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The purpose of this study was to examine the influence of environmental setting (indoor vs. outdoor) on affect and attentional focus during exercise. In this counterbalanced, repeated measures design, 26 women (ages 18-26) exercised at a moderate intensity (60-70% of MHR) for 30 minutes in two settings: indoor track and outdoor path. Participants filled out dimensional measures of affect pre- and post-exercise: Activation Deactivation Adjective Check List, Feeling Scale (FS), and Felt Arousal Scale (FAS). FS, FAS, and ratings of perceived exertion (RPE) were assessed every 10 minutes during exercise. Post-exercise, participants also filled out the Attentional Focus Questionnaire, Perceived Restorativeness Scale (PRS), and Evaluation of Exercise Setting.

Mixed analyses of variance with order as a between-subjects factor and time and setting as within-subjects factors indicated that exercise, regardless of setting, resulted in significant reductions in tiredness, $F(1, 24) = 11.58$, $p = .002$, and significant increases in affective valence, $F(1.9, 46.1) = 7.1$, $p = .002$, arousal, $F(2.29, 55.02) = 21.65$, $p < .001$, and energy $F(1, 24) = 15.79$, $p = .001$ over time. There was a nonsignificant trend in which FS scores were higher in the outdoor setting, $F(1, 24) = 3.17$, $p = .088$. Use of associative and dissociative attention was similar across settings, but exercisers used association more during their first session than their second session, especially if they were indoors for their first session, $F(1, 24) = 13.90$, $p = .001$. Participants reported higher RPE, $F(1, 24) = 17.56$, $p < .001$, but less distressing thoughts $F(1, 24) = 87.06$,

$p < .001$, during outdoor exercise. Most (85%) participants preferred the outdoor setting and rated it as significantly more restorative on the PRS, $F(1, 24) = 9.68$, $p = .005$. Also, participants found the outdoor setting significantly ($p < .001$) more enjoyable, refreshing, and pleasant. Participants reported enjoying the fresh air, natural stimuli, and the greater variability in scenery and terrain. Exploratory analyses indicated that less active participants (< 35 METS/wk) reported more positive affective valence during exercise in the outdoor setting than in the indoor setting, $F(1, 22) = 7.06$, $p = .014$.

These findings suggest that being in an outdoor environment can make exercise more enjoyable, particularly for less active individuals. Future research might examine the environment's impact on longer-term adherence and mood, and ways to manipulate exercise settings to promote enjoyment and positive affect.

PERCEIVED ENVIRONMENTAL RESTORATIVENESS AND AFFECTIVE

RESPONSES TO INDOOR VS.OUTDOOR EXERCISE

by

Amanda L. Williams

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Approved by

Committee Chair

APPROVAL PAGE

This thesis has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Although researchers and health practitioners have increased the public's awareness of the numerous physical and mental health benefits of physical activity, many individuals do not engage in a sufficient level of physical activity. Recommendations for health-enhancing physical activity typically focus on exercise mode, intensity, duration, and frequency (Haskell et al., 2007). However, a growing body of literature from the fields of environmental and exercise psychology suggests that exercise prescriptions should also consider the environment's influence on the health benefits of exercise (Maas & Verheij, 2007). There is evidence to suggest that, through various physiological mechanisms and cognitive processes, natural environments are more likely to encourage stress reduction and psychological restoration than built environments (Kaplan & Berman, 2010; Ulrich et al., 1991). "Green exercise" researchers have proposed that natural environments enhance the positive mood-altering properties of exercise (Barton & Pretty, 2010).

Stress reduction theory (SRT; Ulrich et al., 1991) and attention restoration theory (ART; Kaplan, 1995) both posit that green spaces provide psychological restoration from stress, fatigue, and negative affect. In a landmark study supporting SRT, Ulrich (1984) found that patients who had a window view of nature required less pain medications and recovered faster from gall bladder surgery than patients whose windows overlooked a brick wall. Further support for SRT comes from studies in which participants are exposed to natural or built environments after presentation of stressful stimuli. In these studies, natural environments have been found to more effectively reduce physiological arousal and promote more positive feeling states (Hartig, Evans, Jamner, Davis, & Garling, 2003; Tsunetsugu et al., 2007; Ulrich et al., 1991).

ART (Kaplan, 1995) is based on William James' (1892) proposal that there are two types of attention: voluntary (directed) and involuntary. Directed attention is goal-directed, effortful, and produces cognitive fatigue and irritability after sustained periods; involuntary attention is stimulus-driven, effortless, and promotes recovery from fatigue. ART asserts that the innately fascinating qualities of a natural landscape promote recovery from cognitive fatigue by softly capturing involuntary attention, thus restoring the capacity for directed attention. Numerous studies have demonstrated that the natural stimuli found in parks, gardens, and waterfronts can restore cognitive functioning after exposure to cognitively demanding tasks (e.g., Berman, Jonides, & Kaplan, 2008; Hartig et al., 2003; Hartig, Mang, & Evans, 1991; Kaplan & Berman, 2010). Together, ART and SRT suggest that nature improves mood by reducing negatively felt physiological arousal and by providing a break from cognitively fatiguing stressors.

Positive engagement with external surroundings and "time away from stressors" appear to also play a role in the restorative properties of exercise. Bahrke and Morgan (1978) proposed that exercise reduces anxiety and stress by providing a distraction or "time-out" from daily hassles and worries. Although this distraction hypothesis has been dismissed by many researchers as being overly simplistic (Raglin & Morgan, 1987), there is evidence that the mood-enhancing properties of exercise are more fully realized when exercisers engage in dissociative and/or externally-focused thought patterns (Blanchard, Rodgers, & Gavin, 2004; Hardy & Rejeski, 1989). Dissociative-external thoughts are theorized to provide a distraction from interoceptive cues related to physical exertion; this distraction can be particularly beneficial for individuals who are not accustomed to exercise (Ekkekakis, Hall, & Petruzzello, 2008; Rose & Parfitt, 2007). Rose and Parfitt (2007) found that sedentary individuals who reported being overly preoccupied with bodily cues and other associative thoughts during exercise were more likely to report feelings of negative arousal and exhaustion.

