensibility is not human" (*Nicomachean Ethics*, III, 1119a, 5, trans. 1984). Endorsing an essential hedonistic position, he believed that the pleasure associated with an activity is a crucial determinant of how this activity will be prioritized, since "the more pleasant activity drives out the other activity" whereas "when an activity causes pain, this pain destroys it" (*Nicomachean Ethics*, X, 1175b, 4–23). However, Aristotle also maintained that the ultimate goal of human life is not pleasure per se but *eudaimonia*, defined as the state of personal well-being in a holistic sense. Thus Aristotle rejected the idea that pleasure in general is the aim of all human actions and the purpose of human life. Instead, he elevated the significance of pleasure that is specifically connected with the intellectual life: "For, while there is pleasure in respect of any sense, and in respect of thought and contemplation no less, the most complete is pleasantest, and that of a well-conditioned organ in relation to the worthiest of its objects is the most complete; and the pleasure completes the activity" (*Nicomachean Ethics*, X, 1174b, 20–23). Thus in Aristotle's view, not all pleasures have the same value; the value of pleasure depends on the value of the activity from which the pleasure arises.

Epicurus (341–270 BCE) held that the goal of human life is pleasure. He called pleasure both the starting point and the culmination of a blessed life. Epicurus believed that a pleasant life is not defined by festivities and entertainment, sexual love, or enjoyment of a plentiful table. He held that human beings cannot lead a life of pleasure if it is not also a life of prudence, honor, and justice. According to Diogenes Laertius (trans. 1925),

Epicurus believed that the "misfortune of the wise is better than the prosperity of the fool" (*Lives of Eminent Philosophers*, X, 134). For the Cyrenaics, pleasure referred to cyclical and transient states, such as satiety after a meal. While Epicurus did not deny this type of pleasure, he argued that this is only one type and that a more important type is the pleasure that is enduring. Examples of this latter type include serenity and peace of mind, friendship, and being fearless in the face of death. All these, according to Epicurus, contribute to the highly desirable state of "rest." This concept refers to serenity of the soul, the absence of trouble and unrest of the psyche, and should not be confused with inactivity or indolence of the body. The antitheses to this concept of rest are the ideas of "motion" and "activity," but again these do not refer to the movement of the body but rather to a state of debauchery and consumerism. According to Epicurus, "peace of mind and freedom from pain are pleasures which imply a state of rest; joy and delight are seen to consist in motion and activity" (Diogenes Laertius, *Lives of Eminent Philosophers*, X, 136). Thus pleasure does not mean sensual enjoyment but freedom from pain in the body and from trouble in the mind (*Lives of Eminent Philosophers*, X, 131–132). Epicurus also disagreed with the Cyrenaics in that he believed the "pains of the mind" to be worse than the "pains of the body" because "the flesh endures the storms of the present alone, the mind those of the past and future as well as the present" (*Lives of Eminent Philosophers*, X, 137).

During the Middle Ages, hedonism was rejected as incompatible with Christian values. The humanistic scholars were those who revisited the idea of hedonism. **Erasmus (1466–1536)** and **Thomas More (1478–1535)** proposed their own versions of hedonism. In Thomas More's *Utopia*, for example, people called Utopians believed that pleasure was the ultimate goal of all their activities and that health was the foundation of all pleasures.

René Descartes (1596–1650), as a rationalist, did not accept the version of hedonism according to which pleasure is the most important element in human life. Descartes was, of course, a dualist who believed not only that mind and body are distinct entities but also that one (the mind) must have commanding control over the other (the body). He held that pleasure and pain, as well as what he characterized as "passions" (what would be referred to as "emotions" today), are caused by the flow of animal spirits in the body. They can intrude into and disrupt the function of the ethereal mind, in what

Descartes acknowledged as perhaps the main threat to his concept of substance dualism. Nevertheless, despite these intrusions and disruptions, Descartes adopted the position of the Stoics that the mind must exert control over passions and desires. In his words, "what we call 'titillation' or 'pleasurable sensation' occurs when the objects of the senses produce some movement in the nerves which would be capable of harming them if they did not have enough strength to resist it or if the body was not in a healthy condition" (*The Passions of the Soul*, 94/399, trans. 1985).

Thomas Hobbes (1588–1679) adopted a hedonistic approach to human motivation. In his view, human behavior is directed by self-interest and self-protection. Hobbes held that humans are thus stimulated by appetites, which bring forth a movement toward an object, and aversions, which induce a movement away from an object: "And in animal motion this is the very first endeavor, and found even in the embryo; which while it is in the womb, moveth its limbs with voluntary motion, for the avoiding of whatsoever troubleth it, or for the pursuing of what pleaseth it. And this first endeavor, when it tends towards such things as are known by experience to be pleasant, is called *appetite*, that is, an approaching; and when it shuns what is troublesome, *aversion*, or flying from it" (Hobbes, 1655/1839, p. 407). The Latin-origin words *appetitive* and *aversive* signify approach and withdrawal, and for Hobbes all the passions of the mind consist of appetite and aversion. Hobbes distinguished between different types of pleasures: "Of pleasures or delights, some arise from the sense of an object present; and those may be called pleasure of sense . . . Others arise from the expectation that proceeds from foresight of the end or consequence of things; whether those things in the sense please or displease. And these are pleasures of the mind of him that draweth consequences, and are generally called 'joy.'" (Hobbes, 1651/1839, pp. 42–43).

David Hume (1711–1776) also adopted the basic hedonistic doctrine: "Tis obvious, that when we have the prospect of pain or pleasure from any object, we feel a consequent emotion of aversion or propensity, and are carry'd to avoid or embrace what will give us this uneasiness or satisfaction" (Hume, 1740/1978, p. 414). Hume proposed a division of passions into "direct" (e.g., desire, aversion, grief, joy, hope, fear, despair, and security) and "indirect" (e.g., pride, humility, ambition, vanity, love, hatred, envy, pity, malice, generosity, and their variants). The direct passions "arise immediately from good

or evil, from pain or pleasure," whereas the indirect passions "proceed from the same principles, but by the conjunction of other qualities" (Hume, 1740/1978, p. 276). Although the criteria upon which this division is based are not entirely clear (McIntyre, 2000), a central consideration appears to be the degree of cognitive involvement or elaboration. Hume recognized that "bodily pains and pleasures are the source of many passions . . . but arise originally . . . in the body . . . without any preceding thought or perception" (p. 276). On the other hand, other passions arise from ideas and reflections and are therefore enriched by cognition. Hume did not accept the view that reason should control the passions: "reason is, and ought only to be slave of the passions, and can never pretend to any other office than to serve and obey them" (Hume, 1740/1978, p. 415). He also did not agree with the view that reason alone can be a motive to volition and action. The impulse of actions, he held, arises not from reason but from passion (Watson, 1895).

Julien Offray de La Mettrie (1709–1751) was a physician by training who opposed the dualistic view of emotions and passions (including pleasure) as detached from the body. Introducing an innovative mechanistic view based on classical Newtonian physics, he famously likened humans to complicated machines. Associated with La Mettrie's materialism were his prohedonism views. He maintained that pleasures (such as those associated with sex or taking opium) and pains (such as hunger) are very powerful motives for human actions. Furthermore, in his book *Man as Machine*, La Mettrie wrote that "We were not originally made to be wise and we have perhaps become so by a sort of misuse of our organic faculties . . . Nature created us all solely to be happy – yes, all, from the worm crawling on the ground to the eagle soaring on high" (La Mettrie, 1748/1996, p. 22). Later, in his work *Anti-Seneca* (also known as *Discourse on Happiness*), La Mettrie was even more explicit in his views about the role of pleasure and pain: "We shall be Anti-Stoics! Those philosophers . . . appear impervious to pleasure or pain; we shall glory in feeling both . . . We shall not try to control what rules us; we shall not give orders to our sensations. We shall recognize their dominion and our slavery and try to make it pleasant for us, convinced as we are that happiness in life lies there" (La Mettrie, 1750/1996, p. 119).

For **Claude Adrien Helvétius (1715–1771)**, pleasure and pain are the ruling motives of human behavior: "pleasure and pain are, and always

will be, the only principles of action in man" (M. Helvétius, 1777/1810, p. 146). Following La Mettrie, Helvétius assigned a central role to the pleasures and pains of the body but also acknowledged that pleasure and pain may derive from thought: "I know but two sorts of pain, that we feel and that we foresee. I die of hunger; I feel a present pain. I foresee that I shall soon die of hunger. . . . There are two sorts of pleasures, as there are two sorts of pains: the one is the present bodily pleasure, the other is that of foresight" (M. Helvétius, 1777/1810, pp. 126–129).

Jeremy Bentham (1748–1832) is perhaps the best known representative of the school of English utilitarianism. He accepted psychological hedonism, stating that "nature has placed mankind under the governance of two sovereign masters, pain and pleasure. It is for them alone to point out what we ought to do, as well as to determine what we shall do" (Bentham, 1789/1948, p. 1). He also believed that individual interest supersedes all others. In Bentham's utilitarianism, everything is judged by its utility, which in turn translates to pleasure. Bentham proposed that pleasures and pains can be quantified and developed a "hedonic calculus" according to which actions are evaluated by the net amount of pleasure (minus pain) that they generate.

John Stuart Mill (1806–1873) was also a proponent of utilitarianism who equated the concept of utility with that of pleasure: "Those who know anything about the matter are aware that every writer, from Epicurus to Bentham, who maintained the theory of utility, meant by it, not something to be contradistinguished from pleasure, but pleasure itself, together with exemption from pain" (*Utilitarianism*, Chapter II). Mill accepted fundamental tenets of hedonism, writing, for example, that "pleasure, and freedom from pain, are the only things desirable as ends; and that all desirable things . . . are desirable either for the pleasure inherent in themselves, or as means to the promotion of pleasure and the prevention of pain" (*Utilitarianism*, Chapter II). He countered the opinions of those who had taken hedonism to be a "doctrine worthy only of swine" by emphasizing that there are qualitative differences between pleasures, with those pleasures that involve distinctively human faculties, such as the intellect, the feelings, the imagination, and the moral sentiments, being superior to others (West, 2004).

Herbert Spencer's (1820–1903) work holds a special place in the history of hedonistic ideas because he was the first to articulate the function

of pleasure and pain within an evolutionary framework, and did so even before Darwin's *On the Origin of Species*. He maintained that "there exists a primordial connection between pleasure-giving acts and continuance or increase of life, and, by implication, between pain-giving acts and decrease or loss of life" (Spencer, 1879, p. 82). In his two-volume opus *The Principles of Psychology*, Spencer wrote that "pains are the correlatives of actions injurious to the organism, while pleasures are the correlatives of actions conducive to its welfare. . . . It is an inevitable deduction from the hypothesis of Evolution, that races of sentient creatures could have come into existence under no other conditions" (Spencer, 1905, p. 279). Evolution linked pleasure to approach and pain to avoidance, and consequently "it is undeniable that every animal habitually persists in each act which gives pleasure, so long as it is doing so, and desists from each act which gives pain" (p. 280). These links must be reliable and powerful. Any creature that departs from this cardinal rule becomes extinct: "if the states of consciousness which a creature endeavors to maintain are the correlatives of injurious actions, and if the states of consciousness which it endeavors to expel are the correlatives of beneficial actions, it must quickly disappear" (p. 280). Thus "conduct conducive to life" can only be the conduct "that is conducive to a surplus of pleasures over pains" (Spencer, 1879, p. 45).

Alexander Bain (1818–1903) endorsed Spencer's views on the function of pleasure and pain in evolution: "states of pleasure are connected with an increase, states of pain with an abatement, of some, or all, of the vital functions" (Bain, 1879, p. 283). Interestingly, throughout his work, Bain used "the pleasure of healthy exercise" and "the pain of fatigue" to illustrate his points. Thus immediately after the aforementioned excerpt, he wrote: "it is known that exercise is pleasurable only when we are expending surplus energy, and thereby making the blood to course through the system more rapidly. . . . Let the stage of fatigue, however, be reached, and let the spur to exertion be still continued, we then witness the concurring circumstances of the sense of pain, and the lowering of vital energy" (p. 283). In turn, the "increase in vital power," according to Bain, must be one of the reasons for the "love of exercise for its own sake, or apart from the ends of productive industry, and the preservation of health" (p. 81). Bain also echoed the basic premise of psychological hedonism, linking pleasure to the pursuit and displeasure to the avoidance of action: "when movement concurs with pain, the pain arrests the

movement through its general depressing agency; as, on the other hand, a movement bringing pleasure is sustained and promoted through the connection between pleasure and exalted energy" (p. 302). Bain incorporated these ideas into a theory of voluntary action. He proposed that behavior results from two innate sources, namely spontaneous acts and pleasure. Specifically, beings have an initial propensity for spontaneous behavior, and of the resulting random or accidental actions, some yield pleasure. Once a pleasant experience has occurred, the pleasure transforms that formerly spontaneous behavior to voluntary behavior.

William James's (1842–1910) appraisal of hedonistic ideas is measured and nuanced. In agreement with Spencer, James believed that pleasure signals benefit and pain signals harm, thus facilitating adaptation within an evolutionary framework: "It is a well-known fact that pleasures are generally associated with beneficial, pains with detrimental, experiences. All the fundamental vital processes illustrate this law. Starvation, suffocation, privation of food, drink and sleep, work when exhausted, burns, wounds, inflammation, the effects of poison, are as disagreeable as filling the hungry stomach, enjoying rest and sleep after fatigue, exercise after rest, and a sound skin and unbroken bones at all times, are pleasant" (James, 1890a, p. 143). Moreover, James accepted that pleasure and displeasure can have powerful motivational effects: "As present pleasures are tremendous reinforcers, and present pains tremendous inhibitors of whatever action leads to them, so the thoughts of pleasures and pains take rank amongst the thoughts which have most impulsive and inhibitive power. . . . If a movement feels agreeable, we repeat and repeat it as long as the pleasure lasts. If it hurts us, our muscular contractions at the instant stop" (James, 1890b, p. 550). However, James distanced himself from Bain's "premature philosophy," according to which pleasure and pain "are our only spurs to action." In James's view, although the thought of pleasure or pain can provide the stimulus for many human actions and ongoing pleasure and pain can modulate behavior, "they are far from being our only stimuli. . . . If the thought of pleasure can impel to action, surely other thoughts may. Experience only can decide which thoughts do" (James, 1890b, pp. 550–552).

In the early 1900s, probably influenced by the writings of Bentham and other proponents of utilitarianism, **Sigmund Freud (1856–1939)** postulated the existence of psychic processes aimed at

reducing or eliminating sources of tension that result in displeasure and selecting memories of pleasurable experiences. In 1911, these ideas found direct expression in what became known as the "pleasure principle," promoted by Freud as one of the fundamental mechanisms of human behavior: "The sovereign tendency obeyed by the [unconscious mental processes] is easy of recognition; it is called the pleasure-pain principle (*lust-unlust* in German, or pleasure-displeasure, but translated as pleasure-pain, to highlight Freud's influence from Bentham), or more shortly the pleasure principle. These processes strive toward gaining pleasure; from any operation which might arouse unpleasantness ('pain'), mental activity draws back (repression)" (Freud, 1911/1946, p. 14). The counterpart of the pleasure principle in psychoanalytic theory is the reality principle, according to which maturing human beings learn to control their ids, defer gratification, and endure pain. However, the salience of the pleasure principle is such that it never really succumbs to the reality principle; essentially, the role of the reality principle is to ensure the achievement of pleasure (even if delayed or somewhat reduced) by taking account of the constraints imposed by reality.

The advent of behaviorism created an adverse intellectual environment for hedonistic ideas and essentially set into motion the gradual disappearance of emotions from mainstream psychological research and theorizing. Behaviorists rejected the notion that "inner states," such as pleasant and unpleasant emotions, can be meaningful objects of study for a science of human behavior. According to **B. F. (Burrhus Frederic) Skinner (1904–1990)**, for example, the proper subject matter of the study of emotion consists of (a) the emotional behavior and (b) the conditions that precipitated the behavior. It is indeed a testament to the robustness of hedonistic principles that they survived (of course, described in different terms) even in this environment. Specifically, among several laws theorized to govern the process of learning, **Edward Lee Thorndike (1874–1949)** proposed the so-called law of effect. Consistent with hedonistic ideas, this law suggests that when a behavior is paired with pleasure it becomes more likely to be repeated, whereas if it is paired with displeasure it becomes more likely to be avoided: "of several responses made to the same situation, those which are accompanied or closely followed by satisfaction to the animal will, other things being equal, be more firmly connected with the situation, so that, when it recurs, they will be more likely to recur; those which are accompanied or closely followed by

discomfort to the animal will, other things being equal, have their connections with that situation weakened, so that, when it recurs, they will be less likely to occur. The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond" (Thorndike, 1911, p. 244). The law of effect was supported by some behaviorists, including **Clark L. Hull (1884–1952)** and Skinner, who incorporated reinforcement in operant conditioning, but not others, including **Edward C. Tolman (1886–1959)**, who showed that learning can also occur without reinforcement.

