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PLEASURE FROM THE EXERCISING BODY

Two centuries of changing outlooks in psychological thought

Panteleimon Ekkekakis

> The mere exertion of the muscles after long rest or confinement is in itself a pleasure, as we ourselves feel, and as we see in the play of young animals.
>
> (Darwin, 1872, p. 77).

Researchers working on the effects of physical activity on mental health often express puzzlement, even frustration, that physical activity is not recognized more widely as a *bona fide* mental health intervention in spite of mounting evidence. Attempts to probe the causes of this phenomenon typically reveal two contributing factors, namely a hypercritical treatment of the evidence (e.g., Mead et al., 2009) and, perhaps surprisingly, a lack of awareness of the evidence. For example, when Faulkner and Biddle (2001) asked directors of doctoral training programs in clinical psychology in England about their perceptions of the role of exercise in mental health, one striking finding was their "extremely limited" (p. 439) awareness of relevant studies. One program director remarked: "We might want to ask the question, if there's evidence for exercise, why is noone mentioning it? That would be a more interesting question to us, to be honest" (p. 439). Critiquing a research literature on conceptual and methodological grounds, and choosing to accept or reject its findings on that basis, is perfectly reasonable. In fact, it is the basis of responsible evidence-based practice. So, of the two contributing factors, the former is scientifically warranted and potentially fruitful, in that it can stimulate efforts to further improve the quality of the evidence base (Ekkekakis, 2008). The latter, however, is a different issue altogether. Choosing to ignore an entire literature, or claiming that it does not exist, cannot be construed as either helpful or healthy (Ekkekakis & Backhouse, 2009). Therefore, a contemplation of the historical processes that led to the current situation may prove enlightening.

Like most scientific disciplines, psychology is not immune to the problem of faltering memory (Watson, 1960). The frame of reference for past research and theorizing typically extends over a period of a few years, not decades or centuries. What probably drives this phenomenon is the assumption that the size of the evidence base and the sophistication of theories grow following a monotonic and more-or-less linear trajectory. In other words, there is a belief that there is no backtracking or looping in how scientific knowledge evolves over time. If this were so, being aware of only the latest empirical and theoretical literature would suffice, as that would encapsulate the accumulated experience of the past. In reality, however, the topics, the methods, and the interpretive frameworks that science utilizes at a particular historical juncture are dictated

by Kuhnian paradigms, which are ephemeral and often non-cumulative (Kuhn, 1962/1996). Psychology is no exception (Robins, Gosling, & Craik, 1999).

This chapter traces the history of references to the exercise–pleasure relationship in psychological works since the mid-1800s. The goal of this review is to answer the intriguing question posed by the anonymous director of the clinical psychology program, namely "why is noone mentioning [exercise]"? The crucial role of shifting paradigmatic perspectives in shaping the attitudes toward exercise within the field of psychology should become apparent. In particular, readers should recognize the non-cumulative, even regressive and cyclical, nature of the knowledge development process, a phenomenon that can be attributed directly to the changing paradigms. Finally, a synopsis of what is presently known about the exercise–pleasure relationship is provided.

Alexander Bain (1818–1903)

In the second half of the nineteenth and the early part of the twentieth century, the nascent field of psychology fully embraced the idea of a close relationship between exercise and pleasure. Scottish philosopher Alexander Bain (1855), in his opus entitled "Senses and the Intellect," published a remarkably detailed and insightful analysis of the "feelings of muscular exercise." For Bain, a logician considered one of the forefathers of the scientific psychology of the twentieth century, this interest in exercise was not merely a fortuitous occurrence. He believed that demonstrating a close link between a physical act, such as bodily movement, and a sensory perception or an emotional response would safeguard psychology against critics eager to accuse it of dealing solely with immaterial or metaphysical phenomena.

According to Bain (1855), provided that someone is healthy and adequately rested, exercise induces "a feeling of vigor, strength, or intense vitality" (p. 92). Along with the overall state of good health that ensues from exercise, these feelings account "for a considerable portion of the sum of human pleasure" (p. 92). Echoing the hedonistic ideas of the British Utilitarians, such as Jeremy Bentham (1748–1832) and John Stuart Mill (1806–1873), Bain believed strongly in the "deep-seated bond which connects feeling with action" (p. 102): "When we descend into the gymnastic arena to convert surplus energy into pleasure, the conscious state [the pleasure] is then the spur and guide of our action. We continue our exercise while the pleasure lasts, and cease when it ceases" (p. 98). In fact, Bain believed that human beings have an inherent propensity for exercise: "without any conscious end, in other words, without our willing it, action commences when the body is refreshed and invigorated" (p. 250). Moreover, if this spontaneous tendency is resisted, as in the case of a child not allowed to play or a person imprisoned in a cell, "intense uneasiness or craving is felt" (p. 251). Thus, Bain wrote of a "necessity of bodily exercise [which is] felt by everyone, and most of all by the young" (p. 78).

At the same time, Bain recognized that the pleasure of exercise is not universal but rather conditional. This feeling is at its highest when there is "concurrence of youth with high muscular energy, or the athletic constitution at its prime" (p. 99). Under these conditions, "the pleasure will be very great indeed, and the volitional promptings to keep it up equally great" (p. 99). On the other hand, "with the generality of men, however, the same strong terms cannot be applied to describe this species of emotion, which in them sinks down to a second or third-rate pleasure" (p. 99). In turn, this may explain "the utter neglect of physical exercise as a habitual element of life" (p. 95).

Furthermore, Bain pointed out that the nature of the feelings may change depending on the intensity of the activity. Under most circumstances, "we may derive the greatest amount of pleasurable sensibility, at the least cost of exertion, through the means of well-concerted slow

movements"; this is because "the emotional state is not overwhelmed by the expenditure of active power, and hence the enjoyment is keen" (p. 101). The benefits of slow activity include "soothing down a morbid excitement," "preparing the way for absolute repose," and restoring tranquility after a bustling day (p. 102). However, "slow movements are entirely out of keeping with a fresh and active bodily tone"; they may even be "repugnant and intolerable in such a situation" (p. 102).

Fast or high-intensity movements, on the other hand, have the "tendency to excite and inflame the system into a still more intense condition, such as we term elation, animal spirits, with boisterous manifestations" (p. 103). For example, "in a rapid walk, still more in a run, the consciousness is excited, the gesticulations and speech are rapid, the features betray a high tension. The increase of emotional fervor must be attributed to an exalted condition of the nervous system, of the kind produced by intoxicating stimulants in general" (p. 104). A similar example is "the gleesome and joyous excitement of the young in the midst of their active sports" (p. 98); in this case, "the pleasurable stimulus of exertion diffuses itself over the whole system, lighting up the features with gaiety and mirth, and prompting the vocal organs to cries of delight" (p. 98).

Importantly, Bain, showing his sensitivity to "differences of individual character" (p. 95) pointed out that it is "easier in some temperaments than in others, to perform rapid movements with coolness" (p. 104). He noted that "it is one of the peculiarities of what is called the nervous temperament, or a nervous system naturally prone to vigorous exertion [. . .] to expend itself copiously in all its efforts" (p. 328). Although he recognized that physiological differences in the muscles can explain some of this proneness to vigorous exertion, he insisted that "the power of continuing the exercise without fatigue" (p. 328) is ultimately due to the nervous system: "I must account the quality of the muscle of far inferior importance, and indeed quite trifling in comparison with the quality of the nervous framework" (p. 329).

If intense effort is continued for too long, the pleasure "changes into pain" (p. 97), the "pain of fatigue" (p. 108). In contradistinction to "ordinary fatigue" which Bain considered pleasant, this "over-fatigue" produces "acute pains of various degrees of intensity, from the easily endurable up to severe suffering" (p. 91). As the function of pleasure was to encourage and sustain movement, the function of fatigue is to force its termination: "The peculiarity of the state being exhaustion consequent on exercise, it naturally follows that a cessation of activity should be one of the accompanying circumstances of the feeling. As a mere physical fact, fatigue would lead to inaction. Thus there would be a discouragement to new effort" (p. 93).

James Mark Baldwin (1861–1934)

Baldwin was one of the most prominent psychologists in North America around the turn of the twentieth century. He was a key figure in the establishment of the American Psychological Association (and its sixth president), co-founder (with James McKeen Cattell) of the *Psychological Review*, and the founding editor of the *Psychological Bulletin* (later passing the editorship to John B. Watson).

In the second volume of his highly acclaimed *Handbook of Psychology*, subtitled "Feeling and Will," Baldwin (1891) addressed the relationship between exercise and pleasure, noting that "muscular sensations are pleasurable within the range of easy effort" (p. 120). This is based on the general principle that, when an activity is of moderate intensity and well-matched to the properties of the muscles involved, it tends to be pleasant. If the intensity or duration of exercise exceeds the moderate range, then we experience "the pains of fatigue" (p. 121). Agreeing with Bain, Baldwin considered the pleasure associated with exercise among the most enthralling elements in human experience: "these pleasures of activity, such as pleasures of the chase, of

sports, of general vigor, are more positive apparently than any other sensuous pleasures" (p. 120). Also in agreement with Bain, Baldwin accepted that the notion of an inherent propensity for exercise:

> After confining myself to my writing-table all the morning, my attention loses its elasticity and readiness of concentration: but my muscular system begins to feel an overabundance of energy, a pressing readiness for exercise. And when I give up my intellectual task and indulge my craving for exercise, I have a peculiar feeling of throwing off the mental weight, of getting rid of the thraldom of ideas, in the easy enjoyment of muscular activity.
>
> *(p. 287)*

As was the case with most intellectuals of his time, Baldwin's thinking was greatly affected by the theory of evolution. His *Mental Development in the Child and the Race*, first published in 1894, reflects influences from Darwin's *On the Origin of Species* (published in 1859) and *The Expression of the Emotions in Man and Animals* (published in 1872), as well as the elaboration of the implications of evolutionary ideas for psychology in the revised edition of Herbert Spencer's *Principles of Psychology* (published in 1873). The framework of the theory of evolution enabled Baldwin to explore the broader significance of the effects of exercise on pleasure, in essence providing, for the first time, an answer to the "why" question: why is exercise pleasurable?

