

Do 'Mind over Muscle' Strategies Work?

Examining the Effects of Attentional Association and Dissociation on Exertional, Affective and Physiological Responses to Exercise

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Abstract

Despite the well established physical and psychological benefits derived from leading a physically active life, rates of sedentary behaviour remain high. Dropout and non-compliance are major contributors to the problem of physical inactivity. Perceptions of exertion, affective responses (e.g. displeasure or discomfort), and physiological stress could make the exercise experience aversive, particularly for beginners. Shifting one's attentional focus towards environmental stimuli (dissociation) instead of one's body (association) has been theorized to enhance psychological responses and attenuate physiological stress. Research evidence on the effectiveness of attentional focus strategies, however, has been perplexing, covering the entire gamut of possible outcomes (association and dissociation having been shown to be both effective and ineffective). This article examines the effects of manipulations of attentional focus on exertional and affective responses, as well as on exercise economy and tolerance. The possible roles of the characteristics of the exercise stimulus (intensity, duration) and the exercise participants, methodological issues, and limitations of experimental designs are discussed. In particular, the critical role of exercise intensity is emphasized. Dissociative strategies may be more effective in reducing perceptions of exertion and enhancing affective responses at low to moderate exercise intensities, but their effectiveness may be diminished at higher and near-maximal levels, at which physiological cues dominate. Conversely, associative strategies could enable the exerciser to regulate intensity to avoid injury or overexertion. Thus, depending on intensity, both strategies have a place in the 'toolbox' of the public health or exercise practitioner as methods of enhancing the exercise experience and promoting long-term compliance.

Rates of physical inactivity for adults in the US remain high despite the well publicized health benefits derived from leading a physically active life.^[1] Other industrialized nations face similar public health challenges.^[2-4] Physical inactivity in conjunction with a poor diet accounts for a substantial number of preventable deaths.^[5] Various local, national and international health agencies (e.g. WHO) are beginning to closely examine the reasons behind sedentary behaviour and to develop interventions that address physical inactivity. However, approximately 50% of individuals initiating an exercise programme drop out within the first 6 months and psychological interventions aimed at preventing non-compliance have met with modest success.^[6] Thus, dropout is a major contributor to the physical inactivity epidemic. It is reasonable to assume that, if dropout rates could be drastically reduced, overall public participation rates could be substantially increased.

One possible explanation for the high dropout rate is a causal chain linking exercise intensity, exertional and affective responses (e.g. pleasure vs displeasure, enjoyment vs aversion), and exercise adherence.^[7,8] Studies show that, as exercise intensity increases, affective responses become less positive or more negative.^[9-12] Other studies show that higher exercise intensity levels are associated with reduced adherence and increased dropout, and this effect cannot be fully accounted for by injuries.^[13-17] Providing a possible explanation for these findings, recent evidence demonstrates that affective responses are significant predictors of subsequent physical activity participation.^[18] In short, if exercise intensity is too high, and exercise is not perceived as enjoyable, comfortable or tolerable, it is reasonable to assume that people will be less likely to repeat the activity in the future.^[19]

The problem is that most adults who initiate an exercise programme do so after long periods of

sedentary living and, consequently, face the challenges of a low level of cardiorespiratory fitness and potentially high bodyweight, resulting in strenuous levels of intensity. Thus, during the critical early stages of participation, their experiences may be characterized by high levels of perceived exertion and non-positive affective responses. A commonly employed solution has been to use a cognitive strategy designed to alter how the exercise stimulus is experienced (i.e. reduce the perceptions of physical discomfort or improve the affective response to exercise).

The armamentarium of such cognitive strategies includes manipulations of attentional focus (i.e. association or dissociation), use of audiovisual stimuli (e.g. music or television), self-talk and bolstering the participant's sense of self-efficacy. One indicator of how popular attentional focus strategies, in particular dissociation, are in practice can be found in books developed with the fitness professional in mind. Dissociative techniques are routinely recommended for diverting attention away from uncomfortable or displeasurable bodily sensations during exercise. For example, Rejeski and Kenney^[20] endorsed dissociation as a means of 'countering the discomforts of exercise' (p. 85). The authors suggest focusing on distracting stimuli that are enjoyable, engaging, positive and safe. Similarly, Leith^[21] highlighted the risk of associating during exercise by stating, "Focusing on the physical activity serves to remind us of feelings of fatigue and makes the effort more of a chore" (p. 88).

1. Purpose of the Review

The aim of this review is 4-fold: (i) to examine the effectiveness of manipulating an exercise participant's attentional focus by using association or dissociation in controlling perceptions of exertion, enhancing affective responses, and attenuating physiological strain; (ii) consider what role various study characteristics may have played in some equivocal results that have been reported; (iii) highlight the critical importance of the element of exercise intensity in modulating the effectiveness of association and dissociation; and (iv) provide recommendations for future research.

Although the subject matter for this review is limited to studies of attentional associative and dissociative strategies, it should be noted that there are a number of related techniques that fall under the umbrella of 'cognitive strategies'. These will be dealt with in subsequent instalments in this series of reviews. Specifically, the use of music and other audiovisual stimuli will be examined in a second review and other, less extensively studied, cognitive strategies (i.e. manipulation of self-efficacy, self-talk, hypnotic suggestion and deception) will be covered in a third.

2. Literature Search

To locate studies on the use of association/dissociation (A/D) during exercise, computer searches were conducted in scientific databases (PsycLit, PubMed, Google Scholar) using the terms (and combinations thereof): 'exercise', 'attentional focus', 'association', 'dissociation', 'focal awareness', 'internal focus', 'external focus'. Furthermore, the reference lists of the obtained articles were searched for additional pertinent studies. A total of 88 studies related specifically to endurance or aerobic exercise and A/D were retrieved through these methods. Some of the published papers included more than one study relevant to this review. Articles examining the relationship between A/D strategies during resistance and/or strength training were excluded from this review because of the substantially different physiological demand characteristics of such activities. In certain cases, only unpublished manuscripts or abstracts from papers presented at scientific conferences were available. These are not included in the summary table (table I; available online as supplementary material [Supplemental Digital Content 1, <http://adisonline.com/SMZ/A2>]), but are discussed in the relevant sections of the review, as needed. The studies consist of both descriptive reports and experimental investigations on the influence of A/D on perceived exertion, affective responses, and exercise performance variables including exercise economy and exercise tolerance. Exercise economy is considered here as a physiological index of the efficiency of movement, expressed as physiological

responses required to perform a given exercise workload (e.g. heart rate, oxygen uptake and ventilatory responses). Exercise tolerance is considered here as an index of endurance capacity expressed as maximal exercise duration and/or maximal attained workload during an exercise test (e.g. time to exhaustion, peak power output). Table I (supplementary material) provides detailed information on the characteristics of the sample, the exercise stimuli, study conditions, relevant dependent variables, and highlighted results. The table is divided into subsections, with the studies grouped according to exercise intensity level.