During the 20th century, references to hedonistic ideas can be found in the works of a relatively few motivation researchers, including **Leonard T. Troland (1889–1932)**, **Paul T. Young (1892–1978)**, and **David C. McClelland (1917–1998)**. For example, Troland identified the senses of "beneception" and "nociception" as powerful motivators. Young wrote that one cannot fully understand learning and motivation without taking affective processes into account. McClelland theorized that positive and negative affect are primary states, which become associated with internal or environmental cues and later activate affective states similar to the primary affect but anticipatory in nature.

Hedonistic ideas received more attention and recognition in the writings of emotion theorists in the later part of the 20th century. **Silvan S. Tomkins (1911–1991)**, mentor to scholars who revived the study of emotion such as Paul Ekman and Carroll Izard, reintroduced the idea of affect as the primary motivational system. Acknowledgments of the role of affect in behavior can also be found in the work of cognitivists. However, the importance of affect is portrayed as minor compared with the commanding role of cognition. As one example, in **Albert Bandura's (1925–)** theory of self-efficacy, emotional arousal is postulated to influence behavior, albeit not directly but rather through the cognitive interpretation of its significance for one's efficacy. The recent renewal of scientific interest in the role of affect in human behavior should be attributed primarily to the work of researchers who are active outside the narrow confines of psychology proper. Such high-profile proponents of hedonistic ideas include **Michel Cabanac (1934–)** in physiology, **Daniel Kahneman (1934–)** in behavioral economics, and **Antonio Damasio (1944–)** in neurology.

Having concluded this historical overview, it is instructive to consider the criticisms that have been leveled against hedonism over the years. For

example, James (1890b) referred to some of Bain's positions as the "silliness of the old-fashioned pleasure-philosophy" (p. 551). William McDougall (1916) called them "absurdities" (p. 43). However, it is important to decipher which specific hedonistic ideas the critics opposed. A major source of contention was the entanglement of hedonism with moral philosophy, principally in the writings of the utilitarians, who equated all good with pleasure and argued that the pursuit of pleasure should be life's ultimate objective. McDougall (1916), for example, charged that such a view "in reducing all morality to hedonism ... grossly libels human nature" (p. 190). He went on to say that "surely it is obvious that men do often carry through a line of action which is to them painful in every phase, in the contemplation of it, in deciding upon it, and in its execution and achievement!" (p. 374). Another problem was the claim in the writings of some ardent proponents of hedonism, such as Bain, that the pursuit of (proximal or distal) pleasure and the avoidance of (proximal or distal) displeasure was the motive behind *all* human action. Considering how absolute this claim was, it is not surprising that it was targeted by skeptics. James (1890b), for example, wrote: "Who smiles for the pleasure of the smiling, or frowns for the pleasure of the frown? Who blushes to escape the discomfort of not blushing? Or who in anger, grief, or fear is actuated to the movements which he makes by the pleasures which they yield?" (p. 550).

Nevertheless, the fundamental tenets of motivational hedonism have remained unscathed. There have not been serious attacks against the core idea that pleasure is generally associated with beneficial courses of action, whereas displeasure is typically associated with harm. Furthermore, there is little resistance to the notion that human beings, in most cases, tend to repeat behaviors associated with pleasure and tend to avoid behaviors linked to displeasure. James Mark Baldwin (1891), for example, argued that "this fact, that our most abstract acts of volition are strongly influenced by subconscious affective conditions, is only beginning to have the recognition it deserves" (p. 320) and acknowledged that "it is probable that we make no deliberate decisions whatever in which our own happiness has not been a factor of influence" (p. 327). McDougall (1916), one of the most vocal opponents of psychological hedonism, accepted that "pleasure [tends] to sustain and prolong any mode of action, pain to cut it short" (p. 43). As for the tendency to "seek pleasure and ... try to avoid pain," McDougall characterized this as an "undeniable fact" (p. 364). Thus,

it is crucial for contemporary readers to understand that although the idea that pleasure and displeasure represent powerful motivational forces in human behavior may have lost some of its prominence over the past few decades, it remains essentially unchallenged. Except for some of its most extreme or controversial variants, there have not been devastating conceptual attacks against it. There have not been empirical findings showing that pleasure and displeasure do not account for meaningful portions of behavioral variance; quite the contrary. The idea has remained standing in the very competitive arena of psychological ideas for over 25 centuries. To understand why hedonism is not included in the tables of contents of contemporary psychological textbooks, one must first understand Kuhn.

Hedonistic Ideas and Exercise Behavior

The idea that exercise must be pleasant or else it is unlikely to be continued was promoted by Robert Roberts, a director of a Young Men's Christian Association (YMCA) gymnasium in Boston in the late 1800s and one of the pioneers of the physical training movement. According to what became known as Roberts's "platform," all exercises should be "safe, short, easy, beneficial, and pleasing" to keep the exercisers coming back (Leonard, 1915, p. 124). The idea reappeared in the writings of some of the pioneers of contemporary exercise science. According to William Morgan (1977),

It seems reasonable to assume that [individuals] must experience some form of positive reinforcement from the outset. In other words, if the experience is not pleasurable, one should expect the volunteer to drop out. The exercise must not be perceived as primarily noxious, and it also must be sufficiently pleasurable to compete successfully with other pleasurable options available to the exerciser. (p. 244)

Similarly, Pollock, Wilmore, and Fox (1978) wrote that exercise programs should "meet the criteria for improving and maintaining a sufficient level of physical fitness" but must also be "enjoyable," "rewarding to the participant," and "preferably . . . fun" (pp. 121–122). The reason is that "people participate in programs they enjoy" (Pollock, 1978, p. 59). Dishman, Sallis, and Orenstein (1985) noted that "feelings of enjoyment and well-being seem to be stronger motives for continued participation" than "knowledge of and belief in the health benefits of physical activity" (p. 162), as well as "more

important to maintaining activity than concerns about health" (p. 166). Later, Dishman (1990) suggested that affective variables are probably more important determinants of physical activity participation in the long run than cognitive variables: "Knowledge and belief in the health benefits of physical activity may motivate initial involvement and return to activity following relapse, but feelings of enjoyment and well-being seem to be stronger motives for continued participation" (p. 83). Along similar lines, Biddle (2000) argued that "how people feel during and after activity may be critical in determining whether they continue. Hence, emotion and mood may be motivational" (p. 269).

Despite such calls, the idea that the pleasure or displeasure that exercisers derive from their participation might influence their subsequent behavior (to continue exercising or drop out) has yet to be fully accepted by a broad circle of researchers within exercise psychology. According to Dishman (2003),

Though physical activity arguably offers more opportunities for pleasure than do most other health-related behaviors (compared to brushing, flossing, buckling up, and seeing the doctor, for example), we, ironically, have learned very little about intrinsic reinforcements (e.g., enjoyment of physical activity) for continued participation. (p. 46)

It is again interesting to note that authors in interdisciplinary fields outside exercise psychology, especially those with close ties between research and practice, have been more active in promoting the idea of an affect–behavior connection than authors within exercise psychology. For example, in cardiac rehabilitation, exercise leaders are urged to pay close attention to such factors as "anxieties from the fear of overexertion causing an event, and attaining enjoyment from the exercise." Otherwise, "the required longer-term changes of behavior for maintaining physical activity at appropriate levels are less likely" (Buckley, 2006, p. 48). Similarly, in physical therapy, researchers and practitioners have noted that patients with chronic pain and fatigue tend to develop a fear of physical movement out of concerns that their symptoms might be exacerbated or their injury might reoccur. This fear, termed "kinesiophobia," has been found to be negatively associated with physical activity and positively associated with self-rated disability (Elfvig, Andersson, & Grooten, 2007; Nijs, De Meirleir, & Duquet, 2004).

Missed Clues

The inattention to the motivational implications of affective constructs within exercise psychology contrasts rather sharply with the results of numerous interview-based studies inquiring about the reasons why people adhere to or disengage from exercise. In these studies, themes such as "fun," "pleasure," "energy," and "enjoyment" typically emerge as some of the top reasons people present for adhering to exercise, and conversely themes such as "fear," "pain," "boredom," or "discomfort" emerge as some of the key reasons leading to nonadherence and dropout. Studies yielding such themes have been conducted with children (Kientzler, 1999), adolescents (Daley, Copland, Wright, & Wales, 2008; Flintoff & Scraton, 2001; Loman, 2008), middle-aged adults (Currie, Amos, & Hunt, 1991; Gauvin, 1990; Huberty et al., 2008; Laverie, 1998; Nies & Motyka, 2006; Vanden Auweele, Rzewnicki, & van Mele, 1997), older adults (Fox, Stathi, McKenna, & Davis, 2007; Henderson & Ainsworth, 2003; Lee, Avis, & Arthur, 2007; Lees, Clark, Nigg, & Newman, 2005; O'Brien Cousins, 2000; Wilcox, Oberrecht, Bopp, Kammermann, & McElmurray, 2005), and adults suffering from heart failure (Tierney et al., 2011), arthritis (Hendry, Williams, Markland, Wilkinson, & Maddison, 2006), diabetes (Ferrand, Perrin, & Nasarre, 2008), low back pain (Slade, Molloy, & Keating, 2009), and other conditions (Graham, Kremer, & Wheeler, 2008). According to a review of this literature, affective constructs such as fun and enjoyment "were reported more often as predictors of participation and non-participation than perceived health benefits" (Allender, Cowburn, & Foster, 2006, p. 832).

Moreover, it is fairly well established that affective traits are significantly related to physical activity participation. Depression, trait anxiety, neuroticism, perceived stress, and negative affectivity have been found to predict less activity (e.g., Delahanty, Conroy, & Nathan, 2006; Dergance, Mouton, Lichtenstein, & Hazuda, 2005; Hamid, 1990; Herman et al., 2002; Roshanaei-Moghaddam, Katon, & Russo, 2009; Stetson, Rahn, Dubbert, Wilner, & Mercury, 1997; Yeung & Hemsley, 1997a, 1997b), whereas positive affect has been found to predict more activity (Carels, Coit, Young, & Berger, 2007; Kelsey et al., 2006).

Furthermore, several studies have shown that the pairing of exercise with pleasant or unpleasant affect in one's memory is a significant correlate and predictor of exercise behavior. For example, affective associations (whether respondents associated

physical activity with descriptors like "happy," "joy," or "delighted" as opposed to "sad," "sorrow," or "annoyed") not only directly accounted for significant portions of the variance in self-reported physical activity but also mediated the links between cognitive variables (e.g., anticipated benefits and barriers, cognitive attitudes, perceived behavioral control) and physical activity (Kiviniemi, Voss-Humke, & Seifert, 2007). In a study using a priming paradigm to assess automatic evaluations of exercise stimuli (e.g., "athletic" versus "exhausted"), physically active participants responded significantly faster to positive words after exercise primes, whereas inactive participants responded more rapidly to negative words (Bluemke, Brand, Schweizer, & Kahtert, 2010). In another study, the affective component of attitude (rating physical activity and exercise as "enjoyable" versus "not enjoyable") showed much stronger relations (in fact, in most cases, at least twice as strong) with the self-reported frequency of physical activity and exercise a month later than the cognitive component of attitude (rating physical activity and exercise as "beneficial" versus "harmful") (Lawton, Conner, & McEachan, 2009). Another recent study showed that the anticipation of positive (but not negative) affective responses stemming from "successfully engaging in regular physical activity" for 90 days (i.e., "delighted," "happy," "fulfilled," "calm," "relaxed," or "at ease") was associated with a greater likelihood of initiating physical activity for those participants who were inactive and a greater likelihood of continuing participation for those who were already active (Fridlund Dunton & Vaughan, 2008). In a sample of 389 women between the ages of 18 and 68 years, self-reported physical activity was significantly related to the self-conscious emotions of body-related pride ($r = .27$) and shame ($r = -.23$), as well as shame-free guilt ($r = .32$) and guilt-free shame ($r = -.39$) (Sabiston et al., 2010). In children between the ages of 8 and 12 years, the combination of ratings of "liking" (on a visual analog scale ranging from "don't like at all" to "like very much") and evidence of the relative rewarding value of physical activity (i.e., willingness to press a button to obtain access to one's favorite physical activity as opposed to watching a cartoon) was a significant predictor of minutes spent in moderate-to-vigorous physical activity (assessed by accelerometry) during a week (Roemmich et al., 2008). In a sample of psychiatric patients, those who endorsed the statement "exercise gives me pleasure" were 21 times more likely to exercise than those who answered negatively (Sorensen, 2006).

Overall, the inattention to affect as a motivational force in exercise behavior cannot be attributed to a lack of relevant clues in the literature. If one cares to look, the clues are present. If they have not been more widely noticed, this is probably due to the fact that exercise psychology, under the cognitivist paradigm, seems to have become "increasingly rigid" (Kuhn, 1962/1996, p. 64). In other words, the clues have been missed because findings attributing a powerful role to affective influences on behavior simply fall outside the scope of the dominant paradigm of the past decades.

Stumbling Blocks

When a paradigm ascends to the status of "normal science," it starts to dictate an "orthodox" way of thinking that transcends a broad range of domains of academic life, from what is publishable or fundable to what is worth teaching in undergraduate and postgraduate curricula. As more and more generations of students are indoctrinated within an academic culture that endorses the assumption of rationality and models of human behavior based entirely on information processing, alternative or complementary perspectives become marginalized, rejected, or eventually eradicated from the "mainstream" literature. A reflection of this process, as noted earlier, is that most contemporary textbooks in exercise psychology contain nothing on the role of affect in exercise behavior.

Consequently, graduates of exercise science programs have no knowledge about the importance of affect in shaping decisions about exercise and, more importantly, have not been taught how to optimize the affective experiences derived from exercise participation, with the goal of improving long-term adherence to improve the chances of long-term adherence. Instead, they are instructed only to provide information about the benefits associated with exercise participation (e.g., weight loss outcomes) and to boost self-perceptions that are considered relevant (e.g., self-efficacy), along with a few behavioral techniques (e.g., placement of behavioral prompts at points of decision). References to the role of affect in exercise behavior are absent from almost all major recent reviews on mediators of exercise initiation and maintenance, such as the reports of the Task Force on Community Preventive Services (Kahn et al., 2002) and the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Marcus et al., 2006), as well as from recently proposed theoretical models that focus specifically on exercise behavior

(e.g., Nigg, Borrelli, Maddock, & Dishman, 2008; Schwarzer, 2008).

The marginalization of a potential mechanism in the literature, along with the promotion of theoretical models from which this mechanism is absent or with which this mechanism is seen as incompatible, gradually bring about the elimination of the mechanism from current thinking. Associated concepts and terms are removed from the professional vernacular and forgotten. As the mechanism is given insufficient attention or is altogether ignored, new generations of researchers assume that it either does not exist or does not matter. A weak evidence base weakens the interest of scientists, and in turn weakened interest results in even fewer studies designed to investigate the mechanism, thus perpetuating a vicious cycle. Ultimately, a potentially useful idea may be condemned to obscurity or oblivion.

While reviews have consistently identified enjoyment as a significant correlate of physical activity behavior (Bauman, Sallis, Dziewaltowski, & Owen, 2002; Dishman, 1988, 1990; Dishman et al., 1985; Sallis & Hovell, 1990; Sallis & Owen 1999; Trost, Owen, Bauman, Sallis, & Brown, 2002), at least until recently, if one were to scrutinize the evidence base, one would uncover only weak sources of evidence, such as anecdotal accounts, retrospective surveys, and expert opinions (e.g., Shephard, 1988; Stones, Kozma, & Stones, 1987; Wankel, 1985, 1993). Thus according to a review of factors that mediate physical activity behavior change, "past research provides no support that enjoyment is a mediator of physical activity" (Lewis, Marcus, Pate, & Dunn, 2002, p. 32). The basis for this conclusion was that intervention studies in which enjoyment was examined as a possible mediator of physical activity behavior change showed that enjoyment did not improve as a result of the intervention, regardless of whether physical activity increased or not (Calfas et al., 2000; Neumark-Sztainer, Story, Hannan, Tharp, & Rex, 2003; Nichols et al., 2000; Schneider Jamner, Spruit-Metz, Bassin, & Cooper, 2004). In fact, in some studies the intervention *reduced* enjoyment (Castro, Sallis, Hickman, Lee, & Chen, 1999; Stevens, Lammink, van Heuvelen, de Jong, & Rispens, 2003). Other interventions were observed to reduce perceived autonomy, a theorized powerful mediator of intrinsic motivation (Wilson, Rodgers, Blanchard, & Gessell, 2003). Thus perhaps more than anything else, what the current evidence indicates is that exercise science knows little or nothing about how to enhance the affective experience of physical activity or exercise. Consequently,

to date, no intervention studies have been designed to test whether enhancing the affective responses to physical activity or exercise can improve adherence and retention.

Although the literature examining the effects of physical activity or exercise on affective variables (e.g., mood and anxiety) is extensive and continues to grow, the role of these effects in subsequent physical activity or exercise behavior remains largely unexplored. This could be due to a variety of reasons. First, the main objective of most of this research has been to examine the potential of exercise as a safe, inexpensive, and effective method of improving mental health. Until the last decade or so, the relevance of the "feel better" effects of exercise for enhancing intrinsic motivation and adherence had not been given more than cursory consideration.