According to Baldwin (1894), organisms exhibit an innate "susceptibility to certain organic stimulations, such as food, oxygen, etc." (p. 191). When the need for these "stimulations" is satisfied, pleasure occurs. Pleasure brings forth a "heightened central vitality" which, in turn, results in a "motor excess discharge," manifested in "abundant and varied movements" (p. 191). Of those movements, however, there is a tendency to select those "which bring more of these vital stimulations again; and these finally keep up the vitality of the organism" (p. 191). Exercise, according to Baldwin, is pleasant because it is vitally beneficial for the organism: "In as far as the exercise of muscle in high organisms, or the mere fact of contractility itself in the lower, is vitally good, in so far as it also gives pleasure, and this pleasure serves to issue in excess discharge to the same regions again" (p. 191). Along the same line, Baldwin (1891) wrote in *Feeling and Will*: "Nature's design is that the heart should beat regular and strong. She secures this by my enjoyment of physical exercise" (p. 232). Therefore, exercise is pleasant because it is useful; the function of the pleasure exercise produces is to encourage more exercise.

William James (1842–1910)

In 1890, William James published his *Principles of Psychology*, which he had begun writing in 1878. The two-volume textbook became one of the most widely read psychological texts of all time. In 1892, James was encouraged by the administration of Harvard to organize seminars for teachers, highlighting the connection between psychology and education. Not surprisingly for someone of James' charisma and intellectual renown, the lectures were hugely popular. The transcriptions were published as magazine articles and finally in book form in 1899 under the title *Talks to Teachers on Psychology and to Students on Some of Life's Ideals*.

In one lecture to students, entitled "The Gospel of Relaxation," James (1899) addressed the role of exercise in improving how people feel. What is unique in James' treatment of the subject is that he placed his remarks within the context of his famous theory of emotion. Challenging the conventional view, James had proposed that the experience of emotion consists of the perception of the physiological and behavioral changes that occur upon exposure to a relevant

stimulus: "our emotions are mainly due to those organic stirrings that are aroused in us in a reflex way by the stimulus of the exciting object or situation" (p. 199). For James, this meant that, if the theory is true (and, for him, "it is certain that the main core of it is true," p. 200), there are clear implications for the regulation of emotional reactions: "were this bodily commotion suppressed, we should not so much feel fear as call the situation fearful; we should not feel surprise, but coldly recognize that the object was indeed astonishing" (pp. 199–200). The therapeutic potential of this approach is considerable because what one does is under direct volitional control: "by regulating the action, which is under the more direct control of the will, we can indirectly regulate the feeling, which is not" (p. 201).

Although the role that James saw for exercise as a therapeutic modality was becoming apparent at this point of his lecture, he took his reasoning a step further by making a surprising reference to psychoanalytic theory (at a time when Freud and his ideas were still unknown in North America). He endorsed the view that "bodily discomforts . . . breed a general self-mistrust and sense that things are not as they should be" (p. 203) and these, in turn, form the causal basis of an unhealthy mind. With this, he was ready to begin laying out his views on exercise: "Consider, for example, the effects of a well-toned motor-apparatus, nervous and muscular, on our general personal self-consciousness, the sense of elasticity and efficiency that results" (p. 204). He presented several interesting examples. Because of skiing, Norwegian women, who used to be "sedentary fireside tabby-cats," were transformed into "lithe and audacious creatures, for whom no night is too dark or height too giddy, and who are not only saying good-bye to the traditional feminine pallor and delicacy of constitution, but actually taking the lead in every educational and social reform" (pp. 204–205). Similarly, "the strength of the British Empire . . . is perennially nourished and kept up by nothing so much as by the national worship, in which all classes meet, of athletic outdoor life and sport" (p. 205).

Finally, concerned about the prospect of a technological future that "will more and more require mental power from us, and less and less will ask for bare brute strength" (p. 206), James (1899) said the following about the importance of exercise and physical fitness:

> I cannot believe that our muscular vigor will ever be a superfluity. Even if the day ever dawns in which it will not be needed for fighting the old heavy battles against Nature, it will still always be needed to furnish the background of sanity, serenity, and cheerfulness to life, to give moral elasticity to our disposition, to round off the wiry edge of our fretfulness, and make us good-humored and easy of approach. Weakness is too apt to be what the doctors call irritable weakness. And that blessed internal peace and confidence, that *acquiescentia in seipso*, as Spinoza used to call it, that wells up from every part of the body of a muscularly well-trained human being, and soaks the indwelling soul of him with satisfaction, is, quite apart from every consideration of its mechanical utility, an element of spiritual hygiene of supreme significance.
>
> *(p. 207)*

The personal significance of these strong words is better understood by taking into account two facts about James' own life. First, he had been having recurring bouts of severe and debilitating depression since the late 1860s. Second, he had started having problems with his heart a year earlier, in 1898. These problems eventually led to his death of cardiac failure in 1910, at the age of 68.

The era of behaviorism

Since the early 1890s, William James had been looking for a way out of academic psychology. The reason was that North American psychology was changing in a direction that left him uninspired. The "reflexology" pioneered by Ivan Pavlov and the experimental approach of Wilhelm Wundt were proving enormously influential, as they were seen as offering psychology, only recently divorced from philosophy, a path toward scientific legitimacy. At the dawn of the twentieth century, behaviorism, spearheaded by Edward Thorndike and John B. Watson, became the dominant paradigm. This meant the eradication of subjective constructs, such as pleasure, from the range of topics considered acceptable for scientific study. Exercise, mostly in the form of runway and maze running in animal learning experiments, was treated almost exclusively as an observable dependent variable. In the few cases in which it was used as an independent variable, exercise was presumed to represent a means of inducing arousal.

What is astonishing in the studies published during the early part of the twentieth century is how complete the disregard for the introspection-based theorizing of the late nineteenth century was. The slate was wiped clean and psychologists started "discovering" behavioral phenomena and speculating about their causes entirely anew, as if nothing had been said about them before. For example, it was not long after the systematic observation of rodent behavior began that investigators noticed that animals would run "spontaneously," without being coerced by an extrinsic factor such as food. This was an anomalous observation for the behaviorist paradigm; movement without a readily apparent objective, such as the approach of food or the avoidance of shock, did not make sense. While searching for the "internal stimulus" of this inexplicable behavior, attention was initially directed to such factors as "age, hunger and diet, and hormones" (Shirley, 1929, p. 342).

It was not until the 1950s (Kagan & Berkun, 1954) and 1960s (Hundt & Premack, 1963) that running was openly characterized as "rewarding" or "reinforcing," essentially (though not directly) recognizing once again the ability of exercise to produce pleasure. Several authors (e.g., Hill, 1956) also suggested that there may be an inherent drive for "activity." On one hand, this was an acknowledgment that there is an intrinsic propensity for physical activity, but, on the other, by invoking the concept of "drive," researchers were able to avoid the question of the processes that mediate this propensity and thus any direct reference to subjective factors (i.e., pleasure).

The era of cognitivism

Between the 1960s and the 1980s, psychology witnessed the advent of the cognitive revolution and the shift to a new dominant paradigm. Although this new paradigm was more accepting of subjective states, its attitude toward the body reflected varying degrees of neglect.

Two related trends are evident during the period of cognitivism with respect to how bodily activation, including activation induced by exercise, was viewed. According to one of these perspectives, information from the body has no inherent affective meaning; it only acquires meaning following a process of cognitive appraisal. Thus, afferent information generated from the exercising body is viewed as undifferentiated, diffuse, and highly malleable, such that the same physiological condition can be experienced as pleasant or unpleasant, depending on the outcome of the cognitive appraisal. According to the second perspective, pleasant and unpleasant affective responses emanating from the body are so automated and reflex-like that they are of little or no interest as psychological phenomena.

The origins of these ideas can be traced to Walter Cannon's (1915, 1927) critique of the theory of emotion proposed by William James. Cannon's critique was five-fold: (a) separation

of the viscera from the central nervous system does not alter emotional behavior in experimental animals, (b) the same visceral changes occur in very different emotional, as well as non-emotional, states, (c) the viscera are relatively insensitive structures, (d) visceral changes are too slow to be a source of emotional feelings, and (e) artificial induction of visceral changes typical of certain emotions does not produce these emotions in a manner felt as experientially identical.

Based on these points, Stanley Schachter and Jerome Singer (1962) conducted a study showing that physiological arousal, induced by infusions of epinephrine, could be associated with diverse emotions such as euphoria and anger, following an appropriate cognitive manipulation. The results of this experiment, which was, of course, delimited to specific emotions, epinephrine dosages, experimental manipulations, and participants, led Schachter (1964) to draw some rather grand generalizations: "Cognitions arising from the immediate situation as interpreted by past experience provide the framework within which one understands and labels his feelings. It is the cognition which determines whether the state of physiological arousal will be labeled 'anger,' 'joy,' or whatever" (p. 51). Despite the limitations of the study itself, the idea that physiological arousal provides nothing but an amorphous substrate that can be readily manipulated by cognitive "labeling" became very popular. The timing of the study, in 1962, as the cognitive revolution was gaining momentum, probably played a crucial role in this regard.