Certain environments may lead to greater use of dissociative cognitive strategies. Outdoor exercise has been found to encourage a more externally-focused attention style and result in lower RPE than indoor exercise, even when participants self-selected higher exercise intensities outdoors (Ceci & Hassmen, 1991; Harte & Eifert, 1995; LaCaille et al., 2004). Researchers suggest that the novel stimuli in outdoor environments provide a pleasant distraction from feelings of exertion, thus leading to greater enjoyment and more positive affect than indoor exercise (Focht, 2009; Harte & Eifert, 1995). This tendency to engage in dissociative thoughts during outdoor exercise provides further support for ART's assertion that natural environments encourage effortless and stimulus-driven fascination (Kaplan, 1995).

To study the effects of the environment on psychological responses to exercise, researchers have compared indoor vs. outdoor settings, rural vs. urban settings, and pictures of rural vs. urban environments presented in a laboratory setting. The majority of these studies have found that, irrespective of the environment, exercise results in significant improvements in mood from pre- to post-exercise (e.g., Bodin & Hartig, 2003; Butryn & Furst, 2003; Focht, 2009; Kerr et al., 2006; Plante, Cage, Clements, & Stover, 2006; Pretty, Peacock, Sellens, & Griffin, 2005). In contrast, other findings have suggested that natural environments enhance the psychological benefits of exercise. When compared to indoor exercise, outdoor exercise has been associated with more positive mood, greater use of externally focused attention, lower ratings of perceived exertion, greater vitality, higher satisfaction, and greater enjoyment (Berman et al., 2008; Focht, 2009; Harte & Eifert, 1995; Kerr et al., 2006; LaCaille, Masters, & Heath, 2004; Ryan et al., 2010). Exercise within natural environments, such as parks and nature reserves, has been rated as being significantly more restorative and related to greater improvements in directed-attention abilities, positive mood, and tranquility than exercise within urban environments (Berman et al., 2008; Bodin & Hartig, 2003; Butryn & Furst, 2003). Furthermore, the perceived “greenness” or “naturalness” of the environment has been shown to be related to anxiety reduction (Mackay & Neill, 2010). Simply viewing pictures of nature can have restorative effects, as evidenced by the Pretty et al. (2005) finding that participants who viewed pleasant nature scenes during indoor treadmill exercise experienced significant decreases in tension and anxiety from baseline, whereas participants who viewed urban scenes had smaller increases in positive mood. However, the physical sensation of being outdoors appears to be more revitalizing than viewing pictures of outdoor scenery, as shown by the Plante et al. (2006) finding that while indoor exercise with a virtual reality presentation of nature scenes had a calming effect, outdoor exercise was related to higher levels of energy and enjoyment.

In 2010, Barton and Pretty conducted a meta-analysis to assess the impact of time spent outdoors, exercise intensity, and type of green space on the mental health benefits of green exercise. The meta-analysis only evaluated studies that had been conducted by the authors and their colleagues, and all of the studies utilized the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1971) and the Rosenberg Self-Esteem Scale (Rosenberg, 1979) to assess changes in mood and self-esteem. Participants engaged in a wide array of physical activities (e.g., walking, gardening, cycling, and horseback riding) in various outdoor environments, such as farmland, urban greenspace, forests, and waterfronts. The meta-analysis suggested that as little as 5 minutes of green exercise resulted in more positive mood (d = .54) and higher self-esteem (d = .46; Barton & Pretty, 2010). The authors concluded that an acute bout of green exercise positively impacted mood, regardless of duration, intensity, and location. However, these results should be interpreted cautiously. Because these studies did not utilize a randomized control design in which green exercise was directly compared to an indoor exercise or a non-exercise control condition, these studies cannot claim that the mental health benefits of green exercise are meaningfully different from the benefits gained from indoor exercise or from simply viewing nature. Further, the study samples were comprised of people who self-selected their participation in green activities, thus these people may have been biased toward preferring the outdoors. The majority of the physical activities involved social interaction and environmental conservation work, so it is possible that social factors were largely responsible for the gains in self-esteem and positive mood.

Furthermore, mood was assessed with the POMS, which has been criticized for its emphasis on negative mood states that are not specific to exercise (Ekkekakis et al., 2008).

When studying the effects of environmental setting on exercise experience, researchers have typically utilized categorical measures of discrete mood states, such as the POMS and Exercise-Induced Feeling Inventory (EFI; Gauvin & Rejeski, 1993), at time points before and after exercise (e.g., Barton & Pretty, 2010; Bodin & Hartig, 2003; Butryn & Furst, 2003; Harte & Eifert, 1995). These measures are limited in their scope of specific mood states. Ekkekakis et al. (2008) has suggested that instead of measuring a limited number of discrete mood states, researchers should utilize dimensional measures to assess the full breadth of core affective responses to exercise. Whereas mood is a persistent affective state that represents the accumulation of emotions over time, core affect is a more malleable feeling state that is largely informed by presently felt physical sensations, feelings, and cognitive appraisals of stimuli (Buckworth & Dishman, 2002). In comparison to mood, affect is more heavily influenced by the moment-to-moment changes in internal states that can occur in response to acute exercise. The circumplex model of affect (Russell, 1980) posits that core affect has two bipolar dimensions: valence (pleasure-displeasure) and perceived activation (high-low). Researchers have used single item measures, such as the Feeling State (FS; Hardy & Rejeski, 1989) and Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985), to assess affective valence and arousal while a person is exercising (e.g., Ekkekakis et al., 2008; Focht, 2009). Single-item measures are easy to administer during exercise, and do not provide excessive distraction from the exercise stimulus. However, the FS and FAS provide little insight into specific feelings or affective states. To assess pre- to post- changes in specific affective states, researchers (e.g., Ekkekakis et al., 2008) will often supplement the FS and FAS with the multiple-item Activation Deactivation Adjective Checklist (AD ACL; Thayer, 1986), a dimensional measure that fits within the circumplex model.

Research to support the benefits of green exercise has focused mostly on post-exercise changes in specific mood states; less is known about the impact of environmental "greenness" on the changes in basic affect that occur during exercise. Studies that measure affective valence and arousal during exercise are needed to explore this relationship, as affect during exercise appears to predict adherence to a physically active lifestyle (Kwan & Bryan, 2010; Williams et al., 2008). Studies that only measure mood before and after exercise (e.g., Barton & Pretty, 2010) assume that mood becomes more positive in a linear fashion from pre- to post-exercise. However, research has shown that affect fluctuates in a non-linear fashion during exercise, and that individuals who are less active or have low self-efficacy for exercise actually experience negative feeling states while they are exercising (Backhouse, Ekkekakis, Foskett, & Williams, 2007; Ekkekakis et al., 2008). Furthermore, affect during an acute bout of exercise is a better predictor of enjoyment, self-efficacy, and exercise adherence than the mood states that are felt once an exercise session has ended (Rose & Parfitt, 2007; Kwan & Bryan, 2010; Williams et al., 2008).