A second possible reason is that within exercise psychology there is a strong belief that the "feel better" effect is nearly universal. If that were true, there would be no reason to even contemplate a link between exercise-associated affect and subsequent exercise behavior, simply because there would not be enough variability in the postulated predictor to account for the variability in the criterion. Commenting on this issue, Morgan and O'Connor (1988) wrote:

To argue that people who feel good following exercise would be more likely to adhere than those who do not may be intuitively defensible, but such a view is simplistic because it is quite probable that many or most individuals who discontinue may do so even though they too enjoy an improved mood state following exercise. This hypothesis could be tested empirically but it is probably not necessary because roughly 80% to 90% of individuals in exercise programs report within 8–10 weeks that exercise makes them feel better, but 50% drop out within a few months.

(p. 116)

The "80% to 90%" estimate was based on anecdotal accounts collected after a six-week exercise intervention from a sample of healthy male professors (Morgan, Roberts, Brand, & Feinerman, 1970). This intervention failed to lower self-reported depression, but approximately 85% of the participants "spontaneously volunteered to participate in subsequent exercise studies" because they perceived that they "felt better" (p. 216). However, the validity of this figure can be questioned given the susceptibility of retrospective accounts to bias (Henry, Moffitt, Caspi, Langley, & Silva, 1994).

Rethinking the Exercise–Affect Link

Researchers in recent years have started to place the exercise–affect connection under a new, more critical light. Reexamining this issue has necessitated an overhaul of the conceptual and methodological approach on which previous studies were based. The fundamental assumption behind the new approach was that the exercise–affect relationship is more intricate and multifaceted than just the "feel better" effect. This includes the possibility that some individuals may not feel better when they exercise and that some may even feel worse. As de Geus and de Moor (2008) put it, "we need to reach out to these people through other means than just repeating over and over that 'exercise will make you feel better'" (p. 58).

The first step was to rebuild the methodological platform to ensure that any nonpositive affective changes would not escape detection (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007; Ekkekakis, Parfitt, & Petruzzello, 2011; Ekkekakis & Petruzzello, 1999). This required (a) implementing a measurement approach that encompasses negative in addition to positive affective states, (b) tracking affective changes throughout the entire exercise episode, including the duration of the exercise bout itself, as well as the recovery period, (c) increasing statistical power by reducing error variance due to incomplete standardization of exercise intensity across participants, and (d) examining changes at the level of individuals and subgroups rather than exclusively at the level of group means.

The second step was to develop a new, broad theoretical framework that goes beyond the "feel better" effect and acknowledges the possibility of negative effects and individual variability, makes testable predictions about dose–response patterns, and postulates a specific mechanistic basis. This new framework has been named the dual-mode theory (Ekkekakis, 2003, 2005, 2009a; Ekkekakis & Acevedo, 2006; Ekkekakis, Hall, & Petruzzello, 2005b). From the perspective of this theory, affective responses to exercise are considered evolutionary adaptations, shaped through natural selection to promote Darwinian fitness within the specific context of exercise. The theory postulates that affective responses to exercise are determined by the continuous interplay between two factors, namely "top-down" cognitive parameters (e.g., appraisals of physical self-efficacy and self-presentational concerns) and "bottom-up" interoceptive cues (e.g., signals from chemoreceptors, baroreceptors,

thermoreceptors, mechanoreceptors, and various visceroreceptors in the heart, lungs, and internal organs). The relative importance of these two factors is theorized to change systematically as a function of exercise intensity. Specifically, cognitive factors are expected to be the dominant determinants of affect at intensities below and (mainly) near the ventilatory or lactate threshold (VT/LT), where the intensity begins to pose a challenge. On the other hand, interoceptive cues will gain greater salience at intensities that significantly exceed the VT/LT and a physiological steady state becomes difficult or impossible to maintain.

Within the framework of the dual-mode theory, affective responses to different levels of exercise intensity must be meaningfully linked to the adaptational outcomes associated with these intensities. Specifically, exercise performed at a level of intensity below the VT/LT can be sustained for a long time without causing major homeostatic perturbations and without threatening general health and well-being (assuming a healthy organism). Moreover, given the ability to carry out such activity for prolonged periods, it is reasonable to conclude that this is probably the level of physical exertion that was most common in ancestral environments characterized by hunting and gathering activities occupying large parts of daily life. Since these subsistence activities directly affected survival and the ability to find mates and raise viable children (i.e., the two components of Darwinian fitness), it is reasonable to suggest that a mechanism might have evolved to promote or reward such activities. The most likely candidate for providing such a reward is pleasure (Cabanac, 1992, 2002, 2006, 2010; Panksepp, 1998). This is not an implausible argument, since it is readily accepted in regard to the pleasure that accompanies other human activities of significant adaptational value, such as eating appetizing food when hungry, drinking fresh water when thirsty, or engaging in sexual relationships (e.g., Berridge & Kringelbach, 2008; Denton, McKinley, Farrell, & Eagan, 2009). Thus the dual-mode theory predicts that exercise intensities below the VT/LT should be associated with increases in pleasure among the majority of participants.

Consistent with this prediction, exercise bouts performed below the VT/LT have been shown to improve affect at the level of entire groups (e.g., Bixby, Spalding, & Hatfield, 2001) or at least within subgroups (e.g., Ekkekakis, Hall, & Petruzzello, 2008; Parfitt, Rose, & Burgess, 2006; Rose & Parfitt, 2007). Especially when walking at a self-selected

pace, most individuals tend to report increases in pleasure and energy (Ekkekakis, 2009c; Ekkekakis, Backhouse, Gray, & Lind, 2008; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000). A meta-analysis (Reed & Ones, 2006) showed that the average effect size for the improvement in states that combine pleasure with high perceived activation (e.g., energy or vigor) was nearly twice as high ($d = 0.57$) in studies that employed low intensity (15–39% VO_2 reserve) than studies that employed moderate ($d = 0.35$, 40–59% VO_2 reserve) or high intensity ($d = 0.31$, 60–85% VO_2 reserve).

An exception to this general trend is seen when the individuals involved in exercise are chronically inactive, obese, or both (e.g., Ekkekakis, Lind, & Vazou, 2010; Sheppard & Parfitt, 2008; Welch, Hulley, Ferguson, & Beauchamp, 2007). These physical and lifestyle characteristics render such individuals evolutionary rarities, but unfortunately they now represent the majority of the population in industrialized countries. Among such samples, a decline in pleasure is found even when the intensity is below the VT/LT. Both physical and cognitive mechanisms may account for this finding. Physically, the performance of a body long subjected to sedentary living and further burdened by excess adiposity may be limited by factors besides the cardiorespiratory system. These may include joint stiffness, muscle atrophy, knee and backaches, or ineffective thermoregulation. Likewise, these individuals may cognitively appraise the exercise stimulus in conjunction with the exercise context as posing an evaluative threat. Individuals who are out of shape, overweight, or both are usually aware of their physical condition and appearance, especially in comparison with idealized normative standards. Thus they may feel apprehensive when placed in a situation in which their poor state is likely to be noticed and criticized by others (e.g., in a crowded gymnasium or during an exercise test in a laboratory). These physical and cognitive mechanisms may influence affective responses throughout the entire range of exercise intensity, including below the VT/LT.

When the intensity of physical activity reaches the VT/LT, it starts to pose a substantial physiological challenge to most individuals, regardless of their physical condition. Displeasure is the vehicle by which significant physiological perturbations enter conscious awareness (Cabanac, 2006). Data about the physiological state of the organism are no longer handled only by automatic regulatory loops that operate largely outside conscious awareness but also begin to generate increasingly salient negative

affective experiences. These data, which include acidosis (a drop of pH), hyperventilation, secretion of stress hormones (i.e., epinephrine and cortisol), and numerous other changes, once they exceed critical thresholds, act as "danger signals," and physiological challenges thus become affective challenges. Information about the physiological condition of the body is continuously collected by primary afferent neurons throughout the body and forwarded to the brain via spinal pathways and the vagus nerve (Craig, 2002, 2006).

What probably differentiates intensities near the VT/LT from intensities that exceed the VT/LT is that the intensification of these signals causes additional neural gates to open, allowing this information to reach levels beyond the homeostatic areas of the brain stem, medulla, and hypothalamus. Areas known to be involved in the processing of aversive bodily cues and the generation of affective responses include the amygdala, the insula, and the periaqueductal gray (Cameron, 2009; Carretié, Albert, López-Martín, & Tapia, 2009; Ekkekakis & Acevedo, 2006). As with all varieties of negative affect, the generation of negative affective reactions to exercise calls forth cognitive mechanisms, most likely situated in parts of the anterior cingulate and prefrontal cortices, aimed at controlling this negative response (Feldman Barrett, Mesquita, Ochsner, & Gross, 2007; Ochsner & Gross, 2005, 2008).

The effectiveness of these cortical regulatory mechanisms in controlling negative affective responses depends on an individual's developmental history (i.e., the learning of such coping skills as reappraisal, suppression, or attentional distraction) and on genetically determined individual differences in neural parameters that provide the biological substrate of cognitive control (such as differences in the anatomical size of cortical areas, receptor density, or level of oxygenation; see Hariri & Forbes, 2007). As a result of these differences, some individuals will be more effective in regulating negative affect than others. In turn, these differences may influence the level of exercise intensity than an individual prefers or can tolerate (de Geus & de Moor, 2008; Ekkekakis, 2008; Ekkekakis, Hall, & Petruzzello, 2005a). Thus the dual-mode theory predicts that at intensities proximal to the VT/LT, affective responses will vary, with some individuals reporting increases and others decreases in pleasure.

From an evolutionary standpoint, variable affective responses signal the absence of a direct or unambiguous role in adaptation, including the possibility that the response entails a trade-off between benefits

and risks. In the case of exercise, the ability to control negative affect in the presence of a homeostatic perturbation probably entails such a trade-off. On the one hand, being able to do more work (e.g., cover more ground in pursuit of prey) or being able to continue working under environmentally adverse conditions yields an evolutionary advantage; one is more likely to be a reliable provider of nourishment for oneself, one's mate, and one's progeny. On the other hand, consistently "pushing the envelope" by bringing the organism close to its biological limits is tantamount to challenging one's fate. Given the low tolerance of many physiological systems to deviations from normalcy (e.g., hyper- or hypothermia, metabolic acidosis, or myocardial or cerebrovascular ischemia), operating near the limit raises the risk of sudden death or an incapacitating injury. Therefore, on balance, the ability to regulate the negative affective response to exercise at intensities proximal to the VT/LT is probably neither consistently advantageous nor consistently harmful.

Consistent with theoretical predictions, affective changes at intensities proximal to the VT/LT have been shown to be highly variable (Ekkekakis et al., 2005b; Ekkekakis, Hall, & Petruzzello, 2008; Parfitt et al., 2006; Rose & Parfitt, 2007; Welch et al., 2007). Self-reported individual differences in preference for and tolerance of exercise intensity have been found to account for approximately 20–25% of the variance in ratings of pleasure vs. displeasure during exercise performed at the VT (Ekkekakis et al., 2005a). Similarly, individual differences in situational appraisals of exercise self-efficacy have been found to account for approximately 20–30% of the variance in affective valence at this intensity (Ekkekakis, 2003).

When exercise intensity substantially exceeds the VT/LT and a physiological steady state can no longer be maintained, the adaptational implications are unambiguous: This level of exercise intensity is not only unsustainable but also risky. Exercise must soon stop or the intensity must be reduced to avoid collapse, a system-wide bioenergetic crisis, and possibly irreparable harm. For this to happen, the affective directive to consciousness must be intense, immediate, unequivocal, and irrepressible. Much like intense pain, a strong negative affective response to strenuous exercise has evolved to act as a lifesaver, a fail-safe mechanism that protects the health and long-term well-being of the individual by causing an immediate behavioral withdrawal from the precipitating stimulus. Thus the dual-mode theory predicts a universal decline in pleasure when exercise

intensity exceeds the VT/LT and precludes the maintenance of a physiological steady state.

Consistent with this prediction, there is compelling evidence of declines in pleasure above the VT/LT (Bixby et al., 2001; Bixby & Lochbaum, 2006; Ekkekakis, Hall, & Petruzzello, 2008; Kilpatrick Kraemer, Bartholomew, Acevedo, & Jarreau, 2007; Rose & Parfitt, 2007; Sheppard & Parfitt, 2008). Such declines are reported by all or nearly all individuals. Moreover, at such intensities reports of affective valence develop strong negative correlations with markers of physiological strain such as oxygen uptake, level of lactate accumulation, and the respiratory exchange ratio (e.g., Acevedo, Kraemer, Haltom, & Tryniecki, 2003; Acevedo, Rinehardt, & Kraemer, 1994; Ekkekakis, 2003; Hardy & Rejeski, 1989). These findings suggest a transition to a mode of affect generation in which affective responses become a direct reflection of the perturbed internal environment. As the dual-mode theory predicts, the interoceptive cues evidently become the dominant determinants of the affective state.

Initially it was believed that this might happen as a result of the intensification of these interoceptive cues at supra-VT/LT intensities (Ekkekakis & Acevedo, 2006). For example, as ventilation becomes deeper and more frequent, core temperature rises, and the muscles become more acidic, the corresponding afferent cues might simply overpower the top-down prefrontal control over the affective centers of the brain. More recently, however, an additional possibility emerged. In neuroimaging studies, it was observed that "when humans have strong affective experiences, higher cortical regions tend to shut down" (Panksepp & Panksepp, 2000, p. 115). In both acute (e.g., induction of transient emotions by various experimental manipulations) and chronic paradigms (e.g., depressed patients or individuals suffering from posttraumatic stress), various subdivisions of the prefrontal cortex (often bilaterally) show reduced metabolic activity, usually in conjunction with increased activity in the amygdala (Quirk & Beer, 2006). Although neuroimaging during vigorous exercise with a method that provides good temporal and spatial resolution, such as functional magnetic resonance, remains technically unfeasible, approximately 30 studies using near-infrared spectroscopy of the prefrontal cortex have shown an increase in oxygenation with low-to-moderate levels of exercise intensity but a decrease with high exercise intensity, particularly beyond the respiratory compensation point (see Ekkekakis, 2009b, for a review). These findings suggest that the

intensification of the bodily signals at intensities above the VT/LT might not be the only mechanism that precipitates the "switch" to a mode of affect induction in which interoceptive cues become the dominant determinants. A complementary mechanism might consist of a transient hypometabolism in the prefrontal cortex, the main neural substrate for the regulation of negative affect. The existence of such a mechanism would make adaptational sense, inasmuch as the mediation or control of affect by cognition could introduce distortions in the relationship between the homeostatic perturbation and the negative affective response. The vital importance of this mechanism can be appreciated if one considers what would happen if it did not exist: The "effective" use of a cognitive coping technique, if taken to extremes, would result in death.

If this mechanism is confirmed, it could have important practical implications. It would mean that an exerciser's capacity to cognitively modify his or her affective response during exercise above the VT/LT would be diminished, regardless of the level of experience in using cognitive techniques. For example, an exerciser might be taught to cognitively reframe (reappraise) the unpleasant affective responses as signs of a body that is getting stronger, to counter the negative affect with a bolstered appraisal of efficacy, or to divert his or her attention away from the unpleasant bodily sensations and toward a distracting external stimulus (e.g., a music or television program). These interventions, all cognitive in nature (i.e., manipulating the input and interpretation of information relevant to the affective state), might maintain their effectiveness in influencing the affective response only up to the level of exercise intensity that precipitates a decline in prefrontal oxygenation. The few studies that have examined the role of exercise intensity in the effectiveness of cognitive techniques in influencing subjective responses to exercise support this notion (see Lind, Welch, & Ekkekakis, 2009, for a review).

In closing this section, it is important to underscore that exercise intensity is certainly not the only variable that can influence affective responses. Research has uncovered a multitude of additional variables that play a role, including the sense of efficacy (e.g., Jerome et al., 2002), the satisfaction of basic psychological needs (e.g., Wilson, Mack, Blanchard, & Gray, 2009), self-presentational concerns (e.g., Focht & Hausenblas, 2006; Martin Ginis, Burke, & Gauvin, 2007), and exercise leader behavior (e.g., Loughhead, Patterson, & Carron, 2008).

Some Realistic Examples to Bring Things into Perspective

When discussing vigorous or strenuous exercise, one might tend to visualize Olympic-caliber athletes and herculean-scale athletic endeavors, such as running a marathon. However, it is crucial to remember how relative the concept of intensity is. To bring things into perspective, consider an example of a 45-year-old woman who decides to reinstate physical activity after a couple of decades of mostly sedentary living due to work or family obligations. Let us assume that she presents with a body mass index of 30 kg/m^2 (on the cusp between being categorized as overweight or obese), a maximal oxygen uptake of $18 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$, and a VT at 55% of maximal aerobic capacity (i.e., at approximately $10 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$). These are typical values for middle-aged sedentary women (e.g., see Ekkekakis & Lind, 2006; Ekkekakis et al., 2010). These numbers suggest that the woman in this example would reach her VT at less than three metabolic equivalents (METs) and her maximal capacity at approximately five METs.

