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The Effects of Cognitive Strategy and Exercise Setting on Running

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Exercise Setting on Running

by

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ABSTRACT

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The cognitive strategies of association and dissociation have been identified and studied in runners and other athletes. Association is said to involve thoughts that are task-oriented and may include a focus on pace, strategy, or physiological sensations. Conversely, dissociation involves task-irrelevant thoughts and may include thinking about such things as relationships, work, spiritual matters, or scenery. To date, studies have been largely descriptive, methodologically flawed, failed to use manipulation checks, and/or present unclear or differing conclusions. The emphasis with previous association and dissociation research has also been with elite and/or endurance athletes, such as marathon runners. Additionally, only a few studies have included more than one exercise setting, and these investigations seemed to indirectly suggest that the exercise environment may influence the use of cognitive strategies, performance, and perceived exertion.

In an effort to clarify the effects of cognitive strategies and exercise setting on several dependent variables, the current study investigated a sample of experienced recreational runners in a 3 x 2 mixed experimental design. Exercise setting had three levels (treadmill, indoor track, and outdoor route) and was a within-groups independent variable and cognitive strategy had two levels (association vs. dissociation) as a between-groups factor. The dependent variables were the ratings of perceived exertion, course satisfaction, and performance time for a 5 km run. The results indicated strong effects for the influence of exercise setting. The treadmill setting was rated as least satisfying, while resulting in the highest perceived exertion and slowest performance time. Alternately, the outdoor route resulted in the highest level of course satisfaction, while also yielding the lowest level of perceived exertion. For the dissociation strategy, the outdoor setting garnered the lowest perceived exertion, followed by the indoor track and treadmill, respectively, while with the associative strategy perceived exertion did not significantly differ among the settings. There were no overall differences in perceived exertion or course satisfaction between the cognitive strategies; however, there was a medium effect size and trend for the association group to run faster. The implications and limitations of these data are discussed and suggestions for future research are provided.

(94 pages)

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CHAPTER I

STATEMENT OF THE PROBLEM

Since Morgan and Pollock's (1977) seminal study of elite distance runners, much has been written about the use of the cognitive attentional processes of association and dissociation during running. The process of cognitive association has been generally described as the directing of attention toward task-oriented cues and the physical sensations experienced during exercise (Laasch, 1994-95; Masters & Ogles, 1998a; Morgan & Pollock, 1977; Sachs, 1984; Williams & Leffingwell, 1996). Conversely, the dissociative cognitive process, although somewhat more misunderstood, has been characterized as attentional focus that is unrelated to the experience of running and exercise (Goode & Roth, 1993; Masters & Ogles, 1998a; Morgan, Horstman, Cymerman, & Stokes, 1983; Morgan & Pollock, 1977; Williams & Leffingwell, 1996). Thus, in the case of association, an exerciser may be focusing attention toward his/her pace or strategy being used in the exercise event. Additionally, the focus may include physiological sensations, such as muscle fatigue, heart rate, or breathing. Dissociation, on the other hand, may include such attentional distractions as thinking about work, the scenery, relationships, spiritual matters, etc., which are non-exercise related.

Several researchers have studied the use of cognitive strategies in the context of endurance and/or elite and non-elite athletes, and have concluded that the elite individuals are more likely to utilize associative processes (Mallett & Hanrahan, 1997; Masters & Lambert, 1989; Morgan & Pollock, 1977; Tammen, 1996; Weinberg, 1999). It has also been reported that elite athletes tend to use associative processes while engaged in competitive activities and dissociative processes more regularly in non-competitive exercise, such as training runs (Masters & Lambert, 1989; Okwumabua, 1985; Summers, Sargent, Levey, & Murray, 1982). In their studies of association and dissociation with marathoners in race conditions, Masters and Ogles (1998b) reported finding that dissociating runners tended to run slower. Several authors have proposed that employing associative cognitive strategies enhances running performance (Schomer, 1990; Kirkby, 1996; Silva & Appelbaum, 1989).

Alternatively, non-elite athletes and exercisers have been reported to use dissociative strategies more often while exercising, and have found this strategy effective at reducing perceived exertion and improving satisfaction, endurance, and/or speed (Morgan, Horstman, Cymerman, & Stokes, 1983; Pennebaker & Lightner, 1980; Spink, 1988; Williams & Leffingwell, 1996). The suggestion that a dissociative strategy would result in enhanced performance/endurance has been most consistently studied with non-running physical activities and exercises. In particular, studies requiring individuals to engage in a leg-lifting task have found greater endurance with a dissociation strategy (Gill & Strom, 1985; Weinberg, Smith, Jackson, & Gould, 1984).

Although many of the findings have been confirmatory of the association/ dissociation process with non-runners, there has been a paucity of sound research using an experimental design with running samples. To date, studies have been largely descriptive, methodologically flawed, failed to use manipulation checks, and/or present unclear or differing conclusions (Masters & Ogles, 1998a). Thus, despite the proposed advantages of association/dissociation for performance, the research findings are unclear regarding how instruction in the specific use of cognitive strategies will affect performance as well as other outcomes. In addition to the methodological limits of the studies conducted thus far, the emphasis with cognitive strategies has been with elite and/or endurance athletes, such as marathon runners, which constitute a relatively small segment of the exercising population.

Further, the average runner may most often exercise and run in conditions and settings quite different from those encountered in competitive races or marathons. Many runners, for example, make use of treadmills, local tracks, or run outdoors through more scenic areas or trails. Surprisingly, only a few studies on association and dissociation have included more than one exercise setting. In one such study, Harte and Eifert (1995) merely asked runners what they attended to - either internally or environmentally, and neglected to evaluate how attentional focus and/or environment may influence running performance. Pennebaker and Lightner (1980) also did not directly manipulate cognitive strategy in their study comparing exercise setting. They did however, find that inexperienced runners were able to run faster on a cross-country course than a track without experiencing elevations in perceived exertion. These investigations seem to indirectly suggest that the exercise environment may influence the use of cognitive strategies.

In order to give sound recommendations to individuals for enhancing their exercise and running (wherever they run), it is important to be clear on the advantages either strategy may possess for performance and perceived exertion, and how these can be best utilized in different environments and settings. Thus, the current study used an experimental design, with a sample of experienced recreational runners, to clarify the effects of cognitive strategies and exercise setting on performance and perceived exertion. Runners were assigned to either cognitive strategy (i.e., association vs. dissociation) and asked to run in three different settings (i.e., treadmill, indoor track, and outdoor route).

CHAPTER II

REVIEW OF THE LITERATURE

Running is the activity of choice for many individuals seeking health and physical fitness (Sachs, 1991). Over the last three decades the number of individuals who run regularly has been steadily increasing. In fact, it is estimated that since the mid-1980s there has been a 14.4% increase in the number of people in the U.S. who take part in this form of exercise (Wellner, 1997). Paralleling this surgance of interest in running has been the attention given to the "mind of the runner" and the cognitive foci and strategies used while running. Through the use of a particular psychological set or strategy runners may affect the quality, as well as the performance of their run (Hardy & Nelson, 1988; Sachs, 1984; Schomer, 1990).

Outside the area of running, researchers have long been interested in the psychology of sport and exercise. This is most evident in the area of performance enhancement through the use of mental training and cognitive strategies (Gould & Damarjian, 1996; Strean & Roberts, 1992; Weinberg, 1996; Whelan, Mahoney, & Myers, 1991; Williams & Krane, 1998; Williams & Leffingwell, 1996). These approaches have been broadly defined to include techniques such as goal setting, imagery and mental rehearsal, cognitive anxiety management, and cognitive and attention control. In an early exploratory study, Mahoney and Avener (1977) examined elite-level gymnasts to determine psychological factors related to athletic competence. They found patterns related to successful and superior performance (i.e., qualifying for the Olympic team), such as being better able to control and utilize anxiety, and using self-talk and internal imagery more frequently during training and competition. Interestingly, the authors also found that the less successful athletes tended to focus more of their attention toward the gymnastic move they were currently executing, rather than the prior or next task.

Attentional Focus and Control

Considerable emphasis and study within sport and exercise psychology has since been given to the attentional control and focus of athletes and its relationship to performance variables (Boutcher, 1992; Cox, 1998; Moran, 1996). For instance, Orlick and Partington (1988) extensively studied Canadian Olympic athletes to determine psychological elements related to their performance. These elite athletes reported that one particular factor that interfered with peak performance was the inability to refocus attention after distractions. Olympic athletes with an ineffective focus of attention were preoccupied with concerns about competitors, current standing or score, or thinking too far ahead. Eklund (1994, 1996), finding similar results, studied collegiate wrestlers and found successful athletes used a specific focus of attention and avoided distracting events in their environments. Task-focused thoughts were also reported to increase and irrelevant thoughts decrease as performances improved.

Additionally, Nideffer (1976, 1993) developed an approach to attentional focus and concentration to enhance performance, referred to as Attention Control Training (ACT). This approach, simply stated, recommends the development of an individual and situation-specific intervention program employing a variety of techniques, such as relaxation, thought stopping, attentional refocusing, and mental rehearsal. ACT has also been proposed as a program for arousal management that would ideally be implemented within the athletic setting for experienced and non-recreational athletes.

Nideffer's ACT is based upon the premise that attentional focus is composed of two intersecting dimensions: width and direction. The width of attentional focus is either narrow or broad depending upon the sport situation and type of concentration required. For example, hitting a baseball would require a narrow type of concentration, while an activity in which an athlete would need to attend to several different cues or tasks would dictate a broad focus (Nideffer & Sagal, 1998). Conversely, the direction of attentional focus is defined as either internal or external, with the former representing the athlete's own feelings or thoughts and the latter embodying those outside of the individual. Thus, Nideffer proposed that there are four different types of concentration that are important to sport performance and enhancement.

Although many of the specific techniques incorporated within ACT have been found to enhance sport performance (Williams & Leffingwell, 1996), the intervention model itself is lacking in empirical support. Additionally, Nideffer's conceptualization of attention, albeit appealing, has rarely been utilized by researchers interested in studying the performance of runners. In part, its use is lacking because of the limited applicability (e.g., not recommended for recreational runners), but also because of difficulty the individualized nature of the approach and intervention poses for wide-scale implementation and study.

Associative and Dissociative Cognitive Strategies

Perhaps the most influential work in the area of attention foci has been that of Morgan and Pollock (1977), in which they examined the attentional focus and cognitive strategies used by distance runners. Although they utilized a battery of psychological inventories to attempt to characterize elite athletes, it was their data on cognitive strategies, achieved primarily through clinical interviews, that became the major finding of the study. Contrary to their hypothesis, Morgan and Pollock found that elite marathon runners utilized association during competition rather than a dissociative cognitive strategy, whereas non-elite runners preferred to dissociate during a race. Association by the elite runner is characterized by "attempts to process (painful) information, or 'read his body' and modulate pace accordingly... with the net result that 'pain' is avoided" (Morgan & Pollock, 1977, pp. 399-400). Conversely, dissociation is the process of ignoring the sensory feedback and painful input experienced throughout the run. The elite runners, it was argued, could associate because their superior physical conditioning enabled them to do so.

Morgan and Pollock likened the runners' use of the two divergent cognitive strategies to that of a household furnace and its thermostat whereby the runner is also regulated by his/her perception of effort and sensory system, the "perceptostat." In the case of dissociation, the runner is analogous to a faulty thermostat which either over or undershoots the ideal temperature resulting in inefficiency or eventual breakdown. That is, the runner may perform at a sub-optimal level or not finish the run at all due to injury or overexertion. In contrast, the elite runner using an associative cognitive strategy would receive the sensory input from the beginning and adapt sooner while maintaining a more consistent performance.

Definitional Issues of Association and Dissociation

More recently, the terms of association and dissociation have been elaborated upon and discussed. Masters and Ogles (1998a) have summarized the definitional issues, and, unfortunately, agreement and consistency is currently lacking in how the terms are used. Although some have criticized the association-dissociation conceptualization as being far too simple of a dichotomy (Laasch, 1994-95; Stevinson & Biddle, 1999), there is some overall agreement on the unitary nature of association. Some researchers (e.g., Fillingim & Fine, 1986; Padgett & Hill, 1989) have referred to this process as "internal focus" rather than association, suggesting the two cognitive strategies are merely different foci of a parallel process. Stevinson and Biddle (1998, 1999) have gone on to characterize association as task-relevant thoughts that may be either internal ("inward monitoring") or external ("outward monitoring"). For instance, attending to fatigue or breathing would be considered an internal form of association, while focusing upon conditions, distance markers, or drink stations would be external association. They have also proposed a dissociation dichotomy, which will be discussed shortly. Takai (1998), however, has used the term "attention strategy" to refer to association and the runner's attending to bodily states. Generally, associative strategy or cognitions refer to a mental process that "direct(s) attention toward task-related cues (e.g., strategy, pace) and physical sensations that result from exercise (e.g., breathing, leg muscle fatigue)" (Williams & Leffingwell, 1996; p. 67). Thus, association allows for precise task-oriented thinking during runs aimed at increasing aerobic conditioning and specific processes a runner is needing to employ (Schomer, 1986, 1990).

With dissociation, on the other hand, some confusion seems to exist between the areas of clinical and sport psychology due to the term's dual meaning. Within clinical psychology dissociation has come to represent a generally pathological condition that is a diagnostic classification in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994). Dissociation, in the running-sense, is distinguishable from the clinical condition in the depth and controllability exercised by those utilizing it as a cognitive strategy to affect performance. Unfortunately, perhaps, the most serious obstacle created by this dual use of the term dissociation is that some individuals may erroneously presume that using this strategy while exercising or running is also pathological (Masters & Ogles, 1998a; Stevinson & Biddle, 1999).