3. Defining and Conceptualizing Attentional Focus

3.1 Defining 'Association' and 'Dissociation'

The way association and dissociation have been defined over the years has varied. Originally, the attentional focus strategy of association was characterized as the focus on bodily sensations necessary for optimal performance^[22] and, more specifically, on physical sensations emanating from changes in respiration, temperature and muscular fatigue.^[23] At the other end of the attentional focus spectrum, dissociation was characterized as a cognitive process of actively 'blocking out' sensations of pain or discomfort related to physical effort. As described by Morgan,^[23] an individual who dissociates "purposefully cuts himself off from the sensory feedback he normally receives from his body" (p. 39).

3.2 Conceptual Frameworks for the Study of Attentional Focus

Schomer^[24] characterized the attentional strategies along the single dimension of task-relatedness in his work with marathoners. Integrating Nideffer's^[25] attentional styles concept, association and dissociation were further defined along the dimensions of attentional width (i.e. broad or narrow attentional focus) and attentional direction (i.e. attending to internal or external cues). Schomer^[24] organized tape-recorded verbalizations of marathon runners into sub-

categories that could be more broadly characterized as associative or task-related on the one hand and dissociative or task-unrelated on the other. Specifically, verbalizations that pertained to *feelings and affect*, *body monitoring*, and *command and instruction* were characterized as reflecting an internal/narrow attentional focus. Verbalizations that pertained to *pace monitoring* were characterized as reflecting an external/narrow attentional focus. Verbalizations that pertained to *reflective thoughts*, *personal problem solving*, and *career-related thoughts* comprised an internal/broad attentional focus category. Finally, verbalizations that pertained to *running course information* and *talk and chatter* comprised an external/broad attentional focus category.

More recently, a two-dimensional classification system of attentional focus was proposed by Stevinson and Biddle.^[26,27] According to this system, attentional focus can be characterized along the dimension of *relevancy* (task-relevant vs task-irrelevant), which relates to factors associated with optimally performing a task, and the dimension of *direction* (internal vs external), which relates to the subject of focal awareness. In this two-dimensional approach, an individual's attentional focus strategy can be located within one of four quadrants: (a) internal/task-relevant (e.g. fatigue, breathing, perspiration); (b) internal/task-irrelevant (e.g. daydreams, imagining music, solving math problems); (c) external/task-relevant (e.g. strategy, split times, conditions); and (d) external/task-irrelevant (e.g. scenery, environment, other competitors). These mutually exclusive categories were employed in a series of studies aimed at understanding the phenomenon of 'hitting the wall', in a sample of marathon runners.^[26,27] Employing an internal/task-irrelevant strategy was found to be related to 'hitting the wall' earlier.^[26,27] Similarly, an earlier study had suggested that an internal/task-irrelevant strategy amplified the related sensations of pain and exhaustion.^[28] However, other investigators have questioned this relationship. For example, although 73% of participants running in the Melbourne Marathon reported 'hitting the wall' after mile 19 (30th km), the use of association or dissociation was unrelated to the phenomenon.^[29] Likewise,

Buman et al.^[30] observed that 43% of a sample of marathon runners reported ‘hitting the wall’, and this phenomenon was related to factors that were both arguably associative (e.g. generalized fatigue, 66%; intentionally slowing pace, 46%; muscle cramping/pain, 50%) and dissociative (e.g. loss of concentration, 17%; deliberate direction of attention away from race, 16%).

3.3 Psychometric Assessment of Attentional Focus

Several attempts have been made to develop general and activity-specific standardized self-report measures of A/D in addition to the numerous survey instruments used in early studies. Additionally, certain questionnaires with a broader scope (e.g. commitment, discomfort) have also included scales designed to tap A/D-related constructs. This diversity highlights a major challenge to developing a cohesive conceptual framework in this area. It is also important to note that the lack of consistency in operational definitions has been one of the major obstacles in consolidating the research on A/D strategies. Another major challenge has been the absence of extensively supported and elaborated conceptual models or a unifying theoretical framework.

Early self-report measures included items pertaining to perceived physical symptoms and affective responses,^[31-33] estimated effort and performance time,^[34] strategy prevalence,^[35,36] specific thought content,^[37] and circumstances surrounding strategy usage.^[38] Goode and Roth^[39] developed the Thoughts During Running Scale (TDRS) to assess participants’ thought content during a run. The TDRS was found to correlate with negative and positive mood states. Specifically, the negative mood state *Fatigue* was positively correlated with the TDRS scale *Association* ($r=0.25$) and negatively correlated with the scale *Dissociation* (specifically, with the subscales *Interpersonal Relationships* [$r=-0.21$] and *Daily Events* [$r=-0.19$]). The positive mood state *Vigor* was positively correlated with the scale *Dissociation* (specifically, with the subscales *Interpersonal Relationships* [$r=0.25$], *Daily Events* [$r=0.23$] and *External Surrounding* [$r=0.23$]). The TDRS has

been used to assess attentional thought content in a number of investigations.^[40-42]

Brewer et al.^[43] developed the Attentional Focus Questionnaire (AFQ), which assesses the broad dimensions of *Association* and *Dissociation* but differs from the TDRS in that the AFQ takes into account the influence of exercise intensity. Various items assess the role of specific physical sensations, feelings of fatigue, monitoring technique or pace as well as neutral and valenced (positive or negative) psychological content. The AFQ has also been used extensively in the A/D literature.^[44,45] For example, Masters et al.^[46] observed significant correlations between the *Dissociation* scale of the AFQ and the following scales of the Motivations of Marathoners Scale (MOMS): *Psychological Coping* ($r=0.54$), *Self-Esteem* ($r=0.31$) and *Life Meaning* ($r=0.36$).

Finally, some instruments have been developed to gauge the overall exercise experience, including attentional focus factors. For example, the Running Discomfort Scale (RDS)^[47] includes the scales *Disorientation* and *Task Completion Thoughts*, which reflect the thoughts and feelings experienced by runners. The authors reasoned that distance runners tend to focus either on thoughts related to completing the run or on sensations of discomfort emanating from muscular and respiratory strain. Furthermore, they argued that “under such conditions of perceived discomfort, the mechanisms for the regulation of pain are more likely to stem from psychological than physical bases.”^[47] Similarly, Carmack and Martens^[48] developed the Commitment to Running Scale, which included the dissociation-like factor ‘Spin-out’, characterized as ‘a detached or dreamy state of mind’ (p. 35).

4. Theoretical Mechanisms of Regulating Focal Awareness

Early interest in A/D strategies can be attributed to the seminal work of Morgan and colleagues^[23,49-51] on the physiological and psychological characteristics of long-distance runners. Since then, the role of A/D strategies has been examined in several literature reviews.^[52-57] However, although a considerable amount of evidence

has accumulated, studies were rarely designed to examine specific theoretical propositions, and a guiding theoretical framework has yet to emerge. Nevertheless, the literature does include several potentially relevant conceptual models, which are summarized below.