A juxtaposition of these values with the Compendium of Physical Activities (Ainsworth et al., 2011) suffices to illustrate the enormous challenge of exercise prescription with this typical individual. Activities corresponding to 2.8 METs (sufficient to reach VT) include standing, light play with children, or a slow walk (2.5 mph), but only on a downhill slope. An intensity of 4.0 METs (close to 80% of maximal capacity and probably close to the respiratory compensation point or the maximal lactate steady state) corresponds to such activities as bicycling slowly (<10 mph), doing water calisthenics, sweeping the garage or the sidewalk, walking or running intermittently at a moderate pace while playing with children, or raking the lawn and sacking leaves. As these examples illustrate, for many (perhaps most) sedentary middle-aged or older individuals, a level of exercise intensity that exceeds the VT/LT corresponds to nothing more than common everyday tasks and is certainly far from anything involving herculean effort.

According to the results of recent studies on the exercise-affect link, the woman in the example would not only feel worse while performing an activity as seemingly innocuous as raking and sacking leaves (Ekkekakis et al., 2010) but might also be unable to cognitively control this negative affective response. While it seems reasonable to publicly proclaim that physical activity should be "enjoyable" to be maintained, exercise scientists are only now

beginning to come to terms with the magnitude of the challenge inherent in making this proclamation a reality for the majority of sedentary adults.

Most exercise guidelines still appear strangely oblivious to this challenge. For example, according to the data from the 2000 Behavioral Risk Factor Surveillance System, no more than 3.0% of obese women and 6.4% of obese men trying to lose weight report engaging in physical activity of at least 60 minutes daily (which is what current guidelines recommend) in addition to restricting their caloric intake (Bish et al., 2005). One might start to wonder about the true public health relevance of a recommendation that almost no one seems willing (or able) to follow.

Perhaps the following data might provide an indication of the magnitude of the challenge faced by exercise practitioners. The American College of Sports Medicine (2010) recommends that the initial intensity of activity for obese adults be no more than 40–60% of maximal oxygen uptake reserve. Over time, obese adults are encouraged to exercise for 60–90 minutes. While designing a study to investigate the affective responses of sedentary obese women, Ekkekakis and colleagues (2010) needed to identify a level of treadmill speed that would be appropriate as a warm-up. According to previous studies by Browning and Kram (2005) and Browning, Baker, Herron, and Kram (2006), obese middle-aged women self-select treadmill speeds of approximately 1.40 m/s. Therefore, Ekkekakis et al. set the warm-up speed below this level, at 1.11 m/s (2.50 mph), with the grade at 0%. The obese women in the sample (with an average age of 44.7 years and average body mass index of 35 kg/m^2) had already reached 61% of their maximal aerobic capacity after walking at this speed for only 2 minutes. These results are not unique. The 55 obese women tested by Mattsson, Larsson, and Rössner (1997), who were more physically active and fit than the women in the study by Ekkekakis et al. (2010), approached the upper limit of the recommended intensity range (56% VO_2max) after walking at a self-selected "comfortable" speed (1.18 m/s, or 2.65 mph) for only 4 minutes. Therefore, at least while performing weight-bearing activities such as walking, obese women seem unable to maintain a physiological steady state within the recommended range of 40–60% of maximal oxygen uptake reserve. Even within 2–4 minutes, the intensity will probably exceed 60% and, in all likelihood, the VT. Thus it is perhaps unsurprising that obese women report no increase in pleasure in response to exercise

(Ekkekakis et al., 2010) or that they are highly unlikely to satisfy the current recommendation of 60 minutes of daily moderate-intensity physical activity (Bish et al., 2005).

Are Affective Responses Related to Subsequent Physical Activity Behavior?

In previous sections, it was shown that (a) exercise, depending on its intensity, can reduce pleasure and (b) different individuals exhibit different affective changes in response to exercise. It is important to reiterate that these are recent findings. Before the last decade or so, neither the variability of affective responses nor the fact that people can feel worse during (intense) exercise had been demonstrated reliably (Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000). Both of these elements are crucial, because if the only effect of exercise were to increase pleasure and if this effect were shared by all, or nearly all, people, then there would be no reason to examine whether affective responses could account for behavioral variance. So these recent findings have laid the foundation for the examination of the role of affective responses in subsequent physical activity and exercise behavior.

The implications of the “feel worse” effect documented by several of the studies reviewed above should be considered in the context of the observation that what seems to determine whether an activity registers in memory as pleasant or unpleasant is not necessarily the absolute level of pleasure but rather “the change (for better or worse) that it represents, and how it compares with alternative outcomes” (Varey & Kahneman, 1992, p. 179), such as those associated with sedentary behaviors. In other words, if an exercise bout makes people feel worse (less pleasure) than they did before the bout (even if they do not rate the affect during exercise as “bad”) or if exercise makes people feel less pleasure than alternative options (e.g., watching television or playing video games), this suffices to reduce the likelihood of exercise being their preferred behavioral option.

With evidence of variability in affective responses to exercise, including a “feel worse” effect, investigating whether affective responses to exercise are related to exercise participation seems fully warranted. As shown in Table 16.1, this question has so far been addressed in 11 known studies. While studies conducted in recent years have tended to be more conceptually and methodologically sophisticated than those conducted in the 1990s, it is clear that this line of research is still developing and is

still exploring the best avenues for accomplishing its goal. For example, in some studies affect was assessed in terms of a few distinct states, whereas in others it was assessed in terms of broad dimensions. In some studies the intensity of exercise was determined by perceptions of exertion, in others as a percentage of maximal capacity, and in others in relation to the VT. In some studies physical activity was defined by the number of gymnasium visits (i.e., session attendance), whereas in others it was defined as total free-living activity. Of the studies in the latter category, in some cases activity was assessed by a standardized questionnaire or interview, in others by nonvalidated rating scales, and in others by accelerometry. So clearly the standards of “best practice” are still evolving.

It is also important to point out that all the studies in this area have been correlational (although, to their credit, most have been prospective rather than cross-sectional). Given how little is known about possible methods of improving affective responses to exercise, especially among high-risk groups such as individuals who are sedentary, obese, or in less than perfect health, it is perhaps not surprising that no studies so far have attempted any experimental manipulations of the affective responses with the purpose of assessing their mediational effects on physical activity participation, exercise adherence, or dropout. Perhaps the most obvious candidate for such a manipulation would be the intensity of exercise, since more information is available about this independent variable than any other (Ekkekakis et al., 2011).

The 11 studies summarized in Table 16.1 provide preliminary support for a link between affective responses and exercise behavior. Most notably, the most recent studies, which incorporated several conceptual and methodological innovations, all found evidence of statistically significant associations between affective responses and measures of exercise behavior (Kwan & Bryan, 2010; Schneider, Dunn, & Cooper, 2009; Williams et al., 2008). The common characteristic of these recent studies is that they all included assessments of affect during the exercise bouts. Although the treatment of these data differed among studies (i.e., as absolute scores, as changes from baseline, or as individual linear slopes over time), as did the measures of affect that were used (i.e., a single-item rating scale of pleasure–displeasure or a multi-item questionnaire), these studies support the idea that affective responses during exercise are more variable and perhaps more closely linked to decisions regarding

Table 16.1 Studies Examining the Relation between Affective Responses to Bouts of Exercise and Exercise Participation, Adherence, or Attendance

Study	Sample	Design	Measure	Findings
Annesi, 2002a	69 (20 men, 49 women), mean age 37.9 years (range 20–61 years)	Prospective, 14-week intervention	EFI	Attendance ranged from 17% to 100%. Changes in EFI scores from before to after sessions during weeks 1, 3, 5, 8, 11, and 14 were averaged for each participant. For a subsample ($n = 24$) with low self-motivation, there were significant correlations between attendance and changes in Positive Engagement (.48), Revitalization (.47), Tranquility (.41), and Physical Exhaustion (-.62). However, for participants with medium self-motivation, the correlations were nonsignificant, and for those with high self-motivation, the correlations were in the opposite direction. Change scores in EFI subscales accounted for less than 1% of the variance in attendance but the interactions with self-motivation were significant ($R^2 = .23$ for Positive Engagement; .22 for Revitalization; .20 for Tranquility; .27 for Physical Exhaustion).
Annesi, 2002b	72 (32 men, 40 women), mean age 37.6 years (range 21–54 years)	Prospective, 15-week intervention	EFI	Attendance ranged from 17% to 100%. Changes in EFI scores from before to after six sessions (one every 3 weeks) were averaged for each participant. Participants were then classified as showing a positive ($n = 36$) or a nonpositive ($n = 36$) pattern of change on the EFI overall (where positive meant increases in Positive Engagement, Revitalization, and Tranquility and a decrease in Physical Exhaustion) or only on the Physical Exhaustion subscale (42 positive and 30 nonpositive). The positive or nonpositive pattern of change in the EFI overall or in the Physical Exhaustion subscale explained less than 1% of the variance in attendance. However, controlling for differences in self-motivation raised these percentages to 10% (significant) and 7% (nonsignificant), respectively.
Annesi, 2005	66 (20 men, 46 women), mean age 38.2 years (range 22–60 years)	Prospective, 14-week intervention	EFI	Both attendance (%) and the numbers of days until cessation of exercise (for 4 consecutive weeks) were monitored. A six-item scale was constructed based on the EFI by summing the Revitalization and reversed Physical Exhaustion item scores. This scale was administered before and after 6 exercise sessions (weeks 2, 4, 6, 8, 10, and 12). Attendance ranged from 24% to 100%. One-third of the participants dropped out, and length of adherence ranged from 21 to 98 days. On average, participants reported positive changes on the six-item scale in 73.2% of their exercise sessions (range from 0% to 100%). The percentage of sessions with positive changes correlated significantly with session attendance (.36) and with length of adherence (.37).

(Continued)

Table 16.1 (Continued)

Study	Sample	Design	Measure	Findings
Annesi, 2006	50 women, mean age 38.8 years (range 22–60 years)	Prospective, 12-week intervention	EFI	Only the Revitalization and Physical Exhaustion subscales of the EFI were included. Changes from before to after 6 exercise sessions (weeks 1, 3, 5, 7, 9, and 11) were averaged for each participant. An aggregate score was also derived by summing the Revitalization and reversed Physical Exhaustion scores. Increases in Revitalization were reported by 38 women (76%), and decreases in Physical Exhaustion were reported by 34 women (68%). Attendance ranged from 29% to 100%. Changes in both Revitalization (.31) and Physical Exhaustion (–.28) were significantly related to attendance. Attendance was also significantly predicted by the combination of changes in Revitalization (but not Physical Exhaustion) with both self-motivation ($R^2 = .12$) and with perceived physical condition ($R^2 = .13$). Using changes in the aggregate Revitalization–Exhaustion score increased the percentages of predicted variance ($R^2 = .19$ and $.17$, respectively).
Berger, Darby, Owen, & Carels, 2010	32 obese, sedentary women (25 completed the program, 7 dropped out)	Prospective, 6-month behavioral weight loss intervention	POMS	Among women who completed the program, the intervention did not alter the changes in the POMS factor scores from before to after a graded exercise test. These mood changes were also unrelated to the duration of the exercise tests or the changes in body mass, body mass index, percentage body fat, or exercise enjoyment. The 7 dropouts showed mood changes in opposite directions from those of the 25 completers (increases in tension, depression, anger, fatigue, and confusion and a decrease in vigor; also, a larger increase in fatigue).
Berger & Owen, 1992	87 college students (59 intervention, 28 control)	Prospective, 14-week intervention	POMS, STAI	Students completed the POMS and STAI before and after workouts (swimming and yoga classes) on weeks 1, 6, and 12. A mean change score was computed by subtracting postexercise from pre-exercise scores on the 6 POMS scales and STAI and adding the difference scores from the three assessments. Students attended 91% of the classes. The scores of the six POMS subscales and STAI were used as predictors and the number of absences from class was used as the criterion in a multiple regression. More positive changes significantly predicted fewer absences ($R = .49$).

Carels, Berger, & Darby, 2006	25 obese, sedentary, postmenopausal women, mean age 53.9 years	6-month behavioral weight loss intervention	POMS	The women completed the POMS before and after a graded submaximal exercise test (up to about 75% of age-predicted heart rate reserve) performed at the beginning and end of a weight loss intervention. Change scores in POMS subscales were computed by subtracting postexercise scores from pre-exercise scores. After controlling for income, education, change in body mass index during the intervention, and physical activity or VO_2 max at baseline, changes in mood were not significantly related to physical activity (assessed by accelerometry, diaries, or questionnaire) or VO_2 max at the end of the intervention. However, women who reported more time in planned exercise (assessed by diary) during the middle and final 8 weeks of the intervention reported more pretest (.54, .57) and posttest vigor (.51, .68) and less posttest confusion (-.58, -.67). Similarly, women who reported more postexercise fatigue (-.60) reported less time in planned exercise during the final 8 weeks. No mood states were significantly correlated with calories expended in leisure-time physical activity (assessed by questionnaire or accelerometry). Contrary to hypotheses, women who reported more posttest depression and anger had higher postintervention VO_2 max after controlling for baseline VO_2 max.
Klonoff, Annechild, & Landrine, 1994	23 women	Prospective, 10-week intervention	9-point scales of happiness, euphoria	Before and after an initial aerobics class, the women were asked, "How happy are you?" and "How euphoric are you?" on 9-point rating scales ranging from "Not at all" to "Extremely." Increases were reported on both scales (from 6.18 to 7.45 and from 4.38 to 6.31). Three classes were offered each weekday for 10 weeks (total of 123 possible sessions). Of these, the women attended on average 10.3 sessions (approximately 1 per week) but with great interindividual differences. Paradoxically, attending more sessions was associated with higher anxiety (.42), more reported physical symptoms (.56), and higher body weight (.52). Changes in happiness, euphoria, and the average of the two scales were unrelated to the number of exercise sessions attended. Similarly, blood levels of beta-endorphin and changes in these levels from before to after the initial exercise session were unrelated to attendance.
Kwan & Bryan, 2010	129 nonsedentary, nonathletic adults (62 men, 67 women), mean age 22.4 years	Baseline assessment and 3-month follow-up	PAAS	A measure of the frequency of physical activity was derived by standardizing and averaging the participants' reports of (a) how often they engaged in aerobic exercise in the past 3 months, (b) the average number of days per week they engaged in aerobic exercise in the past 3 months, and (c) how many days they engaged in aerobic exercise in the past week. The PAAS was administered at minutes 5, 10, 20, and 30 of a 30-min treadmill bout at 65% VO_2 max and minutes 15 and 30 of recovery. On average, the participants reported increases in positive affect and decreases in negative affect, tranquility, and exhaustion during exercise. Post exercise, positive affect and tranquility increased, whereas negative affect and fatigue decreased. The participants reported 3.83 days of aerobic exercise per week at baseline and 3.60 days at 3-month follow-up. Larger increases in positive affect and larger decreases in exhaustion during exercise were associated with more frequent aerobic exercise at follow-up (3% and 6% of the variance, respectively) after controlling for pre-exercise affect and baseline level of vigorous physical activity. Similarly, more tranquility and less fatigue at minute 15 of recovery were related to more frequent aerobic exercise at follow-up (5% and 4% of the variance, respectively).

(Continued)

Table 16.1 (Continued)

Study	Sample	Design	Measure	Findings
Schneider et al., 2009	124 adolescents (67 boys, 57 girls), mean age 14.78 years (range 14–16 years)	Cross-sectional, correlational	FS	The participants completed one 30-min cycle-ergometer ride at 80% of the ventilatory threshold (VT) and another at 50% of the distance between VT and VO_2max . Physical activity was assessed by accelerometry over one week. For the participants who wore the accelerometers for at least 8 hours per day on at least 4 days, the proportion of days on which the participant did at least 60 min of moderate-to-vigorous physical activity (MVPA) was calculated. Boys met this criterion on 32% of the days and girls on 17%. Changes in FS from baseline to the average of minutes 10 and 20 during exercise and to the average of minutes 0 and 10 of postexercise recovery were also calculated. The 22% of participants with improved FS scores during sub-VT exercise averaged 54.25 min of daily MVPA, the 22% with no change averaged 46.94 min, and the 56% with declines averaged 39.83 min. Moreover, participants with improved FS scores met the 60-min/day guideline on 36% of days, compared with 22% of those with declines or no change. After controlling for aerobic fitness and sex, a 1-unit increase in FS during exercise was associated with 4.18 min of additional daily MVPA ($R^2 = .03$), 3.23 min of additional moderate activity ($R^2 = .03$), and a 5% increase in the number of days meeting the 60-min/day guideline ($R^2 = .06$). Changes in FS during supra-VT exercise and changes from before to after exercise were not significantly related to physical activity.
Williams et al., 2008	37 sedentary adults (8 men, 29 women), mean age 43.92 years	Prospective, with 6-month and 12-month follow-ups	FS	The FS was administered every 2 min during a submaximal treadmill protocol (up to 85% of age-predicted maximal heart rate). The first FS scores after the participants reached 64% of age-predicted maximal heart rate were recorded; 27.0% reported an increase, 29.7% a decline, and 43.2% no change. Only 31 participants completed assessments of physical activity (physical activity recall interview) at the 6- and 12-month follow-ups. FS scores during moderate intensity were significantly correlated with physical activity at the 6-month (.50) and 12-month (.47) follow-ups. The relationships remained significant after controlling for baseline levels of physical activity and baseline FS. A 1-unit increase in FS was associated with 38 additional minutes of at least moderate physical activity per week at the 6-month follow-up and 41 additional minutes per week at the 12-month follow-up.

