

Attentional Strategies During Rowing

D. Longman^{1,*}, J.C. Hutchinson², J.T. Stock¹ and J.C.K. Wells³

¹*Division of Biological Anthropology, Department of Archaeology and Anthropology, University of Cambridge, Pembroke Street, Cambridge CB2 3DZ, UK*

²*Springfield College, 263 Alden Street, Springfield, MA 01109, USA*

³*Childhood Nutrition Research Centre, UCL Institute of Child Health, London WC1N 1EH, UK*

Abstract: This investigation explored the relationship between task intensity, competitive setting, and attentional strategy in collegiate rowers. Here, the associative-dissociative dimension of attentional focus is considered. Associative thoughts are task-related, whereas dissociative thoughts are not. Previous work has linked associative strategies with higher level performance, and higher intensities of exercise (i.e. those which exceed the ventilatory threshold). Male and female collegiate rowers ($N = 298$) completed three training sessions (one each at low, moderate, and high intensity) and two races (short and long distance). Results revealed that the higher the training intensity, the greater the degree of association. A greater degree of association was also observed in competition as opposed to training, and in short distance versus long distance races. There was no gender difference in attentional strategy. Finally, it was shown that the *variation* in attentional strategy was inversely proportional to exercise intensity. These findings support previous work examining the effect of task intensity on attentional focus [1], in a field based setting. Furthermore, new insight is offered regarding how competition interacts with intensity in this relationship.

Keywords: Cognitive strategies, association, dissociation, rowing, attentional focus.

The cognitive strategies employed by athletes have long been of interest to researchers and practitioners in the field of sport and exercise psychology. One area which has attracted the attention of researchers is the difference between associative and dissociative attentional strategies; a distinction first made in the 1970s [2]. Associative strategies are thought processes in which the participant focuses attention on internal sensations such as heart rate, breathing and fatigue [3]. In contrast, thought processes which divert attention away from internal sensations and which may be considered distracting, such as thoughts about work, interpersonal relationships or passing scenery, are described as dissociative [4, 5].

The relative employment of associative and dissociative strategies during exercise has been considered in several sports, although the majority of studies have focused on running [2, 6, 7]. Morgan and Pollock [2] found that elite marathon runners employed mainly associative strategies, while non-elite runners tended to dissociate to a higher degree. This finding led to a branch of research contemplating the relationship between the level of performance and attentional strategy. While some studies have shown no evidence of a relationship [8–10] the majority of studies have provided evidence for improved performance as a result of the adoption of an associative strategy, and

that more experienced competitors tend to use association to a greater degree than less experienced competitors [11–14]. Effect size in the aforementioned studies ranged from $d = 0.20$ [11] to $d = 0.61$ [12] indicating a small to moderate effect [15].

TASK INTENSITY

Dissociative strategies come to the fore when the duration of exercise increases; an increase in exercise duration is necessarily accompanied by a decrease in intensity when performed with maximal effort. Dissociation allows an athlete to remain relatively desensitized to sensory feedback; reducing feelings of monotony, discomfort and pain [16, 17]. As such, dissociation reduces one's perception of effort [18, 19], which is influential in an athlete's decision-making process with regards to adjusting pace, and, importantly, in deciding whether to continue or stop the activity [20]. As exercise intensity increases, thoughts become more associative. The theoretical rationale for this transition is a pre-conscious, sensory-driven, shift from *top down* to *bottom up* attentional processing [21]. According to attentional control theory [22], attention is regulated by both a goal-directed system, and a stimulus-driven system. The goal-directed attentional system is governed by knowledge, expectations, and current goals and exemplifies *top-down* attentional control [23]. In contrast, the stimulus-driven system is involved in the *bottom-up* control of attention and "is recruited during the detection of behaviorally relevant sensory events, particularly when they are salient" [24].

*Address correspondence to this author at the Division of Biological Anthropology, Department of Archaeology and Anthropology, University of Cambridge, Pembroke Street, Cambridge CB2 3DZ, UK; Tel: 01704 873791; E-mail: dl329@cam.ac.uk

Experimental evidence has supported the concept of an associative attentional shift with increasing workload [21, 25, 26]. The same relationship has been reported among elite runners, albeit for a small sample ($N=8$), [3]. The importance of utilizing associative strategies to maximize performance at high exercise intensities is generally accepted [27]. Through the use of associative strategies, athletes are able to monitor sensory feedback to enhance performance through the appropriate adjustment of race strategy and pace [5].