Consequently, some researchers (e.g., Fillingim, Roth, & Haley, 1989; Rejeski & Kenney, 1987) have utilized the term "distraction" or "external focus" to avoid confusion with the dual meaning of dissociation. However, others have distinguished between the terms dissociation and external focus, as the former representing more imaginative thoughts while the latter embodies attention to specific environmental cues (Padgett & Hill, 1989). Stevinson and Biddle (1998, 1999) have described dissociation as task-irrelevant thoughts that may be internally ("inward distraction") or externally ("outward distraction") directed. Thus, daydreams, philosophical musings, or puzzles would constitute internal dissociative focus, and, conversely, attending to other runners, environment, or chatting is considered external dissociation. Takai (1998) has recently used the terminology "avoidance strategy" with regards to a dissociative strategy and thoughts other than bodily states. Still others have differentiated between the dimensions of dissociation and distress (and association) when characterizing the attentional foci of runners and exercisers (Brewer, Van Raalte, & Linder, 1996).

The work of Goode and Roth (1993) has extended the conceptualization of dissociative thinking beyond any categories discussed thus far. The researchers conducted a factor analysis of cognitions during running which generated the Thoughts During Running Scale (TDRS). They found that multiple factors were needed to conceptualize the non-associative cognitive processes (while association was conceived as a single factor). These factors consisted of thoughts about daily events, interpersonal or social relationships, external surroundings, and spiritual or religious reflection. Bachman, Brewer, and Petitpas (1997), using the TDRS, discerned that some forms of dissociation were more sensitive to situational variables (i.e., competition, interval workout, or long-distance practice run) than other types. That is, thinking about daily events and external surroundings were more susceptible to situational influences than were the other forms of dissociation.

Although some researchers have utilized terms other than dissociation, as discussed above, in the present paper this writer chose to continue referring to the specific cognitive strategies used by runners as association and dissociation. In part, association and dissociation were chosen owing to the "historic foundations" (Masters & Ogles, 1998a, p. 266), but more importantly, because of the clarification provided by the multidimensional aspects (i.e., dissociation subscales) of the TDRS. Thus, this writer believes the TDRS will, upon more widespread use, greatly assist researchers in distinguishing the many qualities of dissociation. Additionally, the term dissociation, by its very resemblance to the term association, helps with the comprehension of the latter during its application to actual runners in sport and exercise settings.

Descriptive Studies of Association and Dissociation

Given the definitional issues previously discussed and the considerable interest in enhancing performance, a large body of research has accumulated following Morgan and Pollock's (1977) influential study documenting runners' use of association and dissociation. Much of the early research was descriptive in nature with an emphasis toward profiling various groups of runners in terms of their use of cognitive strategies. Ungerleider, Golding, Porter, and Foster (1989), for instance, describing Masters-age track and field athletes, found that 76% reported monitoring pain and body signals during competition. Similarly, Okwumabua, Meyers, and Santille (1987) found that older runners reported favoring an associative strategy, but when asked to run a 10 km race they tended to rely more upon a dissociative strategy. Other studies have suggested that runners vary on associative and dissociative use based upon goal or type of the run, duration, experience level, and age (Morgan, O'Connor, Ellickson, & Bradley, 1988; Sachs, 1984; Wrisberg & Pein, 1990). These and additional variables related to association-dissociation will be reviewed in both the context of marathon and recreational running samples.

Marathon and Long-Distance Running Samples

A great deal of the work on associative and dissociative strategies has centered around marathon runners and long-distance endurance races. Efforts have largely had the intention of describing the occurrence and relationship of these strategies. For instance, Summers, Sargent, Levey, and Murray (1982), in their attempt to profile marathon runners, found that most of the runners reported adopting a dissociative strategy during training runs. However, very few runners indicated using this strategy while running the actual marathon completed during the study. While more runners related that they used an associative strategy during the race, most of the strategies reported (63%) were unable to be classified by the authors because they appeared to be a combination of the two cognitive processes. Okwumabua (1985) also found that runners reported using both cognitive strategies throughout the marathon with association being used more frequently than dissociation, particularly as the race progressed. Similarly, Morgan and colleagues (1988) found that 28% of marathon runners reported using both strategies during a race, and the remaining 72% reported exclusive use of association. However, when training runs were examined a different picture emerged; approximately 36% of the sample used both strategies, while 43% and 21% solely used dissociation or association, respectively.

Confirming the previous findings, Masters and Lambert (1989) found that runners preferred association while running a marathon and dissociation (or both strategies) during training runs. However, they also found that the associative strategy was related to faster performances, and the more competitively motivated a runner was the more he/she associated. Examining the associative and dissociative patterns of United States Olympic Marathon Trial competitors, Silva and Appelbaum (1989) concluded that top finishers used both cognitive strategies but did so with adaptive flexibility. Top finishers also tended to begin with associative strategies with dissociation occurring in the latter stages of the race, while low finishers were found to use dissociation early and for prolonged periods. Cox (1998) suggested that marathon runners, however, may need to use dissociative strategies to create psychological distance from the discomfort that accompanies such prolonged physical exertion. Studies of ultra-marathon runners have not entirely supported these findings. Both Kirkby (1996) and Weinberg (1999) found that successful finishers of an ultra-marathon endurance race were more likely to associate; however, Acevedo, Dzewaltowski, Gill, and Noble (1992) found that ultra-marathon runners' cognitive focus was vastly (i.e., 75%) dissociative.

Using micro-cassette recorders to log runners' thoughts, Schomer (1987, 1990) concluded that regardless of running experience (i.e., elite status or not), marathon runners used a predominantly associative cognitive strategy when exerting greater perceived effort. He also extended the previous findings by revealing that a difference in the associative strategy appeared in the specificity of the focus. Novice marathon runners attempted to generally relax while the experienced individuals focused on relaxing a specific muscle group. Schomer further reported that runners did not manage pain by dissociating, as proposed by Morgan and Pollock (1977), but rather by slowing down or associating. Examining competitive runners in a 20 km race, Takai (1998) found that runners who were better able to self determine and accurately recall running pace (rather than using dissociative thoughts) maintained a steadier and more ability-appropriate pace. Further, these runners also maintained a quicker pace throughout the racing distance.

Masters and Ogles (1998b), using both retrospective and prospective designs, found that the use of a dissociative cognitive strategy was not related to an increased risk for a running-related injury. In fact, the marathon runners reported that they were most likely to be injured when driving themselves to perform at maximum capacities. Consistent with earlier findings (e.g., Masters & Lambert, 1989), these individuals were also found to be the runners that utilized an associative cognitive strategy. Interestingly, Stevinson and Biddle (1998) found that runners experienced an earlier onset of "hitting the wall" while completing a marathon if they used an internal associative focus. However, they concluded that internal dissociation was a more hazardous strategy since those runners who did experience "hitting the wall" were using this strategy more than the other runners. The authors also concluded that this cognitive strategy is likely to increase the potential for harm to the runner because of a decrease in sensory feedback.

Examination of cognitive strategies and marathon/long-distance running revealed often conflicting and inconclusive findings across studies. In general, however, some trends appear to stand out in the literature. Elite marathon runners tend to use an associative strategy in greater quantities during races, while relying more on dissociative foci during training runs. Further, non-elite marathon runners are more likely to use a dissociative focus than elite runners. It also appears that although association may correlate with reported injuries it does not appear to be hazardous for runners to use.

Rather, an associative strategy may allow the long-distance runner to better monitor pain and running pace.

Middle- and Short-Distance Running Samples

Although research findings on marathon and long-distance runners have revealed interesting, and sometimes conflicting results on the use of cognitive strategies, these individuals are not necessarily representative of runners and exercisers in general. To complete a marathon, for example, an individual typically sacrifices considerable time that may have been spent engaging with family or other activities to complete the many miles of training that are required over several weeks of preparation for a single marathon race. Thus, marathon runners appear to be a highly committed group of exercisers, particularly when compared to the typical individual who exercises. In fact, most studies show about a 50% dropout rate of exercise program participants within one year (Sallis & Owen, 1999). It would seem, given this disparity in motivation, that the non-marathon (i.e., recreational) runner or exerciser may very likely utilize cognitive strategies differently.

Some researchers have examined the association and dissociation strategies with collegiate, recreational, and novice runners, and found differences from elite athletes in strategy utilization (McDonald & Kirkby, 1995). Other forms of exercise and endurance (e.g., leg extension task) have also been examined, in the context of associative and dissociative cognitive strategies; however, these findings will be discussed later in this review. The descriptive findings on non-marathon runners, along with some of the settings in which they have been studied, will now be briefly examined.

Wrisberg and Pein (1990) surveyed college-age recreational runners after completing a run on an outdoor track to explore the role of running experience on dissociation. Unfortunately, associative strategies were not examined; however, the authors reported that the more experienced runners, regardless of gender, dissociated more than did the inexperienced runners. That is, according to the authors, the experienced runners were more proficient at directing their attentional focus away from unpleasant physical cues related to exercising. Contrary to these results, college cross-country runners were found to use associative more frequently than dissociative strategies, when compared to volunteer students from an introductory psychology course (Brewer, Van Raalte, & Linder, 1996). Further, Okwumabua, Meyers, Schleser, and Cooke (1983) found after a five week cognitive strategy training for novice runners that the use of association increased as participants gained experience. However, the authors noted on reanalysis of the groups that those individuals using a dissociative focus ran faster than their counterparts.

Surveying young athletes of varying abilities, McDonald and Kirkby (1995) found a relationship between runners' preference to use dissociation and ability level when it was difficult to continue running in either a race or training run. Runners of less ability (8 of 10 club runners) were found to rely on total dissociative strategies significantly more than higher ability athletes (1 of 10 international runners). Tammen (1996), indirectly supporting these findings, studied a small group of elite runners completing 1500 and 2300 m and found that as the pace/ intensity of the run accelerated the runners associated more to their bodily sensations and cues.

Experimental Design Studies of Association and Dissociation

Non-Running Studies

Weinberg, Smith, Jackson, and Gould (1984), in a muscular leg-extension task, found that dissociation and "positive self-talk" increased performance compared to the association and control groups. In similar leg-extension tasks, endurance has been improved by employing a dissociative focus (or in combination with an analgesic suggestion) strategy (Gill & Strom, 1985; Spink, 1988). Rejeski and Kenney (1987) also found that individuals completing a comparable hand endurance task had increased endurance using a cognitive dissociative strategy. The dissociation task, however, varied in complexity, and individuals preferring the simple cognitive task experienced greater endurance in the simple task while those favoring the complex performed equally well in both.

While endurance tasks specifying a particular muscle group, like those described above, tend to support a dissociative cognitive strategy, findings with other forms of endurance or exercise have been less consistent. Two studies (Johnson & Siegel, 1992; Russell & Weeks, 1994) examining the effects of attentional focus on heart rate during exercise on a cycle ergometer found no differences between association and dissociation. However, there was a distinct difference in the relation between perceived exertion and attentional strategy employed. The Johnson and Siegel study found that association increased perceived effort using the Rating of Perceived Exertion (RPE) scale (Borg, 1973, 1982). Similarly, Padgett & Hill (1989) found that individuals riding a bicycle ergometer and using an associative focus reported the exercise to be more fatiguing, while also subjectively appearing to last longer. In contrast, the study by Russell and Weeks, who also used the RPE, found that the dissociation focus yielded somewhat higher levels of perceived exertion. With regard to performance enhancement, Scott, Scott, Bedic, and Dowd (1999) found that novice rowers using an associative or dissociative (i.e., video vs. music distractor) strategy experienced the greatest improvements using the former focus on a rowing ergometer machine. Further, no differences or discernable benefits (in terms of performance enhancement) were detected between the two dissociative tasks used in the study.

Spink and Longhurst (1986), in a study with advanced swimmers, found that association was superior to dissociation in decreasing times in a 400 m individual medley trial three days following instruction. More recently, Couture, Jerome, and Tihanyi (1999) found that swimmers assigned to an associative strategy swam faster in a 500 m freestyle trial than those assigned to a control group. Additionally, the authors did not detect differences between association, dissociation, or control groups on RPE or fatigue measures. Clingman and Hilliard (1990), however, did not find an overall difference between association and dissociation in performance times for experienced race walkers, but did when the internal focus was specifically directed toward cadence. That is, walkers were faster when attending to cadence than when focusing upon stride length or externally. The findings from non-running aerobic exercise studies seem to suggest that an associative focus may enhance performance, but that it is unclear which strategy has the most beneficial effect on levels of perceived exertion. Conversely, studies of endurance exercise, such as leg-extension tasks, have yielded results supporting a dissociative cognitive strategy for enhanced performance.

Running Studies

The results from studies investigating cognitive strategies in running samples using experimental designs have yielded even less consistent results than those just reviewed. For instance, Mallett and Hanrahan (1997) reported a decrease in 100 m sprint times for a small sample of elite runners when utilizing specific technical cues (i.e., associative focus) related to the event. Morgan, Horstman, Cymerman, and Stokes (1983), on the other hand, examined only a dissociative strategy (i.e., "pseudomantra") with United States Army enlistee volunteers in which they were asked to walk and run to exhaustion on a treadmill. Compared to a control group, who were not given a strategy, the dissociation focus condition was found to enhance endurance performance by 32%. However, it is noteworthy that the study's conclusions are potentially limited by the high expectancy and demand communicated to participants in the instructions of the dissociation focus condition only.