Note. EFI = Exercise-induced Feeling Scale (Gauvin & Rejeski, 1993); FS = Feeling Scale (Hardy & Rejeski, 1989); PAAS = Physical Activity Affect Scale (Lox, Jackson, Tuholski, Wasley, & Treasure, 2000); POMS = Profile of Mood States (McNair, Lorr, & Droppleman, 1970); STAI = State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970).

subsequent exercise behavior than postexercise responses.

For example, Schneider et al. (2009) reported that during a 30-minute bout of exercise at 80% of the VT, 22% of their adolescent participants reported increases in pleasure, 22% reported no change, and 56% reported decreases. These variable changes were significantly related to moderate-to-vigorous free-living physical activity, moderate-intensity physical activity, and the proportion of days that the adolescents satisfied the current recommendation of 60 minutes of physical activity daily (with betas of .18, .17, and .24, respectively). In contrast, changes from before to after the exercise bout were considerably less variable, with 90% reporting increases in pleasure, 4% reporting no change, and 6% reporting decreases. Not surprisingly, these relatively more homogeneous changes were unrelated to physical activity. Similarly, when the intensity was set so high (50% of the distance between VT and VO_2max) that 85% of the participants felt worse during exercise, the affective changes were again unrelated to physical activity.

These data complement the results of a meta-analysis on the relation between enjoyment-related constructs and physical activity. Specifically, Rhodes, Fiala, and Conner (2009) analyzed studies in which the correlate of physical activity was enjoyment, intrinsic motivation, or the affective component of attitude measured separately from the cognitive or instrumental component. Despite the different labels given to these constructs, they are all assessed by questions referring to whether respondents find physical activity enjoyable, likable, or fun to do. Rhodes et al. collectively called these constructs "affective judgments," a new term with clear cognitive connotations that the authors defined as referring to "*judgments* about the overall pleasure/displeasure, enjoyment, and feeling states expected from enacting physical activity" (p. 181, italics added). According to Rhodes et al., "core affect or generalized feeling states" (i.e., the immediate and short-term affective responses examined in this section) do not belong in this category (p. 182). Nevertheless, these "affective judgments" had an average correlation of $r = .38$ with physical activity participation. Rhodes et al. concluded that this renders these enjoyment-related constructs among the strongest known correlates of physical activity behavior (at least on par with self-efficacy and stronger than the built-environment, social, socio-demographic, and personality variables). Although enjoyment is a broad and multifarious construct, it

is important to note that it shows significant overlap with affective responses to exercise (Focht, 2009; Motl, Berger, & Leuschen, 2000; Raedeke, 2007; Robbins, Pis, Pender, & Kazanis, 2004).

Setting the Stage for a Hedonic Theory of Exercise Behavior

The central theme of this chapter is that the "affect heuristic" might be a powerful, albeit currently underappreciated and underexploited, mechanism that shapes the decision to remain physically active or to drop out. As more information accumulates on the influence of exercise on pleasure and displeasure, the basic idea of an affect-behavior link will have to be elaborated upon and developed into a formal, testable theory of exercise behavior. The main objective of this chapter was to set the stage for this advance. In conjunction with other recent works (Backhouse et al., 2007; Ekkekakis, Hall, & Petruzzello, 2008; Parfitt & Hughes, 2009; Williams, 2008), the evidence discussed in the previous sections supports the development of a model of behavioral decision making that explicitly acknowledges and incorporates affective influences.

As suggested previously, perhaps the main reason for the inattention to the role of affect in theoretical efforts to predict and explain exercise behavior has been the dominating influence of the cognitivist zeitgeist. In a classic article, Loewenstein (1996) made a similar point. He argued that decision-making approaches based on the assumption of rationality fall short in the treatment of motivation and effort because they fail to take into account the impact of affective or visceral factors. In his words, such approaches make "no qualitative distinction between choosing, say one car over another, or 'deciding' to pick up one's pace in the last mile of a marathon; both are simply decisions" (p. 287). As an example, he noted that because of the tendency to underestimate the power of affective influences, one might find it difficult to understand why Olympic speed skaters "fail to maintain their pace in the face of such overwhelming incentives" (p. 287). According to Loewenstein, "physical effort ... often produces an aversive sensation referred to as fatigue or, at higher levels, exhaustion. Like other visceral factors, fatigue and exhaustion are directly aversive and alter the desirability of different activities; most prominently, they decrease the desirability of further increments of effort" (p. 287). His conclusion was that "with all its cleverness ... decision theory is somewhat crippled emotionally, and

thus detached from the emotional and visceral richness of life" (p. 289).

Although these might seem like compelling arguments, it is clear that considerable conceptual groundwork remains to be completed before a formal hedonic theory of exercise behavior can be proposed. Some of the key ideas are highlighted below.

Core Affect or Emotions?

When a participant reports that he or she "feels good" or "feels bad" when exercising, this "good" or "bad" feeling could reflect a response emanating from various levels along the hierarchically organized domain of affect. At the most basic level, which has been called "core affect" (Russell, 2003), this could describe a primitive, automatic, and cognitively unmediated feeling of pleasure or displeasure. Examples of such pleasure include the pure sense of energy and bodily exhilaration that accompanies a brisk walk, a bicycle ride, or a swim on a beautiful day. Examples of such displeasure include the feeling of struggle and distress when one is pushed to the limit of one's endurance capacity or the sense of complete energy drain after a tiring run in hot and humid conditions. These feelings have a distinctly affective character (are unmistakably pleasant or unpleasant, respectively), but they probably do not require an antecedent cognitive appraisal, nor can they be significantly altered by cognition. For example, a 1500-m runner can do very little to change the sense of tension and fatigue during the final lap, despite a genetic predisposition for high tolerance to fatigue. Likewise, a severely deconditioned obese exerciser cannot freely dissociate his or her attention away from (or cognitively reframe) his or her feeling of exhaustion halfway through an aerobics class.

At the other end of the affective spectrum, there are pleasant and unpleasant emotional states that are highly complex, intrinsically culture bound, cognitively induced, and cognitively modifiable. Examples of positive emotions include the contentment and personal satisfaction associated with reaching one's weight loss goal or the sense of pride and empowerment experienced by a formerly sedentary older person after being able to walk briskly for 30 minutes for the first time in many years. Examples of negative emotions include the worry and embarrassment felt by someone with high social physique anxiety when exercising in a gymnasium, surrounded by mirrors and fit people in tight clothing, or the deep fear felt by a patient in cardiac rehabilitation when starting to exercise after a heart attack. In these cases, the positive or negative

emotions follow directly from cognitive appraisals, such as the realization that one has reached a personally important and challenging goal or that one's self-image or physical being is threatened. With appropriate interventions, these cognitive appraisals can be modified and, consequently, the ensuing emotional reactions can be altered.

A hedonic theory of exercise behavior should acknowledge and incorporate the important distinctions between core or basic affect on the one hand and emotions on the other (also see Baumeister et al., 2007; Kahneman, 2003; Shiv, Fedorikhin, & Nowlis, 2005). For some authors, what is most important for determining the motivational implications of a stimulus (such as exercise) is its position along the fundamental dimension of pleasure-displeasure (e.g., Kahneman, 1999; Kahneman, Wakker, & Sarin, 1997; Slovic, Peters, Finucane, & MacGregor, 2005). For example, according to Kahneman et al. (1997),

Pleasure is evidently a "go" signal, which guides the organism to continue important activities such as foreplay or consuming sweet, energy-rich food. Pain is a "stop" signal, which interrupts activities that are causing harm, such as placing weight on a wounded foot. The common characteristic of the basic forms of pleasure and distress is that they regulate the response to the current situation.
(p. 379)

Similarly, episodes of pleasure and displeasure upon exposure to affect-inducing stimuli shape positive or negative memories of these events. In turn, these memories influence the decision on whether to approach or avoid future encounters with these stimuli. According to Kahneman et al. (1997),

Remembered utilities also have an adaptive function: they determine whether a situation experienced in the past should now be approached or avoided. Unlike pain and pleasure, which control behavior in the current situation, learned attractions and aversions adjust current behavior to the remembered evaluations of events in the past.
(p. 380)

Other authors have argued that the affective impact of various activities should be assessed not in terms of a single dimension (such as pleasure-displeasure) but rather in terms of specific emotions (Fredrickson, 2000; Lerner & Keltner, 2000). The main argument for this position is that not all pleasures and displeasures have the same personal significance. Instead, if pleasure (or displeasure) is

experienced as part of a highly personally meaningful emotion, it may have a larger impact on future behavior than the pleasure (or displeasure) that is not a component of such an emotion (such as the purely somatic pleasures or displeasures). According to Fredrickson (2000), "affective states most closely linked with future-oriented social relations and/or personal growth carry relatively high meaning (e.g. love and shame), whereas those most closely linked with immediate individual survival carry relatively low meaning (e.g. pleasure and pain)" (p. 595). Consequently, she predicts the following:

Normal individuals strive harder—and suffer more costs—to repeat experiences that include high meaning positive affects (e.g. love, interest/flow) than to repeat those that include only low meaning positive affect (e.g. pleasure, comfort). Likewise, they most actively avoid experiences that include high meaning negative affects (e.g. shame, remorse), but may routinely endure those that include only low meaning negative affect (e.g. anxiety, disgust). (p. 595)

This position has also been espoused in reference to exercise behavior. According to Rose and Parfitt (2007), "the cognitive appraisal that generates the affective response at various exercise intensities is likely to be more critical to the affect-adherence relationship than the quantitative measure of [Feeling Scale] that results" (p. 306). In other words, "knowing why someone feels the way he or she does during exercise ... could be just as important as knowing how he or she feels" (p. 306). Thus one challenge as this line of research moves forward is to investigate the salient types of cognitive appraisals and ensuing emotions that occur in the context of exercise and then to explore their relative impact on subsequent exercise behavior.

Peak Rule, End Rule, and Duration Neglect

In a remarkably insightful series of studies, Kahneman and coworkers used momentary ratings to track the dynamics of pleasure–displeasure, pain, or discomfort during various pleasant or unpleasant procedures (Fredrickson & Kahneman, 1993; Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993; Redelmeier & Kahneman, 1996; Redelmeier, Katz, & Kahneman, 2003; Varey & Kahneman, 1992). These studies have revealed three important principles that influence how the affective responses experienced during an activity relate to the positive or negative memories formed of that activity and the likelihood of repeating the activity in the

future. According to these principles, what has the largest impact on how an event registers in memory and influences future behavioral choices is the peak (positive or negative) affect experienced during the event (the so-called peak rule) and the affect experienced at the end (the so-called end rule). On the other hand, the duration of the experience seems inconsequential (a phenomenon called "duration neglect").

In an application of these ideas to exercise, Brewer, Manos, McDevitt, Cornelius, and Van Raalte (2000) found that respondents rated as less aversive a hypothetical bout of exercise that was described as 33% longer (20 minutes vs. 15 minutes) if it ended with a reduction in intensity (ratings of perceived exertion of 8, 13, 17, and 11 on the 6–20 scale at the 5th, 10th, 15th, and 20th minutes, respectively, vs. 8, 13, and 17 at the 5th, 10th, and 15th minutes). In a second study, the authors reported that an actual bout of exercise that was 20 minutes long but ended with reduced intensity (heart rate of 120, 140, 160, and 130 beats/min at the 5th, 10th, 15th, and 20th minutes, respectively) was selected for repetition nearly twice as frequently (65% to 35%) as a 15-minute bout that ended with high intensity (heart rate of 120, 140, and 160 beats/min at the 5th, 10th, and 15th minutes).

The Conflict between Affect and Reason

Assuming that the role of affective constructs in shaping behavioral decisions is acknowledged, a larger and arguably even more challenging issue will be to delineate the relative contributions of affect and reason. Both seem important, but how do they interact? Theorists have proposed that the system responsible for judgment and reasoning is characterized by a dual-layer architecture (S. Epstein, 1994; Evans, 2003, 2008; Kahneman, 2003; Slovic, 1996; Stanovich & West, 2000). The evolutionarily more primitive "System 1" is rapid, effortless, inflexible, and automatic. The outcomes of this system include instinctive responses that are innately programmed. For the most part, System 1 processes are theorized to be impervious to volitional control. System 1 relies heavily on affect, opting for choices that are positively laden and avoiding choices that are negatively laden. On the other hand, "System 2" is slower, more effortful, and flexible. Its major advantage compared with System 1 is that it allows abstract reasoning, future projections, hypothesis testing, and other executive processes. Its operations are typically under volitional control and therefore modifiable.

Authors have speculated that in some situations behavioral decisions are made following a conflict between System 1 and System 2 processes (Finucane et al., 2003; Stanovich & West, 2000; Svenson, 2003). Such conflicts have been explored for smoking (Slovic, 2001) and food choice (Shiv & Fedorikhin, 1999, 2002) but not for exercise. However, in anecdotal accounts, many people describe their effort to maintain an exercise program as a “struggle” or an internal conflict, saying, for example, “I know I should be exercising, but . . .” or “I wish I was taking better care of myself.” What statements such as these seem to imply is that although most people are aware of the benefits associated with exercise and, within the bounds of human rationality, can probably infer the long-term negative consequences of sedentary behavior, their behavior is also subject to certain inhibitory or counteracting forces. Affect-based System 1 processes are a likely candidate for this role.

S. Epstein (1994) considered the affect-based experiential system to be the “default option” (p. 716), because it is less effortful and more efficient than the rational system. Moreover, he argued that the affective nature of the experiential system itself makes it “more compelling than is dispassionate logical thinking” (p. 716). Finally, because the workings of the experiential system remain largely outside of conscious awareness, it is very difficult for the rational system to exert control over them. Similar views have been expressed by authors investigating the causes of obesity, addictions, and other problems assumed to have an affective, experiential, or “visceral” component (Loewenstein, 1996, 2001; Slovic, 2001; Slovic et al., 2007). According to Slovic et al. (2007),

The affect heuristic enables us to be rational actors in many important situations. But not in all situations. It works beautifully when our experience enables us to anticipate accurately how we will like the consequences of our decisions. It fails miserably when the consequences turn out to be much different in character than we anticipated.

(p. 1350)

Somatic Markers

Besides the data on exercise-induced affective responses that were reviewed in previous sections, several other pieces of evidence from the literature seem to indicate that exercise may not register as a particularly pleasant stimulus in the memory of many people. The fact that displeasure, discomfort,

and pain are frequently raised as perceived barriers to exercise participation in interview studies is a strong indicator. Furthermore, adult nonobese women consistently chose sedentary options (watching a comedy show, reading a magazine, doing a crossword puzzle, or playing a computer game) over exercise even though they had rated the sedentary and exercise options as equally “liked” and they were allowed to select their own exercise intensity (Vara & Epstein, 1993). This preference for sedentary options over active ones has also been observed among children (L. H. Epstein, Smith, Vara, & Rodefer, 1991; Roemmich et al., 2008). For people who are chronically inactive or obese, the preference for sedentary options may be accentuated (L. H. Epstein, 1998; L. H. Epstein & Saelens, 2000). Very obese children, for example, do not opt for exercise even when gaining access to the sedentary option is made difficult whereas access to exercise is without any cost (L. H. Epstein et al., 1991). This finding is consistent with data showing lowered pleasure ratings during exercise among obese individuals (Ekkekakis & Lind, 2006; Ekkekakis et al., 2010).

Especially considering that the majority of adults are inadequately active and overweight, we hypothesize that even a few attempts to exercise, if they led to experiences of diminished pleasure, might suffice to build a negatively laden memory trace for exercise. This proposition is similar to Damasio’s (1994, 1996) idea of a somatic marker. According to Damasio (1994), somatic markers are “a special instance of feelings [which] have been connected by learning to predicted future outcomes of certain scenarios” (p. 174). When a positive somatic marker is juxtaposed to a certain future outcome, “it becomes a beacon of incentive” (p. 174). Conversely,

When the choice of option X, which leads to bad outcome Y, is followed by punishment and thus painful body states, the somatic-marker system acquires the hidden, dispositional representation of this experience-driven, noninherited arbitrary connection. Re-exposure of the organism to option X, or thoughts about outcome Y, will now have the power to reenact the painful body state and thus serve as an automated reminder of bad consequences to come.