Thus, in the 1970s, the same essential idea found expression in Dolf Zillmann's notion of "excitation transfer." Since physiological arousal was seen as devoid of inherent affective meaning, Zillmann, Katcher, and Milavsky (1972) proposed that high "excitation" generated by exercise (cycling) could be "transferred" to intensify subsequent retaliatory aggressive behavior following a provocation scenario. Exercise-induced "excitation" was "conceived of as [nothing more than] general drive or energy" (p. 249). Zillmann and Bryant (1974) found that the intensification of aggressive behavior is still observable if the exercise-induced "excitation" has subsided by the time the opportunity for retaliatory aggression is given, as long as it was present during the provocation. In subsequent refinements of the "excitation transfer" idea, however, it was emphasized that the transfer effect does not appear as long as the individual can still consciously perceive the exercise-induced excitation and correctly attribute it to the preceding exercise (Cantor, Zillmann, & Bryant, 1975; Zillmann, Johnson, & Day, 1974). Furthermore, because highly physically fit individuals recover quickly from exercise, they are unlikely to manifest a transfer effect (Zillmann et al., 1974). Nevertheless, echoing Cannon, Zillmann hastened to clarify that the absence of a transfer effect immediately post-exercise "is not to say that [the participant] receives highly specific, reliable feedback [from the body]" (p. 504). Instead, the explanations that were offered were that "the subjects may have been preoccupied with 'catching their breath' [or] the intense arousal they experienced distracted them" (p. 513). Likewise, the finding that "the physically most fit persons proved to be the least susceptible to behavior-modifying transfer effects" was attributed to the fact that "they had best recovered from the induced state of sympathetic arousal" (p. 514). Nevertheless, Zillmann et al. did recognize that "provoked subjects enjoying excellent fitness displayed the least aggressive behavior, and those showing the poorest fitness displayed the most," noting that the possibility that "persons of superior fitness are emotionally more secure . . . cannot be ruled out at present" (p. 514).

By the 1980s, cognitivism was reinforced by the parallel rise of other movements with which it shared a strong skepticism toward physicalism, namely postmodernism and social constructionism. With their emphasis on social and cultural environments, these movements had grown increasingly disembodied (Cromby, 2004), extending the distance between the physical body and lived experience: "Such movements [of the body] surely cannot in themselves be our thoughts, the content of our inner lives? Whereas our bodily reactions and responses constitute the indeterminate beginnings of our thoughts and intentions, our perceptions and understandings,

they become determinate only in our voicing of them in relation to a form of life" (Shotter, 1997, p. 19). As soon as social constructionism gained a footing in psychology (Gergen, 1985), it found proponents in the study of emotion. As the balance of interest tilted heavily toward culturally framed social emotions, the importance attributed to bodily processes diminished, installing a cognitive homunculus to a commanding position as monitor, data analyst, and executive officer. According to Averill (1980), "[bodily] feedback is subject to second-order monitoring . . . and it is the monitoring that determines the quality of experience, not the feedback per se" (p. 317).

In certain theories of emotion developed during the period of cognitivism, pleasant and unpleasant states emanating from the body in response to such stimuli as heat or warmth, coldness or coolness, starvation, dehydration, pain, or exercise were recognized as evolutionary forerunners to social emotions. However, these states were either theorized to occur only following a cognitive analysis and interpretation, even a rudimentary one, or they were considered of limited or no interest from a psychological perspective. For example, Scherer (1984) recognized that "even internally generated sensations" can be "emotion producing stimuli" but, for this to happen, they must be subjected to an appraisal process consisting of "a very rapidly occurring sequence of hierarchically organized stimulus processing steps" (p. 306). Following a first check for the novelty or unexpectedness of the stimulus, the second check "consists of the evaluation of the intrinsic pleasantness or unpleasantness of a stimulus which causes the organism to experience pleasure or distress" (p. 307).

Because Scherer (1984) noted that "this check has to do with the inherent pleasantness or unpleasantness of a stimulus, and is not dependent on its relevance to the goals of an organism at that particular moment" (p. 307), Lazarus rejected the characterization of this type of check as part of the "appraisal" process. Lazarus opted instead to classify "inherent pleasantness and unpleasantness" as mere perceptions: "pleasant and unpleasant sensations (e.g., being touched in a particular way or muscle fatigue) . . . should be regarded as perceptual information" (Lazarus & Smith, 1988, p. 287). Furthermore,

> Pleasure and pain are sensory states, not emotions; they lead to emotions when their significance is evaluated and the quality of the resulting emotion depends on the outcome of this evaluation. Muscle fatigue and pain, for example, are often appraised positively and lead to positive emotions for the athlete who believes this is a desirable goal of exercise or practice (as in the expression, "go for the burn") but are appraised quite negatively and lead to negative emotions when some other goal is involved, as when one is struggling to finish a contest in the best position possible, or when pain or distress signifies physical impairment or illness to the person.
>
> *(p. 287)*

By disqualifying sensory pleasure and pain from the domain of emotions, Lazarus essentially questions whether these states are of veritable interest as topics of psychological investigation. He describes them by such adjectives as "universal," "automatic," "hard-wired," "built-in," "innate," "rigid," and "inflexible," to arrive at the suggestion that these phenomena constitute nothing more than neural loops, designed to serve "particular internal homeostatic needs" (Smith & Lazarus, 1990, p. 613) or correct "internal tissue deficits" (p. 612):

> We are built so that sensorimotor pleasure, such as a sweet taste, physical rest, stroking the body, or certain kinds of full stomachs, is almost always elicited by definable physical stimuli in a neurologically intact and receptive person. So, too, with pain.
>
> *(Lazarus, 1991a, p. 55)*

Although Lazarus accepted that sensory "perceptions" of pleasure and displeasure can ultimately lead to emotions following an appropriate appraisal, he agreed with Schachter and Singer that the power of this appraisal in determining the nature of the emotion is absolute. According to Lazarus (1991a), "we do not experience an emotion merely in response to . . . exercising even though homeostatic processes essential to survival are set in motion and coordinated in these situations" (p. 197). "Exercising vigorously," Lazarus (1984) wrote, produces "arousal." This will become an emotion "only if we appraise the encounter (e.g., the physical and social conditions and the bodily state it produces) as having a bearing on our well-being" (p. 124). The appraisal process is theorized to be so omnipotent that even inherently "painful fatigue" can be transformed to an experience of "satisfaction":

> Pain and pleasure are transformed into emotional distress or satisfaction only as a result of appraisals of their significance. For example, competitive runners in a close race who are experiencing painful fatigue on the way to the finish line will probably react with distress because the pain signifies that they are running out of steam and that the race may be lost. However, when the same runners are seeking to condition themselves in training, they are apt to feel satisfaction when they experience the same painful fatigue, because it now signifies that their bodies are being strengthened for future races without much being at stake.
>
> *(Lazarus, 1991b, p. 821)*

In concluding this overview of the references to exercise and pleasure in the psychological literature during the era of cognitivism, it is important to emphasize that the various assertions reviewed here were made in the absence of empirical evidence. Neither Zillmann nor Lazarus, for example, conducted an experiment in which participants were asked to provide self-reports of pleasure–displeasure in response to exercise. Their assertions, therefore, were based entirely on assumptions derived from the cognitivist framework.

Exercise in psychological experiments, 1970s to present

Such was the impact of Zillmann's idea of "excitation transfer" that, by the 1980s, psychology laboratories were teeming with studies involving running, stepping, and cycling (e.g., Clark, Milberg, & Ross, 1983; Hansen, Hansen, & Crano, 1989; Isen, Daubman, & Nowicki, 1987; McDonald, Harris, & Maher, 1983; Sanbonmatsu & Kardes, 1988; Wegner & Giuliano, 1980, 1983; White, Fishbein, & Rutstein, 1981; White & Kight, 1984). Without exception, exercise was used as a means of raising arousal and, in each case, the studies by Zillmann from the 1970s were cited as the basis for this usage. Without testing to ensure that this assumption is true, exercise was chosen because researchers were convinced that it represents a "neutral source of arousal" (White & Kight, 1984, p. 56) or the best method to avoid "confounding the effects of arousal with the effects of valence" (Pham, 1996, p. 375). This usage of exercise, based on the same rationale, continued during the 1990s (e.g., Martin, Harlow, & Strack, 1992; Sinclair, Hoffman, Mark, Martin, & Pickering, 1994) and 2000s (e.g., Lange & Fleming, 2005; Nakajima & Fleming, 2008).

As one example, citing Zillmann's work, Isen et al. (1987) used exercise to induce "affectless arousal" (p. 1122) or "arousal devoid of any particular affective tone" (p. 1128). So convinced were the authors that exercise produces "affectless arousal" that they did not consider it necessary to compare the participants' "affective tone" before and after the exercise; they only asked after exercise. In fact, they even questioned the wisdom of asking participants any affect-related questions in conjunction with an exercise treatment. They criticized their own measure (feel

"positive" versus "negative") for being "inappropriate . . . for treatments such as the exercise condition, in which . . . there is no apparent reason for the question and it is therefore too reactive" (p. 1125).