Adding an association focus group for comparison, Fillingim and Fine (1986) found no differences in performance times in a small group of active jogging college students running one mile on an indoor track. The runners using dissociation did, however, report significantly fewer exercise related symptoms (e.g., fatigue, side cramps, shortness of breath). Similarly, Weinberg, Smith, Jackson, and Gould (1984) failed to find differences in performance (and fatigue ratings) between association, dissociation, and "positive self-talk" strategies on the number of laps completed when compared in a group of college students that ran 30 consecutive minutes on a track.

Another group of researchers (Saintsing, Richman, and Bergey; 1988), making observations supportive of association, assessed the effects of association, dissociation, and "psyching-up" strategies on running times for a 1.5 mile distance following several weeks of training for a group of inexperienced volunteers. Interestingly, the experimenters instructed the participants in the cognitive strategies while training on a cross-country course, but evaluated their performance on a 400 m outdoor track. Although the method of assessing cognitive strategy adherence was not identified by the authors, they found the group receiving associative focus training improved significantly more than those taught the other strategies. Additionally, the dissociation focus and "psyching-up" strategies groups did not yield significantly faster running times than the control group.

This study is noteworthy for several reasons, of which the first is the replication of Morgan and colleagues' (1983) dissociation task (i.e., attend to a pseudomantra in synchrony with each leg movement) that was originally found to improve performance, but did not when retested here. One possible explanation for the failure to replicate the performance improvement may be the different running environment. The original study tested participants on a treadmill, as opposed to an outdoor track, which may present as a much more monotonous task and, thereby, influence the effectiveness of a simple form of dissociation. The Saintsing et al. (1988) study is also notable because the results are congruent with findings from another influential training intervention (Schomer, 1987, 1990) developed to improve marathon runners' associative abilities and subsequent performance. Lastly, although the training assignments appeared to lack adherence in the Okwumabua et al. (1983) study, it is arguable that support for associative strategies exists and the results are generally confirmatory of those found in the Saintsing et al. intervention.

In a frequently cited article, Pennebaker and Lightner (1980) conducted two sets of running experiments examining attentional focus in inexperienced volunteers. The first study, using a treadmill, held physical performance constant during exercise in which participants listened to their own breathing, a tape of distracting street sounds, or nothing at all. The authors reported that individuals in the dissociation condition reported less exercise-related symptoms and fatigue than those using the association focus. The second experiment analyzed running performance on a cross-country course and an outdoor track, each for a distance of 1800 m, with a similar level of inexperienced participants as the previous experiment. Although no differences were found in terms of exercise-related symptoms or perceptions of fatigue, the cross-country course generated significantly faster times from the runners. Pennebaker and Lightner attributed the faster performance on the cross-country course to the restricted internal cues (due to greater focus on the external cues of the running environment) which allowed individuals to increase their pace without the subsequent perceptions of fatigue. Similarly, Ceci and Hassmen (1991) found that runners performing at equivalent levels of perceived exertion ran faster on an outdoor track than a treadmill. Thus, the findings offer support for the influence of exercise setting and, indirectly, for an external attentional focus (i.e., dissociative strategy) being more effective in enhancing performance in novice runners.

In a study essentially comparing two forms of a dissociative cognitive strategy (i.e., pleasant imagery unrelated to running vs. features of the environment) with a control group, Padgett and Hill (1989) found no difference between the two strategies in terms of time or estimated effort in their small sample of college track athletes running one mile on a track. However, those runners asked to attend to their environment (e.g., track) yielded faster times when compared to the "no imagery" control group, while the latter resulted in lower estimates of effort than either attentional task used by the runners. More recently, Harte and Eifert (1995) examined the effects of exercise environment (outdoor route vs. indoor treadmill) and attentional focus (recording of outdoor sounds vs. sounds of own breathing) on affective response and perceived exertion. Unfortunately, neither running time nor distance were considered dependent variables in the design. However, perceived exertion was rated higher following the indoor associative focus run than in either the indoor dissociative focus or outdoor run. Also, following the outdoor run individuals reported feeling less negative affect and more invigorated than at pretest. After the indoor dissociative focus run, participants reported only feeling more fatigue, while in the indoor associative condition runners reported more negative affect and fatigue compared to pretest levels. These results, considered with the earlier work of Pennebaker and Lightner (1980), provide the closest examination of the influence of exercise environment on cognitive strategies in a group of runners.

Limitations of the Cognitive Strategy Studies

Although the body of literature on association and dissociation has grown quickly, as Masters and Ogles (1998a) have observed, it is not without substantial limitations. For instance, much of the emphasis has been with observing the use of association or dissociation strategies with marathon or elite runners, who are usually highly motivated to run and race at optimal levels. Additionally, many studies have been correlational in design (e.g., Summers et al., 1982), with the findings being descriptive rather than allowing causal explanations. The studies involving elite runners (e.g., Tammen, 1996) have frequently based their conclusions on sample sizes as small as eight individuals (or less in some cases).

Of the investigations using experimental designs (with non-elite runners), some (e.g., Clingman & Hilliard, 1990; Mallett & Hanrahan, 1997; Morgan et al., 1983) have failed to assess both association or dissociation and, thus, provide adequate comparisons to draw clear conclusions. Additionally, others (e.g., Pennebaker & Lightner, 1980) have experienced difficulties with attrition due to the inexperience of their participants (i.e., non-running introductory psychology students), while still others have described poor cognitive strategy adherence (e.g., Okwumabua et al., 1983; Sachs, 1984; Weinberg et al., 1984).

Finally, some of the studies completed thus far (i.e., Harte & Eifert, 1995; Padgett & Hill; 1989; Pennebaker & Lightner, 1980), seem to suggest that the cognitive strategy employed by non-elite runners may be influenced by the exercise environment. However, conclusions are difficult because the studies of association and dissociation have not systematically examined cognitive strategies and the different running environments (i.e., scenic outdoor course vs. treadmill vs. track). In fact, the overall limited findings thus far are equivocal, with some supporting a dissociative strategy, others an associative focus, and the remaining seeming to show no differences in performance enhancement or perception of exertion.

Purpose and Research Questions

The purpose of this study was to examine, using a true experimental design with manipulation adherence checks, the effects of the cognitive strategies of association and dissociation on perceived exertion, performance time, and setting satisfaction in experienced non-elite (i.e., recreational) runners. Additionally, the environmental setting for exercise was proposed as a factor, influencing the dependent variables mentioned above, that requires systematic examination. Consequently, the results of this study will provide information to researchers, coaches, and runners on the identification of a more appropriate cognitive strategy for performance enhancement and desired exertion based on the setting of the exercise and/or race.

Accordingly, three primary questions were proposed for this study. These questions, along with their respective hypotheses, are as follows:

1. Will there be any differences in perceived exertion, satisfaction, or performance time between the cognitive strategies across the different settings? It was hypothesized that runners using a dissociative strategy would report higher perceived exertion on the treadmill and indoor track than in the outdoor setting, while those assigned the associative strategy would not report any such differences in perceived exertion among the settings. It

was also hypothesized that dissociating runners would report lower levels of course satisfaction on the treadmill and indoor track, and associating participants would not rate the settings any differently in satisfaction. Finally, it was hypothesized that dissociating runners would yield slower performance times on the treadmill and the fastest times in the outdoor setting. The runners using association were hypothesized to not differ across the settings in terms of performance times.

2. Will there be any differences between the cognitive strategies in perceived exertion, satisfaction, or performance time regardless of the different settings? It was hypothesized that runners in the association group would report higher levels of perceived exertion than those in the dissociation group. It was also hypothesized that the runners in the dissociation group would report greater course satisfaction than their counterparts. Lastly, it was thought that the association group would produce faster performance times than the dissociation group.

3. Will there be any differences between the three settings in perceived exertion, satisfaction, or performance regardless of the cognitive strategy employed? It was hypothesized that higher levels of perceived exertion would be reported with the treadmill and indoor track. Further, it was hypothesized that runners would rate the outdoor route as most satisfying, while the treadmill would be considered the least satisfying setting. Finally, the fastest running times were hypothesized to occur in the outdoor setting.

CHAPTER III

METHODOLOGY

Participants

Sixty individuals who ran an average distance of at least 15 miles per week as a means of exercising participated in this study. Announcements for the study were disseminated in a local running club, road races and events, area sporting good stores and fitness clubs, Utah State University fieldhouse and exercise classes, and public service announcements on a local radio station. For their completion of this study, participants were paid $20, enrolled in a drawing for a $100 cash prize, and mailed the results of the study. Five individuals initially agreed to participate in the study but failed to complete all three runs. Three of these individuals had moved and two indicated they were not able to participate further because of other time commitments.

There were 38 women (63.3%) and 22 men (36.7%) who completed the study. Participants ranged in age from 19 to 49 years (M = 26.80 years, Mdn = 24.00, SD = 8.93), and were 98.3% Caucasian and 1.7% Asian-American. In terms of running practices, the participants' length of running experience prior to participation ranged from 3 to 240 months (M = 78.44 months, Mdn = 72.00, SD = 59.20), while the average weekly mileage and number of days typically ran was 20.92 miles (Mdn = 20.00 miles, SD = 6.22) and 4.43 (Mdn = 4.50 days, SD = 0.96), respectively. Additionally, 16.7% of the participants had not run any races in the 12 months prior to participating, whereas 23.3%, 11.7%, 15%, and 33.3% had run one, two, three, and four or more races, respectively, during the same period. Thirty-five participants (58.3%) denied any running-related or limiting injuries in the 12 month period before the study; however, 23 individuals (38.4%) reported one to two such injuries during this interval.

Dependent Variables and Instruments

Demographic and Running History Questionnaire

Participants were asked general demographic information, such as their age, gender, and ethnicity, as well as training practices (e.g., miles and days run per week, pace per mile, etc.) and race performance history (see Appendix A). Participants were also queried about their running related injuries and pain they experienced in the 12 months prior to this study. Additionally, participants were asked to write on a separate page what they typically thought about and focused upon when running or jogging.

Rating of Perceived Exertion Scale

The Rating of Perceived Exertion scale (RPE; Borg, 1973, 1982) is used to link actual physical exertion to the perception of effort during exercise (see Appendix B). Although RPE has been used with reference to specific body parts (e.g., legs) it was developed to represent a "Gestalt" of perceived exertion and strain. The RPE, also referred to as the "Borg Scale," lists numbers in ascending order between 6 and 20 with an identifier for the uneven numbers (e.g., 7 = Very, very light and 19 = Very, very hard) that correspond to an individual's perception of exertion during exercise. Typically, this scale is presented to the individual on a poster board with verbal instructions and prompts for a rating while s/he is exercising; however, several researchers (e.g., Couture, Jerome, & Tihanyi, 1999; Johnson & Siegel, 1992) have had participants complete this measure immediately upon conclusion of exercise.

The RPE has been found to be a reliable index of the actual metabolic cost of exercise and useful practical indicator of appropriate exercise intensity (Brubaker, 1998; Williams & Eston, 1989). Scores on the RPE have been reported to correlate linearly (.80 - .90) with heart rate during exercise (Borg, 1982), though several psychological factors, such as achievement motivation (Stephens, Janz, & Mahoney, 2000), social influence (Hardy, Hall, & Prestholdt, 1986), sex roles (Rejeski, Best, Griffith, & Kenney, 1987), and cognition (Rejeski, 1985), may influence RPE. In spite of these potential influences, Ceci and Hassmen (1991) found high test-retest reliability (alpha coefficients ≥ .90) following a brief interval for velocity and heart rate in both outdoor track and treadmill running conditions with participants instructed to run at a RPE of 11. Correlation coefficients were also reported to be generally very high for velocity and heart rate at three RPE levels (i.e., 11, 13, and 15) for runs four weeks apart, with the highest values occurring at the most intense level.

<u>Course Satisfaction Rating Scale and Performance Times</u>

The satisfaction with each of the exercise settings was assessed by having the participants rate on a 5-point scale (0 = Disliked very much, 1 = Disliked somewhat, 2 = Not sure, 3 = Liked somewhat, 4 = Liked very much) the extent they liked running the courses (see Appendix C). The performance outcomes on the 5 km distance were monitored for overall running times and recorded to the nearest second using a standard stop-watch.

Thoughts During Running Scale

The Thoughts During Running Scale (TDRS; Goode & Roth, 1993) is a 38-item self-report questionnaire developed to measure association and dissociation thoughts during runs (see Appendix D). Unlike other measures with an association/dissociation dichotomy, the TDRS uses a multidimensional analysis of cognitions, and consists of four separate subscales assessing dissociative cognitions as well as a subscale measuring associative cognitive content. The following five constructs are measured by the TDRS: associative, external surroundings, interpersonal relationships, daily events, and spiritual reflection. Respondents indicate on a 5-point Likert scale the extent to which various thoughts occurred during their most recent run. For instance, a score of 0 is the equivalent of "never" while a score of 4 is "very often."