(p. 180)

Damasio (1994) also examined the possibility that certain actions may have an immediate consequence that is unpleasant but a future outcome that is positive. Interestingly, he offered jogging (along

with surgery, graduate school, and medical school) as one such example. In such cases, the only way to override the tendency to avoid the immediately unpleasant option is if, somehow, the positivity of the future outcome prevails. If it does not, inaction will ensue. Evidence suggests that often the prospect of immediate displeasure is a powerful deterrent. For example, inactivity in patients suffering from chronic fatigue (Nijs et al., 2004) or back pain (Elfving et al., 2007), who are probably well informed about the benefits of regular physical activity, is associated with an acquired fear of movement ("kinesiophobia") that presumably developed as a result of unpleasant or painful prior experiences. The fascinating experimental studies of Shiv and Fedorikhin (1999, 2002; see Shiv et al., 2005, for a review) on the choice between a chocolate cake (rated more favorably from an affective standpoint but less favorably from a cognitive standpoint) and a fruit salad (with the converse ratings) have shown that the likelihood of choosing the option that offers the promise of a future positive outcome is lessened when information processing capacity is compromised (e.g., by limited knowledge, stress, competing considerations, or time pressure).

Conclusion

The evidence discussed in this chapter suggests that the foundation has now been laid for the development of a hedonic theory of exercise behavior. Findings show that affective responses to exercise vary between individuals and include decreases in pleasure (in addition to increases). These changes could reflect processes at any level of the hierarchy that extends from core affect to emotions. "Peak" and "end" affective experiences (positive or negative) are particularly likely to play a key role in how exercise episodes register in memory and thus in shaping a theorized "somatic marker" associated with the concept of exercise. If a positively laden (System 1) somatic marker co-occurs with a positive (System 2) cognitive evaluation of exercise and its meaning (e.g., its long-term health benefits), the chances of exercise participation should be increased. Conversely, the co-occurrence of a negatively laden somatic marker with a negative (or even a neutral or indifferent) cognitive evaluation should suffice to lower the chances of exercise participation.

There is also the possibility of a conflict between the two processes underlying decision making. Presumably such conflicts occur often. It is possible that in most cases, such conflicts involve a positive cognitive evaluation ("I know exercise would be

good for me") but a negative somatic marker derived from prior experiences (e.g., exercise is something that on a previous attempt felt unpleasant, uncomfortable, painful, boring, or embarrassing). In such cases, the behavioral choice would probably depend on which of the two counteracting forces is stronger (with the weighing possibly taking place outside conscious awareness). On the one hand, there are the questions of (a) how convinced one is that exercise would yield the desired outcomes and (b) how personally meaningful those outcomes are. On the other hand, there is the issue of the consistency of unpleasant affective experiences during prior exercise attempts.

In the short run, small imbalances would probably allow at least a few additional exercise attempts (which may or may not modify the somatic marker for exercise). If, however, the negativity of prior experiences is strong enough to tilt the scale heavily, the likelihood of exercise participation would be diminished. Theorists predict that in the long run, affective, "visceral," or "experiential" factors are more likely to prevail over "cognitive" or "rational" ones (S. Epstein, 1994; Loewenstein, 1996; Slovic, 2001; Slovic et al., 2007). In other words, as long as prior exercise experiences have formed a somatic marker charged with negative affect (and additional attempts have failed to alter it to any significant extent), no cognitive evaluation or rational thinking, no matter how positive, might be strong enough to keep a person on the path to long-term exercise adherence. This is especially likely if the efficacy or efficiency of System 2 is compromised (beyond its already limited capacity) by factors that occur commonly in modern life, such as incomplete information, stress, or time pressure (Shiv et al., 2005).

References

- Acevedo, E. O., Kraemer, R. R., Haltom, R. W., & Tryniecki, J. L. (2003). Perceptual responses proximal to the onset of blood lactate accumulation. *Journal of Sports Medicine and Physical Fitness, 43*, 267-273.
- Acevedo, E. O., Rinehardt, K. F., & Kraemer, R. R. (1994). Perceived exertion and affect at varying intensities of running. *Research Quarterly for Exercise and Sport, 65*, 372-376.
- Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Jr., Tudor-Locke, C., ... Leon A. S. (2011). 2011 Compendium of Physical Activities: A second update of codes and MET values. *Medicine & Science in Sports & Exercise, 43*, 1575-1581.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.
- Ajzen, I. (2005). *Attitudes, personality and behaviour* (2nd ed.). Berkshire, England: Open University Press.

- Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior. In D. Albarracín, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (pp. 173–221). Mahwah, NJ: Lawrence Erlbaum.
- Allender, S., Cowburn, G., & Foster, C. (2006). Understanding participation in sport and physical activity among children and adults: A review of qualitative studies. *Health Education Research: Theory and Practice*, 21, 826–835.
- American College of Sports Medicine (2010). *ACSM's guidelines for exercise testing and prescription* (8th ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
- Annesi, J. J. (2002a). Relationship between changes in acute exercise-induced feeling states, self-motivation, and adults' adherence to moderate aerobic exercise. *Perceptual and Motor Skills*, 94, 425–439.
- Annesi, J. J. (2002b). Self-motivation moderates effect of exercise-induced feelings on adherence. *Perceptual and Motor Skills*, 94, 467–475.
- Annesi, J. J. (2005). Relationship between before-to-after-exercise feeling state changes and exercise session attendance over 14 weeks: Testing principles of operant conditioning. *European Journal of Sport Science*, 5, 159–163.
- Annesi, J. J. (2006). Relations of self-motivation, perceived physical condition, and exercise-induced changes in revitalization and exhaustion with attendance in women initiating a moderate cardiovascular exercise regimen. *Women and Health*, 42, 77–93.
- Aristotle (trans. 1984). *Nicomachean ethics* (W. D. Ross & J. O. Urmsion, Trans.). In J. Barnes (Ed.), *The complete works of Aristotle: The revised Oxford translation* (Vol. 2, pp. 1729–1867). Princeton, NJ: Princeton University Press.
- Armstrong, T., Bauman, A., & Davies, J. (2000). *Physical activity patterns of Australian adults: Results of the 1999 National Physical Activity Survey*. Canberra: Australian Institute of Health and Welfare.
- Backhouse, S. H., Ekkekakis, P., Biddle, S. J. H., Foskett, A., & Williams, C. (2007). Exercise makes people feel better but people are inactive: Paradox or artifact? *Journal of Sport and Exercise Psychology*, 29, 498–517.
- Bain, A. (1879). *The senses and the intellect* (3rd ed.). New York: Appleton.
- Baldwin, J. M. (1891). *Handbook of psychology: Feeling and will*. New York: Henry Holt.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44, 1175–1184.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52, 1–26.
- Bauman, A., Armstrong, T., Davies, J., Owen, N., Brown, W., Bellew, B., & Vita, P. (2003). Trends in physical activity participation and the impact of integrated campaigns among Australian adults, 1997–99. *Australia and New Zealand Journal of Public Health*, 27, 76–79.
- Bauman, A. E., Sallis, J. F., Dzawaltowski, D. A., & Owen, N. (2002). Toward a better understanding of the influences on physical activity: The role of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine*, 23(Suppl. 2), 5–14.
- Baumeister, R. F., Vohs, K. D., DeWall, C. N., & Zhang, L. (2007). How emotion shapes behavior: Feedback, anticipation, and reflection, rather than direct causation. *Personality and Social Psychology Review*, 11, 167–203.
- Bechara, A. (2005). Decision making, impulse control and loss of willpower to resist drugs: A neurocognitive perspective. *Nature Neuroscience*, 8, 1458–1463.
- Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex*, 10, 295–307.
- Bentham, J. (1948). *An introduction to the principles of morals and legislation*. New York: Hafner. (Original work published 1789.)
- Berger, B. G., Darby, L. A., Owen, D. R., & Carels, R. A. (2010). Implications of a behavioral weight loss program for obese, sedentary women: A focus on mood enhancement and exercise enjoyment. *International Journal of Sport and Exercise Psychology*, 8, 10–23.
- Berger, B. G., & Owen, D. R. (1992). Mood alteration with yoga and swimming: Aerobic exercise may not be necessary. *Perceptual and Motor Skills*, 75, 1331–1343.
- Berridge, K. C., & Krangelbach, M. L. (2008). Affective neuroscience of pleasure: Reward in humans and animals. *Psychopharmacology*, 199, 457–480.
- Bettman, J. R. (1993). The decision maker who came in from the cold. *Advances in Consumer Research*, 20, 7–11.
- Biddle, S. J. H. (2000). Exercise, emotions, and mental health. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 267–291). Champaign, IL: Human Kinetics.
- Bish, C. L., Michels Blanck, H., Serdula, M. K., Marcus, M., Kohl, H. W. III., & Kettel Khan, L. (2005). Diet and physical activity behaviors among Americans trying to lose weight: 2000 Behavioral Risk Factor Surveillance System. *Obesity Research*, 13, 596–607.
- Bixby, W. R., & Lochbaum, M. R. (2006). Affect responses to acute bouts of aerobic exercise in fit and unfit participants: An examination of opponent-process theory. *Journal of Sport Behavior*, 29, 111–125.
- Bixby, W. R., Spalding, T. W., & Hatfield, B. D. (2001). Temporal dynamics and dimensional specificity of the affective response to exercise of varying intensity: Differing pathways to a common outcome. *Journal of Sport and Exercise Psychology*, 23, 171–190.
- Bluemke, M., Brand, R., Schweizer, G., & Kahlert, D. (2010). Exercise might be good for me, but I don't feel good about it: Do automatic associations predict exercise behavior? *Journal of Sport and Exercise Psychology*, 32, 137–153.
- Brewer, B. W., Manos, T. M., McDevitt, A. V., Cornelius, A. E., & Van Raalte, J. L. (2000). The effect of adding lower intensity work on perceived aversiveness of exercise. *Journal of Sport and Exercise Psychology*, 22, 119–130.
- Browning, R. C., Baker, E. A., Herron, J. A., & Kram, R. (2006). Effects of obesity and sex on the energetic cost of preferred speed of walking. *Journal of Applied Physiology*, 100, 390–398.
- Browning, R. C., & Kram, R. (2005). Energetic cost and preferred speed of walking in obese vs. normal weight women. *Obesity Research*, 13, 891–899.
- Buckley, J. (2006). Exercise physiology and monitoring of exercise in cardiac rehabilitation. In M. K. Thow (Ed.), *Exercise leadership in cardiac rehabilitation: An evidence-based approach* (pp. 47–95). Chichester, UK: John Wiley & Sons.
- Cabanac, M. (1992). Pleasure: The common currency. *Journal of Theoretical Biology*, 155, 173–200.
- Cabanac, M. (2002). What is emotion? *Behavioural Processes*, 60, 69–83.

- Cabanac, M. (2006). Exertion and pleasure from an evolutionary perspective. In E. O. Acevedo & P. Ekkekakis (Eds.), *Psychobiology of physical activity* (pp. 79–89). Champaign, IL: Human Kinetics.
- Cabanac, M. (2010). The dialectics of pleasure. In M. L. Kringsbach & K. C. Berridge (Eds.), *Pleasures of the brain* (pp. 113–124). New York: Oxford University Press.
- Callias, K. J., Sallis, J. F., Nichols, J. F., Sarkin, J. A., Johnson, M. F., Caparosa, S., . . . Alcaraz, J. E. (2000). Project GRAD: Two-year outcomes of a randomized controlled physical activity intervention among young adults. *American Journal of Preventive Medicine, 18*, 28–37.
- Cameron, O. G. (2009). Visceral brain-body information transfer. *NeuroImage, 47*, 787–794.
- Carels, R. A., Berger, B., & Darby, L. (2006). The association between mood states and physical activity in postmenopausal, obese, sedentary women. *Journal of Aging and Physical Activity, 14*, 12–28.
- Carels, R. A., Coit, C., Young, K., & Berger, B. (2007). Exercise makes you feel good, but does feeling good make you exercise? An examination of obese dieters. *Journal of Sport and Exercise Psychology, 29*, 706–722.
- Carretié, L., Albert, J., López-Martín, S., & Tapia, M. (2009). Negative brain: An integrative review on the neural processes activated by unpleasant stimuli. *International Journal of Psychophysiology, 71*, 57–63.
- Castro, C. M., Sallis, J. F., Hickman, S. A., Lee, R. E., & Chen, A. H. (1999). A prospective study of psychosocial correlates of physical activity for ethnic minority women. *Psychology and Health, 14*, 277–293.
- Craig, A. D. (2002). How do you feel? Interoception: The sense of the physiological condition of the body. *Nature Reviews Neuroscience, 3*, 655–666.
- Craig, A. D. (2006). Physical activity and the neurobiology of interoception. In E. O. Acevedo & P. Ekkekakis (Eds.), *Psychobiology of physical activity* (pp. 15–28). Champaign, IL: Human Kinetics.
- Currie, C. E., Amos, A., & Hunt, S. M. (1991). The dynamics and processes of behavioural change in five classes of health-related behaviour: Findings from qualitative research. *Health Education Research: Theory and Practice, 6*, 443–453.
- Daley, A. J., Copland, R. J., Wright, N. P., & Wales, J. K. H. (2008). "I can actually exercise if I want to; it isn't as hard as I thought": A qualitative study of the experiences and views of obese adolescents participating in an exercise therapy intervention. *Journal of Health Psychology, 13*, 810–819.
- Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain*. New York: Putnam.
- Damasio, A. R. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex. *Philosophical Transactions of the Royal Society of London, Series B, 351*, 1413–1420.
- de Geus, E. J. C., & de Moor, M. H. M. (2008). A genetic perspective on the association between exercise and mental health. *Mental Health and Physical Activity, 1*, 53–61.
- Delahanty, L. M., Conroy, M. B., & Nathan, D. M. (2006). Psychological predictors of physical activity in the Diabetes Prevention Program. *Journal of the American Dietetic Association, 106*, 698–705.
- Denton, D. A., McKinley, M. J., Farrell, M., & Eagan, G. F. (2009). The role of primordial emotions in the evolutionary origin of consciousness. *Consciousness and Cognition, 18*, 500–514.
- Dergance, J. M., Mouton, C. P., Lichtenstein, M. J., & Hazuda, H. P. (2005). Potential mediators of ethnic differences in physical activity in older Mexican Americans and European Americans: Results from the San Antonio Longitudinal Study of Aging. *Journal of the American Geriatrics Society, 53*, 1240–1247.
- Descartes, R. (trans. 1985). The passions of the soul (R. Stoothoff, Trans.). In *The philosophical writings of Descartes* (Vol. 1, pp. 325–404). Cambridge, UK: Cambridge University Press.
- Diogenes Laertius (trans. 1925). *Lives of eminent philosophers* (Vol. 2, R. D. Hicks, Trans.). Cambridge, MA: Harvard University Press.
- Diogenes Laertius (trans. 1972). *Lives of eminent philosophers* (Vol. 1, R. D. Hicks, Trans.). Cambridge, MA: Harvard University Press.
- Dishman, R. K. (1988). Exercise adherence research: Future directions. *American Journal of Health Promotion, 3*, 52–56.
- Dishman, R. K. (1990). Determinants of participation in physical activity. In C. Bouchard, R. J. Shephard, T. Stephens, J. R. Sutton, & B. D. McPherson (Eds.), *Exercise, fitness, and health: A consensus of current knowledge* (pp. 75–101). Champaign, IL: Human Kinetics.
- Dishman, R. K. (2001). The problem of exercise adherence: Fighting sloth in nations with market economies. *Quest, 53*, 279–294.
- Dishman, R. K. (2003). The impact of behavior on quality of life. *Quality of Life Research, 12*(Suppl. 1), 43–49.
- Dishman, R. K., & Buckworth, J. (1996). Increasing physical activity: A quantitative synthesis. *Medicine & Science in Sports & Exercise, 28*, 706–719.
- Dishman, R. K., Sallis, J. F., & Orenstein, D. R. (1985). The determinants of physical activity and exercise. *Public Health Reports, 100*, 158–171.
- Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition and Emotion, 17*, 213–239.
- Ekkekakis, P. (2005). The study of affective responses to acute exercise: The dual-mode model. In R. Stelter & K. K. Roessler (Eds.), *New approaches to sport and exercise psychology* (pp. 119–146). Oxford, UK: Meyer & Meyer Sport.
- Ekkekakis, P. (2008). The genetic tidal wave finally reached our shores: Will it be the catalyst for a critical overhaul of the way we think and do science? *Mental Health and Physical Activity, 1*, 47–52.
- Ekkekakis, P. (2009a). The Dual-Mode Theory of affective responses to exercise in metatheoretical context: I. Initial impetus, basic postulates, and philosophical framework. *International Review of Sport and Exercise Psychology, 2*, 73–94.
- Ekkekakis, P. (2009b). Illuminating the black box: Investigating prefrontal cortical hemodynamics during exercise with near-infrared spectroscopy. *Journal of Sport and Exercise Psychology, 31*, 505–553.
- Ekkekakis, P. (2009c). Let them roam free? Physiological and psychological evidence for the potential of self-selected exercise intensity in public health. *Sports Medicine, 39*, 857–888.
- Ekkekakis, P., & Acevedo, E. O. (2006). Affective responses to acute exercise: Toward a psychobiological dose-response model. In E. O. Acevedo & P. Ekkekakis (Eds.), *Psychobiology of physical activity* (pp. 91–109). Champaign, IL: Human Kinetics.