4.1 'Competition of Cues'

Pennebaker and Lightner^[31] proposed a 'competition of cues' mechanism as an explanation for the effects of A/D strategies during exercise. In their study, participants performed 10 minutes of self-paced treadmill exercise while (a) listening to their own breathing (to induce an internal focus), (b) listening to ambient street sounds (to induce an external focus), or (c) wearing headphones without sound (control). The authors noted that after the exercise bout, participants reported perceiving more negative physical symptoms, fatigue and tension during the internal focus condition compared with the other two conditions. In contrast, greater perceptions of enjoyment and satisfaction as well as improved exercise performance were reported under the external focus condition. Cardiovascular measures, however, showed no difference across experimental conditions. The authors concluded that "To the extent that one source of potential stimuli (e.g. the external environment) is tapped extensively, other sources (e.g. internal sensations) go unused" (p. 172). Thus, the concept of 'competition of cues' implies that the subjective exercise experience will depend on whether individuals maintain either an internal or an external attentional focus.

4.2 Parallel Processing of Information Model

A model advanced by Leventhal and co-workers,^[58,59] which focused on the experience of pain, posited that there are separate but parallel pathways in which informational (i.e. noxious attributes of the stimulus) and emotional (i.e. generation of distress) qualities of pain are processed. The process was thought to consist of both preconscious and conscious phases. During the preconscious phase, a vast amount of sensory data relating to both the stimulus attributes (including

intensity, duration and location) and the emotional qualities are gathered by sensory receptors. Whether or not this information is attended to, and thus comes into *focal awareness*, depends on the status of theorized attentional channels. If the attentional channels carrying pain-related information are selected, as in the case of association, then this information reaches conscious awareness, resulting in observable behavioural responses. Conversely, if attentional channels carrying non-pain-related information are selected, as in the case of dissociation, then pain information is likely to remain outside focal awareness.

4.3 Social Psychophysiological Model

Rejeski^[60,61] applied the model of Leventhal and Everhart^[59] to the sensations of fatigue and perceived exertion associated with exercise. Rejeski^[61] noted that the original model failed to account for "how environmental and task variables contribute to the perceptual salience of specific physiological variables during exercise" (p. 376). He further argued that perception is not a passive process but rather an active process that is amenable to cognitive manipulations. According to Rejeski,^[60] perceived exertion is determined by both psychological (e.g. cognitive strategies, individual differences, motivation) and physiological (e.g. lactate, hydrogen ions) factors. During exercise of low- and moderate-demand characteristics (intensity and duration), perceived exertion was theorized to reflect a greater contribution from psychological factors. As the intensity and duration progress, however, the contribution of physiological factors increases (as a still-undetermined mathematical function). The more perceived exertion reflects the influence of physiological cues, the smaller the contribution of psychological factors and, therefore, the smaller the potential impact of cognitive strategies.

By acknowledging the contribution of psychological factors, the model also incorporates the notion of individual differences in exercise tolerance. The level of exercise intensity at which there is a critical shift in the balance between psychological and physiological determinants of perceived exertion was not identified. Nevertheless,

individuals were thought to exhibit different levels of tolerance around this hypothetical threshold. That is, for some individuals the complete domination of perceived exertion by physiological cues might be at a lower, and for others at a higher, percentage of their actual maximal exercise capacity. The purpose of a psychological intervention, therefore, could be to extend the range of exercise intensity during which psychological factors remain influential. When applied to A/D strategies, Rejeski's^[60] social psychophysiological model implies that such interventions are more likely to be effective when the demand characteristics of the exercise stimulus are submaximal rather than maximal.

4.4 Social-Cognitive Perspective of Perceived Exertion and Exertion Tolerance

Tenenbaum^[62] proposed a social-cognitive model of perceived exertion that makes very similar predictions to that proposed by Rejeski.^[60,61] This model specifically addresses the relationship between exercise intensity and attentional focus strategies. In particular, at low levels of effort sense, the exerciser maintains the capacity to freely shift between an associative and a dissociative focus. Thus, during exercise of low intensity, the exerciser may shift between attending to and diverting away from discrete physiological sensations such as sweating and heavy breathing. As the exercise intensity and effort sense increase, however, focal awareness becomes predominantly internal and cognitive strategies become gradually less effective at influencing perceived exertion. During high exercise intensities, perceived exertion reflects symptoms of fatigue and exhaustion, and the ability to voluntarily shift attention away from them is diminished.

4.5 Dual Mode Model

The previously described models represent an evolution of conceptual ideas surrounding the factors that shape the exercise experience. The notions of a continuous and dynamic competition between internal and external cues, the active channelling of sensory input into and away from focal awareness, and the intensity-dependent shift

in the contributions of psychological factors (including differences in attentional focus) and physiological cues constitute important theoretical advances. These ideas have served as the foundation of the Dual Mode Model (DMM).^[63] This model further postulates that the ventilatory threshold (VT), because it is associated with an accentuation of several physiological parameters (blood lactate accumulation, frequency and depth of ventilation, sympathetic shift in autonomic regulation), might represent the level of exercise intensity demarcating the transition from a cognition-dominant to an interoception-dominant mode of eliciting both affective^[63] and exertional^[64] responses. According to the DMM, affective and exertional responses during exercise performed at intensities below and proximally to the VT involve primarily cortical pathways. On the other hand, at intensities that exceed the VT and preclude the maintenance of a physiological steady state, interoceptive afferent cues reach areas of the brain responsible for the elicitation of affective and exertional responses following direct, faster routes, bypassing the cortex.^[65]

5. Review of Findings

Studies on the effects of association and dissociation in the context of exercise reflect a great diversity of conceptual and methodological approaches. To facilitate the synopsis of this body of evidence, this section is organized into summaries of descriptive reports and experimental studies. This latter section is further divided into studies focusing on: (i) perceptual responses, including perceived exertion and self-reported physical symptoms; (ii) psychological responses, including affect, cognitive performance and exercise adherence; and (iii) physiological variables, including exercise economy and tolerance.

5.1 Descriptive Reports

Descriptive investigations include examinations of the prevalence of and circumstances surrounding the use of attentional focus strategies. However, no consistent trends have emerged. Factors that have been examined as possibly

associated with the use of attentional focus strategies have included ability level, nature of the task, age and sex, temporal patterning (i.e. when each strategy is used) and risk of injury. Specifically, some studies have reported that an associative focus is more frequently employed by elite than non-elite^[23,66] and more experienced than inexperienced competitors,^[67] among whom it is predictive of success.^[68] However, other studies contradict these findings, indicating that ability level does not influence use of attentional focus strategies.^[24,69-71] More rigorous control for exercise intensity might be one way to clarify this relationship.^[70]

Likewise, in some studies, the nature of the task was shown to be related to the selection of the attentional focus strategy, with association being used primarily in competition and dissociation being used primarily during training.^[23,40,44,49,51,72] Alternatively, other studies have reported either greater reliance on dissociative focus^[35,73] or a mixed attentional focus strategy^[29,36] during competitive endurance activities. Once again, however, unmasking the relationship between the nature of the task and A/D usage would require careful control for exercise intensity, something that is not usually feasible in field studies.

The relationship between age and use of attentional focus strategies seems consistent with association being reported during a larger percentage of time by younger participants than older participants during endurance events.^[73-76] Conversely, the effects of sex are less clear. Although some evidence exists for gender-specific use of associative^[44] and dissociative^[68,70] focus, other studies have demonstrated no such difference.^[35,69] Some researchers have observed that female exercisers gauge progress using a different set of performance information indicators, including associative factors,^[77] and others have shown sex differences in the specific thought content of attentional focus. For example, solving personal problems was found to be more common among female runners whereas male runners were more likely to engage in social conversations.^[78] These conclusions, however, are again limited by the lack of control for exercise intensity in most studies (see Tenenbaum and Connolly^[70] for an exception).