In another example, Anderson, Deuser, and DeNeve (1995) conducted a study to investigate the effects of hot temperatures on state hostility and positive/negative affect. Exercise was included to provide an opportunity to test the validity of a self-report measure of arousal. Reportedly, the measure was found to be "sensitive to changes in perceived arousal created by brief exercise" (p. 441), as the mean score increased from before to after exercise, and subsequently decreased during the recovery period. One important attribute of the measure of arousal, however, was that the item pool represented a nearly perfect confound of arousal and pleasure–displeasure. Almost all high-arousal items denoted some degree of pleasure (e.g., energetic, lively, vigorous, excited, sharp, alert, powerful) and, conversely, almost all low-arousal items denoted some degree of displeasure (e.g., depressed, weak, drowsy, exhausted, sluggish, weary, dull, tired, worn-out, tired, fatigued, sleepy). Therefore, although it was just as likely that exercise induced pleasure, the researchers interpreted their findings as indicative only of arousal.

What is particularly noteworthy in this body of research is the strong reliance on the assumption that the arousal induced by exercise is "affectless." With very few exceptions (Kim & Baron, 1988; Stangor, 1990), researchers accepted this assumption without making any attempt at empirical verification, despite the fact that Zillmann also had not provided any such evidence. Even in the few cases in which the assumption was put to a test, the methods were generally inadequate, as if they were aimed primarily to appease readers rather than provide a rigorous assessment. For example, Kim and Baron (1988) used a purpose-made questionnaire inquiring about very specific emotional states of no relevance to the experimental situation (anger, relaxation, anxiety, friendliness) and only compared a "high" to a "low" exercise condition rather than a no-exercise control. In another case, when a reviewer suggested that the assumption should be tested, the researchers questioned whether exercise could have affect-altering effects, arguing instead that any such findings would probably be artifactual (Sinclair et al., 1994, see Note 3).

Erber and Erber (2000) also used exercise but their intention was not to induce "affectless" arousal. They theorized that any activity requiring effort would "take the mind off" a previously induced happy or sad mood and, in effect, "attenuate" that mood. They found that 10 minutes of step exercise, much like working on difficult math problems, could produce the hypothesized "attenuation" effect. As noted by Thayer (2000), in putting forth their "attenuation" interpretation, the researchers did not consider alternative explanations: "exercise is a powerful mood regulator, and easily could become the overriding influence on mood measurements with weak film manipulations having little effect by comparison" (p. 203).

Beyond assumptions: evidence for the exercise-induced "feel-better" effect

It took a century for research to begin to put Alexander Bain's introspective observations to the test. Starting in the 1960s, reviewers from medicine (e.g., Hammett, 1967) and sport science (e.g., Morgan, 1969) began piecing together fragments of rudimentary evidence from correlational studies linking physical fitness to emotional stability. The first quasi-experimental and experimental designs appeared in the 1970s. While most of the emphasis continued to be on personality traits and self-perceptions, the first studies examining the effects of chronic exercise training (e.g., Greist et al., 1978; Morgan, Roberts, Brand, & Feinerman, 1970; Schwartz, Davidson, & Goleman, 1978) and acute exercise bouts (e.g., Bahrke & Morgan, 1978; Morgan, Roberts, & Feinerman, 1971; Nowlis & Greenberg, 1979) on variables from the affective domain also started to emerge.

A considerable boost to the study of the phenomenon that came to be known as the exercise-induced "feel-better" effect was given with the publication of state measures of affective variables, including the state version of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) and the Profile of Mood States (McNair, Lorr, & Droppleman, 1971). These measures were the first standardized questionnaires appropriate for operationalizing this phenomenon. Thus, essentially by necessity, the "feel-better" effect was operationally defined as (and treated as tantamount to) post-exercise anxiety reduction and mood enhancement. As the availability and popularity of these measures grew during the 1980s, the studies demonstrating post-exercise anxiolysis (e.g., Boutcher & Landers, 1988; Raglin & Morgan, 1987; Wilson, Berger, & Bird, 1981) and positive mood shifts (e.g., Berger & Owen, 1983; Lichtman & Poser, 1983; Roth, 1989; Steptoe & Bolton, 1988; Steptoe & Cox, 1988) increased in number. Furthermore, over time, their methodological quality improved substantially.

It is important to note that, although most of these studies were conducted by researchers with academic backgrounds in exercise science, a significant number were published in journals from the broader field of psychology, including psychotherapy, psychosomatic medicine, health psychology, and psychophysiology. Evidently, these studies did not go unnoticed by psychologists specializing in the study of affective phenomena. Starting in the 1980s, both Robert Thayer (1987a, 1987b), developer of the Activation Deactivation Adjective Check List (Thayer, 1986), and David Watson (1988; McIntyre, Watson, & Cunningham, 1990), co-developer of the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), conducted studies examining the link between physical activity and mood using their own measures. Thus, during the 1980s, research on the exercise-induced "feel-better" effect broke the confines of specialty journals, appearing for the first time in "mainstream" psychological publications, such as the *Journal of Personality and Social Psychology* (e.g., Thayer, 1987a; Watson, 1988), in addition to several other journals published by the American Psychological Association.

Perhaps an important part of the answer to the question posed in the beginning of this chapter (i.e., "why is noone mentioning [exercise]?") can be found in the following observation. In the January 1987 issue of the *Journal of Personality and Social Psychology*, Thayer (1987a), based on research evidence, reported an "unexpectedly strong effect associated with the 10-min brisk walk—up to 2 hr of reduced tension and increased energy" (p. 124). This article has 126 entries in the Citation Index (as of June 2012). Six months later, in the same journal, as noted earlier, Isen et al. (1987), based solely on assumptions, used exercise to induce "affectless arousal" (p. 1122) or "arousal devoid of any particular affective tone" (p. 1128). However, this article is cited at approximately five times the rate (617 times), according to the Citation Index.

By the end of the 1990s, the database on the "feel-better" phenomenon included hundreds of studies (for reviews, see Ekkekakis & Petruzzello, 1999; Tuson & Sinyor, 1993; Yeung, 1996). This led one reviewer to conclude that "both survey and experimental research . . . provide support to the well publicized statement that 'exercise makes you feel good'" (Fox, 1999, p. 413) and another to state that "there is no need for further research or reviews dealing with the question of whether or not physical activity results in improved mood" (Morgan, 1997, p. 230).

Coming full circle: nineteenth-century ideas in twenty-first-century laboratories

In the early part of the twenty-first century, research on the exercise–pleasure relationship entered a new phase, characterized by an updated methodological and conceptual approach. What is remarkable about the findings from this contemporary line of research, however, is the similarity of the themes that are emerging and the conclusions that are drawn to the observations of

Alexander Bain and James Mark Baldwin, stated well over a century ago. It could be argued that modern laboratory experimentation is now, finally, testing their seminal hypotheses and providing empirical support for their pioneering insights. In essence, contrary to any assumptions about the supposedly linear pattern of growth of scientific knowledge, research is only now, after a long, paradigm-imposed embargo, continuing the work that they started in the 1800s.

First, affective responses are examined from a more global perspective, now extending beyond state anxiety and the six distinct mood states tapped by the Profile of Mood States. In newer studies, affect is conceptualized as a dimensional domain, defined by two orthogonal and bipolar dimensions, namely affective valence (ranging from pleasure to displeasure) and perceived activation or arousal. The advantage afforded by this model, named the affect circumplex, is that, at least theoretically, it allows for comprehensive coverage of the content domain of interest in a very efficient manner (requiring the measurement of only two constructs).

Second, instead of limiting assessment to only the pre- and post-exercise time points, newer studies use repeated measurements to track changes in valence and activation throughout the exercise bout and recovery period. Because affect responds dynamically and often instantaneously to changing conditions, such as the progressively intensifying physical strain of exercise or the termination of strenuous effort, examination of pre-to-post changes may misrepresent the true shape of the response trajectory as it unfolds over time.

Third, instead of focusing solely on analyses of change at the level of the entire sample, recent studies also include examinations of change at the level of subgroups and individual participants. The reason for this is that not all individuals respond to the same exercise stimulus in the same direction; some may report increases but others decreases in pleasure. Consequently, analyses of change at the level of the sample mean may conceal disparate and divergent patterns of change at the level of individuals.

Fourth, instead of defining exercise intensity as percentages of maximal capacity (e.g., maximal heart rate of oxygen consumption), several recent studies use metabolic markers, such as the ventilatory (or "gas exchange") threshold and the respiratory compensation point. The ventilatory threshold occurs when relatively more carbon dioxide is produced than the oxygen that is consumed. The respiratory compensation point is the intensity at which pulmonary ventilation begins to rise disproportionately to the amount of carbon dioxide that is produced (see Figure 1.1).

These are adaptationally important benchmarks because of what they mean for the ability of the person to continue exercise. Below the ventilatory threshold, in the so-called "moderate" domain of intensity, an individual can exercise for a long time while physiological indices, such as heart rate, oxygen uptake, and blood lactate, can remain stable. When the intensity exceeds the ventilatory threshold, in what is called the "heavy" domain of intensity, physiological steady-state is disrupted (i.e., even when the workload remains constant, physiological indices begin to rise) and an organism-wide stress response begins (e.g., lactate accumulation rises, accompanied by increases in catecholamine and cortisol concentrations, and a sympathetic shift in autonomic activity). Provided that the distance from the ventilatory threshold is not too large, if a person continues to exercise, a physiological steady-state may be reestablished after several minutes. However, judging by most physiological indicators, the organism would be exhibiting a full-blown stress response. Finally, when the intensity exceeds the respiratory compensation point, the maintenance of physiological steady-state is no longer possible; physiological indices rise continuously until the person reaches the limits of tolerance and has to stop. This domain of intensity is termed "severe."