Teleoanticipation is defined as a subconscious pacing strategy developed with reference to current position relative to the finishing point, and was first proposed as a concept by Ulmer in 1996. Studies examining teleoanticipation and cognitive strategy provide indirect evidence for the link between cognitive strategy and exercise intensity. In distance running, the relative balance of associative and dissociative thoughts may be dependent upon which stage of the race the athlete is in. In the early stages of a race thoughts are predominantly associative, switching to predominantly dissociative as the run progresses before reverting back to associative towards the end [28]. In parallel with this observation, upon instruction to maintain a constant level of perceived exertion during a bout of exercise, an athlete's speed falls over time, reaches a stable low point before increasing towards the end [29]. This suggests that attentional strategy and perceived effort have a direct relationship. This pattern of work output reported by Ulmer matches the levels of association reported by Sachs; a high initial intensity being accompanied by associative strategies, a mid-exercise fall in speed with increasing dissociation, and finally an intensity rise with a more associative focus.

VARIABILITY IN ATTENTIONAL STRATEGY

Variability in attentional strategy may be inversely proportional to exercise intensity, as discussed by Hutchinson and Tenenbaum [21]. At low to moderate exercise intensity, athletes have the *cognitive flexibility* to manipulate their attentional focus. Cognitive flexibility refers to the mental ability to adjust thinking or attention in response to changing goals and/or environmental stimuli [30]. Thus, when task demands are low, athletes may adopt an associative strategy, a dissociative strategy, or alternate between the two, depending on situational and/or personal factors [31]. However at high exercise intensity, where the increased physiological demand and increasingly unpleasant afferent stimuli shift focus toward *bottom-up*

processing, athletes' attentional focus will be predominantly associative with a low degree of variance. Using event-related brain potentials, neuroscientists have shown that the amount of attentional resources that are devoted to a given task are decreased during high-intensity exercise [32]. This attentional narrowing, together with the aforementioned switch to *bottom-up* attentional processing, is expected to manifest in low statistical variability in associative and dissociative attentional strategy at high exercise intensity, namely an attentional focus.

GENDER DIFFERENCES

Workload has been identified as having greater influence than gender upon the degree of association utilized during exercise [33]. Empirical evidence concerning the relationship between gender and attentional strategies employed during exercise is unclear. Significant gender differences have not been identified in studies spanning the disciplines of race walking [34], running [35–37] and rowing [11, 26]. Conversely, in other research women have exhibited greater degrees of dissociation in endurance activities such as running, swimming and cycling [8, 38]. Further research is needed to elucidate the relationship between attentional strategies and gender [26].

COMPETITION VERSUS PRACTICE

Research has previously demonstrated that athletes associate more during competition than they do during training [e.g., 38, 39]. It is unclear whether this difference should be attributed to the task intensity factor or competitive factor during competition; that is, do athletes compete at a higher intensity than they typically train, or does the competitiveness of the situation determines the degree of association? It is possible that both factors may play a role in the relationship between attentional strategy and level of competitive setting. Masters and Ogles [40] suggested that "driven and competitive athletes associate as a means of enhancing their performance" (p. 294). This notion is supported by the finding that association positively correlated ($r = .30$) with drive/competitiveness and negatively ($r = -.51$) with performance time in a sample of marathon runners [41]. This particular finding led Masters and Lambert [41] to conclude that more competitive athletes seek to gain an advantage in a competitive situation by concentrating on all physical aspects related to running performance. However, Bachman *et al.* [39] reported

that interval training sessions elicited similar degrees of association as the race condition, despite athletes rating the race as being significantly more competitive than the interval training session. This finding supports the notion that intensity of effort is also a determining factor of the degree of association.