Goode and Roth (1993) presented evidence for factorial validity of the TDRS subscales by comparing the goodness-of-fit for the five-factor model to both a two- and three-factor model as previously described in the literature (e.g., Morgan & Pollock, 1977; Padgett & Hill, 1989). Although none of the models provided a perfect fit of the data, the five-factor model provided a significantly better fit than either of the other models. Additionally, Goode and Roth reported satisfactory internal consistency reliability alphas for the subscales ranging from .77 to .85, as well as factor correlations that reflected both convergent and divergent validity. That is, the associative subscale had low correlations

(.02 - .22) with the other subscales, while these non-associative subscales were more correlated (.24 - .85) with each other. Bachman et al. (1997) used the TDRS to assess the degree of associative and dissociative cognitive content for runners engaging in an easy training run, interval workout, or race. The authors found that the TDRS successfully discriminated between the higher physically demanding conditions (i.e., interval workout and race) and the easy training run with regard to several subscales, but particularly associative and external surroundings. This is noteworthy because the current study specifically examined external surroundings (i.e., exercise setting) and its effect upon the use of associative and dissociative strategies.

Research Design

The study's experimental layout was a 3 x 2 mixed design with exercise setting having three levels (treadmill, indoor track, and outdoor route) as a within-groups independent variable and cognitive strategy with two levels (association vs. dissociation) as a between-groups factor. The dependent variables were the ratings of perceived exertion, course satisfaction, and performance times. Participants were designated to either the association or dissociation strategy based on matched random assignment for age, gender, and training practices. Following group assignment, participants were asked to complete their runs in all three of the exercise settings in consecutive weeks, but no sooner than every other day. The sequence of the setting was counterbalanced to control for order effects.

Procedures

All participants completed an institutional review board approved informed consent statement prior to participation (see Appendix E). At the time of the first scheduled run, participants completed a demographic and running history questionnaire along with reporting what they typically think about and focus upon when running or jogging. Following completion of the study the responses regarding typical thoughts and focus were coded by the experimenter for the amount of associative focus present. More specifically, each thought/response was classified by a single rater (the experimenter) for attentional focus based upon the work of Goode and Roth (1993) and the items of the TDRS. The participants were tracked by identification numbers which enabled the rater to be blind to the participant and cognitive strategy. The classifications were initially made then rechecked for appropriateness and accuracy to ensure complete compliance with the TDRS conceptualization of association and dissociation. Following the classification of each thought/response an associative focus percentage was calculated by dividing the number of associative responses by the total number of responses and multiplying this by 100.

Immediately prior to each of the experimental runs, participants were specifically instructed in their respective cognitive strategy and questioned as to their comprehension of their task (to ensure understanding and adherence). These instructions were in the form of scripts that were read to the participants (see Appendixes F and G). For the association strategy condition, participants were equipped with the *Polar Vantage XL* model portable heart-rate monitor that provided feedback via a wrist receiver that beeped at programmable intervals (i.e., every 30 s). The beeps served as a reminder to the participant to monitor his/her heart rate. Participants were instructed to focus attention throughout the run to the feedback from the monitor. It should be noted that this particular experience was chosen as a focus for participants in this condition because of the practical appeal and ecological validity it provided. That is, heart-rate monitors are widely used by runners in an effort to guide training, optimize race performance, and monitor recovery (O'Toole, Douglas, & Hiller, 1998) and would, therefore, seem to be a logical choice for encouraging an associative strategy. As a manipulation check for the fidelity of the associative task, the participants were asked their highest and lowest heart rates per the monitor information. The actual heart-rate information from the run was stored in the monitor, although not made available to the participant, and later recorded by the experimenter for comparison. Participants in this condition were also equipped with wrist watches to allow them to monitor their pace throughout the run.

Alternately, participants in the dissociative strategy condition were prohibited from monitoring their pace with wrist watches, but rather, were asked to listen to music throughout the run. They were equipped with a portable cassette player worn in a snug and flexible lightweight waist belt with headphones. Participants selected the music they wanted to listen to throughout the run from an available menu of choices provided by the experimenter. The music choices consisted of a variety of music styles to accommodate a broad scope of listeners and, thus, encourage actual attending to the tape and cognitive strategy (Gfeller, 1988). Music choices included: Vivaldi, Cities 1997 Sampler, Miles

Davis, and the soundtrack to Forest Gump (see Appendix H). This experience was designed to closely resemble behavior and practices frequently used by individuals exercising and involved in recreational running, and is congruent with procedures used by other researchers (e.g., Copeland & Franks, 1991; Pennebaker & Lightner, 1980) to encourage use of a dissociative strategy. Additionally, using music has been reported to enhance adherence to physical activity (Karageorghis & Terry, 1997), and was expected to encourage dissociative strategy compliance in this experiment. Immediately prior to this experience, the participants were instructed that they would have to report back to the experimenter the number of songs heard once the run was completed. As in the associative strategy condition, this measure served to provide a manipulation check for the fidelity of the strategy employed.

In all of the exercise bouts, participants were given the following instructions: "I'm going to ask you to run for 5 km. I want you to try and go as fast as you like. At the end of the distance your time will be recorded. As you run today, I want you to remember the attention focus you've been instructed to use and that you'll be asked about it once you complete the run. Go ahead and begin." All participants were read this set of instructions prior to each run to encourage adherence to the designated cognitive strategy, and also to maintain the same level of competitive incentive and expectation across all groups.

The actual exercise bout consisted of participants running a distance of 5 km in their assigned exercise settings. The settings were an indoor 200 m track, a 5 km outdoor flat road route, and a standard motor-driven treadmill within the Wellness Center of the

Health, Physical Education and Recreation Department of Utah State University. In each setting, the temperature, relative humidity, and wind velocity (as applicable) were determined and recorded. The treadmill grade was set to 1% to make the effort equivalent to running outdoors and on the track. This adjustment was based upon the work of Jones and Doust (1996) in which they determined that a 1% incline on a treadmill most accurately reflected the energetic cost of running outdoors for durations greater than 5 min. For all conditions, the participants' completion times were monitored and recorded by a research assistant with all participants being informed of their completion times at the conclusion of each run.

Upon completion of each exercise bout participants were asked to report their satisfaction with the course they were assigned to run and their degree of perceived effort. The participants' degree of perceived effort were measured using the RPE scale. The performance indicator was the participants' 5 km completion time for the exercise bout measured to the nearest second. Participants also completed a TDRS immediately after each exercise event to assess the prevalence of associative and dissociative thoughts during the run. This instrument served as an additional manipulation check with elevated scores on the representative association and dissociation subscales indicating strategy adherence or non-adherence.

Statistical Analysis

Data gathered from the participants were analyzed using the Statistical Packages for Social Sciences (SPSS) graduate student version 10.0 for Windows. A series of mixed model Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) models were used to examine the exercise settings and cognitive strategies. Independent sample t-tests were used for comparison of the participant characteristics and environment conditions. Manipulation checks for adherence to the prescribed cognitive strategy were evaluated with both calculation of percentages, Multivariate Analysis of Variance (MANOVA), and independent samples t-tests. Percentages of adherence to the music or heart-rate monitor manipulations were calculated by dividing the total number of correct observations (made by participants) by the total number of observations and multiplied by 100. MANOVA and follow-up univariate F-tests were used for examination of the TDRS subscales following each of the runs, while t-tests were used to compare the groups on two items on the TDRS that specifically pertained to the assigned attentional tasks. Finally, standardized mean difference effect sizes were estimated throughout to allow for examination of practical significance independent of statistical significance (Stevens, 1990, 1996).

CHAPTER IV

RESULTS

Several research questions were previously posed and will each be explicitly addressed and summarized; however, examination of three other variables important to the study will first be presented. The first of these analyses is the comparison of participant characteristics (e.g., age, mileage per week, running pace, attentional focus) between those in the associative and dissociative conditions. The second analysis will be that of adherence to the respective assigned cognitive strategy. This inspection will include the manipulation checks of reported number of songs, maximum heart rate, and TDRS responses. Finally, a comparison of the environmental conditions (i.e., temperature, relative humidity, and wind velocity) for association and dissociation groups will be presented. This, again, is to examine for group equivalence across conditions.

Participant Equivalency Check

The participants in the association and dissociation groups were compared on several pre-intervention characteristics using independent samples t-tests. An alpha level of .05 was set to determine statistical significance. Such an approach increases the risk of a Type I error; however, this was not a concern because a statistically significant finding suggests that participants may differ on a particular characteristic. That is, it would be more conservative, in this case, to allow for rejecting the null hypothesis when it is true (or saying the groups differ when they do not). The participant characteristics examined were as follows: age, average miles run per week, average days run per week, typical running pace, number of months running, running related injuries or pain in the previous 12 months, and typical percentage of associative focus during running.

All t-tests comparing the two groups of runners were non-significant except for the average mileage run per week, $t(58) = 2.66$, $p = .01$. The means and standard deviations can be found in Table 1. Estimated standardized mean difference effect size for the weekly mileage comparison yielded a 0.69 which is considered to be medium and generally apparent (Stevens, 1990, 1996). Although the difference in the mean weekly mileage for the two groups was approximately four miles, which may seem to be of little relative importance with regard to the overall running conditioning for participants in this study, subsequent evaluations of cognitive strategies were performed using ANCOVA procedures with weekly mileage as the covariate.

Table 1

Means and Standard Deviations for Participant Characteristics in Associative and Dissociative Conditions

	Associative		Dissociative	
Characteristic	M	SD	M	SD
Age	26.57	9.25	27.03	8.75
Average miles run per week*	22.95	6.50	18.88	5.28
Average days run per week	4.53	1.01	4.33	0.92
Typical running pace	8.34	1.12	8.65	1.07
Number of months running	80.00	60.81	76.93	58.61
Running related injuries/pain	0.80	0.81	0.40	0.81
Typical % of associative focus	28.00	27.50	21.50	30.15

*$p < .05$

Cognitive Strategy Adherence

Adherence to the assigned cognitive strategy was assessed through three methods. For the dissociative group, participants were queried about the number of songs they listened to while running as verified by a research assistant. The associative group, on the other hand, was questioned about the maximum heart rate experienced during the run, which was also verified by a research assistant. The final method involved both groups completing the TDRS after each run for comparisons between the attentional focus subscales as well as two particular items.

Percentages were used to describe and examine the first two methods of checking strategy adherence. Adherence to the music or heart-rate monitor tasks was estimated by dividing the total number of correct observations by the total number of observations and then multiplied by 100. Estimates were made for all three of the exercise settings separately; therefore, three percentages are reported for both groups. The dissociative strategy participants correctly identified the number of songs played while they were running on the treadmill, indoor track, and outdoor route in 63%, 70%, and 63% of the cases, respectively. The associative strategy participants, while attending to their heart rate, correctly identified their maximum beat per minute ($\pm$ 5 bpm) in 87%, 79%, and 90% of the cases for the treadmill, indoor track, and outdoor route.

A MANOVA was used for a between-groups comparison of the TDRS subscales to assess if participants' attentional focus was consistent with cognitive strategy assignment. An alpha of .05 was again used for determination of statistical significance.

The MANOVA (Wilks' Lambda value = 0.494), as expected, was statistically significant, F (5, 54) = 11.08, $p < .001$, revealing that there was at least one statistically significant difference among the subscales for the two groups. Following this finding, the univariate F-tests were examined to determine which TDRS subscales were different. The TDRS subscale of association significantly differed between the groups, F (1, 58) = 25.66, $p < .001$, as did the external surroundings focus subscale, F (1, 58) = 5.52, $p = .022$, indicating the groups were significantly different in their foci of attention. Examination of the standardized mean difference effect sizes for the association and external surroundings subscales for the two groups revealed estimates of 1.31 and -0.61, respectively. Reportedly, effect sizes around 0.50 are considered medium, while greater than 0.80 are large (Stevens, 1990). The remaining TDRS subscales (i.e., daily events, interpersonal relationships, and spiritual reflection) were not statistically significant. See Table 2 for a summary of participant responses on the subscales.

Also of interest with the TDRS subscales are the means that Goode and Roth (1993) reported following the use of this instrument with runners of similar characteristics but given no specific cognitive strategy instructions (see Table 2). In particular, the mean associative subscale score was 21.50 for the non-instructed runners, but in this experiment was 22.42 for the runners asked to associate and 16.61 for those assigned to the dissociative task. Conversely, the non-instructed runners reported a mean of 10.70 on the external surroundings subscale, while those in this study's associative and dissociative conditions had means of 9.33 and 11.66, respectively. Inspection of the Goode and Roth data lends additional support to the integrity of the use of the attentional foci asked of participants in this experiment.

The associative and external surroundings subscales also have particular items (i.e., "music that I am listening to", "managing my heart rate") that query about the cognitive tasks assigned to participants in this experiment. Thus, as a more precise manipulation check of adherence to the specific task assigned, a comparison was made between the two cognitive conditions on these two TDRS items using independent samples t-tests. Both the item pertaining to managing heart rate, $t\ (58) = 7.14$, $p < .001$, and listening to music, $t\ (58) = -9.18$, $p < .001$, were statistically different between the association and dissociation participants. Standardized mean difference effect sizes between the two groups were substantially large for the associative (1.87) and dissociative (-2.38) items. The mean response of the associating participants to the managing heart rate item was 3.10 (SD =

Table 2

Means, Standard Deviations, and Effect Sizes of TDRS Subscales for Associative and Dissociative Conditions

	Associative		Dissociative		
TDRS subscale	M	SD	M	SD	ES
Association**	22.42	4.26	16.61	4.62	1.31
Daily events	13.42	7.89	13.77	8.13	-0.04
External surroundings*	9.33	4.13	11.66	3.51	-0.61
Interpersonal relationships	7.68	4.55	9.04	5.14	-0.28
Spiritual reflection	1.82	1.41	2.11	2.05	-0.16

*p < .05; **p < .01

Note. Goode & Roth (1993) means for subscales for runners not given any specific cognitive strategy instruction: associative (21.5), daily events (18.7), external surroundings (10.7), interpersonal relationships (11.6), spiritual reflection (2.3).