According to the dual-mode theory (Ekkekakis, 2003), affective responses are matched to these domains of intensity in a manner that corresponds to their adaptational implications (see

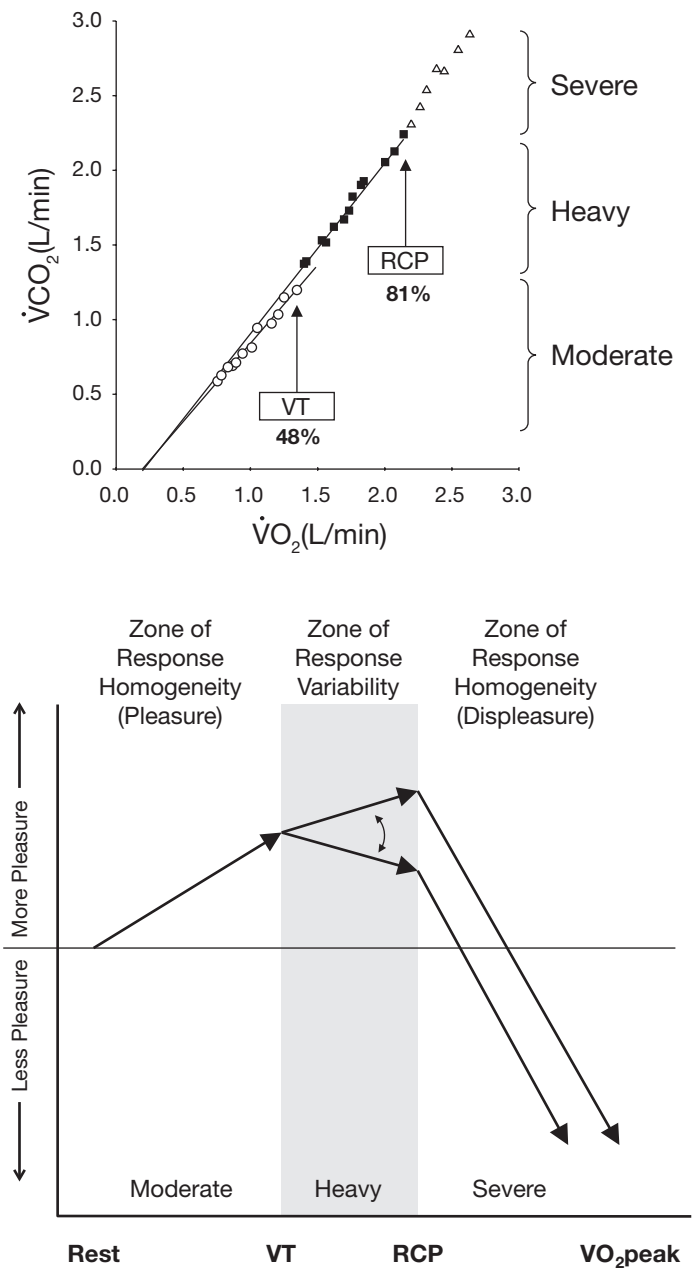


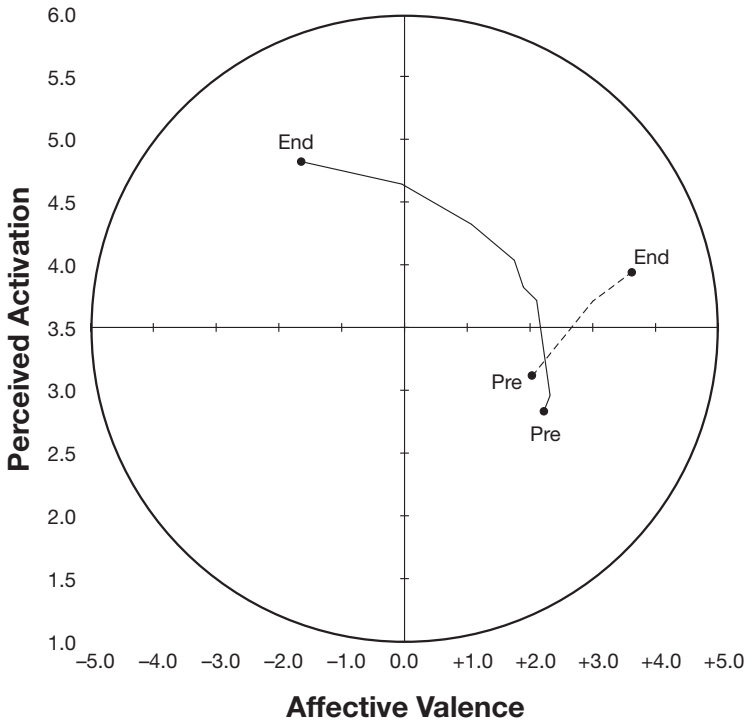
Figure 1.1 Panel (a): The ventilatory threshold (VT) and respiratory compensation point (RCP) represent distinct changes in the slope of the gas-exchange relationship and demarcate the domains of moderate, heavy, and severe exercise intensity. In this example, the first change in slope (VT, beginning of the *heavy* domain) occurs at 48% and the second change in slope (RCP, beginning of the *severe* domain) occurs at 81% of peak oxygen uptake (VO_2peak). Panel (b): According to the dual-mode theory (Ekkekakis, 2003), there is (1) homogeneity of affective responses in the moderate domain, with the predominant response being pleasure, (2) variability in the heavy domain, with some individuals reporting increases and others decreases in pleasure, and (3) homogeneity in the severe domain, with the predominant response being displeasure.

Figures 1.1 and 1.2; also see Ekkekakis, Parfitt, & Petruzzello, 2011, for a review). Specifically, within the moderate domain, most healthy individuals report stable or increasing levels of pleasure during exercise, typically followed by further improvements during the post-exercise period (also see the chapter by Reed in this volume). For example, during and after self-paced walks, most participants report higher pleasure, activation, and perceived energy (Ekkekakis, Backhouse, Gray, & Lind, 2008; Ekkekakis, Hall, Van Landuyt, & Petruzzello, 2000). From an evolutionary perspective, it has been suggested that this positive response was selected to reward and encourage the vitally important subsistence activities (hunting, gathering) that occupied a substantial portion of daily life in the Pleistocene environment (Ekkekakis, Hall, & Petruzzello, 2005a; Raichlen, Foster, Gerdeman, Seillier, & Giuffrida, 2012; Sher, 1998). These speculations are, of course, highly reminiscent of Baldwin's (1891) thoughts on the evolutionary significance of exercise-induced pleasure, which were, in turn, inspired by the writings of Darwin and Spencer.

In the domain of heavy intensity, as the exerciser begins to experience a challenging barrage of interoceptive cues generated by the perturbation of the physiological state, affective responses begin to exhibit interindividual variability. Some individuals continue to report increases in pleasure, while others report decreases (Ekkekakis et al., 2005a; Van Landuyt, Ekkekakis, Hall, & Petruzzello, 2000). This is again consistent with Bain's (1855) observation that it is "easier in some temperaments than in others, to perform rapid movements with coolness" (p. 104). From an evolutionary standpoint, while strong adaptational pressures tend to produce response homogeneity, such variability is interpreted as a response that has ambiguous adaptational implications. Put differently, continuing to experience pleasure while the body is exhibiting symptoms of stress foretelling of an impending metabolic crisis is like a double-edged sword. On one hand, this trait may provide an adaptational advantage by enabling someone to persist and gain the competitive edge in a physical effort (e.g., while fighting or hunting). On the other hand, challenging one's biological limits raises the level of risk (e.g., for exhaustion, heatstroke, skeletal or muscular injury, cardiac arrest). Thus, on balance, neither those individuals who continue to experience pleasure at this level of intensity nor those who begin to experience displeasure will have an unambiguous adaptational advantage. Evidence shows that people differ in their preference for different levels of exercise intensity and exhibit different levels of tolerance to high-intensity exercise. These individual differences account for significant portions of the variability in affective responses in this domain of intensity, beyond what is accounted for by such factors as sex, age, and maximal aerobic capacity (Ekkekakis, Hall, & Petruzzello, 2005b).