- Ekkekakis, P., Backhouse, S. H., Gray, C., & Lind, E. (2008). Walking is popular among adults but is it pleasant? A framework for clarifying the link between walking and affect as illustrated in two studies. *Psychology of Sport and Exercise, 9*, 246–264.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005a). Some like it vigorous: Individual differences in the preference for and tolerance of exercise intensity. *Journal of Sport and Exercise Psychology, 27*, 350–374.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2005b). Variation and homogeneity in affective responses to physical activity of varying intensities: An alternative perspective on dose-response based on evolutionary considerations. *Journal of Sports Sciences, 23*, 477–500.
- Ekkekakis, P., Hall, E. E., & Petruzzello, S. J. (2008). The relationship between exercise intensity and affective responses demystified: To crack the forty-year-old nut, replace the forty-year-old nutcracker! *Annals of Behavioral Medicine, 35*, 136–149.
- Ekkekakis, P., Hall, E. E., Van Landuyt, L. M., & Petruzzello, S. J. (2000). Walking in (affective) circles: Can short walks enhance affect? *Journal of Behavioral Medicine, 23*, 245–275.
- Ekkekakis, P., & Lind, E. (2006). Exercise does not feel the same when you are overweight: The impact of self-selected and imposed intensity on affect and exertion. *International Journal of Obesity, 30*, 652–660.
- Ekkekakis, P., Lind, E., & Vazou, S. (2010). Affective responses to increasing levels of exercise intensity in normal-weight, overweight, and obese middle-aged women. *Obesity, 18*, 79–85.
- Ekkekakis, P., Parfitt, G., & Petruzzello, S. J. (2011). The pleasure and displeasure people feel when they exercise at different intensities: Decennial update and progress towards a tripartite rationale for exercise intensity prescription. *Sports Medicine, 41*, 641–671.
- Ekkekakis, P., & Petruzzello, S. J. (1999). Acute aerobic exercise and affect: Current status, problems, and prospects regarding dose-response. *Sports Medicine, 28*, 337–374.
- Elfvig, B., Andersson, T., & Grooten, W. J. (2007). Low levels of physical activity in back pain patients are associated with high levels of fear-avoidance beliefs and pain catastrophizing. *Physiotherapy Research International, 12*, 14–24.
- Emmons, R. A., & Diener, E. (1986). A goal-affect analysis of everyday situational choices. *Journal of Research in Personality, 20*, 309–326.
- Epstein, L. H. (1998). Integrating theoretical approaches to promote physical activity. *American Journal of Preventive Medicine, 15*, 257–265.
- Epstein, L. H., & Saelens, B. E. (2000). Behavioral economics of obesity: Food intake and energy expenditure. In W. K. Bickel & R. E. Vuchinich (Eds.), *Reframing health behavior change with behavioral economics* (pp. 293–311). Mahwah, NJ: Lawrence Erlbaum.
- Epstein, L. H., Smith, J. A., Vara, L. S., & Rodefer, J. S. (1991). Behavioral economic analysis of activity choice in obese children. *Health Psychology, 10*, 311–316.
- Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist, 49*, 709–724.
- Evans, J. St. B. T. (2003). In two minds: Dual-process accounts of reasoning. *Trends in Cognitive Sciences, 7*, 454–459.
- Evans, J. St. B. T. (2008). Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology, 59*, 255–278.
- Feldman Barrett, L., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annual Review of Psychology, 58*, 373–403.
- Ferrand, C., Perrin, C., & Nasarre, S. (2008). Motives for regular physical activity in women and men: A qualitative study in French adults with type 2 diabetes, belonging to a patients' association. *Health and Social Care in the Community, 16*, 511–520.
- Finucane, M. L., Peters, E., & Slovic, P. (2003). Judgment and decision making: The dance of affect and reason. In S. L. Schneider & J. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 327–364). New York: Cambridge University Press.
- Flintoff, A., & Scraton, S. (2001). Stepping into active leisure? Young women's perceptions of active lifestyles and their experiences of school physical education. *Sport, Education and Society, 6*, 5–21.
- Focht, B. C. (2009). Brief walks in outdoor and laboratory environments: Effects on affective responses, enjoyment, and intentions to walk for exercise. *Research Quarterly for Exercise and Sport, 80*, 611–620.
- Focht, B. C., & Hausenblas, H. A. (2006). Exercising in public and private environments: Effects on feeling states in women with social physique anxiety. *Journal of Applied Biobehavioral Research, 11*, 147–165.
- Fox, K. R., Stathi, A., McKenna, J., & Davis, M. G. (2007). Physical activity and mental well-being in older people participating in the Better Ageing Project. *European Journal of Applied Physiology, 100*, 591–602.
- Fredrickson, B. L. (2000). Extracting meaning from past affective experiences: The importance of peaks, ends, and specific emotions. *Cognition and Emotion, 14*, 577–606.
- Fredrickson, B. L., & Kahneman, D. (1993). Duration neglect in retrospective evaluations of affective episodes. *Journal of Personality and Social Psychology, 65*, 45–55.
- Freud, S. (1946). Formulations regarding the two principles in mental functioning (J. Riviere, Trans.). In *Collected papers* (Vol. IV, pp. 13–21). London: Hogarth. (Original work published 1911)
- Fridlund Dunton, G., & Vaughan, E. (2008). Anticipated affective consequences of physical activity adoption and maintenance. *Health Psychology, 27*, 703–710.
- Gauvin, L. (1990). An experiential perspective on the motivational features of exercise and lifestyle. *Canadian Journal of Sport Sciences, 15*, 51–58.
- Gauvin, L., & Rejeski, W. J. (1993). The Exercise-induced Feeling Inventory: Development and initial validation. *Journal of Sport and Exercise Psychology, 15*, 403–423.
- Gosling, J. C., & Taylor, C. C. (1982). *The Greek pleasure*. Oxford: Oxford University Press.
- Graham, R., Kremer, J., & Wheeler, G. (2008). Physical exercise and psychological well-being among people with chronic illness and disability: A grounded approach. *Journal of Health Psychology, 13*, 447–458.
- Hamid, P. N. (1990). Positive and negative affectivity and maintenance of exercise programs. *Perceptual and Motor Skills, 70*, 478.
- 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.
- Hariri, A. R., & Forbes, E. E. (2007). Genetics of emotion regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 110–132). New York: Guilford.

- Helvétius, M. (1810). *A treatise on man; his intellectual faculties and his education* (Vol. 1, W. Hooper, Trans.). London: Albion Press. (Original work published 1777.)
- Henderson, K. A., & Ainsworth, B. E. (2003). A synthesis of perceptions about physical activity among older African American and American Indian women. *American Journal of Public Health, 93*, 313-317.
- Hendry, M., Williams, N. H., Markland, D., Wilkinson, C., & Maddison, P. (2006). Why should we exercise when our knees hurt? A qualitative study of primary care patients with osteoarthritis of the knee. *Family Practice, 23*, 558-567.
- Henry, B., Moffitt, T. E., Caspi, A., Langley, J., & Silva, P. A. (1994). On the "remembrance of things past": A longitudinal evaluation of the retrospective method. *Psychological Assessment, 6*, 92-101.
- Herman, S., Blumenthal, J. A., Babyak, M., Khatri, P., Craighead, W. E., Krishnan, K. R., & Doraiswamy, P. M. (2002). Exercise therapy for depression in middle-aged and older adults: Predictors of early dropout and treatment failure. *Health Psychology, 21*, 553-563.
- Hobbes, T. (1839). Elements of philosophy: The first section. In W. Molesworth (Ed. and Trans.), *The English works of Thomas Hobbes of Malesbury* (Vol. 1, Ch. 25, pp. 387-410). London: John Bohn. (Original work published 1655.)
- Hobbes, T. (1839). Leviathan or the matter, form, and power of a commonwealth ecclesiastical and civil. In W. Molesworth (Ed.), *The English works of Thomas Hobbes of Malesbury* (Vol. 3, Ch. 6, pp. 38-51). London: John Bohn. (Original work published 1651.)
- Huberty, J. L., Ransdell, L. B., Sidman, C., Flohr, J. A., Shultz, B., Grosshans, O., & Durrant, L. (2008). Explaining long-term exercise adherence in women who complete a structured exercise program. *Research Quarterly for Exercise and Sport, 79*, 374-384.
- Hume, D. (1978). Of the passions. In P. H. Nidditch (Ed.), *A treatise of human nature: Being an attempt to introduce the experimental method of reasoning into moral subjects* (2nd Ed., p. 275-454). Oxford, UK: Oxford University Press. (Original work published 1740.)
- James, W. (1890a). *The principles of psychology* (Vol. 1). London: Macmillan.
- James, W. (1890b). *The principles of psychology* (Vol. 2). London: Macmillan.
- Jerome, G. J., Marquez, D. X., McAuley, E., Canaklisova, S., Snook, E., & Vickers, M. (2002). Self-efficacy effects on feeling states in women. *International Journal of Behavioral Medicine, 9*, 139-154.
- Kahn, E. B., Ramsey, L. T., Brownson, R. C., Heath, G. W., Howze, E. H., Powell, K. E., ... Corso, P. (2002). The effectiveness of interventions to increase physical activity: A systematic review. *American Journal of Preventive Medicine, 22*(Suppl. 4), 73-107.
- Kahneman, D. (1999). Objective happiness. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), *Well-being: The foundation of hedonic psychology* (pp. 3-25). New York: Sage.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58*, 697-720.
- Kahneman, D., Fredrickson, B. L., Schreiber, C. A., & Redelmeier, D. A. (1993). When more pain is preferred to less: Adding a better end. *Psychological Science, 4*, 401-405.
- Kahneman, D., Wakker, P. P., & Sarin, R. (1997). Back to Bentham? Explorations of experienced utility. *Quarterly Journal of Economics, 112*, 375-405.
- Kelsey, K. S., McEvoy DeVellis, B., Begum, M., Belton, L., Gerken Hooten, E., & Kramish Campbell, M. (2006). Positive affect, exercise and self-reported health in blue-collar women. *American Journal of Health Behavior, 30*, 199-207.
- Kientzler, A. L. (1999). Fifth- and seventh-grade girls' decisions about participation in physical activity. *Elementary School Journal, 99*, 391-414.
- Kilpatrick, M. W., Kraemer, R. R., Bartholomew, J. B., Acevedo, E. O., & Jarreau, D. (2007). Affective responses to exercise are dependent on intensity rather than total work. *Medicine & Science in Sports & Exercise, 39*, 1417-1422.
- Kishi, T., & Elmquist, J. K. (2005). Body weight is regulated by the brain: A link between feeding and emotion. *Molecular Psychiatry, 10*, 132-146.
- Kiviniemi, M. T., Voss-Humke, A. M., & Seifert, A. L. (2007). How do I feel about the behavior? The interplay of affective associations with behaviors and cognitive beliefs as influences on physical activity behavior. *Health Psychology, 26*, 152-158.
- Klonoff, E. A., Annechild, A., & Landrine, H. (1994). Predicting exercise adherence in women: The role of psychological and physiological factors. *Preventive Medicine, 23*, 257-262.
- Koob, G. F. (2008). Hedonic homeostatic dysregulation as a driver for drug-seeking behavior. *Drug Discovery Today: Disease Models, 5*, 207-215.
- Kuhn, T. S. (1962). Historical structure of scientific discovery. *Science, 136*, 760-764.
- Kuhn, T. S. (1996). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press. (Original work published 1962)
- Kwan, B. M., & Bryan, A. (2010). In-task and post-task affective response to exercise: Translating exercise intentions into behaviour. *British Journal of Health Psychology, 15*, 115-131.
- La Mettrie, J. O. (1996). Machine man. In A. Thomson (Ed. and Trans.), *Machine man and other writings* (pp. 1-39). Cambridge, UK: Cambridge University Press. (Original work published 1748.)
- La Mettrie, J. O. (1996). Anti-Seneca or the sovereign good. In A. Thomson (Ed. and Trans.), *Machine man and other writings* (pp. 117-143). Cambridge, UK: Cambridge University Press. (Original work published 1750.)
- Laverie, D. A. (1998). Motivations for ongoing participation in a fitness activity. *Leisure Sciences, 20*, 277-302.
- Lawton, R., Conner, M., & McEachan, R. (2009). Desire or reason: Predicting health behaviors from affective and cognitive attitudes. *Health Psychology, 28*, 56-65.
- Lee, L. L., Avis, M., & Arthur, A. (2007). The role of self-efficacy in older people's decisions to initiate and maintain regular walking as exercise: Findings from a qualitative study. *Preventive Medicine, 45*, 62-65.
- Lees, F. D., Clark, P. G., Nigg, C. R., & Newman, P. (2005). Barriers to exercise behavior among older adults: A focus group study. *Journal of Aging and Physical Activity, 13*, 23-33.
- Leonard, F. E. (1915). *Pioneers of modern physical training* (2nd ed.). New York: Association Press.
- Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition and Emotion, 14*, 473-493.

- Lewis, B. A., Marcus, B. H., Pate, R. R., & Dunn, A. L. (2002). Psychosocial mediators of physical activity behavior among adults and children. *American Journal of Preventive Medicine*, 23(Suppl. 2), 26–35.
- Lind, E., Welch, A. S., & Ekkekakis, P. (2009). Do "mind over muscle" strategies work? Examining the effects of attentional association and dissociation on exertional, affective, and physiological responses to exercise. *Sports Medicine*, 39, 743–764.
- Loewenstein, G. (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes*, 65, 272–292.
- Loewenstein, G. (2001). A visceral account of addiction. In P. Slovic (Ed.), *Smoking: Risk, perception, and policy* (pp. 188–215). Thousand Oaks, CA: Sage.
- Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision making. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 619–642). New York: Oxford University Press.
- Loman, D. G. (2008). Promoting physical activity in teen girls: Insight from focus groups. *MNCN: The American Journal of Maternal/Child Nursing*, 33, 294–299.
- Loughhead, T. M., Patterson, M. M., & Carron, A. V. (2008). The impact of fitness leader behavior and cohesion on an exerciser's affective state. *International Journal of Sport and Exercise Psychology*, 6, 53–28.
- 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.
- Lutter, M., & Nestler, E. J. (2009). Homeostatic and hedonic signals interact in the regulation of food intake. *Journal of Nutrition*, 139, 629–632.
- Marcus, B. H., Williams, D. M., Dubbert, P. M., Sallis, J. F., King, A. C., Yancey, A. K., ... Claytor, R. P. (2006). Physical activity intervention studies: What we know and what we need to know. *Circulation*, 114, 2739–2752.
- Martín, S. B., Morrow, J. R., Jackson, A. W., & Dunn, A. L. (2000). Variables related to meeting the ACSM/CDC physical activity guidelines. *Medicine & Science in Sports & Exercise*, 32, 2087–2092.
- Martín Ginis, K. A., Burke, S. M., & Gauvin, L. (2007). Exercising with others exacerbates the negative effects of mirrored environments on sedentary women's feeling states. *Psychology and Health*, 22, 945–962.
- Matsson, E., Larsson, U. E., & Rössner, S. (1997). Is walking for exercise too exhausting for obese women? *International Journal of Obesity*, 21, 380–386.
- McDougall, W. (1916). *An introduction to social psychology* (10th ed.). London: Methuen.
- McIntyre, J. L. (2000). Hume's passions: Direct and indirect. *Hume Studies*, 26, 77–86.
- McNair, D. M., Lorr, M., & Droppleman, L. F. (1971). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service.
- Mees, U., & Schmitt, A. (2008). Goals of action and emotional reasons for action: A modern version of the theory of ultimate psychological hedonism. *Journal for the Theory of Social Behavior*, 38, 157–178.
- Mellers, B. A. (2004). Pleasure, utility, and choice. In A. S. R. Manstead, N. Frijda, & A. Fischer (Eds.), *Feelings and emotions: The Amsterdam symposium* (pp. 282–300). New York: Cambridge University Press.
- Metzger, J. S., Catellier, D. J., Evenson, K. R., Treuth, M. S., Rosamond, W. D., & Siega-Riz, A. M. (2008). Patterns of objectively measured physical activity in the United States. *Medicine & Science in Sports & Exercise*, 40, 630–638.
- Miles, L. (2007). Physical activity and health. *Nutrition Bulletin*, 32, 314–363.
- Moore, B. A., & O'Donohue, W. T. (2008). Hedonic approach to pediatric and adolescent weight management. In W. T. O'Donohue, B. A. Moore, & B. J. Scott (Eds.), *Handbook of pediatric and adolescent obesity treatment* (pp. 143–151). New York: Routledge.
- Morgan, W. P. (1977). Involvement in vigorous physical activity with special reference to adherence. In L. I. Gedvilas & M. E. Kneer (Eds.), *Proceedings of the National College Physical Education Association for Men/National Association for Physical Education of College Women national conference* (pp. 235–246). Chicago, IL: National College Physical Education Association for Men.
- Morgan, W. P., & O'Connor, P. J. (1988). Exercise and mental health. In R. K. Dishman (Ed.), *Exercise adherence: Its impact on public health* (pp. 91–121). Champaign, IL: Human Kinetics.
- Morgan, W. P., Roberts, J. A., Brand, F. R., & Feinerman, A. D. (1970). Psychological effect of chronic physical activity. *Medicine and Science in Sports*, 2, 213–217.
- Morris, J. N. (1994). Exercise in the prevention of coronary heart disease: Today's best buy in public health. *Medicine & Science in Sports & Exercise*, 26, 807–814.
- Morrow, J. R., Jackson, A. W., Bazzarre, T. L., Milne, D., & Blair, S. N. (1999). A one-year follow-up to *Physical activity and health: A report of the Surgeon General*. *American Journal of Preventive Medicine*, 17, 24–30.
- Motl, R. W., Berger, B. G., & Leuschen, P. S. (2000). The role of enjoyment in the exercise–mood relationship. *International Journal of Sport Psychology*, 31, 347–363.
- Naqvi, N., Shiv, B., & Bechara, A. (2006). The role of emotion in decision making: A cognitive neuroscience perspective. *Current Directions in Psychological Science*, 15, 260–264.
- Neumark-Sztainer, D., Story, M., Hannan, P. J., Tharp, T., & Rex, J. (2003). Factors associated with changes in physical activity. *Archives of Pediatric and Adolescent Medicine*, 157, 803–810.
- Newsom, J. T., McFarland, B. H., Kaplan, M. S., Huguet, N., & Zani, B. (2005). The health consciousness myth: Implications of the near independence of major health behaviors in the North American population. *Social Science and Medicine*, 60, 433–437.
- Nichols, J. F., Wellman, E., Caparosa, S., Sallis, J. F., Calfas, K. J., & Rowe, R. (2000). Impact of a worksite behavioral skills intervention. *American Journal of Health Promotion*, 14, 218–221.
- Nies, M. A., & Moryka, C. L. (2006). Factors contributing to women's ability to maintain a walking program. *Journal of Holistic Nursing*, 24, 7–14.
- Nigg, C. R., Borrelli, B., Maddock, J., & Dishman, R. K. (2008). A theory of physical activity maintenance. *Applied Psychology*, 57, 544–560.
- Nijs, J., De Meirleir, K., & Duquet, W. (2004). Kinesiophobia in chronic fatigue syndrome: Assessment and associations with disability. *Archives of Physical Medicine and Rehabilitation*, 85, 1586–1592.