ABILITY LEVEL

The ability level of an athlete may be related to attentional strategy. It has been widely reported that elite runners employ predominantly associative attentional strategies, while non-elite runners dissociate to a higher degree. This distinction has been supported in marathon runners [14, 41, 42, 43], middle distance runners [36], rowers using the indoor rowing ergometer [11] and in a comprehensive review of twenty years of research in the field [40]. Furthermore, dissociative strategies may be more effective than associative strategies when the individual is not experienced with a particular endurance task, with the opposite being true of more experienced athletes [44]. Nevertheless, other research examining the link between ability level and attentional strategy have found no relationship among endurance athletes [8], marathon runners [10] and Ironman triathletes [45] in a field based setting. To date, this relationship has not been examined among rowers in a field based (non-ergometer) setting.

METHODOLOGICAL ISSUES

There are methodological challenges facing research in this area of study [21]. In their comprehensive review, Masters and Ogles [46] noted that in addition to suffering from small sample sizes, this research area faces inherent difficulties due to the unobservable nature of participants' attentional strategies, and participants being engaged in physical activity when cognitions occur. The various methods of circumventing this experimental difficulty all suffer from their respective limitations.

Scientific research requires standardized techniques to assess a given variable; however, the available literature reports an array of methodologies. These range from structured interviews [36, 47], to questionnaires [4, 14] and video/audio-based analyses [16, 48]. Each method has its limitations. Retrospective questioning may be inaccurate due to the distorting effect of time on memory [16], while the use of recording devices to capture verbalized thoughts during task engagement may cause discomfort and an

unwanted burden leading to decreased performance level, as well as experimentally-imposed dissociative thoughts [46]. Self-report of thought processes, whether retrospective or real-time, are also prone to selective reporting due to potential embarrassment. There is also the slight danger of vague thoughts being incorrectly classified by researchers. In light of such methodological difficulties and misinterpretations, it has been suggested that the best protocol is to ask the participants themselves to decide on the relative balance of associative and dissociative thoughts experienced [49]. Assuming that the participants clearly understand the distinction between association and dissociation, such a method is preferable as it avoids problems associated with experimenter misinterpretation and selective verbalizing of thoughts. It is worth emphasizing, however, that recalled attention focus can be inaccurate due to the distorting effect of time on memory [16].

Further adding to these methodological issues, there has been a degree of confusion in the literature regarding the definitions of the terms 'association' and 'dissociation'. Associative thoughts have been described as being both thoughts pertaining to bodily sensations [42] and also as those relevant to performance, be they internal or external [41]. Similarly, dissociation may encompass thoughts that deliberately distract attention from bodily sensations or simply those not pursuant to the task at hand. This confusion has been addressed through the description of a two-dimensional model that considers both the direction of attention (i.e. internal or external) and the degree of focus on the task (i.e. task-relevant or task-irrelevant) [49]. In this model, task relevant thoughts are considered associative while task-irrelevant thoughts are dissociative. An internal thought pertains to oneself, and external thoughts do not. Thus, a runner focusing on his or her breathing would be using internal association, whereas thinking about the passing scenery would be an example of external dissociation. A runner checking split times would be external associative, and thinking through a personal problem is internal dissociation. Stevinson and Biddle [49] attested that these four categories were "all inclusive and mutually exclusive" (p. 232) in terms of the wide range of cognitions available to endurance performers. However, subsequent studies (e.g., 11,18) found that only the task-relevant/task-irrelevant dimension of attention focus contributes meaningfully to perceptions of exertion. For the purposes of this study, the task-relevant/task-irrelevant dimension of attention focus will

be used; associative thoughts are considered as being task-relevant, whereas dissociative thoughts are not [16].

PURPOSE AND HYPOTHESES

This investigation sought to expand upon the existing field of knowledge concerning cognitive strategies during sport and exercise; to date the majority of research has been laboratory based, which can compromise ecological validity. A second limitation pertaining to research to date, small sample size, was also addressed. Based upon previous research the following hypotheses were tested:

Hypothesis 1. There would be a positive relationship between the degree of association and task intensity.

Hypothesis 2. There would be no gender difference in cognitive strategy.

Hypothesis 3. There would be a higher degree of association in competitive situations relative to training.

Hypothesis 4. More experienced rowers (i.e. those who have competed at the national and international level) would exhibit a greater degree of association relative to less experienced rowers (i.e. those who have not competed at the national or international level).

Hypothesis 5. The statistical variability in attentional strategy would be inversely proportional to task intensity.