Within the domain of severe intensity, there is no chance of re-establishing physiological stability and the risk of a potentially fatal metabolic crisis grows with every step. Therefore, the body must issue an unambiguous directive to consciousness that the activity must be stopped or

Figure 1.2 Panel (a): Affective responses to exercise, plotted in a two-dimensional space, where the horizontal axis represents affective valence (pleasure vs displeasure) and the vertical axis represents perceived activation. The solid line shows the trajectory of change during a graded treadmill test to volitional fatigue (average duration 11.3 minutes). The dotted line shows the change in response to a 15-minute self-paced treadmill walk. Panel (b): The two lines represent the responses of 44.4% of a sample ($N = 63$) who reported gradual improvements (rightward shift) and 41.3% who reported gradual declines (leftward shift) in affective valence during a 30-minute session of cycle-ergometry at 60% of maximal aerobic capacity. These results illustrate (1) the predominantly positive affective response below the ventilatory threshold (walk), (2) the predominantly negative affective response above the ventilatory threshold (graded test to fatigue), and (3) the variable affective response at intensities proximal to the ventilatory threshold (cycling at 60%). The data were drawn from Hall et al. (2002), Ekkekakis, Hall, Van Landuyt, & Petruzzello (2000), and Van Landuyt, Ekkekekis, Hall, & Petruzzello (2000), respectively.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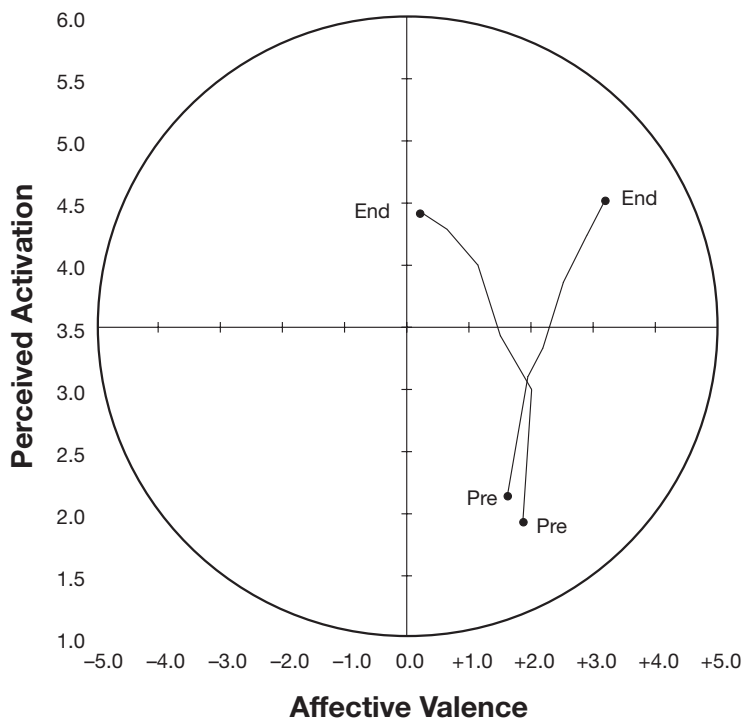
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Affective Valence

its intensity must be reduced immediately, in order to prevent collapse and irreparable damage. This directive comes in the form of a universal, automatic, and cognitively unmanageable negative affective response that quickly and effectively diminishes any desire to continue. This irrepressible negative affective response appears to be driven by two factors acting jointly, as redundant safeguards (Ekkekakis & Acevedo, 2006). First, there is an overwhelming intensification of afferent cues from the strained body. Physiological variables, such as ventilation, oxygen uptake, lactate concentration, and core temperature, account for most of the reliable variance in reports of affective valence within the domain of severe intensity (Ekkekakis, 2003). Second, there is significant reduction in the oxygenation and, therefore, presumably the activity of the dorsolateral prefrontal cortex, an area known to be involved in the cognitive control of negative affect (Ekkekakis, 2009).

Finally, once the strenuous activity is stopped, there is a rapid (among physically fit individuals, instantaneous) affective rebound from negativity to positivity (see Figure 1.3), consistent with the "affective or hedonic contrast" phenomenon described by Solomon (1980, 1991). The magnitude of the rebound is proportional to the extent of the negative shift during a strenuous bout of exercise, but typically somewhat larger in absolute terms (Ekkekakis, Hall, & Petruzzello, 2008). Thus, as a result of this rebound, within seconds or minutes, the post-exercise affective state may become more positive than the pre-exercise state. Although such pre-to-post improvements in affect were interpreted in the past as additional evidence for the exercise-induced "feel-better" effect, this interpretation is debatable. A more appropriate interpretation is that the positivity is not a response to the exercise itself but rather to the cessation of exercise (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007).

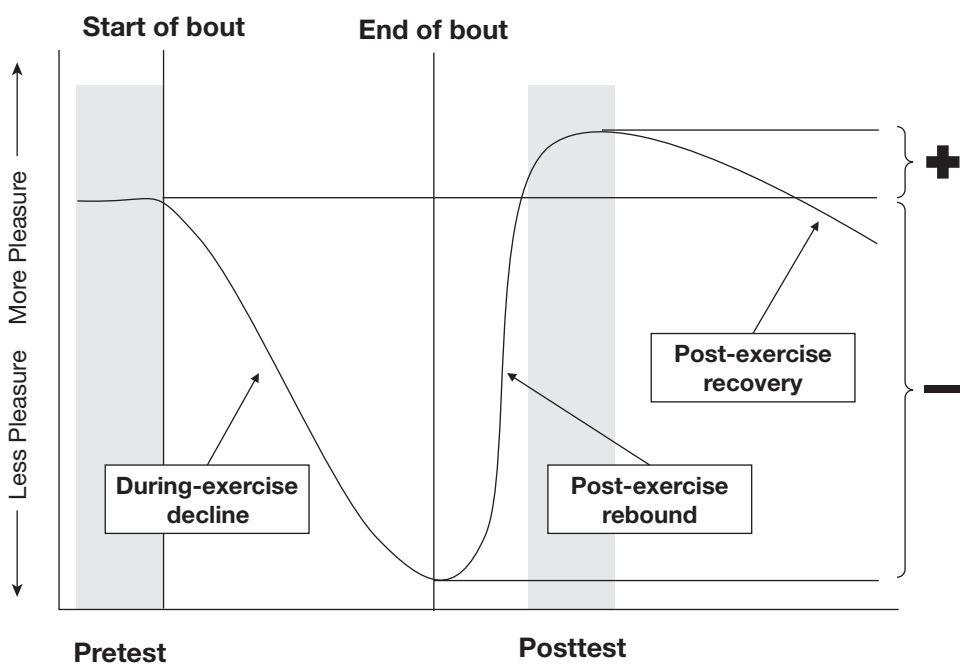
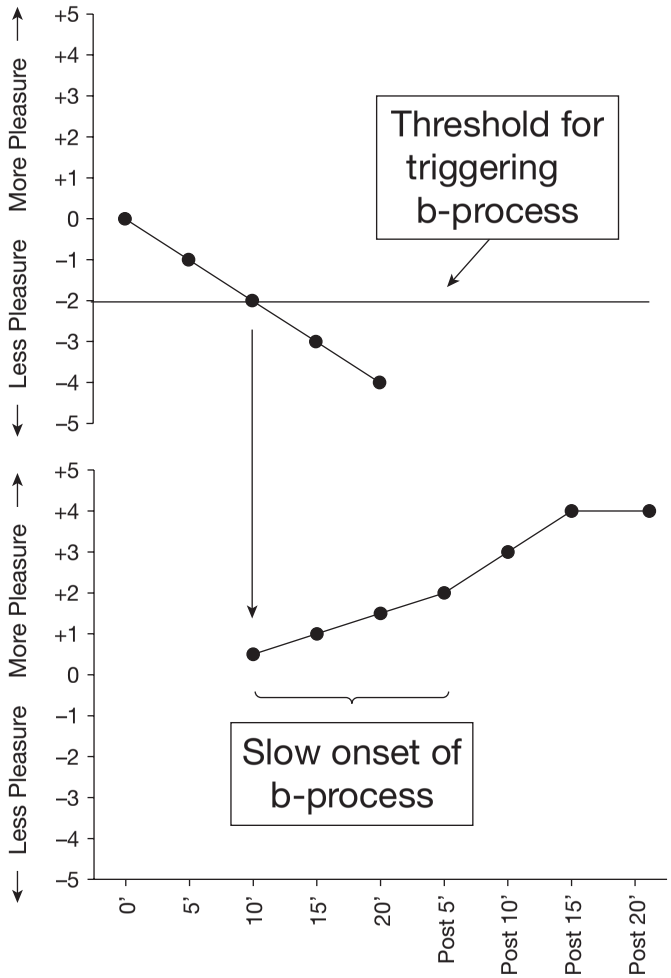


Figure 1.3a Panel (a): Schematic representation of a typical affective response to strenuous exercise (e.g., at intensity exceeding the ventilatory threshold), illustrating the affective decline during the bout (-) and the affective rebound after the bout, leading to a post-exercise state that is more positive than the pre-exercise one (+).



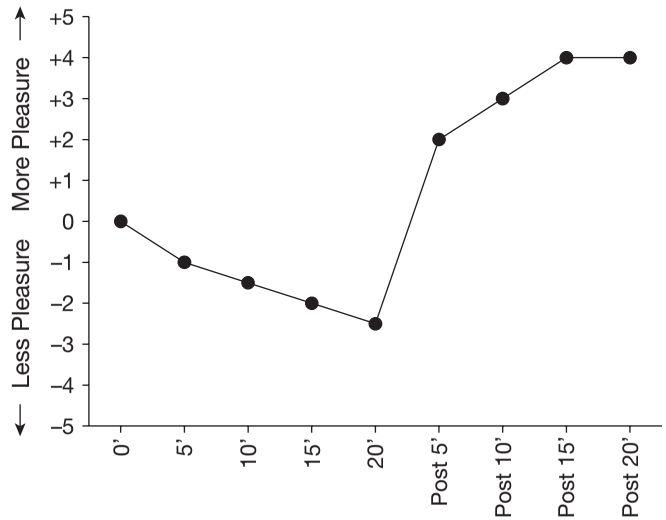


Figure 1.3b Panel (b): This type of response is consistent with Solomon's (1980, 1991) opponent-process model. According to Solomon and Corbit (1974), the "exhilaration following . . . endurance-challenging exercise" (p. 143) is an example of the operation of an opponent process. Solomon postulated that, for each stimulus charged with negative affect (termed a-process), an opponent-process (or b-process), charged with positive affect, is aroused. The function of the opponent-process is to return the organism to a state of affective equilibrium. Solomon (1980) proposed that the a-process "closely tracks the stimulus intensity" (p. 710) and, once it "reaches a critical intensity" (Solomon, 1991, p. 339), it "trips" the opponent-process into action. In turn, the opponent-process "has a long latency, a sluggish course of increase, and a sluggish course of decay" (Solomon, 1980, p. 710) after the a-process is terminated. Solomon (1980) speculated that the b-process might reflect the function of endogenous opioids (see Chapter 2 by Boecker & Dishman in this volume). Assuming a progressive homeostatic perturbation (a-process) during exercise (top left graph), an opponent-process with the characteristics described by Solomon might be aroused (bottom left graph). Through the function of an affect summator computing |a-b|, the resultant affect (right graph) would closely resemble the response pattern shown in panel (a).