Ekkekakis et al. (2008) proposed that during lower intensity exercise, such as walking, affect is largely impacted by cognitive appraisal of internal and external stimuli.

Cognitive appraisal of the external environment appears to have an effect on feeling states, as evidenced by Focht's (2009) finding that women had more pleasant affect and higher arousal when walking outdoors than when walking on a treadmill. The researcher theorized that the outdoor walk was a more pleasant experience because the environmental stimuli distracted the exercisers from physiological cues and other task-related thoughts, however, the study did not measure the exerciser's attentional focus or their perceptions of the environment. The current study expands upon Focht's (2009) work by measuring the relationships between perceived environmental restorativeness, attentional focus, and affect. Although Focht (2009) used the FS and FAS to measure changes in affective valence and arousal, he measured more specific mood states with the EFI (Gauvin & Rejeski, 1993), a categorical measure that does not fit within the circumplex model of affect. Although this approach of combining single-item measures of valence and arousal with multiple-item measures of specific mood states captures the broader scope of affect (Ekkekakis et al., 2008), there is a need for research that uses dimensional measures to assess the impact of environmental setting on affective responses to exercise. In line with past research using the circumplex model of affect (Backhouse et al., 2007; Ekkekakis et al., 2008), the single-item FS and FAS measures were used in the current study to assess valence and arousal during exercise, and the AD ACL was administered at pre- and post-exercise to measure changes in specific affective states.

With the exception of LaCaille et al. (2004), previous research (e.g., Focht, 2009; Harte & Eifert, 1995; Kerr et al., 2006) has compared outdoor exercise to exercising on a treadmill. This methodology does not control for the possibly confounding effects of overground movement. In one study, walking overground on an indoor track was associated with greater enjoyment and more favorable attitudes toward exercise than walking on a treadmill (Marsh et al., 2006). To strengthen the argument that it is the environmental surroundings, rather than the experience of walking overground, that explains the potential differences in affective responses to outdoor versus indoor exercise, participants in the current study were asked to exercise on an indoor track and outdoor path.

Furthermore, participants in past studies have typically been experienced runners or elite athletes (Bodin & Hartig, 2003; Kerr et al., 2006; LaCaille et al., 2004), who tend to use more associative strategies during exercise than novices or casual exercisers. There is a need to include participants who are not highly fit or who do not regularly exercise, as these people are more likely to use environmental stimuli as distractions from feelings of displeasure and fatigue. It is also important to identify factors that can make exercise more enjoyable for less active individuals, as increased enjoyment and positive affect during exercise may increase the likelihood that these individuals will adopt and adhere to an exercise program (Rose & Parfitt, 2007; Williams et al., 2008). Because past “green exercise” research has relied largely on self-selected samples of outdoor exercise groups who may have been biased towards preferring outdoor settings (e.g., Barton & Pretty, 2010; Mackay & Neill, 2010), a sample more representative of the general population was recruited.

The researcher chose to only recruit women for the current study. Because women tend to be less physically active and more prone to depression than men (Buckman & Dishworth, 2002), there is a need for research that provides insight into how to make exercise a more enjoyable and mood-enhancing experience for women. Because past research has suggested that women tend to be more influenced by the external surroundings during exercise than men (Butryn & Furst, 2003; Plante et al., 2006), it is particularly salient to measure the impact of environmental setting on affective responses to exercise among women.

There is an additional need for research that evaluates the effect of the environment on psychological responses to 30 minutes of moderate-intensity exercise, as this is the amount of exercise that is recommended by the ACSM for promotion of cardiovascular health and other health benefits (Haskell et al., 2007). Furthermore, exercising at 60% heart rate reserve has been associated with mood enhancement (Ekkekakis & Pettruzello, 1999). Exercise sessions in previous indoor vs. outdoor exercise studies have varied widely in duration and intensity- with participants walking at a self-selected pace for few as 10 minutes (Focht, 2009), running at a “relaxed pace” for as long as one hour (Bodin & Hartig, 2003), or for the length of time required to complete four miles (Butryn & Furst, 2003). Studies often have not controlled for intensity (e.g., Plante et al., 2006), but evidence suggests that participants may self-select a faster pace outside (Ceci & Hassmen, 1991; LaCaille et al., 2004). The current study used HR monitors to ensure that participants exercised at the prescribed (60-70% age-predicted maximum heart rate reserve, or HRmax) intensity across settings. By utilizing PA guidelines to inform the design of the current experimental conditions, the researcher intended to increase the meaningfulness and applicability of findings regarding the effect of exercise environment on affect.

Purpose and Hypothesis

The purpose of the current study was to determine if environmental setting has an effect on affective responses during and after an acute bout of exercise. To explore this main research question, affect was measured in line with the circumplex model of affect (Russell, 1980). The researcher administered single-item measures of affective valence (FS) and arousal (FAS) throughout the exercise session to measure the changes in affect that occured during exercise. A multiple-item dimensional measure of affect, the AD ACL, assessed pre- and post-exercise affective states. Of particular interest was whether individuals experienced more positive affect during outdoor exercise, as more positive experiences with exercise are associated with a greater likelihood that individuals will adopt and maintain a more physically active lifestyle (Focht et al., 2007; Kwan & Bryan, 2010; Williams et al., 2008). The effects of exercise setting on ratings of perceived exertion (RPE), attentional style, and perceived environmental restorativeness were also assessed. The specific research questions (RQ) and hypotheses (H) of the current study are as follows:

1. RQ: What is the effect of the environment on affective valence and arousal during and after exercise?

   H: Participants will report more positive affective valence and higher arousal levels during and after outdoor exercise than the indoor condition.

2. RQ: What is the effect of the environment on perceived exertion?

H: Participants will report lower ratings of perceived exertion during outdoor exercise than the indoor condition.

3. RQ: What is the effect of the environment on attentional style?

   H: Participants will report a more externally-focused, dissociative style of attention during outdoor exercise than indoor exercise.

4. RQ: To what extent do exercise environments differ in perceived restorativeness?

   H: Participants will perceive the outdoor condition to be more restorative than the indoor condition.