0.76), while the mean rating for the dissociating group was 1.44 (SD = 1.02). These responses most closely correspond to "frequently" and "rarely" on the TDRS for the associating and dissociating groups, respectively. Alternately, the mean responses for the associating and dissociating groups on the listening to music item were 0.71 (SD = 0.92) and 2.99 (SD = 1.00), which most closely correspond to "rarely" and "frequently."

Taken together, these findings strongly support the integrity of the interventions used with the participants. That is, participants in the association group were significantly more focused upon internal processes (i.e., heart rate) and aspects of running, while those in the dissociative group attended more to external surroundings (i.e., listening to music) and non-running processes. It is noteworthy that this experiment incorporated such manipulation checks because adherence to strategy and attentional focus represents a serious weakness of previous studies in this area (Masters & Ogles, 1998a).

Environmental Conditions

The environmental conditions of temperature, relative humidity, and wind velocity were measured for the association and dissociation groups to examine for equivalence of the experimental conditions. Seven independent samples t-tests were used to make the comparisons between the groups (i.e., two treadmill, two indoor track, and three outdoor route). As noted before, such an approach increases the risk of a Type I error; however, this was appropriate because a statistically significant finding suggests that environmental conditions may have differed for the association and dissociation groups. It would, therefore, be a more conservative stance to allow for an increased risk of saying the groups differ when they do not and, in turn, reduce the likelihood of a Type II error. Using an alpha of .05 for determination of statistical significance, it was found that none of the comparisons were significant. See Table 3 for a summary of the environmental conditions. These findings indicate that the conditions the participants ran in did not significantly differ between the two groups.

Comparison of Cognitive Strategies and Exercise Settings

Examination of the cognitive strategies and exercise settings will be presented by the respective dependent variable (i.e., RPE, course satisfaction rating, and performance time) followed with a summary of the research questions and specific hypotheses. Recall that weekly mileage was statistically different between the groups, and in such cases analysis of covariance is an appropriate method of adjusting means to account for initial

Table 3

Means and Standard Deviations of Environmental Conditions for Associative and Dissociative Groups Among the Exercise Settings

	Associative		Dissociative	
Environmental conditions	M	SD	M	SD
Treadmill temperature	72.13	3.23	73.03	3.10
Track temperature	71.63	4.46	70.30	4.33
Outdoor temperature	55.50	14.44	52.73	15.48
Treadmill humidity	35.63	14.09	33.03	11.22
Track humidity	33.03	10.05	30.23	13.19
Outdoor humidity	42.83	16.49	47.62	22.05
Outdoor wind velocity	5.00	3.31	4.27	3.57

differences (Stevens, 1990, 1996). Therefore, analyses of cognitive strategy involved ANCOVA to control for this covariate. An essential assumption of ANCOVA is that homogeneity of regression lines not be violated, which is checked by examination of the interaction term of the covariate for non-significance. For all analyses the interaction term failed to reach statistical significance ($p > .05$); therefore, the assumption was satisfied and ANCOVAs were performed. However, ANOVAs were performed to examine the exercise setting main effects for each of the dependent variables because the exercise setting was a within-subjects variable and consequently not influenced by pre-experiment differences. For each analysis, the within-subjects independent variable was exercise setting (treadmill, indoor track, and outdoor route) and the between-subjects independent variable was cognitive strategy group (association vs. dissociation). Thus, the comparisons of exercise settings and cognitive strategies were made with a series of 3 x 2 mixed model ANOVAs and ANCOVAs with weekly mileage serving as the covariate.

Rating of Perceived Exertion

The interaction of exercise setting and cognitive strategy was not statistically significant for alpha set at .05 with RPE as the dependent variable, $F(2, 114) = 2.22$, $p = .11$, $eta^2 = 0.04$. Although this interaction approaches statistical significance the effect size magnitude is in the small range and only accounts for approximately 4% of the variance. Similarly, the main effect for cognitive strategy was not statistically significant, $F(1, 57) = 0.96$, $p = .33$, and yielded an effect size that was also small in magnitude (0.20).

Examination of exercise setting and RPE revealed a statistically significant main effect, F (2, 116) = 14.12, $p < .001$, indicating a difference in participants' ratings of perceived exertion existed among the three settings. Bonferroni post-hoc analysis revealed that all comparisons were statistically significant ($p < .05$). Examination of the mean ratings of perceived exertion for the treadmill, indoor track, and outdoor route yielded the following ratings, respectively: 14.75 (SD = 2.01), 13.93 (SD = 1.84), and 13.28 (SD = 1.85). Standardized mean difference effect sizes revealed estimates ranging from 0.35 to 0.76 with the largest effect size occurring for the treadmill/outdoor route comparison (see Table 4 and Figure 1). The ratings of perceived exertion by participants fell in the "somewhat hard" to "hard" range with scores of 13 and 15 corresponding to these, respectively. The results of this analysis revealed that the runners reported experiencing the least amount of exertion in the outdoor route, while the greatest level of perceived exertion occurred in the treadmill condition.

Course Satisfaction Rating

The interaction of exercise setting and cognitive strategy with course satisfaction rating as the dependent variable was not statistically significant, F (2, 114) = .70, $p = .50$, $eta^2 = 0.01$. Additionally, the main effect for cognitive strategy failed to reach statistical significance, F (1, 57) = .11, $p = .74$. The standardized mean difference effect size for the comparison was also small in magnitude (-0.06).

The main effect for setting, however, was statistically significant, F (2, 116) = 75.98, $p < .001$, suggesting a difference in participants' ratings of satisfaction existed among the exercise settings. Bonferroni post-hoc analysis revealed that all comparisons were statistically significant ($p < .05$). The mean satisfaction scores for the treadmill, indoor track, and outdoor route were 1.04 (SD = 1.07), 1.95 (SD = 1.17), and 3.38 (SD = 0.99), respectively. Satisfaction ratings such as these range from a response of "disliked somewhat" to just above "liked somewhat." Calculated standardized mean difference effect sizes for the comparisons ranged from -0.81 to -2.27 which all exceed the standard considered to be large (see Table 4 and Figure 2). These findings indicate that participants found the outdoor route most satisfying to run and the treadmill least gratifying.

Performance Time

The interaction of cognitive strategy and exercise setting, using ANCOVA with weekly mileage as the covariate, was not statistically significant for running time as the dependent variable, F (2, 114) = 0.66, $p = .52$, $eta^2 = 0.01$. Examination of the cognitive strategy main effect revealed a modest trend toward statistically significant differences with the associative participants running faster, F (1, 57) = 2.88, $p = .09$. The adjusted means for the associative and dissociative groups were 26.10 (SD = 4.39) and 27.89 min (SD = 3.94), respectively. Calculation of a standardized mean difference effect size revealed an estimate of -0.43, which approaches medium in magnitude and translates to a running time difference of 1 min 47 s over the course of 5 km.

The main effect for exercise setting was statistically significant, F (2, 116) = 65.53, $p < .001$, suggesting a difference existed among the three settings. Bonferroni post-hoc comparisons revealed that two of the three comparisons were statistically significant (p <

.001). That is, running on the treadmill resulted in significantly slower 5 km time than on either the indoor track or outdoor route. The mean running time on the treadmill was 29.60 min (SD = 4.91) compared to 25.83 (SD = 3.64) on the indoor track and 25.56 (SD = 4.15) for the outdoor running route. These mean differences are approximately four minutes, which translate to about 1 min 20 s slower per mile for the treadmill setting. The standardized mean difference effect sizes also revealed large effect sizes for the comparisons between the treadmill and indoor track (ES = 0.88) and outdoor route (ES = 0.89). The effect size for the non-significant comparison was inconsequential (see Table 4 and Figure 3). These findings indicate that exercise setting influenced the runners' pace. More specifically, running on the indoor track and outdoor route yielded faster times than the treadmill condition.

Summary of Hypotheses for Research Questions and Supplemental Analyses

The results pertaining to the specific hypotheses for the three research questions will be presented below. These hypotheses predict specific findings that are analyzed by planned comparisons and, therefore, were completed despite the non-significant interactions previously presented.

Hypotheses for Research Question 1

It was hypothesized that runners using a dissociative strategy would report higher RPE in the treadmill and indoor track than the outdoor setting, while those assigned the

Table 4

Means, Standard Deviations, and Effect Sizes of RPE, Course Satisfaction, and Performance Time for the Exercise Settings

	Treadmill		Indoor track		Outdoor route		T vs. I	T vs. O	I vs. O
	M	SD	M	SD	M	SD	ES	ES	ES
RPE	14.75	2.01	13.93	1.84	13.28	1.85	0.43*	0.76**	0.35*
Satisfaction	1.04	1.07	1.95	1.17	3.38	0.99	-0.81**	-2.27**	-1.32**
Running Time	29.60	4.91	25.83	3.63	25.56	4.15	0.88**	0.89**	0.07

*p < .05; **p < .01

Note. T = Treadmill, I = Indoor track, O = Outdoor route.

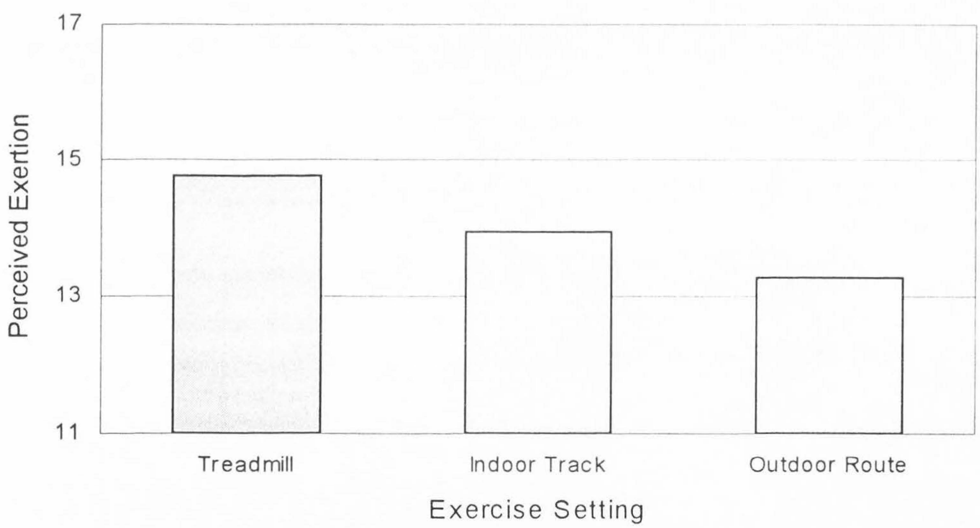

Figure 1. Mean RPE for the treadmill, indoor track, and outdoor route

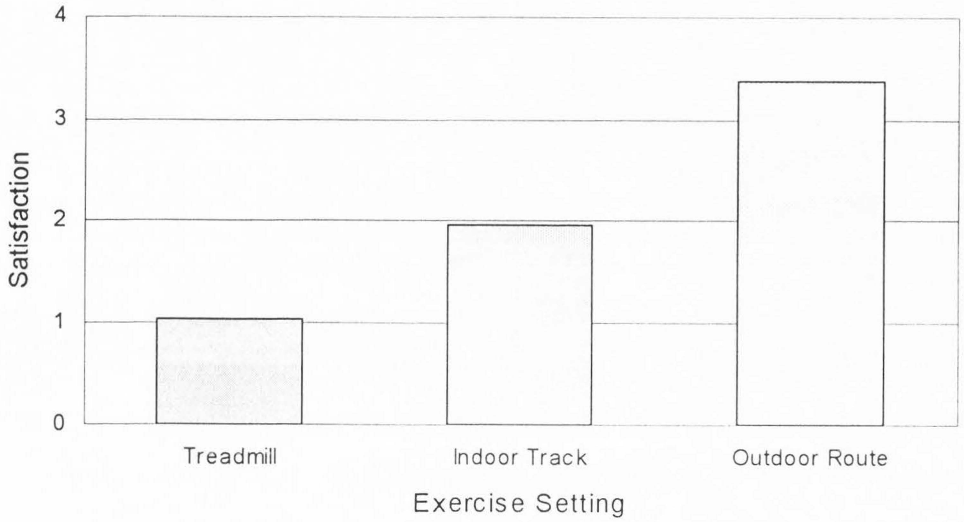

Figure 2. Mean course satisfaction ratings for the exercise settings

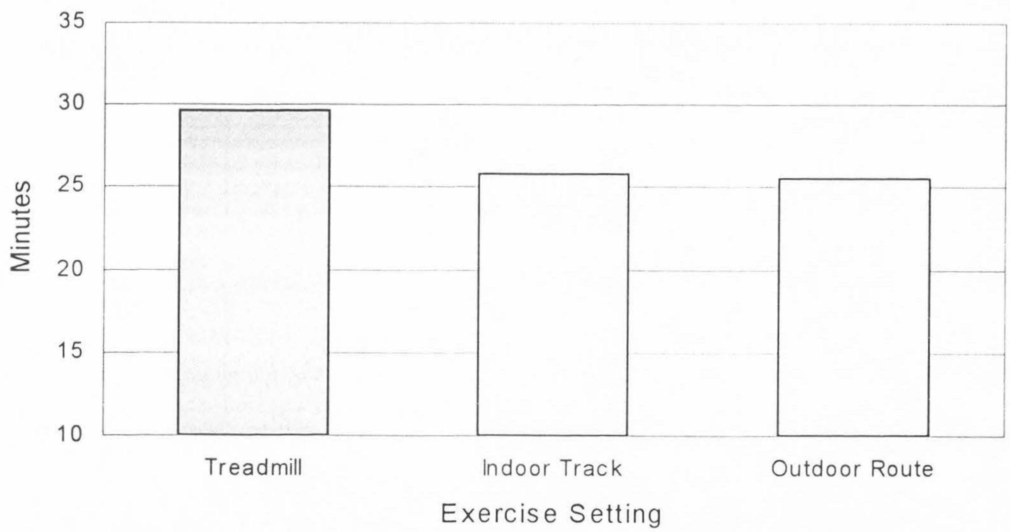

Figure 3. Mean performance times for the exercise settings

associative strategy would not report any such differences in RPE among the settings. The one-way repeated measures ANOVA for the dissociation group was statistically significant, F (2, 58) = 14.84, $p < .001$, while the association group failed to reach significance ($p > .05$). Follow-up paired t-tests for perceived exertion revealed that the treadmill was rated as requiring greater effort than the indoor track, t (29) = 3.13, $p < .01$, and outdoor route, t (29) = 5.20, $p < .001$. Also, the indoor track was rated as requiring greater exertion than the outdoor route by the dissociation group, t (29) = 2.35, $p < .05$. Mean RPE responses and effect sizes for the dissociative and associative groups are summarized in Table 5 and depicted visually in Figure 4.