Supporting another of the observations of Bain and Baldwin, recent studies have provided empirical evidence for a link between affective responses to exercise and exercise behavior. The more pleasant the exercise is, the more physical activity a person is likely to do (Schneider, Dunn, & Cooper, 2009; Williams et al., 2008; Williams, Dunsiger, Jennings, & Marcus, 2012). However, skeptics might argue that, if exercise can be pleasant, what accounts for the persistently low rates of public physical activity participation or what Bain (1855) called "the utter neglect of physical exercise as a habitual element of life" (p. 95)? The answer to this challenging question may lie, at least in part, in what is essentially an evolutionary aberration, namely the extremely poor physical condition of many contemporary humans.

To illustrate, consider the example of a participant from a study conducted by the author. A 41-year-old woman weighed 61 kg and had a Body Mass Index of 25 kg/m^2, on the cusp between being considered normal weight or overweight. She was apparently healthy, as she had not been diagnosed with a chronic cardiorespiratory, circulatory, or metabolic condition and was not receiving any medication. However, as a result of sedentary living over a period of decades, her maximal aerobic capacity was very poor. Her peak aerobic capacity was only 17 ml of oxygen per kilogram of body weight per minute (bottom 1% according to normative data). Her ventilatory threshold was at 60% of that, or at approximately 10 ml per kg per min (2.86 times the basal metabolic rate, or MET). Examples of physical activities rated at 2.5 METs and, therefore, within her "moderate" range of intensity include slow walking (less than 4 miles per hour) without carrying any extra weight, mild stretching, fishing from a seated position, dusting, washing dishes, watering flowers, playing the piano, and sewing. In contrast, physical activities rated at 3.0 METs, and therefore within her "heavy" domain of intensity, include such common everyday tasks as slow walking while carrying an external load (e.g., bags of groceries weighing under 20 lbs), fishing from a standing position, cleaning windows, sweeping the floor, washing the car, painting the walls, picking fruit from a tree, bowling, or golfing. Because these activities would require her to enter the domain of heavy intensity, they would probably suffice to induce a reduction in pleasure. To make matters worse, being overweight or obese (conditions now shared by over 60% of the population in industrialized countries) is associated with significantly reduced levels of pleasure over most of the range of exercise intensity compared to being normal weight (Ekkekakis & Lind, 2006; Ekkekakis, Lind, & Vazou, 2010).

Conclusion

Although the exercise-induced "feel-better" effect is not universal, it is now a reliably established phenomenon. It is typically associated with moderate levels of exercise intensity (i.e., below the ventilatory threshold) and, for some individuals, even with intensities that are slightly higher. However, as the rate of obesity rises and the average level of aerobic capacity falls, the phenomenon may become increasingly harder to detect in modern humans. Therein lies the challenge for public health, including public mental health. To keep people physically active and thus enable them to benefit from the effects of exercise, the exercise must be pleasant. When it is not, dropout is likely to ensue, leading to an even poorer state of physical conditioning, and a perpetuation of the vicious cycle.

As to the question posed in the beginning of this chapter, namely why so many colleagues in psychology appear unaware of evidence linking exercise to pleasure, a critical reading of the literature indicates that the reason is not the absence of evidence. Rather, the culprit must be sought among the list of usual suspects: artificial disciplinary chasms, dualistic rifts, paradigm-induced tunnel vision, uncritical adoption of assumptions, and a faltering historical memory.

References

Anderson, C.A., Deuser, W.E., & DeNeve, K.M. (1995). Hot temperatures, hostile affect, hostile cognition, and arousal: Tests of a general model of affective aggression. *Personality and Social Psychology Bulletin*, *21*, 434–448.

Averill, J.R. (1980). A constructivist view of emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion: Theory, research, and experience* (Vol. 1, pp. 305–339). New York: Academic Press.

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.

Bahrke, M.S., & Morgan, W.P. (1978). Anxiety reduction following exercise and meditation. *Cognitive Therapy and Research*, *2*, 323–333.

Bain, A. (1855). *The senses and the intellect*. London: John W. Parker & Son.

Baldwin, J.M. (1891). *Handbook of psychology: Feeling and will*. New York: Henry Holt & Company.

Baldwin, J.M. (1894). *Mental development in the child and the race: Methods and processes*. New York: Macmillan.

Berger, B.G., & Owen, D.R. (1983). Mood alteration with swimming: Swimmers really do "feel better." *Psychosomatic Medicine*, *45*, 425–433.

Boutcher, S.H., & Landers, D.M. (1988). The effects of vigorous exercise on anxiety, heart rate, and alpha activity of runners and nonrunners. *Psychophysiology*, *25*, 696–702.

Cannon, W.B. (1915). *Bodily changes in pain, hunger, fear and rage: An account of recent researches into the function of emotional excitement*. New York: D. Appleton & Company.

Cannon, W.B. (1927). The James-Lange theory of emotions: A critical examination and an alternative theory. *American Journal of Psychology*, *39*, 106–124.

Cantor, J.R., Zillmann, D., & Bryant, J. (1975). Enhancement of experienced sexual arousal in response to erotic stimuli through misattribution of unrelated residual excitation. *Journal of Personality and Social Psychology*, *32*, 69–75.

Clark, M.S., Milberg, S., & Ross, J. (1983). Arousal cues arousal-related material in memory: Implications for understanding effects of mood on memory. *Journal of Verbal Learning and Verbal Behavior*, *22*, 633–649.

Cromby, J. (2004). Between constructionism and neuroscience: The societal co-constitution of embodied subjectivity. *Theory and Psychology*, *14*, 797–821.

Darwin, C. (1872). *The expression of the emotions in man and animals*. London: John Murray.

Ekkekakis, P. (2003). Pleasure and displeasure from the body: Perspectives from exercise. *Cognition and Emotion*, *17*, 213–239.

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. (2009). 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., & 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. (2009). Exercise and psychological well-being. In R. Maughan (Ed.), *Olympic textbook of science in sport* (pp. 251–271). Hoboken, NJ: Wiley-Blackwell.

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). 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. (2005b). 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. (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.

Erber, R., & Erber, M.W. (2000). The self-regulation of moods: Second thoughts on the importance of happiness in everyday life. *Psychological Inquiry*, *11*, 142–148.

Faulkner, G., & Biddle, S. (2001). Exercise and mental health: It's just not psychology! *Journal of Sports Sciences*, *19*, 433–444.

Fox, K.R. (1999). The influence of physical activity on mental well-being. *Public Health Nutrition*, *2*, 411–418.

Gergen, K.J. (1985). The social constructionist movement in modern psychology. *American Psychologist*, *40*, 266–275.

Greist, J.H., Klein, M.H., Eischens, R.R., Faris, J., Gurman, A.S., & Morgan, W.P. (1978). Running through your mind. *Journal of Psychosomatic Research*, *22*, 259–294.

Hall, E.E., Ekkekakis, P., & Petruzzello, S.J. (2002). The affective beneficence of vigorous exercise revisited. *British Journal of Health Psychology*, *7*, 47–66.

Hammett, V.B.O. (1967). Psychological changes with physical fitness training. *Canadian Medical Association Journal*, *96*, 764–768.

Hansen, R.D., Hansen, C.H., & Crano, W.D. (1989). Sympathetic arousal and self-attention: The accessibility of interoceptive and exteroceptive arousal cues. *Journal of Experimental Social Psychology*, *25*, 437–449.

Hill, W.F. (1956). Activity as an autonomous drive. *Journal of Comparative and Physiological Psychology*, *49*, 15–19.

Hundt, A.G., & Premack, D. (1963). Running as both a positive and negative reinforcer. *Science*, *142*, 1087–1088.

Isen, A.M., Daubman, K.A., & Nowicki, G.P., (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52*, 1122–1131.

James, W. (1890). *The principles of psychology*. New York: Henry Holt.

James, W. (1899). *Talks to teachers on psychology and to students on some of life's ideals*. New York: Henry Holt & Company.

Kagan, J., & Berkun, M. (1954). The reward value of running activity. *Journal of Comparative and Physiological Psychology*, *47*, 108.

Kim, H.-S., & Baron, R.S. (1988). Exercise and the illusory correlation: Does arousal heighten stereotypic processing? *Journal of Experimental Social Psychology*, *24*, 366–380.

Kuhn, T.S. (1962/1996). *The structure of scientific revolutions* (3rd ed.). Chicago: University of Chicago Press.