METHOD

Participants

Participants were 298 rowers (169 male and 129 female; age $M = 24.35$ years, $SD = 3.35$), recruited from university rowing teams across the United Kingdom. All participants had more than 2 years of rowing experience: $M = 5.07$, $SD = 2.00$). Regarding ability level, 35 participants had competed internationally, 93 had competed at the national level, 106 had competed at the regional level, and 64 had competed at the university level. Written informed consent was obtained from the participants. Participants were not compensated for their involvement in the project. All participants were informed that their responses were anonymous, and that they could withdraw from the study at any time.

Ethical approval was given by the University of Cambridge Human Biology Ethics Committee.

Measures

Attentional strategy was assessed using a single-item scale. The scale consisted of a 10cm bipolar line, with "Dissociative" written on the extreme left and "Associative" written on the extreme right [3]. Rowers marked the point on the scale that best represented the proportion of associative versus dissociative thoughts for the completed exercise. An attention score was then calculated through careful measurement of the location of the mark along the line in millimeters (range 0-100; higher score denoting greater association). Though single-item measures cannot be assessed for their internal reliability, the ecological validity of the scale was found to be sound (see a detailed elaboration on this issue in [50]).

Procedures

Club captains were contacted via email, and those who expressed an interest in participant recruited all members of their respective squads to partake in the study, addressing the potential problem of volunteer bias. The difference between associative and dissociative strategies was explained in person by the first author and questions regarding the distinction were answered. The purpose of the investigation was not explained at this time. All participants completed three training sessions and two competitive races. The races were 2000m and 6800m in length (termed short and long races, respectively).

The three training sessions were conducted at different levels of intensity and duration. Typical training sessions were used for analysis, ensuring that the rowers were familiar with them. Low intensity training was performed at a heart rate (HR) between 55%-70% of maximum heart rate (HR_{max}) for 45 min. Moderate intensity training was performed at 70%-80% of HR_{max} for 30 min. High intensity training consisted of five performance intervals of between 3 min to 3'30" duration with a long (5 min) recovery. In the high intensity session the goal was to complete the five intervals in the shortest possible time (i.e. maximal effort). HR_{max} was recorded as being the maximum heart rate achieved during a standard 2000m rowing ergometer test within the last 6 months (only athletes with this data were chosen to participate in this investigation). This method of HR_{max} determination was chosen over formulaic approaches [51, 52] due to the

large degree of error inherent in the estimation of HR_{max} [53]. The maximum heart rate was reported by the rowers' coaches (who kept a record of this data), and training session heart rates were collected by the experimenter. Heart-rate was not recorded during the races as the majority of rowers did not want to wear the chest strap whilst competing. All rowers were, however, confident they were working to maximal effort in both races. The three training sessions were conducted at standardized intervals (48hr between each session, during which the rowers did not train) and at the same time of day. The order of presentation of training sessions was evenly and fully counterbalanced.

All training sessions and races were completed using carbon fiber single scull boats. In order for a direct comparison between training and competition to be valid, only training sessions performed in a boat were analyzed. Upon completion of each session, rowers were asked to self-report their relative balance of associative and dissociative thoughts, as recommended by Stevinson and Biddle [49]. Participants used a pen to mark the point that best represented the proportion of associative versus dissociative thoughts for each condition on the cognitive strategies scale. The attention score was calculated through careful measurement of the location of the mark along the line in millimeters. All ratings were taken within 30 min of completion of the training session/race. Immediate data collection was not possible due to the time taken to row back to the boating dock area.

Data Analysis

Hypotheses 1 and 2 were addressed across the three training conditions using a 3 (condition; low, moderate, high) x 2 (gender) mixed factorial ANOVA. Differences in attentional strategy across the two competition distances were analyzed using a 2 (race distance) x 2 (gender) mixed factorial ANOVA. Hypothesis 3 was addressed by comparing mean values for training and competition using a 2 (condition;

training or competition) x 2 (gender) mixed factorial ANOVA. Hypothesis 4 was addressed using a one-way ANOVA with ability level (international, national, regional, university) as the independent variable and attentional focus (averaged across all conditions) as the dependent variable. Finally, Hypothesis 5 was addressed using Levene's test for equality of variances across conditions. All analyses were performed using SPSS v21.