It was also hypothesized that dissociating runners would report lower levels of course satisfaction in the treadmill and indoor track, and associating participants would not rate the settings any differently in satisfaction. The one-way repeated measures ANOVA for the dissociation group was statistically significant, F (2, 58) = 31.38, $p < .001$, as it was the association group, F (2, 58) = 45.61, $p < .001$. Examination of the paired t-tests for the dissociation group's course satisfaction ratings revealed statistically significant differences among the treadmill and indoor track, t (29) = -7. 48, $p < .001$, treadmill and outdoor route, t (29) = -3.97, $p < .001$, and indoor track and outdoor route, t (29) = -4.19, $p < .001$. Similarly, testing of the association group's satisfaction ratings were significant between the treadmill and outdoor route, t (29) = -11.71, $p < .001$, treadmill and indoor track, t (29) = -2.83, $p < .01$, and indoor track and outdoor route, t (29) = -5.98, $p < .001$. Mean satisfaction ratings and standardized mean difference effect sizes can be found in Table 5 (see also Figure 5).

Finally, it was hypothesized that dissociating runners would yield slower performance times in the treadmill and the fastest times in the outdoor setting, while those using association were hypothesized to not differ across the settings. The one-way repeated measures ANOVAs were statistically significant for both the dissociating, F (2, 58) = 26.17, $p < .001$, and the associating runners, F (2, 58) = 40.38, $p < .001$. Analyses for the dissociative condition revealed that there was a statistically significant difference between the treadmill and outdoor route, t (29) = 5.70, $p < .001$, as well as a similar difference between the treadmill and indoor track, t (29) = 5.16, $p < .001$. As for the participants in the associative strategy, the comparisons between settings followed a similar pattern with statistically significant differences found for the treadmill versus indoor track, t (29) = 6.64, $p < .001$, and the comparison between the treadmill and outdoor route, t (29) = 8.12, $p < .001$. Mean performance times and standardized mean difference effect sizes are presented in Table 5 (see also Figure 6).

To summarize the findings for research question one, the hypotheses with regard to RPE, exercise settings, and cognitive strategies were confirmed in the above analyses. However, the hypotheses regarding course satisfaction were confirmed with the dissociation group but not with the association group. The hypotheses regarding performance times for the two groups were only partially confirmed. That is, the slowest running time occurred on the treadmill with the dissociation group as predicted; however, the outdoor route did not stand out as the fastest setting. Contrary to expectations, the associating group experienced a substantially slower running time on the treadmill than in the other settings.

Table 5

Means, Standard Deviations, and Effect Sizes of RPE, Course Satisfaction, and Performance Time for Cognitive Strategy and Exercise Setting

	Treadmill		Indoor Track		Outdoor Route		T vs. I	T vs. O	I vs. O
	M	SD	M	SD	M	SD	ES	ES	ES
Dissociation									
RPE	14.87	1.85	13.63	1.77	12.83	1.56	0.69**	1.19**	0.48*
Satisfaction	1.03	1.16	2.07	1.17	3.30	1.18	-0.89**	-1.94**	-1.05**
Running time	30.12	4.89	26.91	3.38	26.40	3.55	0.78**	0.88**	0.15
Association									
RPE	14.63	2.17	14.23	1.89	13.73	2.03	0.20	0.43	0.26
Satisfaction	1.05	1.00	1.83	1.18	3.47	0.78	-0.72**	-2.27**	-1.67**
Running time	29.08	4.97	24.75	3.62	24.72	4.58	1.01**	0.91**	0.01

*p < .05; **p < .01
Note. T = Treadmill, I = Indoor track, O = Outdoor route.

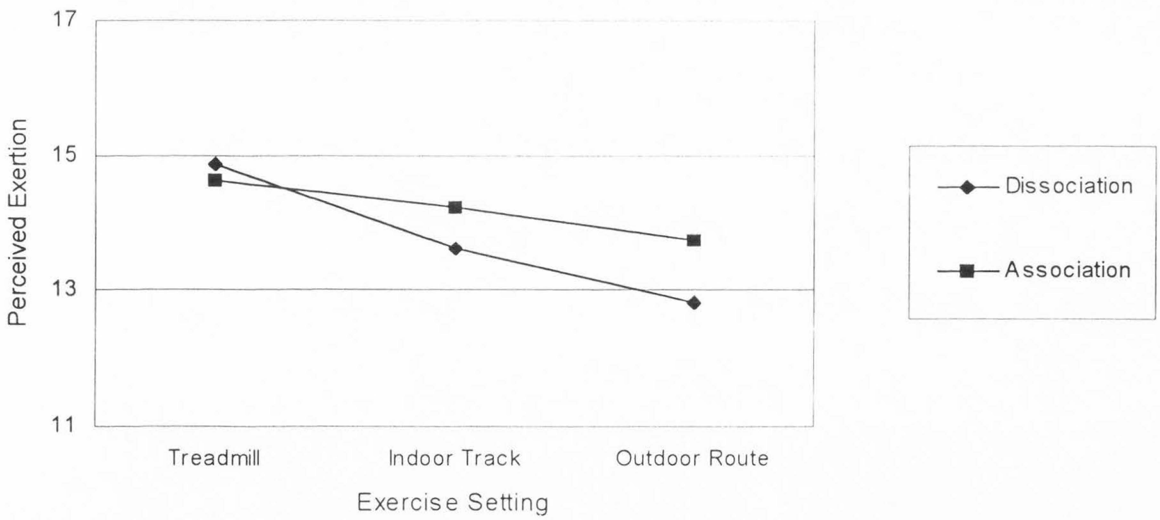

Figure 4. RPE for association and dissociation strategies in the exercise settings

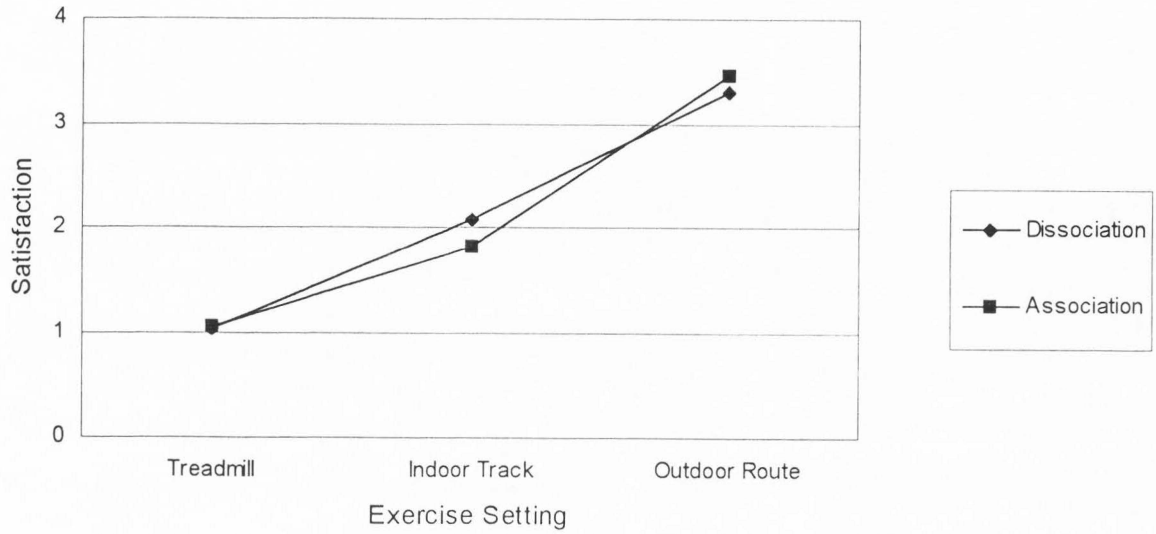

Figure 5. Course satisfaction ratings for association and dissociation strategies in the exercise settings

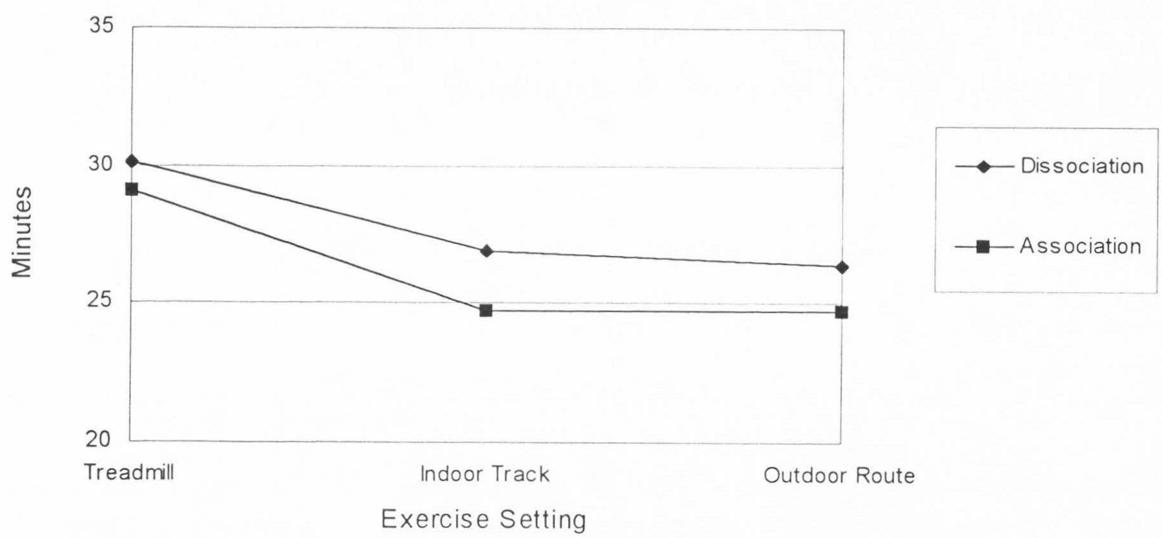

Figure 6. Performance times for association and dissociation strategies in the exercise settings

Hypotheses for Research Question 2

It was hypothesized that the association group would report higher levels of perceived exertion, while the dissociation group would report greater course satisfaction. Further, it was thought that the association group would produce faster performance times than the dissociators. For RPE and course satisfaction, the differences between the groups did not occur and the hypotheses were not confirmed. Examination of the group differences for performance time revealed a medium effect size and modest trend toward statistically significance for the association group running faster. Thus, the hypothesized differences between the association and dissociation groups were only partially confirmed.

Hypotheses for Research Question 3

It was hypothesized that higher levels of perceived exertion would be reported in the treadmill and indoor track, and the fastest performance times would occur in the outdoor setting. Further, it was hypothesized that runners would rate the outdoor route as most satisfying, while the treadmill would be considered the least satisfying exercise setting. The runners reported the least amount of exertion in the outdoor route, while the greatest level of perceived exertion occurred in the treadmill condition. Further, runners reported finding the outdoor route most satisfying to run and the treadmill least gratifying. Running in the outdoor route did result in faster performance times when compared with the treadmill, but not when compared with the indoor track. Thus, the hypotheses regarding RPE and course satisfaction were confirmed, while the hypothesis that the outdoor route would yield the fastest performance time was only partially confirmed.

CHAPTER V

DISCUSSION

The research questions that were posed in this study examined differences in perceived exertion, satisfaction, and performance time between cognitive strategies (i.e., association vs. dissociation) across three exercise settings (i.e., treadmill, indoor track, and outdoor route) in a sample of recreational runners. Additionally, main effect differences for cognitive strategies and exercise setting were investigated. This chapter includes a summary and interpretation of the main findings along with a discussion of the implications. Finally, the limitations of this study are discussed along with suggestions for focus of future research.