Research on the temporal patterning of A/D use clearly illustrates that a mix of attentional focus strategies is used over the course of endurance events.^[26,37,74,75,79-81] Although association appears to be the primary strategy throughout an event, the ratio of associative to dissociative focus approaches an equal distribution during the middle stages before becoming more associative towards the finish. The individual ability to shift between association and dissociation during exercise, termed *attentional flexibility*, has been identified as a topic that deserves future research consideration.^[56,69,82] Moreover, although Schomer^[24,83-85] has consistently emphasized that injury prevention might be one of the most important possible benefits of using association, other studies have failed to find a relationship between using a particular attentional focus strategy and the occurrence of injuries.^[44,86] However, there is evidence that having sustained a previous injury contributes to using a more associative focus during subsequent exercise.^[76]

5.2 Perceived Exertion

Ratings of perceived exertion (RPE) have been perhaps the most widely studied outcome in investigations examining the effectiveness of A/D strategies (35 out of 88 studies). Perceived exertion represents a 'gestalt' of all sensory inputs pertaining to the intensity of exercise. Theoretically, an attentional focus strategy that amplifies physical sensations, as in the case of association, should result in consistently higher perceived exertion ratings. Conversely, any attentional focus strategy that attenuates physical sensations, as in the case of dissociation, should result in consistently lower ratings.

A review of the studies investigating the relationship between A/D strategies and perceived exertion, however, reveals that findings have been inconclusive. In some cases, these results may be due to the confounding influence of sex or uncontrolled individual-difference variables. For example, Wrisberg et al.^[87] reported that, under a self-focused (i.e. associative), low-intensity exercise condition, male participants displayed higher heart rates and lower

perceived exertion ratings, whereas female participants exhibited lower heart rates and higher perceived exertion ratings. On the other hand, female participants classified as 'externals' on a locus-of-control scale (i.e. tended to attribute outcomes to external causes) reliably reported higher perceived exertion ratings across cycle ergometer and treadmill exercise conditions compared with a group of 'internal' female participants.^[88,89]

Some evidence suggests that both associative and dissociative strategies can result in higher perceived exertion ratings. For example, some studies have demonstrated higher perceived exertion ratings during short-^[90,91] and long-^[24,78,83-85] distance running and rowing^[45] related to associative strategies or thinking. On the other hand, other studies have shown that dissociative thinking can also result in higher RPE.^[43,92,93] Delignières and Brisswalter^[94] noted higher perceived exertion scores when participants performed a dissociative task (i.e. reaction time) while cycling at 20%, 40%, 60% and 80% maximal oxygen uptake ($\dot{V}O_{2max}$). Conversely, other investigations have noted that dissociation results in lower perceived exertion ratings during running,^[42,95] cycle ergometry,^[96,97] moderate-intensity exercise^[94,95] and various self-paced physical activities.^[34] Several researchers, using self-reported physical symptoms as a complement to perceived exertion, have observed fewer physical symptoms when focusing externally or dissociating compared with associating.^[31,32]

Finally, a number of studies have found no difference in RPE between association and dissociation strategies during swimming,^[98,99] outdoor versus indoor running,^[100] cycling at low, moderate and high exercise intensities,^[33,101,102] self-paced running^[22] and military marching.^[103] Evidence suggests that lower perceived exertion may be related to dissociation at lower exercise intensities and to association at higher exercise intensities.^[70,104] In fact, some researchers have suggested that a shift from dissociation to association appears to be initiated around a rating of 13 ('somewhat hard')^[105] or when relative exercise intensities exceed 50% of maximal workload.^[70]

5.3 Affective and other Psychological Responses

Studies examining the effect of A/D strategies on psychological responses have focused on a wide range of variables, including affective responses, cognitive performance and programme adherence. Some researchers have proposed that exercise-induced affective responses represent a type of associative experience. For example, in a series of studies on marathon running and self-regulatory processes, Schomer^[24,83-85] argued that an internal/task-related associative strategy consisted, in part, of "feelings and affect" (p. 45).^[85] These thoughts were composed of general whole-body sensations, feelings of vitality or fatigue, and nonspecific overall body tiredness and/or stiffness. Researchers have examined the range of psychological responses, from basic affect to specific emotional feeling states to broad mood states.

5.3.1 Affective, Emotional and Mood-Related Measures

Affective, emotional and mood-related responses have received less attention than RPE within the A/D literature (29 of 88 studies). Investigations of the basic affective dimension of pleasure-displeasure in A/D research have been based on the Feeling Scale, an 11-point rating scale ranging from 'I feel very good' (during exercise) to 'I feel very bad'.^[106] Based on the results of studies using this measure, both association and dissociation have been found to be related to declines in pleasure. Researchers have observed declining pleasure ratings with a dissociative strategy during treadmill exercise at 90% $\dot{V}O_{2max}$,^[92] as well as greater post-exercise distress reports in untrained participants performing stair-climbing exercise.^[43] Baden et al.^[95] observed a relationship between more negatively valenced affective responses and greater associative thinking during 20 minutes of treadmill running at 75% peak treadmill running speed. Participants exercised under conditions in which they were: (i) informed of how long they would be running ('20 minutes'); (ii) told they would run for 10 minutes and then unexpectedly were told to run for 10 additional minutes

('10 minutes'); or (iii) not informed of the duration ('UN'). In each 20-minute condition, there was a significant linear increase in associative thinking over time. There was a significant decline in pleasure ratings between minutes 10 and 11 during the '10 minutes' condition compared with either the '20 minutes' or 'UN' conditions. Other authors have also commented on the phenomenon of parallel increases in associative thought content and decreases in pleasure and enjoyment. For example, Brewer et al.^[43] noted that "focusing on distress cues while performing an endurance task is counterproductive in terms of both performance and quality of experience (i.e. pain, affect)" (p. 12).

At the other end of the attentional focus continuum, association and negatively valenced affective ratings have also been found to be related. Welch and colleagues^[105] noted declining pleasure ratings reported by young physically inactive women during a cycle ergometer test to volitional exhaustion. This decline in affective valence was paired with more associative thinking, particularly beyond the VT. The authors noted that, "on average, participants held a greater awareness of the physical sensations of the physiological changes around the VT and beyond, which is likely to manifest itself in both the type of attentional focus reported and the affect experienced" (p. 416).

Besides A/D, other concurrent cognitive appraisals may also be influential. Cioffi^[107] had participants perform 10 minutes of cycle ergometry at 60% $\dot{V}O_{2max}$ either with (association) or without (dissociation) instructions to closely monitor physical sensations. Half of the participants within each condition were then informed that they could be randomly shocked during the trial. Post-experimental examination of the physical sensations experienced revealed that, regardless of receiving or not receiving instructions to monitor physical sensations, individuals who had received the threat rated their physical sensations as more unpleasant compared with the no-threat group.