RESULTS

Tests of the distributional properties of the data revealed that the data was negatively skewed, so a log transformation was performed to normalize the data [54]. Levene's test revealed unequal variances between conditions; therefore the repeated measures ANOVA was paired with the post hoc Games-Howell test which does not assume equal variances [55, 56].

Results of a 3 x 2 mixed factorial ANOVA revealed a significant main effect for training intensity $F(2, 592) = 936.07, p < .001, \eta_p^2 = .76$. Pairwise comparisons revealed significant differences between the three training conditions and a positive relationship between training intensity and association (see Table 1); therefore Hypothesis 1 was accepted. As predicted by Hypothesis 2, there was no main or interactive effect of gender for training intensity ($p > .05$).

Results of a 3 x 2 mixed factorial ANOVA revealed a significant main effect for competition distance, $F(1, 296) = 110.28, p < .001, \eta_p^2 = .27$, and a significant competition distance by gender interaction effect $F(1, 296) = 7.80, p < .006, \eta_p^2 = .03$. For the main effect of distance, pairwise comparisons showed that participants reported significantly ($p < .001$) greater association in the short race ($M = 94.56, SD = 7.56$) than in the long race ($M = 90.47, SD = 10.35$; Cohen's $d = .45$), therefore Hypothesis 3 was accepted. The two-way interaction revealed that male and female attentional strategies did not differ in the long race (male $M = 90.58, SD = 10.13$; female $M = 90.62, SD =$

Table 1: Descriptive Statistics (Means ± SD) and Effect Sizes (Cohen's d) for Percentage of Associative thoughts in Three Rowing Training Conditions

	M ± SD	Low intensity	Moderate intensity	High intensity
Low intensity	50.07 ± 21.65	-		
Moderate intensity	69.57 ± 18.08	.98*	-	
High intensity	89.96 ± 10.74	2.33*	1.37*	-

Note: Higher score indicates greater association. * = $p < .001$.

10.62; $p = .759$), but during the short race males reported greater association ($M = 95.78$, $SD = 5.49$) than females ($M = 93.33$, $SD = 9.48$; $p < .001$; Cohen's $d = .61$).

When the mean attentional strategy of the training and racing conditions were compared results showed a significant main effect $F(1, 296) = 613.50$, $p < .001$, $\eta_p^2 = .68$. Pairwise comparisons showed that participants reported significantly ($p < .001$) greater association in competition ($M = 92.50$, $SD = 8.46$) than in practice conditions ($M = 69.86$, $SD = 15.02$; Cohen's $d = 1.86$). Depending on athlete ability level and racing conditions, time to complete the standard international 2000m regatta distance in a single scull boat can vary from the current world record of 6:33.35 min to 8:30 min in lower standard club races. The interval training group is therefore the most appropriate condition to compare to the 2000m race, in terms of both duration and intensity. A paired samples t -test was conducted to compare cognitive strategy during interval training and the 2000 m competition. Results revealed a significant difference $t(297) = 10.67$, $p < .001$, with participants reporting greater association in the 2000 m competition ($M = 94.72$, $SD = 7.58$) than in the interval training condition ($M = 89.96$, $SD = 10.74$; Cohen's $d = .51$).

A one way ANOVA showed that the difference in average (across the 5 conditions) degree of association between Group 1 (international level; $M = 89.93$, $SD = 5.34$), Group 2 (national level; $M = 81.64$, $SD = 9.18$), Group 3 (regional level; $M = 78.59$, $SD = 9.28$) and Group 4 (university level; $M = 69.67$, $SD = 11.98$) was statistically significant $F(3,294) = 38.10$, $p < 0.001$. Post hoc comparisons using Tukey's HSD test showed that rowers in Group 1 used association significantly more than the other groups, rowers in Group 2 did not differ from rowers in Group 3 but did associate significantly more than rowers in Group 4 and 5, and rowers in Group 3 associated significantly more than rowers in Group 4. Hypothesis 4 is thereby accepted. Levene's test indicated unequal variances between the training and competition conditions, $F(1,594) = 239.06$, $p < .001$. There was greater statistical variance in attentional strategy at the lower exercise intensities (see Figure 1), supporting Hypothesis 5.