In addition to these main research questions, correlational analyses explored the relationships between affect, RPE, perceived environmental restorativeness, and attentional style. Affect is predicted to be positively related to perceived environmental restorativeness and an externally-focused, dissociative style of attention. RPE is expected to have an inverse relationship with affect, whereby lower levels of perceived exertion will be related to more positive affect. Furthermore, past research (Focht, 2009; Harte & Eifert, 1995) has suggested that an externally-focused, dissociative style distracts from feelings of over-exertion, thus leading to more positive affect.

An integration of these predicted relationships suggests that the outdoor exercise condition will be associated with a more dissociative style of attention, lower RPE, greater perceived restorativeness, and more pleasant affective states than the indoor environments.

CHAPTER II

REVIEW OF THE LITERATURE

Although the health benefits of an active lifestyle are widely known, 25% of U.S. adults do not engage in leisure-time physical activity (CDC, 2010). To address the increasing health care costs and negative physical and mental health outcomes associated with inactivity, a growing number of health initiatives and research efforts have been directed towards increasing physical activity. Researchers have become particularly interested in the variables underlying the mood enhancing effects of acute exercise, as manipulation of these variables may increase enjoyment of exercise and improve adherence (Ekkekakis, Hall, & Petruzzello, 2008; Focht, 2009; Williams et al., 2008). A growing number of studies have identified the exercise environment as one such variable, with researchers proposing that cognitive appraisals of the environment impact affective responses to acute exercise (e.g., Focht, 2009; Hartig, Evans, Jamner, Davis, & Garling, 2003; Pretty, Peacock, Sellens, & Griffin, 2005). While these researchers have demonstrated that post-exercise mood is more positive after exposure to natural environments than built environments, less is known about the effect of the environment on affect during exercise. The current literature review proposes that because affect during exercise is a better predictor of adherence than post-exercise mood states (Williams et al., 2008), there is a need for an ongoing investigation into the mechanisms underlying affective responses to outdoor exercise.

Harte and Eifert (1995) proposed that the environment impacts the emotional experience of exercise through various pathways of attention and cognitive processes. Researchers have studied the relationships between these constructs by comparing exercise within the built environment (such as urban and indoor settings) to exercise within the natural environment (such as parks and rural landscapes). The findings from these studies provide the foundational framework for the "green exercise" and "ecotherapy" research groups in the U.K. and Australia, who have garnered interest and funding from several government agencies and non-profit organizations (Maller, Townsend, Leger, Henderson-Wilson, & Pryor, 2008; Pretty, Griffin, Sellens, & Pretty, 2003). These groups advocate the use of “green exercise”, which includes outdoor exercise, conservation work, and wilderness therapy, as a modality for improving physical and mental health. Similarly, Shinrin-yoku (“forest bathing”) researchers in Japan advocate the health benefits of nature walks and the “taking in of nature” (Tsunetsugu et al., 2007). The current literature review draws upon the fields of environmental psychology and exercise psychology to explore the theoretical basis of “green exercise” research.

Prominent figures within environmental psychology, such as Wilson (1984), Ulrich (1984), and Kaplan (1995), have suggested that our society’s growing disconnect from nature has negatively impacted our quality of life. The fields of exercise and environmental psychology have both presented psycho-evolutionary theories suggesting that leading a sedentary lifestyle in a man-made, built environment violates our evolutionary makeup. For example, the anthropological hypothesis of stress suggests that our flight-or-fight response evolved during a time in which a high reactivity to stress was vital for survival (Sapolsky, 2004). Being physically active and easily aroused was adaptive to a lifestyle of hunting, gathering, and fleeing from predators. Today's urban environment is radically different from the natural environments of our ancestors, with empirical evidence suggesting that the human stress response is not equipped to effectively deal with a sedentary lifestyle and the modern stressors of work deadlines, urban commutes, large crowds, and other daily hassles (James, 1991). In 2005, Louv coined the term "nature deficit-disorder" to describe mental and physical health deficits related to decreased exposure to natural environments. Likewise, many proponents of the "green exercise" movement cite sociobiologist Wilson's biophilia hypothesis (1984) as further evidence that humans are genetically predisposed to live more active, nature-oriented lifestyles (Pretty et al., 2003). In *Biophilia,* Wilson proposed that humans instinctively prefer natural environments and possess "the innate tendency to focus on life and life-like processes" as a survival mechanism (1984, p.1). Similarly, Ulrich et al. (1991, p.208) presented a psycho-evolutionary theory of stress reduction in which humans have a "biologically prepared readiness" to automatically respond to natural, non-threatening stimuli with positive and restorative changes in emotion, arousal, and attention.

Although psycho-evolutionary theories provide fuel for fascinating discourse, they are difficult to examine with empirical methods. Researchers find support for relevant theories by studying more quantifiable phenomena, such as the impact of environmental factors and acute exercise on psychological constructs. Bahrke and

Morgan's distraction hypothesis (1978) provides a plausible explanation of green exercise’s psychological benefits. Bahrke and Morgan (1978) proposed that exercise reduces anxiety and stress by providing a “time-out” from daily hassles and worries, as evidenced by the finding that twenty minutes of walking on a treadmill, meditating, or quietly reading a magazine all resulted in significant reductions in state anxiety. However, because subsequent research has suggested that when compared to other “time-out” activities, exercise results in longer-lasting reductions in anxiety (Raglin & Morgan, 1987), many researchers have dismissed the distraction hypothesis as being overly simplistic. Although there are clearly additional factors influencing exercise’s effects on anxiety, the distraction hypothesis continues to guide and inform research questions. Within the context of green exercise research, the distraction hypothesis has seemingly been repackaged into more eco-friendly terms. More specifically, researchers have proposed that physical activity (PA) in an inherently fascinating, natural environment provides a break from the stress of an over-stimulating and mentally-fatiguing built environment (Kaplan, 1995; Ulrich et al., 1991).