Other investigations of A/D strategies have focused on distinct feeling states. The most commonly used instrument to measure these specific states has been the Exercise-induced

Feeling Inventory (EFI).^[108] It should be noted that, unlike the Feeling Scale, the EFI has typically been administered before and after exercise, not during exercise. Contrary to the previously discussed findings, dissociation has been consistently linked to improvements in the feeling states of *revitalization*, *positive engagement* and *tranquillity*, and reductions in *physical exhaustion* during submaximal aerobic exercise in young, healthy participants.^[42,109]

Studies examining other affective states have reported varying relationships with A/D strategies. For example, Durtschi and Weiss^[66] found that 'non-elite' Olympic-trial marathon runners were more anxious in the days prior to and immediately before the event compared with their 'elite' (invited) counterparts. Subsequent analyses of thought-content reports provided by the non-elite competitors showed greater dissociative thinking than elite competitors during the event. Using a similar sample but investigating a rather different phenomenon, Masters^[110] reported a significant positive correlation between dissociation and the euphoric 'runner's high' among marathon competitors. More recently, Couture et al.^[103] found that only the control group reported lower perceived fatigue scores during a military march, whereas the experimental groups of association (i.e. biofeedback), dissociation (i.e. meditation) and combined association-dissociation (i.e. biofeedback and meditation) did not.

Finally, some researchers have focused on broad mood states. With respect to ultra-endurance events, association has been found to be related to worsening mood states,^[81] and the variance in negative mood states can be almost entirely accounted for by pain sensations.^[79] The effects of dissociation, on the other hand, appear less consistent. Reports of no effect^[33] or fewer physical symptoms and more positive mood with dissociative strategies^[32] have been published, even from the same laboratory. However, exercise intensity was not precisely controlled in these studies.

Pennebaker and Skelton^[111] provided a helpful theoretical basis for understanding the link between psychological responses and A/D

strategies. They argued that simply attending to physical symptoms intensifies the sensations and that these sensations are interpreted based on contextual cues. Mood states can serve as contextual cues. Results from their investigations highlight low to modest correlations between negative mood states and physical-symptom reporting. Given that physical symptoms are influenced by both attentional focus and interpretive cues, these investigators recommended that future research should examine “which situational variables force attention to the body and bring into play various [interpretive] sets” (p. 529).

5.3.2 Other Psychological Responses

Some investigations have demonstrated that association is related to longer reaction times^[112] and more response errors, specifically at high heart rates. This has been interpreted as suggestive of “an internalizing of attention as individuals focus on internal signals of pain and fatigue rather than upon the external stimuli.”^[113] Other studies of cognitive tasks, however, have shown either no decrement^[81] or improved performance.^[103] According to some researchers, performance outcomes depend on dissociative complexity.^[101] However, the lack of control for relative exercise intensity also cannot be discounted as a possible reason for the inconsistent results.

Studies of exercise compliance are similarly inconclusive. On the one hand, thematic analysis of case vignettes in a qualitative study showed that both attentional focus strategies would contribute to improved compliance.^[114] On the other hand, while a dissociative compared with an associative strategy was found to improve both immediate and long-term exercise programme adherence,^[115] other evidence suggests that use of internal (i.e. associative) or external (i.e. dissociative) self-statements was unrelated to run distance or adherence at 6 months.^[116]

5.4 Preferred Attentional Focus Style

An area that warrants future research consideration involves individual differences in the

preference for a particular attentional focus strategy. Although some studies have found a strong preference for one strategy over the other (e.g. association over dissociation),^[86] others suggest a more equal division during an endurance activity.^[103] Some researchers have proposed examining *attentional flexibility* during exercise,^[56,82] and there appears to be support for the tendency to shift between strategies^[24,80] regardless of age or running distance.^[74,75] For example, Saintsing et al.^[117] noted that individuals assigned to association and dissociation groups used the designated strategy 62% and 43% of the time, respectively, for the duration of a 1.5-mile run. In other words, participants opted to use a strategy other than their assigned one between one-third to over half of the time it took to complete the run. Surprisingly, despite the indications that individuals tend to use both A and D strategies within a single exercise bout, there is presently no further evidence on the prevalence or effectiveness of the combined use of the two strategies.

Some investigators^[80,98,118,119] have noted difficulty in getting participants to adhere to the assigned attentional focus strategy. In some cases, there has been outright refusal by the participants to adopt a specific strategy.^[84,85] In other cases, participants were grouped depending on the strategy they *actually* used.^[118] To further complicate matters, there may be discrepancies between which strategy is preferred and which improves performance,^[120] although there is some support for improved performance and easier strategy adherence when using the preferred technique.^[121]

Tailoring strategies to an individual's preference may improve compliance^[98] as well as improve work output.^[121] The preference for an attentional focus strategy is as unique as the individual, and *what* is attended to depends, in part, on past experience and the importance assigned to stimuli.^[122] As noted by Pargman,^[122] “in regard to certain contextual demands, some styles are more supportive of efficient, accurate, or desirable outcomes” (p. 396). It should be kept in mind, however, that during exercise of high intensity, association might be unavoidable.^[70,83,90,105,123]

5.5 Personality Factors

The preference for a predominantly associative or dissociative strategy may be accounted for, in part, by individual dispositional tendencies. For example, some investigators^[88,89] have observed that locus of control influences perceived exertion during exercise. Locus of control refers to how people process the information about and reinforcement from a behaviour. Individuals with an external locus of control attribute reinforcement to factors beyond (i.e. external to) their control and attend to non-relevant information. In contrast, individuals with an internal locus of control attribute reinforcement to factors emanating from within (i.e. internal) and seek out information relevant to the activity. The authors argued that differences in information-processing capacities between 'internals' and 'externals' would be evident in how somatic cues were rated.^[89] When applied to exercise, individuals with an internal locus of control are theorized to actively seek out information regarding the activity (e.g. effort sense), whereas those with an external locus of control divert their attention outward. Results from exercise studies have shown that individuals with an external locus of control report higher perceived exertion ratings compared with individuals with an internal locus of control, particularly at higher workloads.^[88,89] It should be noted, however, that the hypothesized link between an internal locus of control and association, and an external locus of control and dissociation, has not yet been established.

Additional traits may serve as a proxy to either associative or dissociative cognitive styles. For example, of Jung's four basic personality dimensions of extraversion-introversion, sensing-intuition, thinking-feeling and judging-perceiving, *sensing* appears most relevant to A/D research. Specifically, *sensing* is related to how an individual perceives and understands his or her environment by relying on the five senses (i.e. attend to bodily sensations). In a sample of 50 competitive marathoners, Gontang et al.^[124] reported that the most common personality profile was *introvert-sensing-thinking-judging* (ISTJ). Some support for this has also been provided by other researchers.^[125]

Other, more specific, dispositions have also been examined, including competitiveness, commitment and motivation. It is difficult to draw any definitive conclusions from these relatively few studies. There appears to be some support for association to be positively correlated with the trait *competitiveness*.^[40,46] Dissociation, on the other hand, appears more related to the individual's commitment to^[48] and motivation for running,^[72] as well as his or her thought content.^[36] Furthermore, sex might play a role in some situations, as female runners have been shown to be more likely to engage in 'personal problem solving' during marathon training.^[78]

5.6 Exercise Economy

In addition to the self-reported and other psychological outcomes summarized in the previous sections, the effects of A/D on a range of physiological outcomes have also been investigated. In the following sections, we examine studies investigating effects on heart rate, oxygen consumption, ventilatory responses, the respiratory exchange ratio and hormonal responses.