DISCUSSION

A positive relationship between the degree of association and task intensity in rowing was observed in both training and competition ($p < .001$). There was no gender difference in cognitive strategies in any

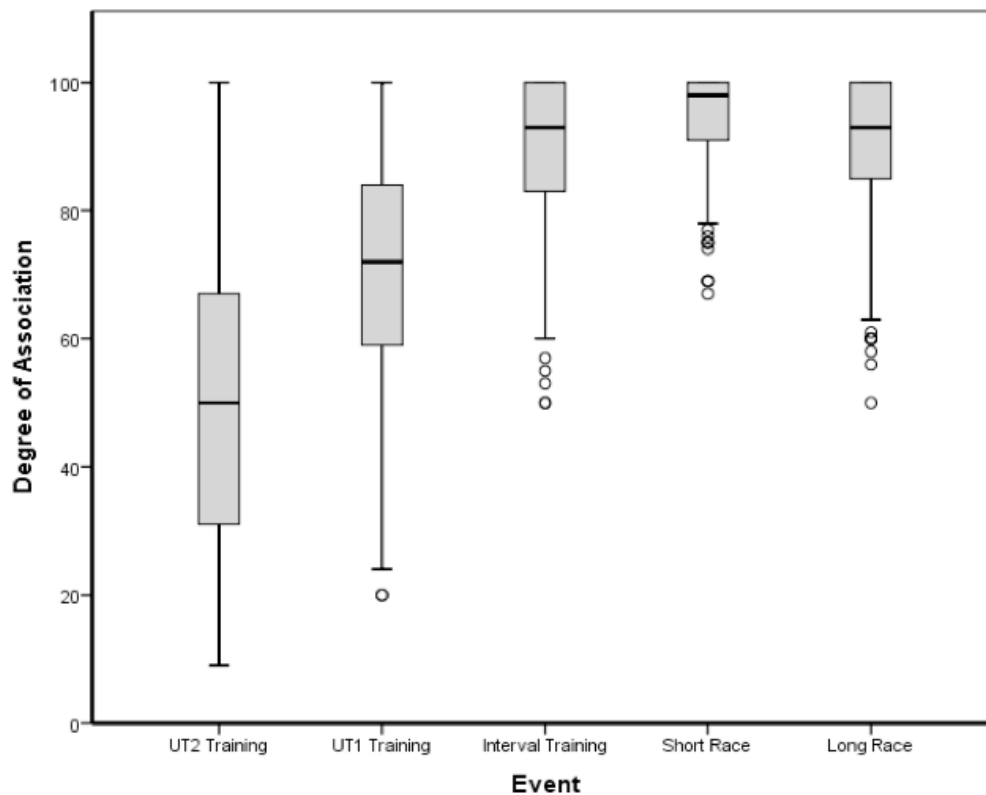


Figure 1: Box plot showing a significant difference ($p < .000$) in the variance of self-reported cognitive strategy in different rowing conditions. The box includes observations from the 25th to the 75th percentile; the horizontal line within the box represents the median value. Lines outside the box represent the 10th and 90th percentiles.

event. The hypothesis that there would be a higher degree of association in competitive scenarios relative to training was supported by a significant difference between training and racing association scores ($p < .001$). More experienced rowers reported greater use of association as a cognitive strategy than less experienced rowers. Finally, variation in attentional focus was inversely proportional to intensity in both training and competition settings (Levene's test, $p < .001$).

Task Intensity and Attentional Strategy

The results of this investigation suggest that there is a positive relationship between the task intensity and the degree of self-reported associative attentional focus ($p < .001$). This finding is in accordance with previous reports of attentional strategies employed by runners and race walkers, as well as laboratory tasks involving cycling and isometric hand grip tasks [3, 21, 34] as well as the general findings of a comprehensive review [46]. These findings are consistent with theoretical predictions concerning the relationship between physical effort and allocation of attention [1], and the model of parallel information-processing, which explains that physiological sensations will come to the fore of attentional focus when exercise intensity exceeds a certain threshold [17].