Summary and Implications of Findings

The hypotheses that exercise settings would influence perceived exertion, satisfaction, and performance were generally supported. In contrast, the hypotheses about cognitive strategies are less supported and clear-cut. Through this study several important findings emerged:

1. The most robust finding of this study was that perceived exertion, satisfaction, and performance time were substantially influenced by exercise setting. For perceived exertion, the highest levels were reported for the treadmill run, while the lowest occurred with the outdoor route. For course satisfaction, the outdoor route was rated as most satisfying to run and the treadmill was rated as the least. As predicted, the outdoor route yielded a

faster performance time than the treadmill setting; however, no difference was detected between the indoor track and outdoor route. The indoor track did, however, result in a faster performance time than the treadmill setting.

2. Using a dissociative strategy resulted in dissimilar levels of perceived exertion depending upon the exercise setting, while with the associative strategy perceived exertion did not significantly differ among the settings. For the dissociation strategy, the outdoor setting garnered the lowest level of perceived exertion, followed by the indoor track and treadmill, respectively.

3. When combining settings, there were no differences in perceived exertion or satisfaction between the cognitive strategies. Examination of cognitive strategy for performance time revealed a less clear-cut outcome. The result was a modest trend toward a difference with a medium effect size for the association group running faster.

The results from this study demonstrate the considerable influence of exercise setting upon perceived exertion, satisfaction, and performance times, and are generally consistent with the few studies in this area. In terms of perceived exertion and satisfaction, these results are supportive of Harte and Eiferts' (1995) finding that a group of trained runners reported increased feelings of exertion and lower satisfaction for treadmill conditions when compared to an outdoor route. Similarly, the current findings are compatible with Ceci and Hassmens' (1991) observation that runners performing at the same level of perceived exertion ran faster on an outdoor track than a treadmill. However, Pennebaker and Lightners' (1980) finding that running an outdoor course resulted in quicker performance times (than an outdoor track) was only partially replicated. That is, in this study, although the outdoor route and indoor track showed no significant differences, both resulted in quicker times than the treadmill.

As a means of explaining findings comparable to those discussed above, several researchers (e.g., Boutcher, 1992, Pennebaker & Brittingham, 1982; Pennebaker & Lightner, 1980; Rejeski, 1985) have turned to an information-processing perspective. Briefly, two core ideas to this perspective are: a) attention has a limited capacity and; b) information attended to from one source curbs ability to attend to information from a rivaling source (e.g., internal vs. external). Given the exercise settings in this study required different external attentional effort (e.g., monitoring for obstacles and changing route), the pattern shown in the findings suggests that internal sensations were more likely to be attended to when the external environment was less engaging and/or varied. Consequently, the least engaging/varied setting (i.e., treadmill) resulted in the highest levels of perceived exertion which likely facilitated the slower pace over the 5 km distance. Alternately, the similar performance times but dissimilar perceived exertion levels for the track and outdoor route suggest that the contrasting setting demands may have allowed for different availability of internal sensations. That is, the outdoor route likely resulted in lower ratings of perceived exertion than the track (even though the performance times were comparable) because the former required the runners to attend to other matters that occupied their limited attentional capacity.

The finding that a dissociative strategy resulted in dissimilar levels of perceived exertion depending upon the exercise setting, while with the associative strategy perceived exertion did not significantly differ among the settings may appear incongruous with the above suggestions. However, Johnson and Siegels' (1987) work on passive and active attentional focus (i.e., listening to music vs. solving arithmetic problems) may help to clarify this finding. They found that exercisers completing a constant flow of arithmetic problems reported the task required greater attention and capacity than did listening to music, and that the former task resulted in lower levels of reported perceived exertion. Although not directly assessed in the current study, it appears that attending to the music (i.e., dissociation) likely required less active and continual attentional effort and capacity than did monitoring heart rate every 30 s. Consequently, runners attending to music had more attentional flexibility and availability in which the demands of setting were likely to become more apparent, whereas those focusing on heart rate information likely had less attention available for such effects. That is not to say that the dissociating runners experienced higher (or lower) levels of perceived exertion; rather, the demands of the setting appeared more salient. Thus, with greater amounts of attention at their disposal in the less engaging/varied settings, it seems that runners attending to music were more able to shift attention to internal cues and sensations (e.g., fatigue, perceived exertion).

Pennebaker and colleagues (1980; 1982) have supposed that runners use perceived exertion as a gage for determining pace. Extrapolating from their studies, one would predict dissociators to experience less awareness of internal sensations and lower levels of perceived exertion that would result in faster performance times than associators. Interestingly, the runners attending to their heart rate (i.e., associators) in the current study did not report significantly higher levels of perceived exertion than those in the dissociation condition. Further, the dissociators did not garner faster performance times than the runners using association. Perhaps, as Takai (1998) suggested, runners using an associative focus set and maintain a target pace that is more consistent with their abilities which allows them to avoid an excessively fast or slow pace during runs. Thus, an association strategy that allows ongoing monitoring of pace might result in faster overall performance times without significantly higher perceived exertion. The findings from the current study seem to support Takai's (1998) position. That is, the analyses did not produce unequivocal support for association (i.e., there was a trend toward statistical significance); however, the performance time difference between the two groups was 1 min 47 s over the course of 5 km (which is equivalent to a medium magnitude effect size). For practical purposes, improving one's performance time by this span over 5 km is substantial to most runners of the experience and ability level in this study.

Given this magnitude and the trend toward statistical significance, examination of post hoc observed power (0.38) was inspected for the cognitive strategy main effect, and was found to be poor (< 0.45; Stevens, 1996). Using the recommendations of Stevens (1996) for reducing error variance and increasing power for such cases, an unanticipated and supplemental follow-up analysis was conducted in which another relevant variable was included as a factor (i.e., blocked). Several researchers (e.g., Brewer, Van Raalte, & Linder, 1996; McDonald & Kirkby, 1995; Weinberg, Smith, Jackson, & Gould, 1984; Wrisberg & Pein, 1990) have considered gender when examining cognitive strategies, therefore, gender appeared to be a relevant factor to include in the analysis at this stage. Although males (24.14 min; $\underline{SD} = 3.01$) ran significantly faster than females (28.65 min; $\underline{SD} = 3.94$), $\underline{F}\ (1, 55) = 27.78$, $\underline{p} < .001$, there was no gender by cognitive strategy interaction. More interestingly, the analysis also revealed a significant difference for cognitive strategy, F (1, 55) = 4.54, $p < .05$, with associators running faster than dissociators. Consistent with this finding, several studies (e.g., Masters & Ogles, 1998b; Schomer, 1990; Scott, Scott, Bedic, & Dowd, 1999; Tammen, 1996) have reported increased performance with the use of an associative strategy. Thus, this study's additional analysis (and effect size estimation) for the cognitive strategy comparison also offers support for the use of an associative strategy over dissociation for obtaining faster performance times.

The findings with exercise setting and cognitive strategy may have produced seemingly inconsistent results when it comes to drawing conclusions about attentional focus. For instance, the quicker performance times and lower perceived exertion in the more engaging/varied settings are supportive of the beneficence of an external focus of attention or dissociation (see Pennebaker & Lightner, 1980). Conversely, the direct comparison of listening to music or monitoring one's heart rate suggest that an associative strategy can yield faster performance times without significantly higher perceived exertion. Although speculative, it may be that the findings are not inconsistent if one looks beyond the association-dissociation conceptualization and also considers the degree of active-passive attentional processing required for each of the settings and tasks. As mentioned previously, the heart-rate monitoring focus likely required more attentional effort and capacity than did the music focus. Thus, the associative strategy in this study may have been a more active manipulation of attentional processing. Further, the exercise settings appear to span over the active-passive attention continuum with the outdoor route requiring the most active attention and treadmill most passive. Some researchers have distinguished between active and passive attentional methods/tasks and suggested the former to be more effective in reducing perceived exertion and enhancing exercise experience (Johnson & Siegel, 1987; Karageorghis & Terry, 1997). It may be, therefore, that an additional variable to consider with cognitive strategies is the degree of active attentional focus required for the task.

These findings, taken together, point to the importance and influence attentional foci (i.e., setting and cognitive strategies) have upon running performance and perceived exertion, in particular. Consequently, several implications and suggestions for runners (and those working with runners) readily come to mind. For instance, those wishing to improve performance times may facilitate this goal by training in an environment that is more attentionally engaging or varied (e.g., outdoor route) as opposed to running on a treadmill. Additionally, the level of perceived exertion will be relatively lower while running the outdoor route, which will likely foster greater satisfaction. For those runners who may have limited access to more inherently engaging settings due to poor weather or other conditions, they would be advised to incorporate other environmental/attentional cues that require active and sustained attention. In such a case, for example, a runner may attempt to randomly alter the incline and/or pace of the treadmill for varying time intervals. Also, frequently monitoring heart rate and attempting to maintain a specific targeted zone may be advantageous, particularly for those interested in improved performance time but limited to the use of a treadmill. For those less interested in performance improvement, but wishing to reduce their perceived effort, positioning the treadmill in a more visually (e.g., near a window) or socially (e.g., shared/frequented area of the home) engaging setting may produce better results.

More engaging/varied exercise environments, such as the outdoor setting in this study, result in lower levels of perceived exertion and higher levels of satisfaction. This finding is consistent with preferences reported in other studies (e.g., Harte & Eifert, 1995; Pennebaker & Lightner, 1980) and suggests that the setting may influence the overall evaluation of the exercise experience and subsequent response of the exerciser. This is compatible with research on adherence which indicates that the exercise setting and environment are important factors in dictating who continues with an exercise program (USDHHS, 1999). Notably, beginning exercisers often report disliking the exercise experience and fail to maintain an exercise program (Sallis & Owen, 1999). Previous research has suggested adherence can be improved with a dissociative strategy (Martin et al., 1984) and that inexperienced runners are more likely to engage in its use (Laasch, 1994-95). However, the findings from this study also suggest that exercising in a more engaging or varied setting may further help to reduce the unpleasantness experienced (e.g., higher perceived exertion, fatigue) by these individuals and improve exercise adherence levels. Thus, an additional implication of this study for individuals embarking upon exercise, or wishing to maintain a running program, would be to seek out stimulating and varied environments on an ongoing basis. At a broader community level, this study suggests an increased emphasis on creating exercise trails or routes that allow the runner to be more satisfied with and attend to environmental cues would also appear to encourage running and exercise.

Finally, for those who may be in race conditions and are wanting to perform at a quicker pace (and level consistent with their abilities), it appears that choosing a related associative strategy, such as frequently monitoring heart rate, would yield faster times without substantially higher perceived exertion. That is not to say the runner should attempt to ignore environmental/external cues and exclusively rely on an internal focus of attention. On the contrary, utilizing both cues would appear to have some merit in facilitating a faster performance time. For instance, some researchers (e.g., Sachs, 1991; Silva and Appelbaum, 1989) have suggested that using an attentional focus in which one is able to monitor effort and pace while also being able shift to other demands (i.e., using adaptive flexible strategies) is more fitting for competitive running and racing. Stevinson and Biddle (1998) found that marathoners who "hit the wall" used more dissociative foci, while too much association was related to an earlier onset of the same type of discomfort. Thus, a constant associative strategy seems less likely to produce the desired race outcome the runner is seeking. Rather, regular associative monitoring combined with attending to the environmental cues would appear to be the best strategy in terms of both maximizing performance and minimizing perceived exertion.

Limitations and Future Research

Although this study incorporated several features to address methodological short-comings identified in the literature, some limitations exist. Perhaps the most notable limitation of this study was the lack of a "no-strategy" control or pre-test comparison for the association and dissociation conditions. Since listening to music can increase aerobic endurance (Karageorghis & Perry, 1997), it is conceivable that both strategies used in this study may have facilitated improved performance times for the runners. Consequently, the true effects the cognitive strategies had upon the runners may have been masked. In defense of this study's design, however, there was concern that recruitment of appropriate participants would be difficult and once recruited, attrition may be problematic because of the level of commitment required of the runners (i.e., returning for three runs). Striving to achieve a balance between practicality and experimental rigor, while also addressing previous methodological limitations, a 3 x 2 mixed design with exercise setting as a within-groups independent variable and cognitive strategy as a between-groups factor was ultimately chosen. Additionally, the explicit purpose of this study was to compare the two cognitive strategies and attempt to clarify the differences and advantages between them. To this end, an additional group/condition was not necessary.

This investigation was conducted with recreational runners using 5 km as the designated endurance distance for several reasons. It was determined in reviewing the literature that examination of cognitive strategies with recreational runners was lacking, and that much of the literature considered either much longer or shorter distances (e.g., marathon, mile) or non-running tasks altogether. Because of these limitations, the widespread popularity of the 5 km distance, and concern with possible attrition, the 5 km distance appeared the most suitable interval. However, the findings and conclusions from this study may not generalize to either longer or shorter running distances, other forms of exercise, or more experienced or elite runners. In fact, Takai (1999) found that runners who inaccurately recalled their pace tend to decrease their pace substantially more than accurate recallers of pace following the initial 5 km phase of a 20 km race. Thus, for distances beyond 5 km and requiring greater endurance additional studies will be needed.