5.6.1 Heart Rate

Measuring absolute (HR_{peak} , HR_{max}) or relative ($\%HR_{peak}$, $\%HR_{max}$) heart rate as well as blood pressure while associating or dissociating has been common practice within the attentional focus literature. Twenty-one of the 88 studies have included heart rate data. Findings from studies in which such measures were taken have shown equivocal results. Several investigators have reported no changes in absolute heart rate or blood pressure^[22,31,90,97,101,126] under either association or dissociation conditions. Alternatively, other researchers have observed that association results in lower^[103] as well as higher^[45] heart rate. For example, Rushall et al.^[127] noted significantly higher heart rates while using task-relevant statements (i.e. association) compared with a control condition in a sample of competitive cross-country skiers. Similarly, dissociation has been found to decrease^[103,104] as well as increase^[128] heart rate. For example, Morgan and colleagues^[50] observed lower heart

rates during the initial phase (minute 5) of an incremental treadmill test under a dissociative condition compared with both placebo and control conditions. These differences, however, were eliminated by the final minute of the test.

5.6.2 Oxygen Consumption

Measures of absolute ($\dot{V}O_{2\text{peak}}$, $\dot{V}O_{2\text{max}}$) and relative ($\% \dot{V}O_{2\text{peak}}$, $\% \dot{V}O_{2\text{max}}$) oxygen consumption are another studied index of exercise intensity level and economy within the A/D literature (six of 88 studies). Unlike the conflicting findings on heart rate, results on oxygen consumption have typically shown no effect. Smith and colleagues^[128] found no difference in oxygen consumption (mL/kg) per kilometre between a control condition and both passive and active association. Morgan et al.^[50] failed to find differences in $\dot{V}O_{2\text{max}}$ or $\% \dot{V}O_{2\text{max}}$ under dissociation at any stage of an incremental treadmill test. Finally, Hatfield et al.^[126] observed no differences in $\dot{V}O_2$ between a feedback (i.e. association), a distraction and a control condition during a submaximal treadmill run. Only Martin et al.^[129] noted that competitive runners who scored high on a self-attention questionnaire, and therefore could be classified as having a more associative orientation, demonstrated better running economy – defined as lower oxygen uptake relative to bodyweight (e.g. mL/kg/min).

5.6.3 Ventilatory Responses

Ventilatory measures, including minute ventilation (\dot{V}_E) and ventilatory equivalents ($\dot{V}_E/\dot{V}O_2$, $\dot{V}_E/\dot{V}CO_2$), also provide information as to the exercise intensity level or economy during an exercise bout. In general, it appears that association has a beneficial effect on ventilatory responses (two of 88 studies). For example, Hatfield et al.^[126] had participants complete a 36-minute submaximal (sub-ventilatory threshold) treadmill run under the conditions of biofeedback, distraction (reaction time task) and control. The researchers observed significant differences in numerous ventilatory variables between the feedback and other conditions. Specifically, the feedback condition elicited lower $\dot{V}_E/\dot{V}O_2$, \dot{V}_E (L/min), respiration rate, tidal volume and

pressure of end-tidal oxygen and carbon dioxide compared with the other conditions. These results confirmed an earlier study by Hatfield et al.,^[130] in which an associative strategy (visual feedback of ventilatory responses) resulted in significantly lower $\dot{V}_E/\dot{V}O_2$ compared with both a control and a dissociative condition. Collectively, these results prompted the researchers to suggest a link between associative coping strategies and ventilatory efficiency and to conclude that “psychological processes may alter metabolic efficiency during intense activity” (p. 441).

Attempts have been made to design interventions aimed at helping runners tune into their ventilatory responses. Simes^[131] developed a cognitive coping strategy that incorporated both associative and dissociative elements (Pace-Assisted Dissociation/Association; PADA) in addition to running mechanics. This strategy involved the “coordination of respiration with stride frequency with continuous attention to it maintained by counting respirations” (p. 2). This strategy was thought to be most beneficial during uphill running to avoid the transition into anaerobic supplementation. Simes^[131] stated, “By keeping the respiration and stride frequency in synchrony on the uphill grade, the runner naturally shortens the stride length and thus stays closer to anaerobic threshold or the optimum metabolic workload” (p. 2).

5.6.4 Respiratory Exchange Ratio

Another index of exercise economy that has received little attention in the A/D literature (two of 88 studies) is the respiratory exchange ratio (RER). This measure provides another index of exercise economy by highlighting the relative contribution of either carbohydrate or fat oxidation towards energy expenditure. Despite the relatively few studies that have included this measure, there appears to be support for an associative strategy resulting in a lower ratio (i.e. higher percentage of fat oxidation). For example, Hatfield and colleagues^[126] reported significantly lower RER values in participants using biofeedback (i.e. association) compared with either a distraction or a control condition during a run just below the ventilatory threshold.

In a similar study, Smith et al.^[128] observed that the most economical runners (those showing lower HR, \dot{V}_E and RER) reported significantly less use of dissociation compared with the least economical runners. However, the most and least economical runners did not differ in the use of association. As in many other studies in this literature, intensity was not precisely controlled.

5.6.5 Hormonal Responses

To date, only one known study has examined the influence on A/D strategies on stress hormone markers. To examine the effects of differences in attentional focus on the stress hormone response, Harte and Eifert^[100] had participants run outdoors (dissociation) or indoors on a treadmill for 45 minutes with either an internal (association) or external (dissociation) focus. The researchers noted that adrenaline (epinephrine) did not appreciably differ between conditions, but that both cortisol and noradrenaline were higher under the indoor-internal focus condition. Moreover, participants rated the indoor-internal focus as least pleasing compared with the other conditions. However, the results are confounded by a notable limitation of the study: specifically, exercise intensity was not controlled and therefore the effects of the physical stress of exercise and the A/D intervention could not be teased apart.

5.7 Exercise Tolerance

The effects of A/D strategies on exercise tolerance and other performance measures have been examined in 28 of 88 studies in the A/D literature. A variety of measures of performance have been used, such as distance covered (e.g. metres rowed, running distance), time elapsed (e.g. running time, time to exhaustion) or work reproduction. The majority of investigations support association as a more beneficial strategy compared with either dissociation or no strategy for enhancing performance times during swimming,^[119,120] cross-country skiing,^[127] running,^[42,117,132,133] rowing,^[45,134] race walking,^[135] triathlon^[38] and submaximal cycle ergometry.^[136] Conversely, dissociative thought content has been shown to be related to slower marathon

times^[44,66] as well as experiencing the phenomenon of 'hitting the wall' earlier and for a longer duration.^[27] It should be noted, however, that an alternative explanation for these results is that the performance demands may dictate the attentional focus strategy utilized. This implies that it might not be that the use of association led to improved performance but rather that, under the conditions of maximal effort required to achieve a great performance, attentional focus might be forced to shift toward association.^[60-63]

However, there have also been some inconsistent findings of the effectiveness of A/D strategies on performance. According to Lorentzen and Sime (personal communication), in some cases, an equal number of respondents have reported perceived running performance improvements with association and dissociation. Nietfield^[137] failed to find a significant correlation between the strategy of monitoring performance-related factors (i.e. association) and performance on a 1-mile run. Moreover, using a dissociative strategy during a graded exercise test has been shown to result in both performance improvements^[50] and decrements.^[104] Furthermore, an attentional strategy commonly used under one set of circumstances may not be beneficial under another.^[80]

It should also be pointed out that not all authors agree that altering one's perception of pain or exertion can be seen as a beneficial strategy. For example, Guyot^[138] noted that runners who pushed themselves to the point of feeling pain did not have better running statistics compared with those who did not push themselves to pain during a run. Of particular interest is the author's conclusion that "it makes little sense to take risks associated with medical symptoms and injury when the main goals of running are improved health and fitness" (p. 460).