At the other end of the spectrum, exercise of lower intensity (and longer duration) was accompanied by greater dissociation. Thoughts which compete with sensory feedback in order to occupy focal awareness have the capacity to distract from any pain or discomfort experienced, and thus reduce ratings of perceived exertion [18, 19, 57]. Dissociation as a cognitive strategy may therefore allow the athlete to dampen afferent feedback, allowing a reduction in the sensations of pain and discomfort which can be inherent in prolonged bouts of exercise. Previous reports have demonstrated the efficacy of various sensory interventions for promoting dissociation during exercise, such as imagery [58] and listening to music [31]. From a practical perspective, coaches may then be advised to promote athlete dissociation during long, low-intensity training sessions to relieve monotony and reduce discomfort. For athletes training with a high-volume program, this may have implications for reducing the incidence of burnout [e.g., 57– 60]. Caution should be advised, however, as dampening of afferent feedback may increase incidence of injury [41].

Gender and Attentional Strategy

The hypothesis that there would be no apparent gender differences in the attentional strategies employed during exercise of varying intensities and duration is largely supported. Cognitive strategies have been described as coping mechanisms to deal with the stresses of exercise [26, 36]. Women's sport is rapidly gaining parity with male events on the international sporting scene, with the London 2012 Olympics being the first games with equal numbers of events for each sex. Consequently, it seems reasonable to assume that female athletes train and compete with the same intensity as their male counterparts. It therefore follows that, as both male and female competitors are faced with the same stresses, their coping mechanisms should be similar. Although no gender differences were revealed in the training protocols or the long race, men associated significantly more than women in the short race. Similar findings have previously been reported in endurance athletes, and a cultural explanation posed. Antonini-Philippe and colleagues suggest that women may dissociate more than men as they are culturally conditioned to avoid pain, and thus employ dissociative strategies to a greater degree. In contrast, men view tolerance as being a masculine trait, indicating strength [8, 38]. Further research, perhaps analyzing the cognitive strategies of men relative to women across a range of cultures and tasks, is required.

Competition and Attentional Strategy

Significant differences were found between the mean of the training scores and competition attentional scores ($p < .001$) and also between 2000m racing and interval training ($p < .001$). This is a more salient analysis due to the parity offered by the maximal-effort required for both interval training and racing. As such, there is an increase in associative thinking when an athlete makes the switch from training to racing that is seemingly independent of exercise time and intensity. This is an important finding, as it suggests the effects of competition may add to those of exercise intensity with respect to the degree of associative thinking. The increase in association reported when transitioning from maximal effort interval training to maximal effort racing (2000m) would seem to be due to the increase in competitiveness, as the intensity is consistent (i.e. maximal effort). An alternative interpretation is that increased competitiveness is linked to enhanced association as it allows extra intensity of effort to be found. This is not a new concept [61]. Previous research has demonstrated that competition leads to

enhanced performance in running [62], possibly as a result of a greater total anaerobic energy yield [63] and reduced perceived exertion [64].

When interval training was compared to races of over 2000m in length, there was no significant difference in cognitive strategy. These findings may be interpreted in two ways. First, the vast majority of races of this length take place during the winter season as "head races". In such races, boats race in a time-trial format, rather than side-by-side in the 2000m multi-lane regattas of the summer season. In this racing format, rowers experience a decreased awareness of small changes in speed relative to the opposition, which can lead to a decrease in the sense of competition, and therefore a decrease in associative strategies. Alternatively, the increased competitiveness of the long race may be counteracted by decreased intensity in comparison to shorter interval training efforts, resulting in similar levels of association between the two. Future research that endeavors to disentangle the effects of competition and task intensity on the degree of association in sport is warranted.

Task Intensity and Variability in Attentional Strategy

Tenenbaum [1] advocated a concept of effort symptomatology stating that under conditions of low exercise intensity attention can be shifted voluntarily from dissociative mode to association, and from wide to narrow spans. However, during high intensity exercise, the voluntary control of attention is severely diminished, and thus, the effectiveness of external strategies on perceived and sustained effort is limited. Consequently, the ability to manipulate ratings of perceived exertion and exertion tolerance shifts from "easy" at low levels of intensity to "hard" at high intensity levels. Based upon this model, Hutchinson and Tenenbaum [21] proposed that variation in cognitive strategy may be inversely proportional to exercise intensity. This hypothesis was supported by the current investigation; the variance in attentional focus of the three rowing training categories was significantly greater than that of the two racing categories. It may be advantageous for athletes to develop attentional flexibility in endurance exercise, (i.e. their ability to switch between cognitive strategies). As an example, a competitor in an endurance event might be able to dissociate during monotonous sections of the race or event to minimize perceived exertion, but then switch to association when concentration is required, such as when technically difficult terrain is encountered or for better performance

outcomes [27] when the race situation becomes more competitive.