Support for including “time away from stressors” as one of the mechanisms underlying affective responses to green exercise comes from attention restoration theory (ART; Kaplan, 1995). The basic tenets of ART can be traced back to the work of William James (1892), who presented the psychological concept of voluntary, directed attention. James (1892) contended that focusing one's attention toward something not inherently interesting requires a great deal of energy and effort. This ability to maintain focus and inhibit distractions is highly susceptible to mental fatigue, which can result in irritability and the overwhelming sense that one does not have the necessary resources to meet demands. Within the framework of Lazarus' (1966) model of stress, mental fatigue leads to perceived inability to cope with demands, which then leads to the experience of psychological stress (Kaplan, 1995). In order to recover from mental fatigue, ART proposes that one must engage in activity that only requires involuntary, effortless attention. Kaplan (1995) suggested that because humans have evolved a biophilic tendency to be inherently fascinated by nature, exposure to natural environments replenishes one's capacity for directed attention (Wilson, 1984). Conversely, built environments contain stressors, such as noise pollution and traffic, which result in mental fatigue and various disturbances in mood. These negative mental states have been aptly referred to under the umbrella terms of “nature deficit-disorder” and “technostress” (James, 1991; Louv, 2005; Brod, 1984). Although stress reduction and cognitive restoration can occur when viewing nature through pictures or window views, it appears as if being outdoors augments these benefits through increased vitality and altered states of consciousness (Berto, 2005; Felsten, 2009; Kjellgren & Burkall, 2010; Ryan et al., 2010). Kaplan (1995) suggested that in order for an environment to be perceived as restorative, it must have the following four characteristics: 1) provide a sense of being far away from daily hassles, 2) be effortlessly engaging, 3) encourage exploration and reflection, and 4) be compatible with one's needs.

Support for ART comes from studies that expose participants to stressors or cognitively fatiguing tasks and then measure the impact of natural and urban environments on restoration of cognitive performance (Kaplan & Berman, 2010). Hartig, Mang, and Evans (1991) randomly assigned participants to walk in a natural environment, walk in an urban environment, or quietly read a magazine in a room with relaxing music. Prior to participating in these 40 minute treatment conditions, participants completed the Stroop task and a binary classification task to induce attentional fatigue. Performance on a proofreading task at post-test was significantly higher among the participants who went on the nature walk. Furthermore, participants perceived the natural environment to be significantly more restorative than the urban and indoor environments. Cognitive performance was positively correlated with the participants' ratings of the environments' perceived restorativeness (Hartig et al., 1991). In a similar study, Hartig et al. (2003) found that while a 50-minute nature walk improved performance on an attention task (the Necker Cube Pattern Control task), an urban walk actually resulted in performance deficits. The nature walk was also related to more positive affect and decreased anger, whereas the urban walk had the opposite effect.

Kaplan’s (1995) proposal that one can be revitalized by attending to external stimuli in the environment appears to be related to Bahrke and Morgan's (1978) hypothesis that dissociative, externally-focused thoughts during acute bouts of exercise provide distraction from stressors. Similarly, research has found that dissociative thoughts during exercise are related to improved mood and lower rates of perceived exertion and exhaustion (Hardy & Rejeski, 1989)**.** Because higher rates of perceived exertion have been correlated with negative affect during exercise, it’s plausible that positive engagement with the external environment may help improve mood by providing a distraction from feelings of overexertion and negative arousal (Ekkekakis et al. 2008;

Focht, 2009; Rose & Parfitt, 2007). Blanchard, Rodgers, and Gauvin (2004) found that runners who reported engaging in mostly dissociative-external thoughts while running on an indoor track experienced significant increases in revitalization and decreases in exhaustion. If external focus during indoor exercise was associated with more positive improvements in mood, then it could be supposed that these improvements would be enhanced in an aesthetically pleasing outdoor environment. Furthermore, individual differences in affective response to exercise may be related to cognitive appraisals of the environment's restorativeness, regardless of whether exercise is conducted indoors or outdoors. To examine these hypotheses, Pretty et al. (2005) proposed that green exercise researchers should focus on the following levels of engagement with nature: (1) exercising outdoors, (2) exercising indoors while viewing nature through windows, paintings, or pictures, and (3) active engagement with nature (in activities such as gardening). The current literature review will limit its scope to acute exercise studies.

Indoor versus Outdoor Exercise Environments

To demonstrate the exercise environment's effect on mood, many researchers have utilized research designs that compare psychological responses to indoor vs. outdoor exercise. To further isolate the effects of the environment, researchers have chosen to control for exercise intensity and duration, which have both been implicated as factors in mood alteration (Ekkekakis & Petruzzello, 1999; Ekkekakis et al., 2008)**.** In one such paper, Kerr et al. (2006) presented findings from two within-subjects experiments that differed only in the participants' level of running expertise. While one study utilized data from recreational runners, the other study involved competitive runners from a university track team. Each participant ran 5 km on both a tree-lined footpath and on an indoor treadmill. During these runs, a heart rate (HR) monitor reminded the runners to remain at 60% heart rate reserve, which is a moderate intensity typically associated with mood enhancement (Ekkekakis & Pettruzello, 1999). Tension and effort were measured at pre-run and then again at 10 minutes post-run. Although it was found that, irrespective of skill level or setting, running was associated with positive changes in mood, the recreational group displayed significantly higher pride scores and the competitive runners had significantly higher tension and effort scores after the outdoor run. Although the author did not offer an in-depth interpretation of these findings, it's possible that because the track athletes had practiced and competed on the outdoor course, they may have associated the outdoor run with more competitive effort. Furthermore, the researchers suggested that the nonsignificant findings may be related to the fact that the participants in this study were experienced runners, a group that tends to utilize more associative-internal attentional focus, thus downplaying the potential impact of environment on mood (Kerr et al., 2006). However, because attentional style and cognitive appraisal of the environment were not assessed during this study, its conclusions are based more on assumptions than concrete evidence.

To examine the idea that the mood-enhancing effects of the exercise environment may be partly mediated by attentional style, researchers have utilized creative methodology to either manipulate or assess attentional processes during acute exercise. In Harte and Eifert's (1995) study, 10 male endurance athletes participated in four counterbalanced conditions: (1) 45 minute outdoor run on a college campus, (2) 45 minute indoor treadmill run with the external stimulation of listening to outdoor noises, (3) 45 minute indoor treadmill run with the internal stimulation of listening to one's heart beat through a microphone, and (4) 45 minutes of sitting in a room with a magazine. At pre- and post-test, participants filled out the Profile of Mood States (POMS; McNair, Lorr, Droppleman, 1971). At post-test, the participants also indicated their rate of perceived exertion (RPE; Borg, 1998), reported how much they "liked" the activity, and the directional focus of their attention during the activity. While the outdoor run positively affected mood, the two indoor runs actually negatively impacted mood. Furthermore, the outdoor course was reported as the preferred setting and was associated with a more external focus of attention and lower RPE. Conversely, the indoor run with internal stimulation (magnified heart beat) was associated with the highest RPE, lowest enjoyment, and most internally focused attention (Harte & Eifert, 1995). It was also found that the indoor, internally focused run resulted in significantly higher levels of noradrenaline and cortisol than the other conditions, indicating that this condition's negative impact on mood may have been related to physiological stress. Overall, this study demonstrated that the mood enhancing properties of running may be enhanced by being outdoors and having a more externally focused attentional style. This suggests that focusing on external cues in an outdoor environment can counteract the negative mood effects associated with intense exercise by providing a pleasant distraction from feelings of exertion (Hardy & Rejeski, 1989; Harte & Eifert, 1995).