Lange, L.J., & Fleming, R. (2005). Cognitive influences on the perception of somatic change during a feigned chemical release. *Journal of Applied Social Psychology*, *35*, 463–486.

Lazarus, R.S. (1984). On the primacy of cognition. *American Psychologist*, *39*, 124–129.

Lazarus, R.S. (1991a). *Emotion and adaptation*. New York: Oxford University Press.

Lazarus, R.S. (1991b). Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist*, *46*, 819–834.

Lazarus, R.S., & Smith, C.A. (1988). Knowledge and appraisal in the cognition-emotion relationship. *Cognition and Emotion*, *2*, 281–300.

Lichtman, S., & Poser, E.G. (1983). The effects of exercise on mood and cognitive functioning. *Journal of Psychosomatic Research*, *27*, 43–52.

Martin, L.L., Harlow, T.F., & Strack, F. (1992). The role of bodily sensations in the evaluation of social events. *Personality and Social Psychology Bulletin*, *18*, 412–419.

McDonald, P.J., Harris, S.G., & Maher, J.E. (1983). Arousal-induced self-awareness: An artifactual relationship? *Journal of Personality and Social Psychology*, *44*, 285–289.

McIntyre, C.W., Watson, D., & Cunningham, A.C. (1990). The effects of social interaction, exercise, and test stress on positive and negative affect. *Bulletin of the Psychonomic Society*, *28*, 141–143.

McNair, D.M., Lorr, M., & Droppleman, L.F. (1971). *Manual for the Profile of Mood States*. San Diego, CA: Educational and Industrial Testing Service.

Mead, G.E., Morley, W., Campbell, P., Greig, C.A., McMurdo, M.E.T., & Lawlor, D.A. (2009). Exercise for depression. *Mental Health and Physical Activity*, *2*, 95–96.

Morgan, W.P. (1969). Physical fitness and emotional health: A review. *American Corrective Therapy Journal*, *23*, 124–127.

Morgan, W.P. (1997). Conclusion: State of the field and future research. In W.P. Morgan (Ed.), *Physical activity and mental health* (pp. 227–232). Washington, DC: Taylor & Francis.
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.
Morgan, W.P., Roberts, J.A., & Feinerman, A.D. (1971). Psychologic effect of acute physical activity. *Archives of Physical Medicine and Rehabilitation*, *52*, 422–425.
Nakajima, M., & Fleming, R. (2008). Cognitive and physiological determinants of symptom perception and interpretation. *Journal of Applied Biobehavioral Research*, *13*, 42–66.
Nowlis, D.P., & Greenberg, N. (1979). Empirical description of effects of exercise on mood. *Perceptual and Motor Skills*, *49*, 1001–1002.
Pham, M.T. (1996). Cue representation and selection effects of arousal on persuasion. *Journal of Consumer Research*, *22*, 373–387.
Raglin, J.S., & Morgan, W.P. (1987). Influence of exercise and quiet rest on state anxiety and blood pressure. *Medicine and Science in Sports and Exercise*, *19*, 456–463.
Raichlen, D.A., Foster, A.D., Gerdeman, G.L., Seillier, A., & Giuffrida, A. (2012). Wired to run: Exercise-induced endocannabinoid signaling in humans and cursorial mammals with implications for the "runner's high." *Journal of Experimental Biology*, *215*, 1331–1336.
Robins, R.W., Gosling, S.D., & Craik, K.H. (1999). An empirical analysis of trends in psychology. *American Psychologist*, *54*, 117–128.
Roth, D.L. (1989). Acute emotional and psychophysiological effects of aerobic exercise. *Psychophysiology*, *26*, 593–602.
Sanbonmatsu, D.M., & Kardes, F.R. (1988). The effects of physiological arousal on information processing and persuasion. *Journal of Consumer Research*, *15*, 379–385.
Schachter, S. (1964). The interaction of cognitive and physiological determinants of emotional state. *Advances in Experimental Social Psychology*, *1*, 49–80.
Schachter, S., & Singer, J.E. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*, 379–399.
Scherer, K.H. (1984). On the nature and function of emotion: A component process approach. In K.R. Scherer & P. Ekman (Eds.), *Approaches to emotion* (pp. 293–317). Hillsdale, NJ: Lawrence Erlbaum.
Schneider, M., Dunn, A., & Cooper, D. (2009). Affect, exercise, and physical activity among healthy adolescents. *Journal of Sport and Exercise Psychology*, *31*, 706–723.
Schwartz, G.E., Davidson, R.J., & Goleman, D.J. (1978). Patterning of cognitive and somatic processes in the self-regulation of anxiety: Effects of meditation versus exercise. *Psychosomatic Medicine*, *40*, 321–328.
Sher, L. (1998). The endogenous euphoric reward system that reinforces physical training: A mechanism for mankind's survival. *Medical Hypotheses*, *51*, 449–450.
Shirley, M. (1929). Spontaneous activity. *Psychological Bulletin*, *26*, 341–365.
Shotter, J. (1997). The social construction of our inner selves. *Journal of Constructivist Psychology*, *10*, 7–24.
Sinclair, R.C., Hoffman, C., Mark, M.M., Martin, L.L., & Pickering, T.L. (1994). Construct accessibility and the misattribution of arousal: Schachter and Singer revisited. *Psychological Science*, *5*, 15–19.
Smith, C.A., & Lazarus, R.S. (1990). Emotion and adaptation. In L.A. Pervin (Ed.), *Handbook of personality: Theory and research* (pp. 609–637). New York: Guilford.
Solomon, R.L. (1980). The opponent-process theory of acquired motivation: The costs of pleasure and the benefits of pain. *American Psychologist*, *35*, 691–712.
Solomon, R.L. (1991). Acquired motivation and affective opponent-processes. In J. Madden (Ed.), *Neurobiology of learning, emotion, and affect* (pp. 307–347). New York: Raven.
Solomon, R.L., & Corbit, J.D. (1974). An opponent-process theory of motivation: Temporal dynamics of affect. *Psychological Review*, *81*, 119–145.
Spielberger, C.D., Gorsuch, R.L., & Lushene, R.E. (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
Stangor, C. (1990). Arousal, accessibility of trait constructs, and person perception. *Journal of Experimental Social Psychology*, *26*, 305–321.
Steptoe, A., & Bolton, J. (1988). The short-term influence of high and low intensity physical exercise on mood. *Psychology and Health*, *2*, 91–106.
Steptoe, A., & Cox, S. (1988). Acute effects of aerobic exercise on mood. *Health Psychology*, *7*, 329–340.
Thayer, R.E. (1986). Activation-Deactivation Adjective Check List: Current overview and structural analysis. *Psychological Reports*, *58*, 607–614.
Thayer, R.E. (1987a). Energy, tiredness, and tension effects of a sugar snack versus moderate exercise. *Journal of Personality and Social Psychology*, *52*, 119–125.

Thayer, R.E. (1987b). Problem perception, optimism, and related states as a function of time of day (diurnal rhythm) and moderate exercise: Two arousal systems in interaction. *Motivation and Emotion*, *11*, 19–36.

Thayer, R.E. (2000). Mood regulation and general arousal systems. *Psychological Inquiry*, *11*, 202–204.

Tuson, K.M., & Sinyor, D. (1993). On the affective benefits of acute aerobic exercise: Taking stock after twenty years of research. In P. Seraganian (Ed.), *Exercise psychology: The influence of physical exercise on psychological processes* (pp. 80–121). New York: Wiley.

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.

Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology*, *54*, 1020–1030.

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Watson, R.I. (1960). The history of psychology: A neglected area. *American Psychologist*, *15*, 251–255.

Wegner, D.W., & Giuliano, T. (1980). Arousal-induced attention to self. *Journal of Personality and Social Psychology*, *38*, 719–726.

Wegner, D.M., & Giuliano, T. (1983). On sending artifact in search of artifact: Reply to McDonald, Harris, and Maher. *Journal of Personality and Social Psychology*, *44*, 290–293.

White, G.L., Fishbein, S., & Rutstein, J. (1981). Passionate love and the misattribution of arousal. *Journal of Personality and Social Psychology*, *41*, 56–62.

White, G.L., & Kight, T.D. (1984). Misattribution of arousal and attraction: Effects of salience of explanations for arousal. *Journal of Experimental Social Psychology*, *20*, 55–64.

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.

Williams, D.M., Dunsiger, S., Jennings, E.G., & Marcus, B.H. (2012). Does affective valence during and immediately following a 10-min walk predict concurrent and future physical activity? *Annals of Behavioral Medicine*, *44*, 43–51.

Wilson, V.E., Berger, B.G., & Bird, E.I. (1981). Effects of running and of an exercise class on anxiety. *Perceptual and Motor Skills*, *53*, 472–474.

Yeung. R.R. (1996). The acute effects of exercise on mood state. *Journal of Psychosomatic Research*, *40*, 123–141.

Zillmann, D., & Bryant, J. (1974). Effect of residual excitation on the emotional response to provocation and delayed aggressive behavior. *Journal of Personality and Social Psychology*, *30*, 782–791.

Zillmann, D., Johnson, R.C., & Day, K.D. (1974). Attribution of apparent arousal and proficiency of recovery from sympathetic activation affecting excitation transfer to aggressive behavior. *Journal of Experimental Social Psychology*, *10*, 503–515.

Zillmann, D., Katcher, A.H., & Milavsky, B. (1972). Excitation transfer from physical exercise to subsequent aggressive behavior. *Journal of Experimental Social Psychology*, *8*, 247–259.