Ability Level and Attentional Strategy

The present study reported that experienced rowers tend to associate more than rowers with less experience. This is consistent with previous work concerning marathon runners [14, 40, 42, 43], middle distance runners [36] and rowers using the indoor ergometer [11]. Much of the research concerning attentional strategy and ability level has been observational, and therefore cannot yield any conclusions with respect to causation. A relatively small number of studies have employed an experimental design, and may offer some insight into whether a causal relationship between attentional strategy and performance does indeed exist. The literature is mixed, with both association [13, 65, 66] and dissociation [6, 67] possibly conferring a performance gain, or maybe no causation at all [68]. The mixed reports concerning the putative relationship between cognitive strategy and ability level is perhaps due to experimental limitations such as small sample sizes and lack of control groups or pre-test data. Despite this, the balance of evidence does appear to be in favor of the existence of such a relationship [5].

Morgan's [42] findings purport that it is the high ability levels of elite athletes allow them to associate. That is, these athletes are accustomed to sensations of fatigue and have developed appropriate coping strategies to deal with them. When considering marathon runners, it was suggested that they are elite "not because they have learnt to associate, but because they can afford to associate" (p. 16). Masters & Ogles [41] argue that elite athletes are able to interpret their pain as sensory input that relatively is void of strong emotional overlay, and thus less aversive. This likely stems from their greater experience and increased coping-efficacy. Given that strong afferent feedback is relatively unavoidable at high exercise intensity [21, 26] a recommendation may be made that less experienced athletes be encouraged to develop, through psychological skills training (e.g. self-talk, imagery), redefinitional strategies that require that they attend to the exertional pain, but interpret it in a non-emotional way [41].

LIMITATIONS AND FUTURE RESEARCH

Although this study benefitted from a natural setting (thus increasing ecological validity) and a large sample

size, it is not without its limitations. A recall method was employed to assess attentional focus. At the outset of this paper the limitations of various methods of assessing state attentional focus during task engagement were outlined. While the recall method avoids the limitations of selective reporting, misinterpretation, and experimentally-imposed dissociative thoughts, recalled attentional focus can be imprecise due to the distorting effect of time on memory. In addition, retrospective distortions can be produced by current knowledge and beliefs [69].

The use of a single item scale that asked participants to report an overall balance of associative and dissociative thoughts may represent an oversimplification. More insight into the attentional strategies of rowers may have been obtained by asking participants to estimate the amount of time spent in association and dissociation at various time points during the course of an event, particularly the long duration events. Future studies might seek to extend the present findings by adopting this approach. Further, it might be useful to include some participation evaluation of the efficacy or functionality of various attentional strategies, in addition to their prevalence.

Finally, no attempt was made to quantify perceived exertion in the present study. This means that no inferences can be drawn regarding the impact of cognitive strategy on perception of effort. Task intensity was measured (*via* HR) in the three training sessions, but not in the racing conditions (at the rowers' request). This means a direct task intensity comparison cannot be made between racing and training conditions.

CONCLUSION

In summary, this investigation has demonstrated that (a) the higher the training intensity, the greater the degree of associative thoughts, (b) there is a greater degree of associative thoughts during competition than during training, (c) in competition settings, there is a greater prevalence of associative thoughts in the shorter race distance, (d) more elite rowers reported more use of association than less elite rowers, (e) no gender differences were found in attentional strategies during rowing, and (f) variation in cognitive strategy was inversely proportional to exercise intensity. These findings reinforce the link between task intensity and attentional allocation during sport and exercise. A key finding of this investigation is that competition setting appears to potentially mediate the workload-attention allocation relationship in that athletes tend to associate

more when in a competitive setting compared to training, even when training is conducted at maximal effort.

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