LaCaille, Masters, and Heath (2004) built upon Harte and Eifert's (1995) work by including manipulation checks and the Thoughts During Running Scale (TDRS; Goode

& Roth, 1993) to evaluate compliance with the assigned associative or dissociative cognitive strategy. Recreational runners were randomly assigned to either an associative condition with a heart rate monitor or to a dissociative condition with music. For the associative condition, runners were asked to pay close attention to the HR monitor so they would be able to report their highest and lowest HR values after the run (LaCaille et al., 2004). Runners in the dissociative condition were asked to focus on the music so they would be able to report the number of songs that they listened to during the run. The runners used their assigned cognitive strategies during three different 5 km runs on a laboratory treadmill, indoor track, and on an outdoor route. Although they were not asked to run at a specific intensity, they were informed that their 5K time would be recorded. Immediately after each run, the participants completed the TDRS and reported their mood and satisfaction with the course. Although analyses revealed that the associative runners reported significantly more associative thoughts and the dissociative runners reported significantly more thoughts related to the external surroundings, it is interesting to note that the associative group still reported having dissociative thoughts related to daily events and interpersonal relationships. Irrespective of cognitive strategy, people ran significantly faster and reported significantly lower RPE after the outdoor and indoor track runs than the treadmill run. In addition, the outdoor run was associated with higher vitality, greater satisfaction, and significantly lower RPE than both of the indoor conditions. The authors suggested that the lack of a strong relationship between cognitive strategy, RPE, and mood indicates that attending to the HR monitor beeps during the associative condition may have provided a distraction from feelings of exertion (LaCaille et al., 2004). LaCaille et al. (2004) proposed that the runners would have had a more internalized focus of attention if they had been asked to pay attention to bodily sensations and keep their HRs within a certain range, rather than just noting the highest and lowest values. A major methodological limitation of this study was that it did not utilize pre-test measures to look at how cognitive strategy and running environment influenced mood over time. Research should measure pre-exercise mood states to not only better establish a causal relationship between exercise and affective change, but to statistically control for any baseline differences in mood across conditions.

Outdoor Exercise in Rural and Urban Environments

In addition to comparing indoor to outdoor exercise, researchers have also examined the impact of exercising in different types of outdoor environments. Environmental psychology researchers, such as James (1991), Ulrich (1984), and Kaplan and Berman (2010) have presented evidence that natural environments are more therapeutic and psychologically restorative than built, urban environments. In a study by Berman, Jonides, and Kaplan (2008), participants engaged in a mentally fatiguing task before going on two different 50-55 minute walks in either an arboretum or through a traffic-heavy downtown area. The nature walk was rated as being more restorative and refreshing, and was also related to significant improvements in positive mood and directed-attention performance on a backwards digit-span task. In a Japanese Shinrin-yoku ("forest bathing") study, participants were asked to walk for 15 minutes in a forest and in an urban area (Tsunetsugu et al., 2007). The forest walk resulted in significantly greater feelings of comfort, calmness, and refreshment, and was also associated with significantly lower levels of cortisol than the urban walk (Tsunetsugu et al., 2007). In a very similar study by the same researchers (Park et al., 2007), a 20-minute forest walk was found to be associated with significantly higher feelings of stress reduction and lower levels of cortisol and cerebral activity in the prefrontal area than an urban walk. Although these environmental studies (Berman et al., 2008; Park et al., 2007; Tsunetsugu et al., 2007) suggest that exposure to natural environments facilitates greater cognitive restoration and stress reduction than urban environments, they provide little insight into how more vigorous, health-enhancing exercise augments the psychological benefits of being in a natural setting.

Researchers with more exercise-specific research questions have utilized higher intensity exercise conditions to examine how different outdoor settings influence post-exercise mood. In a naturalistic study that surveyed 101 outdoor exercisers (including mountain bikers, kayakers, and trail runners) before and after they exercised in their regular training environments, it was found that participation in a single bout of self-selected outdoor exercise was related to significant reductions in anxiety and stress (Mackay & Neill, 2010). A Greenness Rating Scale was developed to examine whether the perceived naturalness of the exercise environment was related to the psychological outcomes of outdoor exercise. Analyses of these scores revealed that the greenest, or most natural, environments were related to the most significant decreases in anxiety. This study provides support for the distraction hypothesis and ART, and suggests that the psychological benefits of outdoor exercise are impacted by cognitive appraisals of the environment's naturalness. However, the authors acknowledged that the generalizability and meaningfulness of their findings are compromised by the use of self-selected outdoor exercise groups, not including a control condition, and using a self-developed, single-item scale to measure greenness (Mackay & Neill, 2010). Furthermore, this study did not control for the possible confounding effects of social interactions. Other studies (e.g., Bodin & Hartig, 2003) have addressed these limitations by using more tightly controlled experimental designs and more reliable measures of environmental restorativeness.

In Bodin and Hartig's (2003) study, experienced runners were asked to run at a relaxed pace for an hour on two different routes: a nature reserve and a route next to a busy road. Each runner ran the routes two times, for a total of four runs. Before and after each run, participants filled out the EFI (Gauvin & Rejeski, 1993), a measure of negative mood states, and completed a series of cognitive tasks. At five minutes post-run, runners also filled out the Perceived Restorativeness Scale (PRS; Hartig, Korpela, Evans, & Garling, 1997), which measures ART's four constructs of restorativeness: the sense of being away, fascination, extant, and compatibility with needs. Overall, the participants preferred running in the reserve, and rated the reserve as being more restorative than the urban route (Bodin & Hartig, 2003). There were significant decreases in anxiety, depression, and anger from pre- to post-run, regardless of the environmental setting. Also, irrespective of setting, participants actually demonstrated a large, significant decrease in cognitive performance post-run. However, because the cognitive tasks were administered only five minutes post-run, it is possible that residual arousal and exhaustion may be responsible for the observed decline in cognitive performance. Another limitation of this study was that the "urban" running route actually had a substantial amount of greenery and a relatively low density of buildings. It is possible that the researchers may have found significant differences in mood if they had compared the nature reserve to a more urban environment. Also, the researchers pointed out that the small sample (*n* = 12) was comprised of only experienced runners, a group that has been shown to be more internally focused and less affected by the external environment than recreational runners (Bodin & Hartig, 2003; Morgan & Pollock, 1977).