In studies of work reproduction or recall, some results suggest a greater ability to reproduce running times^[139] with an associative strategy, whereas other investigations report no difference between association and dissociation during submaximal cycling^[140] or self-paced running.^[32] These conflicting results could be due to differences in the demand characteristics of the exercise bouts or

differences in the participants' experiences with the task in different studies. Exercise intensity was controlled in only one study.^[140] Finally, it has also been suggested that, compared with the importance of training variables and other psychological factors (e.g. self-efficacy), A/D strategies might be less critical for performance.^[118]

6. Discussion

As can be seen from this review, there continues to be strong research interest in attentional focus strategies within the context of physical activity. Yet, despite some refinements in the conceptualization of association and dissociation, there remain many inconsistencies in the findings and, accordingly, important inconsistencies in the recommendations issued to exercisers and practitioners. For example, a common theme that has emerged in this review is the lack of experimental control for exercise intensity. Given that the focus of one's attention depends, in part, on what cues one is most aware of, it is surprising that greater attention to exercise intensity was not observed in more investigations. This review examined the effects of attentional focus strategies on specific perceptual, affective and physiological variables associated with exercise. In general, studies of exercise economy, tolerance, affective responses and perceptions of exertion have not yielded consistent findings.

Some studies suggest that improvements in one factor may be at the expense of another. For example, during 5 km runs, LaCaille et al.^[42] noted improved running performance times with an associative strategy but significant improvements in feeling states using a dissociative strategy. Attempting to find the point where physiological risk and psychological benefit are balanced seems critical. Indeed, numerous investigators have commented on the reciprocal relationship between increased physiological stress and deteriorating psychological responses.^[43] For example, Harte and Eifert,^[100] in their study of hormonal marker changes under associative versus dissociative conditions, concluded that "patterns of urinary adrenaline, noradrenaline, and cortisol excretion and

concomitant emotional change differ when environmental setting and the focus of attention are altered and a normally pleasant task becomes tedious and negatively evaluated" (p. 54).

Furthermore, an important effect of attentional focus strategies might be during the post-exercise experience.^[141] Influencing how the exercise stimulus is perceived and registered in memory might be critical for an exerciser's subsequent motivation to continue engaging in exercise. Researchers have noted differences in psychological responses to experimentally induced pain depending on whether the individual monitored was distracted from or suppressed the painful sensation. Cioffi and Holloway^[141] found that use of a dissociative coping strategy (i.e. distraction and suppression) during the exposure to a painful stimulus was associated with higher pain ratings during the post-exposure period. In contrast, monitoring specific sensory components of pain allowed individuals to assume control over the stimulus, resulting in non-valenced descriptions of pain. In other words, an individual was more likely to describe the experience in negative affective terms after being distracted from or suppressing thoughts of pain during exposure. While actively monitoring the sensations, however, the individual was more likely to describe the pain in neutral terms (e.g. "The more I paid attention to it, the more the pain started to feel more like an itch").^[141]

6.1 Future Directions: What are the Possible Sources of Inconsistencies?

The studies highlighted in this review have contributed considerably to the current understanding of associative and dissociative cognitive strategies across the realm of exercise. There remains, however, a need to address and clarify some key issues that might have contributed to the inconsistent results.

6.1.1 Participant Characteristics

Arguably, because of the pioneering work of Morgan,^[23,49] much of the focus on the associative versus dissociative styles debate has centered on elite athletes. Of the 88 studies included in this review, 57 investigations (≈65%) used participants

who could be classified as moderately to well trained athletes, competitive at the local, regional or national level in their sport. For example, Beaudoin et al.^[92] investigated highly trained men (average $\dot{V}O_2$: 70.5 mL/kg/min), Takai^[139] sampled endurance runners averaging approximately 145 km/wk, Netfield^[137] tested competitive mile runners (average times: men 4:29 minutes; women 5:27 minutes), Morgan et al.^[51] used runners with average 10 km times of 27:49 minutes, and Durtschi and Weiss^[66] researched competitive male (average time 2:20 hours) and female (average time 2:50 hours) marathon runners. Conversely, only nine studies ($\approx 10\%$) used participants who could be classified as 'sedentary', with the remaining 22 studies (25%) sampling participants characterized as 'healthy'. Consequently, the samples represented in this review reflect a bias in favour of competitive athletes and, therefore, also a possible bias in favour of using or preferring associative strategies.

Given Morgan's^[23] assertion that dissociation might be more advisable for helping the untrained individual tolerate an exercise bout, it seems difficult to arrive at any definitive conclusions given the paucity of research using physically inactive individuals. Drawing generalizable conclusions is further complicated because participants were primarily <30 years of age in most studies (55%). Consequently, it appears premature (and potentially hazardous) to recommend either association or dissociation to middle-aged, overweight, sedentary individuals who may be at risk for chronic disease (probably the typical profile of beginning exercisers in the US and other industrialized countries with high rates of physical inactivity).

6.1.2 Exercise Stimulus

The second issue deals with the nature of the exercise stimulus. Understandably, because of the early work with marathoners, running has continued to be the most studied exercise mode in attentional focus research ($\approx 47\%$). Following running, the most common modalities are, in order: cycle ergometry ($\approx 22\%$), treadmill exercise (e.g. exercise testing, $\approx 14\%$), rowing ergometry ($\approx 5\%$), swimming ($\approx 5\%$), walking (3%) and

stairclimbing, cross-country skiing and military marching (1% each).