- O'Brien Cousins, S. (2000). "My heart couldn't take it": Older women's beliefs about exercise benefits and risks. *Journal of Gerontology*, 55B, P283-P294.
- Ochsner, K. N. & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences*, 9, 242-249.
- Ochsner, K. N. & Gross, J. J. (2008). Cognitive emotion regulation: Insights from social cognitive and affective neuroscience. *Current Directions in Psychological Science*, 17, 153-158.
- Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. New York: Oxford University Press.
- Panksepp, J., & Panksepp, J. B. (2000). The seven sins of evolutionary psychology. *Evolution and Cognition*, 6, 108-131.
- Parfitt, G., & Hughes, S. (2009). The exercise intensity-affect relationship: Evidence and implications for exercise behavior. *Journal of Exercise Science & Fitness*, 7, S34-S41.
- Parfitt, G., Rose, E. A., & Burgess, W. M. (2006). The psychological and physiological responses of sedentary individuals to prescribed and preferred intensity exercise. *British Journal of Health Psychology*, 11, 39-53.
- Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., ... Wilmore, J. A. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association*, 273, 402-407.
- Pedersen, B. K., & Saltin, B. (2006). Evidence for prescribing exercise as therapy in chronic disease. *Scandinavian Journal of Medicine and Science in Sports*, 16(Suppl. 1), 3-63.
- Plato (trans. 1997). Republic (G. M. A. Grube & C. D. C. Reeve, Trans.). In J. M. Cooper (Ed.), *Plato: Complete works* (pp. 971-1223). Indianapolis, IN: Hackett.
- Pollock, M. L. (1978). How much exercise is enough? *Physician and Sportsmedicine*, 6, 50-64.
- Pollock, M. L., Wilmore, J. H., & Fox, S. M. (1978). *Health and fitness through physical activity*. New York: John Wiley & Sons.
- Prochaska, J. O., & DiClemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research & Practice*, 19, 276-288.
- Prochaska, J. O., Redding, C. A., & Evers, K. E. (2008). The transtheoretical model and stages of change. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research, and practice* (4th ed., pp. 97-121). San Francisco: Jossey-Bass.
- Prochaska, J. O., Velicer, W. F., Rossi, J. S., Goldstein, M. G., Marcus, B. H., Rakowski, W., ... Rossi, S. R. (1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychology*, 13, 39-46.
- Quirk, G. J., & Beer, J. S. (2006). Prefrontal involvement in the regulation of emotion: Convergence of rat and human studies. *Current Opinion in Neurobiology*, 16, 723-727.
- Raedeke, T. D. (2007). The relationship between enjoyment and affective responses to exercise. *Journal of Applied Sport Psychology*, 19, 105-115.
- Redelmeier, D. A., & Kahneman, D. (1996). Patients' memories of painful medical treatments: Real-time and retrospective evaluations of two minimally invasive procedures. *Pain*, 66, 3-8.
- Redelmeier, D. A., Katz, J., & Kahneman, D. (2003). Memories of colonoscopy: A randomized trial. *Pain*, 104, 187-194.
- Reed, J., & Ones, D. S. (2006). The effect of acute aerobic exercise on positive activated affect: A meta-analysis. *Psychology of Sport and Exercise*, 7, 477-514.
- Rhodes, R. E., Fiala, B., & Conner, M. (2009). A review and meta-analysis of affective judgments and physical activity in adult populations. *Annals of Behavioral Medicine*, 38, 180-204.
- Rhodes, R. E., & Nigg, C. R. (2011). Advancing physical activity theory: A review and future directions. *Exercise and Sport Sciences Reviews*, 39, 113-119.
- Robbins, L. B., Pis, M. B., Pender, N. J., & Kazanis, A. S. (2004). Exercise self-efficacy, enjoyment, and feeling states among adolescents. *Western Journal of Nursing Research*, 26, 699-715.
- Robinson, T. E., & Berridge, K. C. (2008). The incentive sensitization theory of addiction: Some current issues. *Philosophical Transactions of the Royal Society of London, Series B*, 363, 3137-3146.
- Roemmich, J. N., Barkley, J. E., Lobarinas, C. L., Foster, J. H., White, T. M., & Epstein, L. H. (2008). Association of liking and reinforcing value with children's physical activity. *Physiology and Behavior*, 93, 1011-1018.
- Rolls, E. T. (2007). Understanding the mechanisms of food intake and obesity. *Obesity Reviews*, 8(Suppl. 1), 67-72.
- Rose, E. A., & Parfitt, G. (2007). A quantitative analysis and qualitative explanation of the individual differences in affective responses to prescribed and self-selected exercise intensities. *Journal of Sport and Exercise Psychology*, 29, 281-309.
- Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, 15, 175-183.
- Roshanaci-Moghaddam, B., Katon, W. J., & Russo, J. (2009). The longitudinal effects of depression on physical activity. *General Hospital Psychiatry*, 31, 306-315.
- Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, 110, 145-172.
- Sabiston, C. M., Bruner, J., Kowalski, K. C., Wilson, P. M., Mack, D. E., & Crocker, P. R. E. (2010). The role of body-related self-conscious emotions in motivating women's physical activity. *Journal of Sport and Exercise Psychology*, 32, 417-437.
- Sallis, J. F., & Hovell, M. F. (1990). Determinants of exercise behavior. *Exercise and Sport Sciences Reviews*, 18, 307-330.
- Sallis, J. F., & Owen, N. (1999). *Physical activity and behavioral medicine*. Thousand Oaks, CA: Sage.
- Schneider, M., Dunn, A., & Cooper, D. (2009). Affect, exercise, and physical activity among healthy adolescents. *Journal of Sport and Exercise Psychology*, 31, 706-723.
- Schneider Jamner, M., Spruit-Metz, D., Bassin, S., & Cooper, D. M. (2004). A controlled evaluation of a school-based intervention to promote physical activity among sedentary adolescent females: Project FAB. *Journal of Adolescent Health*, 34, 279-289.
- Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology*, 57, 1-29.
- Schwarzer, R., Luszczynska, A., Ziegelmann, J. P., Scholz, U., & Lippke, S. (2008). Social-cognitive predictors of physical exercise adherence: Three longitudinal studies in rehabilitation. *Health Psychology*, 27, S54-S63.
- Shephard, R. J. (1988). Exercise adherence in corporate settings: Personal traits and program barriers. In R. K. Dishman (Ed.),

- Exercise adherence: Its impact on public health* (pp. 305–319). Champaign, IL: Human Kinetics.
- Sheppard, K. E., & Parfitt, G. (2008). Patterning of physiological and affective responses during a graded exercise test in sedentary men and boys. *Journal of Exercise Science & Fitness*, 6, 121–129.
- Shiv, B., & Fedorikhin, A. (1999). Heart and mind in conflict: The interplay of affect and cognition in consumer decision making. *Journal of Consumer Research*, 26, 278–292.
- Shiv, B., & Fedorikhin, A. (2002). Spontaneous versus controlled influences of stimulus-based affect on choice behavior. *Organizational Behavior and Human Decision Processes*, 87, 342–370.
- Shiv, B., Fedorikhin, A., & Nowlis, S. M. (2005). Interplay of the heart and the mind in decision-making. In S. Ratneswar & D. G. Mick (Eds.), *Inside consumption: Consumer motives, goals, and desires* (pp. 166–184). London: Routledge.
- Simon, H. A. (1983). *Reason in human affairs*. Stanford, CA: Stanford University Press.
- Slade, S. C., Molloy, E., & Keating, J. L. (2009). People with chronic low back pain who have participated in exercise programs have preferences about exercise: A qualitative study. *Australian Journal of Physiotherapy*, 55, 115–121.
- Slooman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119, 3–22.
- Slovic, P. (2001). Cigarette smokers: Rational actors or rational fools? In P. Slovic (Ed.), *Smoking: Risk, perception, and policy* (pp. 97–124). Thousand Oaks, CA: Sage.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 397–420). New York: Cambridge University Press.
- Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision-making. *Health Psychology*, 24, S35–S40.
- Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2007). The affect heuristic. *European Journal of Operational Research*, 177, 1333–1352.
- Sober, E., & Wilson, D. S. (1998). *Unto others: The evolution and psychology of unselfish behavior*. Cambridge, MA: Harvard University Press.
- Sorensen, M. (2006). Motivation for physical activity of psychiatric patients when physical activity was offered as part of treatment. *Scandinavian Journal of Medicine and Science in Sports*, 16, 391–398.
- Spencer, H. (1879). *The data of ethics*. New York: Appleton.
- Spencer, H. (1905). *The principles of psychology* (3rd ed., Vol. 1). New York: Appleton.
- Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, 23, 645–726.
- Stetson, B. A., Rahn, J. M., Dubbert, P. M., Wilner, B. I., & Mercury, M. G. (1997). Prospective evaluation of the effects of stress on exercise adherence in community-residing women. *Health Psychology*, 16, 515–520.
- Stevens, M., Lammin, K. A. P. M., van Heuvelen, M. J. G., de Jong, J., & Rispen, P. (2003). Gronningen Active Living Model (GALM): Stimulating physical activity in sedentary older adults: Validation of the behavioral change model. *Preventive Medicine*, 37, 561–570.
- Stones, M. J., Kozma, A., & Stones, L. (1987). Fitness and health evaluations by older exercisers. *Canadian Journal of Public Health*, 78, 18–20.
- Stroebe, W., Papies, E. K., & Aarts, K. (2008). From homeostatic to hedonic theories of eating: Self-regulatory failure in food-rich environments. *Applied Psychology*, 57, 172–193.
- Svenson, O. (2003). Values, affect, and processes in human decision making: A differentiation and consolidation theory perspective. In S. L. Schneider & J. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 287–326). New York: Cambridge University Press.
- Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. New York: Macmillan.
- Tierney, S., Mamas, M., Skelton, D., Woods, S., Rutter, M. K., Gibson, M., ... Deaton, C. (2011). What can we learn from patients with heart failure about exercise adherence? A systematic review of qualitative papers. *Health Psychology*, 30, 401–410.
- Troiano, R. P., Berrigan, D., Dodd, K. W., Mâsse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometers. *Medicine & Science in Sports & Exercise*, 40, 181–188.
- Trost, S. G., Owen, N., Bauman, A. E., Sallis, J. F., & Brown, W. (2002). Correlates of adults' participation in physical activity: Review and update. *Medicine & Science in Sports & Exercise*, 34, 1996–2001.
- Vanden Auweele, Y., Rzewnicki, R., & van Mele, V. (1997). Reasons for not exercising and exercise intentions: A study of middle-aged sedentary adults. *Journal of Sports Sciences*, 15, 151–165.
- 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.
- Vara, L. S., & Epstein, L. H. (1993). Laboratory assessment of choice between exercise or sedentary behaviors. *Research Quarterly for Exercise and Sport*, 64, 356–360.
- Varey, C., & Kahneman, D. (1992). Experiences extended across time: Evaluation of moments and episodes. *Journal of Behavioral Decision Making*, 5, 169–185.
- Wankel, L. M. (1985). Personal and situational factors affecting exercise involvement: The importance of enjoyment. *Research Quarterly for Exercise and Sport*, 56, 275–282.
- Wankel, L. M. (1993). The importance of enjoyment to adherence and psychological benefits from physical activity. *International Journal of Sport Psychology*, 24, 151–169.
- Warburton, D. E. R., Katzmarzyk, P. T., Rhodes, R. E., & Shephard, R. J. (2007). Evidence-informed physical activity guidelines for Canadian adults. *Applied Physiology, Nutrition, and Metabolism*, 32, S16–S68.
- Watson, J. (1895). *Hedonistic theories from Aristippus to Spencer*. New York: Macmillan.
- Weber, E. U., & Johnson, E. J. (2009). Mindful judgment and decision making. *Annual Review of Psychology*, 60, 53–85.
- Welch, A. S., Hulley, A., Ferguson, C., & Beauchamp, M. R. (2007). Affective responses of inactive women to a maximal incremental exercise test: A test of the dual-mode model. *Psychology of Sport and Exercise*, 8, 401–423.
- West, H. R. (2004). *An introduction to Mill's utilitarian ethics*. New York: Cambridge University Press.

- Wilcox, S., Oberrecht, L., Bopp, M., Kammermann, S. K., & McElmurray, C. T. (2005). A qualitative study of exercise in older African American and white women in rural South Carolina: Perceptions, barriers, and motivations. *Journal of Women and Aging, 17*, 37-53.
- Williams, D. M. (2008). Exercise, affect, and adherence: An integrated model and a case for self-paced exercise. *Journal of Sport and Exercise Psychology, 30*, 471-496.
- Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise, 9*, 231-245.
- Wilson, P. M., Mack, D. E., Blanchard, C. M., & Gray, C. E. (2009). The role of perceived psychological need satisfaction in exercise-related affect. *Hellenic Journal of Psychology, 6*, 183-206.
- Wilson, P. M., Rodgers, W. M., Blanchard, C. M., & Gessell, J. (2003). The relationship between psychological needs, self-determined motivation, exercise attitudes, and physical fitness. *Journal of Applied Social Psychology, 33*, 2373-2392.
- Yeung, R. R., & Hemsley, D. R. (1997a). Exercise behaviour in an aerobics class: The impact of personality traits and efficacy cognitions. *Personality and Individual Differences, 23*, 425-431.
- Yeung, R. R., & Hemsley, D. R. (1997b). Personality, exercise and psychological well-being: Static relationships in the community. *Personality and Individual Differences, 22*, 47-53.
- Young, P. T. (1959). The role of affective processes in learning and motivation. *Psychological Review, 66*, 104-125.
- Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*, 151-175.



OXFORD LIBRARY OF PSYCHOLOGY

Editor in Chief PETER E. NATHAN

The Oxford Handbook of Exercise Psychology

Edited by

Edmund O. Acevedo

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

Oxford University Press, Inc., publishes works that further
Oxford University's objective of excellence
in research, scholarship, and education.

Oxford New York
Auckland Cape Town Dar es Salaam Hong Kong Karachi
Kuala Lumpur Madrid Melbourne Mexico City Nairobi
New Delhi Shanghai Taipei Toronto

With offices in
Argentina Austria Brazil Chile Czech Republic France Greece
Guatemala Hungary Italy Japan Poland Portugal Singapore
South Korea Switzerland Thailand Turkey Ukraine Vietnam

Copyright © 2012 by Oxford University Press, Inc.

Published by Oxford University Press, Inc.
198 Madison Avenue, New York, New York 10016
www.oup.com

Oxford is a registered trademark of Oxford University Press

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted, in any form or by any means,
electronic, mechanical, photocopying, recording, or otherwise,
without the prior permission of Oxford University Press

Library of Congress Cataloging-in-Publication Data
The Oxford handbook of exercise psychology / edited by Edmund O. Acevedo.
p. cm. — (Oxford library of psychology)
ISBN-13: 978-0-19-539431-3 (acid-free paper)
ISBN-10: 0-19-539431-3 (acid-free paper)
1. Exercise—Psychological aspects. 2. Physical fitness—Psychological aspects.
I. Acevedo, Edmund O.
GV481.2.O94 2012
613.71—dc23
2011037048

9 8 7 6 5 4 3 2 1
Printed in the United States of America
on acid-free paper