A few of the limitations of the Bodin and Hartig (2003) study have been addressed by Butryn and Furst (2003), who not only recruited a larger sample size of female recreational runners, but also asked runners to rate the “urbanness” or “naturalness” of the running environment (Butryn & Furst, 2003). Each runner ran four miles at a self-selected pace in two different settings: one route was on a highly vegetated trail through a park and the other route was alongside a busy road in an industrial area. Participants reported pre- and post-exercise mood with the EFI and Profile of Mood States (POMS; McNair et al., 1971). After each run, they also retrospectively reported their RPE and filled out the Thoughts During Running Scale (Goode & Roth, 1993). After their second run, the participants were asked about their preferred setting and the settings’ degree of “urbanness” and “naturalness” (Butryn & Furst, 2003). Results indicated that, regardless of setting, the runners’ mood was enhanced post-run. These findings are similar to Bodin and Hartig (2003), and suggest that individuals do not necessarily have to be in a rural environment to experience the positive mood effects of outdoor exercise. Although the park run was related to significant increases in tranquility, thoughts about the external surroundings were not related to positive mood change. The authors suggested that this could have been related to the women's anecdotal reports that they felt unsafe running by themselves in the more isolated park (Butryn & Furst, 2003). The authors suggested that future research could eliminate the confounding effects of feeling unsafe by presenting slides, videos, or virtual reality presentations of different outdoor settings to exercisers in a controlled lab environment (Butryn & Furst, 2003). This suggestion assumes that restorativeness is impacted mainly by visual processes, and downplays the restorative role of multisensory engagement that occurs in a complex environment.

Viewing Nature During Indoor Exercise

Butryn and Furst's (2003) recommendation to expose exercisers to different nature views during indoor exercise are reflected in the green exercise research of Pretty et al. (2005). In one particular study, participants walked for twenty minutes on a treadmill while viewing pictures of outdoor scenes that were either rural or urban and pleasant or unpleasant. Participants in a control group viewed a blank white screen as they walked. At pre-test, the researchers obtained physiological measures of resting heart rate and blood pressure (BP). Participants were then asked to fill out the POMS. These measures were repeated after the exercise bout. Regardless of treatment condition, walking resulted in significant decreases in BP and significant increases in vigor. However, only the participants who viewed the rural pleasant scenes displayed a significant decrease in all three BP measures. Conversely, urban scenes were related to slight increases in BP measures, suggesting that the urban views partially counteracted the positive effects of exercise. The results also indicated that pleasant scenes, regardless of whether they were urban or rural, were related to the largest decreases in tension and anxiety. The researchers interpreted these findings as indicators that the psychological benefits of green exercise can be realized in both urban and rural settings, as long as the settings are perceived to be pleasant (Pretty et al., 2005).

Although the Pretty et al. (2005) study suggests that merely viewing images of nature can positively impact mood, it seems presumptuous to generalize these findings to actual outdoor exercise. Looking at pictures walking on a treadmill does not adequately capture the cognitive and physical demands of navigating through crowds on a busy city sidewalk or traversing a stream during a trail run. In a more recent non-exercise study, Kjellgren and Burhall (2010) utilized both quantitative and qualitative measures to compare the restorativeness of viewing nature pictures to actually being immersed in nature. Although both conditions were related to stress reduction and enhanced mood, participants who viewed pictures of nature reported feelings of restlessness and longing to actually be in nature. The researchers suggested that viewing pictures of nature lacks the sensory stimulation and revitalizing effects of being outdoors. Although this study neither involved exercise nor included a control condition, it serves as a reminder to researchers that the multisensory experience of being in nature cannot be perfectly replicated in a laboratory setting.

The distinction between viewing and engaging with nature during exercise is demonstrated in Plante, Cage, Clements, and Stover’s (2006) study, which expanded upon the slide show methods of Pretty et al. (2005) by utilizing a virtual reality presentation to simulate an outdoor walk. Participants were randomly assigned to one of three conditions: a 20-minute outdoor walk on an aesthetically pleasing course around a college campus, a virtual reality presentation of the same outdoor walk while walking on a treadmill, or a 20-minute seated viewing of the virtual reality presentation (Plante et al., 2006). At pre- and post-exercise, participants filled out the Activation-Deactivation Adjective Check List Short Form (AD-ACL; Thayer, 1986) and the Physical Activity Enjoyment Scale (PACES; Kendzierski & DeCarlo, 1991)**.** At post-test, participants in all three conditions experienced significant reductions in tension. However, the indoor virtual reality walk was related to significantly lower levels of tension than the other groups. The outdoor walk was reported to be significantly more enjoyable than the other conditions and was also related to significantly higher levels of energy than the non-exercise virtual reality condition. These outdoor exercise effects were much more pronounced in the female participants, which the researchers interpreted as evidence that females may be more sensitive to environmental factors than males (Plante et al., 2006). Although the researchers did not offer much explanation for this gender difference, it seems plausible that because the females were less calm than the males at pre-test, they may have had a greater need for restoration. Plante et al. (2006) interpreted their findings as evidence that while walking outdoors increases energy and vitality, walking indoors with a virtual reality presentation of a natural setting promotes relaxation. These findings support Kjellgren and Burhall's (2010) observation that being immersed in nature is more revitalizing than merely viewing pictures.

Green Exercise Meta-Analysis

The mood-enhancing benefits of outdoor exercise have been summarized in a meta-analysis of 10 green exercise studies (Barton & Pretty, 2010). All of these studies utilized the POMS and Rosenberg Self-Esteem Scale (Rosenberg, 1979) to measure mood and self-esteem pre- and post-exercise. The reviewed studies were conducted in several diverse natural settings (e.g., farmland, forests, and water fronts) and with a wide range of physical activities (e.g., cycling, horseback riding, walking, and farming). Furthermore, the duration of the activities ranged from as little as five minutes to as long as an entire day, and the exercise intensity ranged from light to vigorous (>3 METS to >6 METS). Barton and Pretty calculated that, overall, these green exercise activities had moderate effect sizes for mood (d = .54) and self-esteem (d = .46). They concluded that the largest mood benefits came from light and vigorous activity and from activities that lasted only 5 minutes.