Several researchers (e.g., Master & Ogles, 1998a; Okwumabua et al., 1983; Sachs, 1984) have noted difficulties with participant adherence to designated cognitive strategies. For instance, Sachs (1984) observed that runners were often opposed to being constrained to a strategy that was unfamiliar to them and possibly conflicting with their typical methods. Thus, this study attempted to use strategies and foci of attention (i.e., music and heart-rate monitors) that would likely be familiar to recreational runners and not evoke resistance or non-adherence to the assigned task. Additionally, a rationale was presented to the runners that was expected to foster a positive expectation in the respective strategy and task. Several manipulation checks were also implemented to encourage and assess adherence. However, it is noteworthy that there was little additional training (and practice) given to runners for either association or dissociation strategies. It may be that training in the employment of a cognitive strategy may significantly influence use and satisfaction with that strategy. Although this study assessed course satisfaction, runners were not queried about their level of satisfaction with the cognitive strategy they were asked to utilize. It seems that runners' level of satisfaction and specific training in the use of these cognitive strategies would be needed before their effectiveness and influence could be adequately evaluated.

Several additional recommendations for future study are apparent following this examination. For example, other forms of association and dissociation may garner different outcomes with regard to satisfaction, perceived exertion, and performance. Some research exists that suggests all forms of association are not equivalent in terms of effects on performance time. For instance, Clingman and Hilliard (1990) found that race walkers were quicker when directing attentional focus toward their cadence than stride length. Similarly, the attentional complexity of the dissociative task may also influence the experiences of runners. Further research examining these specific variables and conditions is needed.

Although a great deal of attention in the literature has been given to exercise and affective responses (e.g., Gauvin & Rejeski, 1993; Gauvin, Rejeski, & Norris, 1996; Hansen, Stevens, & Coast, 2001), much less notice has been devoted to the influence of cognitive strategies on such responses. In one of the few analyses of both an associative and dissociative attentional focus in runners, Harte and Eifert (1995) indicated that those employing the former focus experienced more negative affect compared to pretest levels. Masters and Lambert (1989) have also suggested that runners may use a dissociative strategy because it is likely to provide reinforcing effects through mood elevation. This intuitive relationship between cognitive strategies has, however, received little empirical attention, with the overwhelming emphasis in the literature being placed upon performance variables and perceived exertion/fatigue. Affective responses related to cognitive strategies and foci may also be influential to continued exercise, particularly for beginning runners. Accordingly, clarification of these potential relationships is deserving of more study in the research literature.

A final recommendation requiring additional consideration related to the issue of different techniques for the assessment of attentional focus and cognitive strategies. As

Masters and Ogles (1998a) noted, various methods and measures have been used throughout the literature (with each having its built-in biases and limitations). For instance, some investigators have relied on retrospective reports of strategy use (e.g., Morgan & Pollock, 1977) while others have used portable recorders to collect responses during exercise (e.g., Schomer, 1986,1990). An innovative approach, although quite intensive, was explored by Blackburn and Hanrahan (1994) in which runners on a treadmill used both a think-aloud and video technique to record thoughts as they occurred and also stimulate memory when later viewed. The present investigation, similar to several other studies, attempted to direct exercisers' attentional focus through obvious tasks and then relied upon participants' reports of their thoughts at the conclusion of each of the runs. As these approaches differ substantially, it would be beneficial if a more standardized protocol and comprehensive assessment were developed and validated. In this regard, Goode and Roth (1993) have produced the TDRS; however, it remains to be widely used and validated.

In summary, several recommendations for areas of additional attention and future research were proposed. It appears that examination of cognitive strategies for distances beyond 5 km using controlled experiments as well as studies involving more specific and prolonged training in the use of such strategies are needed. Further, investigating and comparing different forms of both associative and dissociative tasks, while varying attentional complexity would help to clarify the effects of modifying one's attentional foci. The relationship between attentional focus and exercise adherence as well as affective response deserve more thorough examination. Finally, a standardized protocol and comprehensive means of assessing the use of cognitive strategies, such as the TDRS, need to be validated and more widely implemented among the studies being completed in this area.

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APPENDIXES

Appendix A

Running History Questionnaire

Identification #__________ Age:__________ Height:_________ Weight:_________

Ethnicity: African Amer.☐ Asian Amer.☐ Caucasian☐ Hispanic☐ Native Amer.☐ Other:______

Sex: Female ☐ Male ☐ Years/months running:________________________________

On average, how many miles do you currently run/jog in a week?_______________________________

On average, how many days do you currently run/jog in a week?_______________________________

Has this amount changed in the last 12 months, and if so, how much has it increased or decreased?____

What is your longest run (in miles), on average, throughout the week?__________________________

What is your typical pace (minutes/mile) for your training runs?_______________________________

Has this pace changed in the last 12 months, and if so, how much has it increased or decreased?____

In the columns below, please write the races you have participated in during the last 12 months with the approximate month, distance, and finishing time. (Please use the back of form if more space is needed.)

Month	*Distance of race*	*Finishing time in minutes*

Have you experienced any running related injury or pain in the last 12 months? No ☐ Yes ☐

If yes, please specify in the columns below the pain/injury, its duration, and if you stopped running during this time. (Please use the back of form if more space is needed.)

Pain/injury	*Duration*	*Continue*	*Discontinue Running*
		☐	☐
		☐	☐
		☐	☐
		☐	☐

Appendix B

Rating of Perceived Exertion Scale

I now want you to try to estimate how hard you felt the work was during the run. That is, I want you to rate the degree of perceived exertion you felt. By perceived exertion I mean the total amount of exertion and physical fatigue, combining all sensations and feelings of physical stress, effort and pain, shortness of breath or work intensity, but try to concentrate on your total, inner feeling of exertion. Try to estimate as honestly and objectively as possible. Don't underestimate the degree of exertion you felt, but don't overestimate it either. Just try to estimate as accurately as possible.

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Appendix C

Course Satisfaction Rating Scale

Instructions: Please rate (by circling the number) how much you liked running in the setting you just completed. Write any additional comments you have about this setting in the space available below your rating.

0	1	2	3	4
Disliked Very Much	**Disliked Somewhat**	**Not Sure**	**Liked Somewhat**	**Liked Very Much**

Appendix D

Thoughts During Running Scale

Instructions: Read each item carefully and mark the box under the category which best describes your thoughts during your most recent run.

	Never	Rarely	Occasionally	Frequently	Very Often
1. Nothing in particular, my mind wanders	□	□	□	□	□
2. Things that have gone well for me.	□	□	□	□	□
3. How my body feels.	□	□	□	□	□
4. Financial matters.	□	□	□	□	□
5. Nature (for example, trees, flowers, sky).	□	□	□	□	□
6. Plans for the future.	□	□	□	□	□
7. How fatigued or tired I feel.	□	□	□	□	□
8. The music that I am listening to.	□	□	□	□	□
9. How good I look because I am physically active.	□	□	□	□	□
10. The conversation I am having with a companion.	□	□	□	□	□
11. My hobbies.	□	□	□	□	□
12. Deadlines at work or school.	□	□	□	□	□
13. Religious thoughts (for example, prayer).	□	□	□	□	□
14. My girlfriend or boyfriend.	□	□	□	□	□
15. Increasing or decreasing my pace.	□	□	□	□	□
16. How well I feel.	□	□	□	□	□
17. The scenery around me.	□	□	□	□	□
18. The proper mechanics of running.	□	□	□	□	□
19. My job.	□	□	□	□	□
20. My family (spouse and/or children).	□	□	□	□	□
21. All the benefits of running.	□	□	□	□	□
22. Recent successes.	□	□	□	□	□
23. What I will do when I finish my run.	□	□	□	□	□
24. The problems and hassles of daily life.	□	□	□	□	□
25. Housework/ yardwork/ daily chores.	□	□	□	□	□
26. The discomfort of exercising.	□	□	□	□	□
27. Upcoming social activities.	□	□	□	□	□
28. The buildings or homes along the run.	□	□	□	□	□
29. Family problems.	□	□	□	□	□
30. Managing my heart rate and my breathing.	□	□	□	□	□
31. Spiritual matters.	□	□	□	□	□
32. Relationships with others.	□	□	□	□	□
33. My daydreams or fantasies.	□	□	□	□	□
34. Work or school projects.	□	□	□	□	□
35. Recent incidents where I felt hurt or angry.	□	□	□	□	□
36. Watching other people.	□	□	□	□	□
37. How much farther I have to run.	□	□	□	□	□
38. Environmental hazards (dogs, crime, construction).	□	□	□	□	□

Appendix E

Informed Consent

Informed Consent for Running Study

As a participant in this study being conducted by Kevin S. Masters, Ph.D. and Rick LaCaille, M.A. of the Psychology Department at Utah State University, I understand that:

The purpose of this study is to examine the effects of attention on running. It is expected that there will be approximately 60 participants in this study. While I may not benefit personally from participation in this study, it is expected that the results will be of great benefit to others, such as researchers and psychologists. I will, however, receive $20 for completing this study as well as be placed in a random cash drawing for $100 once the study is concluded.

I understand that participation in this study involves running a distance of 5 kilometers on three separate days within a three week period. During this time, I will be asked to focus my attention on a specific task. Additionally, I will be asked to complete a few brief ratings and questionnaires following each run. Although the amount of time to complete these activities will vary by the individual, each day the entire procedure is estimated to take approximately one hour or less.

I am aware that the researchers are not interested in the individual responses or data of participants, but that of groups of people. The results from participating will be reported in the context of group performances and responses. Thus, any information about my individual participation will not be disclosed when the data are analyzed as groups.

I also understand that there are no known risks associated with participating in this study. The distance I am asked to run is 5 kilometers, and is substantially less than the average weekly distance of 15 miles that participants are expected to regularly run as a minimum for participation in the study. Further, I understand that my participation in this study is completely voluntary, and I am able to withdraw my consent, without consequences, at any time during the study procedures. There may also be situations in which my participation may be terminated without my consent. For instance, this may occur if I have jeopardizing health conditions (e.g., pregnancy) or if I fail to keep my appointments.

Finally, to protect my confidentiality, codes will be used in place of identifying information (e.g., name) to label all forms and questionnaires. I understand that all research materials will be kept in a safe place to further ensure my confidentiality. Upon my completion of this study, I will be fully debriefed about the study. The overall study results will be available in approximately six to nine months from the primary researchers. I may, however, inquire about the study procedures at any time or contact Dr. Masters or Rick LaCaille with any questions or concerns at 797-1460.

The Institutional Review Board (IRB) for the protection of human subjects at Utah State University has reviewed and approved this research project.

____________________________ ____________________

Name (please print) Date

____

Signature

I certify that the research study has been explained to the above individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised, have been answered.

____________________________ ___________________________

Kevin S. Masters, Ph.D. Rick LaCaille, M.A.

Appendix F

Association Strategy Instructions

In this study you are being asked to focus your attention and concentration on your bodily sensations and running. That is, you will be monitoring your heart rate approximately every 30 seconds throughout your run, and be asked to report back at the end of the run the lowest and highest rates you observed on the heart rate monitor. Monitoring and attention to bodily sensations is a strategy used by many athletes to enhance performance. Some runners and athletes have also concentrated on bodily and "inner" aspects such as breathing, relaxing muscle groups, pace of stride, or the mechanics of running. Although your primary focus will be on your heart rate, you may also attend to some of these other things and find them helpful to you during the run.

Remember that you will be running a distance of 5 kilometers (approximately 3 miles) today, and that we would like you to use the focus just described throughout your entire run. Do you have any questions?

To verify that you understand the attentional focus, please briefly describe what it is you are to concentrate on throughout the run.

Appendix G

Dissociation Strategy Instructions

In this study you are being asked to focus your attention and concentration on things other than your bodily sensations and running. That is, you will be listening to a cassette tape of music throughout your run, and be asked to report back at the end of the run aspects about the tape and music. Distracting attention from bodily sensations is a strategy used by many athletes to enhance performance. Some runners and athletes have also thought about work or school projects, relationships, spiritual matters, or even daydreams. Although your primary focus will be on the music played on the cassette tape, you may also attend to some of these other things and find them helpful to you during the run.

Remember that you will be running a distance of 5 kilometers (approximately 3 miles) today, and that we would like you to use the focus just described throughout your entire run. Do you have any questions?

To verify that you understand the attentional focus, please briefly describe what it is you are to concentrate on throughout the run.

Appendix H

Music Selections and Songs

1. Vivaldi
    1. Concerto in E major
    2. Concerto in G minor
    3. Concerto in F major
    4. Concerto in F minor

2. Cities '97 Sampler
    1. The Wallflowers - 6th ave. heartache
    2. Keb Mo - That's not love
    3. The Why Store - Lack of water
    4. Amanda Marshall - Birmingham
    5. Del Amitri - Tell her this
    6. Anders Osborne - Pleasin' you
    7. Bob Dylan - A hard rain's a gonna fall
    8. Edwin McCain - Alive
    9. The Badlees - Fear of falling
    10. Brian Setzer - Rumble in Brighton

3. Miles Davis
    1. So what
    2. Freddie freeloader
    3. Blue in green
    4. All blues
    5. Flamenco sketches
    6. Flamenco sketches - alternate take

4. Soundtrack to Forest Gump (Rock -n- Roll)
    1. Elvis Presley - Hound dog
    2. Duanne Eddy - Rebel rouser
    3. Clarance Henry - I don't know why but I do
    4. The Rooftop Singers - Walk right in
    5. Wilson Pickett - Land of 1000 dances
    6. Joan Baez - Blowin' in the wind
    7. CCR - Fortunate son
    8. Aretha Franklin - Respect
    9. Bob Dylan - Rainy day women
    10. The Beach Boys - Sloop John B
    11. The Mamas & the Papas - California dreamin'
    12. Buffalo Springfield - For what's it worth
    13. Jackie DeShannon - What the world needs now is love
    14. The Doors - Break on through
    15. Simon & Garfunkel - Mrs. Robinson