The most commonly studied intensity level has been submaximal (63 studies; $\approx 71\%$). Within these studies, the range has varied from 4 minutes of submaximal cycle ergometry^[89] to the sustained effort needed to complete an ultraendurance run.^[35] In 13 studies ($\approx 15\%$), the intensity level was characterized as 'self-selected' or 'self-paced'. Of these investigations, the exercise stimulus ranged from running 1 mile^[32] to 30 minutes of cycle ergometry.^[34] Intensity levels that approached or reached maximal were investigated in 12 ($\approx 14\%$) of the studies. Examples range from performing a 30-minute treadmill run at 90% $\dot{V}O_{2max}$ ^[92] to cycling to volitional exhaustion.^[105]

As can be seen in table I (supplemental material), the wide range of intensity levels and durations of the exercise stimuli make it difficult to conclude when each strategy is most effective. It seems particularly noteworthy that exercise intensity has been identified as a critical moderator of the effectiveness of A/D strategies in most of the theoretical models discussed earlier.^[60-63] Yet, with rare exceptions,^[70,123] A/D studies have not been specifically designed to test the proposed moderating role of exercise intensity. This seems surprising, as several authors have found that attentional focus tends to become more associative as exercise intensity increases.^[70,83,90,96,105,123] Others have commented that a level of exercise intensity that is high enough could render any attempt at manipulating one's attentional focus ineffective.^[23,62,63,140] For example, Siegal et al.^[140] speculated that an increased workload might "eventually negate the attentional effect" (p. 152). Given the central role that has been attributed to exercise intensity through the years, the absence of more experimental investigations that have directly compared the effectiveness of A/D strategies across different levels of exercise intensity is striking.

In anticipation of future experimental investigations on the role of exercise intensity, it might be worth highlighting the possibility that the intensity-dependent changes in the effectiveness of A/D strategies might be linked to important physiological landmarks such as the ventilatory threshold and respiratory compensation point.^[63,65] Intuitively, it

seems reasonable to suggest that a dissociative strategy would be mostly effective when peripheral physiological changes first start to generate a bombardment of the brain's interoceptive mechanisms with salient cues. This is likely initiated when an exerciser reaches his or her ventilatory threshold. It is at that level of intensity that the notion of 'competition of cues', first advanced by Pennebaker and Lightner^[31] as the mechanism by which dissociation exerts its beneficial effects, appears most relevant. Conversely, when exercise intensity is raised to a level that does not permit the maintenance of a physiological steady state and homeostasis is in jeopardy, the need for survival and successful adaptation dictates a direct, veridical link between bodily cues and conscious awareness. One could speculate that this switch to an association-dominant mode is probably unavoidable (i.e. not amenable to deliberate manipulation)^[62,63] and takes place proximally to the respiratory compensation point or the maximal lactate steady state.

6.1.3 Experimental Designs

The final issue deals with the level of methodological quality that characterizes many investigations in this area. There seems to have been a preponderance of studies lacking a control group or condition and an over-reliance on correlational designs and observational methods of data collection. Twenty-one of the 88 studies ($\approx 24\%$) reviewed used self-reports of attentional focus during the exercise bout. Although 42 studies ($\approx 48\%$) compared different experimental conditions (e.g. association group vs dissociation group), only 18 investigations ($\approx 20\%$) had a control group or condition. It is clear that, although quasi-experimental, correlational and observational studies have been instrumental in raising awareness for the possible importance of A/D strategies in influencing both performance and the experience that exercisers derive, definitive results can only be obtained through tightly controlled, hypothesis-driven experimental investigations. In that sense, it could be argued that the level of evidence that is currently available, despite its volume, continues to be preliminary in nature and, as such, it forms a relatively weak foundation for deriving meaningful practical recommendations.

6.2 A Comment on A/D Guidelines and Applications

The theme that emerges from the present review appears to be one of inconsistency in the findings and lack of systematicity in the investigational approaches. Nevertheless, efforts have been made to issue A/D-related recommendations to exercisers and sport competitors. For the reasons noted in the previous sections, these should be viewed with caution.

Some authors have outlined comprehensive psychological skills packages designed to improve performance in a variety of endurance sports.^[142,143] These packages include cognitive strategies such as self-talk, imagery, arousal regulation and attentional focus manipulation. Similarly, some researchers have endorsed the benefits of one attentional focus strategy over the other.^[23,71] For example, some have argued that an outward distraction "allows the enjoyment derived from the atmosphere to be fully appreciated, and this degree of distraction minimizes the effect of any discomfort."^[27] Stanley et al.^[96] recommended dissociation for recreational athletes "as long as the physical effort is tolerable" (p. 361), while Berger^[144] concluded that dissociation could "be achieved most easily at a gentle, slow pace" (p. 45). Conversely, other authors have recommended an associative strategy as most beneficial for self-regulation^[24,56,82-85,98] and prevention of dropout.^[98] Schomer^[24] observed that his sample of marathon runners "preferred to deal with pain or discomfort associatively by talking about their origin, and adjusting pace and stride to alleviate the symptoms" (p. 55).

As noted earlier, the intensity level of the exercise bout appears to be a constant theme in each of these recommendations and it deserves greater attention in future research.^[123] Increasing levels of exercise intensity are associated with unpleasant sensations of pain and fatigue,^[145] prompting some to question whether cognitive strategies can compete with salient physical sensations.^[62] Studies have shown that thought content becomes more associative as intensity increases.^[70,83,90,96,105,123]

Other researchers contend that the decision to use either attentional focus strategy depends on whether there is a specific desired outcome or on

the experience level of the individual. A number of researchers have noted the benefit of using association to improve performance and dissociation to enhance the physical activity experience.^[45,80] In contrast, other investigators have advanced the idea of association as the optimal strategy for individuals experienced with sensations generated internally and their meaning, whereas dissociation as the preferred strategy for inexperienced individuals for whom processing of internal sensations might be unfamiliar.^[53,56] However, at present, evidence for the validity of these interpretations remains scant.

There appears to be a paradox within the attentional focus literature. More specifically, it seems that using attentional associative strategies for fit individuals allows for better regulation of effort and pace. Alternatively, attentional dissociative strategies have been recommended for individuals initiating an exercise programme as a means of better tolerating the physiological strain associated with exercise. However, there are several scenarios (e.g. previously sedentary and inexperienced individuals initiating an unsupervised programme of physical activity, and overweight or obese individuals) in which intensity may rise to a level where focal awareness becomes centered exclusively on somatic cues. As suggested by the theoretical models outlined earlier, this may happen despite an individual's effort to divert attention away from internal cues and towards external cues.^[60-63] In addition, in some exercise environments, such as rehabilitation programmes, individuals are often encouraged to focus attention on bodily cues in order to monitor intensity and effort level to prevent potentially dangerous levels of exertion. This paradox has prompted other investigators to call for studies using improved conceptual models^[146] and identifying the link between attentional focus and bodily responses.^[31,53,119,147] Possibly the most persuasive argument was outlined by Masters and Ogles.^[55] In concluding their review of 20 years of A/D research, the authors stated:

“The theoretical foundations of A/D need further development. The field presently operates on somewhat implicit and unexamined theoretical underpinnings. Since Morgan and Pollock's (1977)

initial study, little has been done to directly advance our theoretical understanding of why, when, how, and in what context, and for whom A/D operates. Studies that offer theoretical proposals and then test them empirically are encouraged” (p. 267).

The lack of consensus and the current state of attentional focus research is still well captured by Sachs'^[80] earlier conclusion: “It is clear that we cannot yet provide definitive recommendations on the use of associative and dissociative strategies” (p. 300). Thus, it appears that, based on the findings of this review of the A/D literature, little substantive progress has been made in the past decade since the last major review.^[55] Given the obesity and physical inactivity epidemic currently impacting most industrialized nations, it seems imperative that future A/D research should consider the limitations that have characterized past investigations and give particular attention to the critical role of exercise intensity before any definitive recommendations can be advanced to the general public.

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