Although this meta-analysis suggests that even short bouts of outdoor exercise can have mental health benefits, the findings should be interpreted cautiously. First of all, the number of reviewed studies is small (n = 10) and limited to studies conducted by the green exercise research group. Although Barton and Pretty (2010) stated that the meta-analysis represents no conflicts of interest, the fact that they are two of the primary researchers in the green exercise group suggests potential biases. Other limitations of the reviewed studies were that they did not include control conditions (such as exercising in a non-green environment or being sedentary in a green environment), did not utilize randomization, and did not control for the possible confounding effects of social interactions. Many of the activities included social engagement and environmental conservation work, which may have had a greater influence on mood and self-esteem than the actual exercise stimulus. Another limitation is that the participants self-selected participation in green exercise; these people may have been outdoor enthusiasts who had pre-existing expectations regarding the "feel good" properties of outdoor exercise. Furthermore, improvement in mood was quantified as reductions in the Total Mood Disturbance score of the POMS. Research within the field of exercise psychology has suggested that the POMS, a categorical measure of mood originally designed for clinical populations, is not an appropriate measure for assessing exercise-related changes in mood and affect (Ekkekakis et al., 2008). Although this meta-analysis provides support for the benefits of green exercise (Barton & Pretty, 2010), there is a need for research that uses randomized, controlled methods to examine the mechanisms underlying the mood-enhancing effects of green exercise.

New Research Directions

Green exercise research has borrowed key concepts from environmental psychology and exercise psychology to propose that outdoor environments enhance the positive mood-altering properties of acute exercise (Pretty et al., 2005). The synergistic benefits of green exercise have been repeatedly demonstrated in studies that compare exercise in natural outdoor environments to exercise in indoor or urban environments (e.g., Butryn & Furst, 2003; Kerr et al., 2006; LaCaille et al., 2004). Furthermore, the positive impact of "greenness" on mood has been demonstrated in exercisers who merely view pictures or videos of outdoor environments (Pretty et al., 2005; Plante et al., 2006). The proposed mechanisms for this relationship involve a complex interplay of exercise setting, attentional processes, and cognitive appraisal (Harte & Eifert, 1995). Our current understanding of this complex and dynamic interaction is informed by the central tenets of attention restoration theory (Kaplan, 1995), stress reduction theory (Ulrich et al., 1991), Bahrke and Morgan's (1978) distraction/”time-out” hypothesis, and Morgan and Pollock's (1977) early work on attentional style. An in-depth look at past research reveals that the mood enhancing effects of outdoor exercise may be attributed, in part, to the perceived restorativeness of exercise environments and the distraction that these environments provide from feelings of exhaustion and fatigue (Berman et al., 2008; Bodin & Hartig, 2003; Harte & Eifert, 1995).

To better understand the mechanisms underlying these processes, future green exercise research must address the methodological limitations of past research. In order for this field to grow, researchers need to utilize research designs and measures that are informed by the most recent advances in exercise psychology. Many of the limitations of the currently reviewed studies stem from how the researchers chose to measure affect. Many of the researchers utilized the POMS (Barton & Pretty, 2010; Butryn & Furst, 2003; Harte & Eifert, 1995), which has been criticized for its overemphasis on negative mood states. Furthermore, because the POMS was not designed to measure exercise-specific mood states, researchers have suggested that it may not be appropriate for assessing exercise-induced changes in mood (Ekkekakis et al., 2008). Although exercise-specific mood inventories, such as the EFI, more accurately measure the unique mood states typically associated with acute exercise, these categorical measures are limited in their scope. Because categorical measures consist of a limited number of discrete items, they cannot capture the entire breadth of affective states that occur during exercise. These limitations have been addressed by utilizing the circumplex model of affect (Russell, 1980), which proposes that basic affect is comprised of two bipolar dimensions: valence (pleasure-displeasure) and perceived activation (high-low). Different combinations of these dimensions represent the basic affective states underlying more specific emotions, such as excitement, tension, fatigue, or calmness (Ekkekakis et al., 2008).

Because the reviewed studies only assessed pre- and post-exercise mood states, they do not provide adequate insight into the affective changes that occur during exercise. As demonstrated by research with the circumplex model (Backhouse et al., 2007; Ekkekakis et al., 2008; Focht, 2009), only measuring mood before and after exercise ignores the fluctuating affective changes that may occur during exercise. These studies have directly challenged past interpretations of the relationship between exercise and mood, which assumed that mood improved in a linear fashion during exercise. The reviewed green exercise studies utilized multiple-item measures like the POMS, EFI, and AD-ACL to assess specific pre- and post-exercise mood states, but these measures are not practical for measuring affect throughout exercise. To repeatedly administer these multiple-item measures during exercise would not only be too time-consuming, but would potentially provide too much distraction from the external surroundings (which is an integral element of green exercise). Backhouse et al. (2007), Ekkekakis et al. (2008), and Focht (2009) have addressed this issue by administering single-item scales of affective valence (Feeling Scale; Hardy & Rejeski, 1989) and perceived activation (Felt Arousal Scale; Svebak & Murgatroyd, 1985) at timed intervals throughout an exercise bout. Although perhaps not as specific or reliable as multiple-item measures, these measures allow the researchers to track changes in affect throughout exercise. Multiple-item, dimensional measures of affect, such as the AD ACL, can be administered at time points pre- and post-exercise to augment use of the FS and FAS (Ekkekakis et al., 2008). Because affect during acute exercise has been found to be more predictive of adherence than post-exercise mood states (Williams et al., 2008), it appears that green exercise researchers could increase the meaningfulness of their results if they could demonstrate that affect is more positive during outdoor than during indoor exercise.

Ekkekakis et al. (2008) proposed that when exercising at intensities lower than ventilatory threshold, individual differences in affective responses are largely mediated by cognitive appraisal of the exercise stimulus. At exercise intensities above ventilatory threshold, strong interoceptive cues seem to overwhelm these individual differences, causing exercisers to more negatively interpret their arousal and to engage in more associative, internally-focused thinking. Similarly, Rose and Parfitt (2007) found that inter-individual differences in affective responses during exercise were mediated by the participants' interpretations of intensity and their attentional focus. As previously suggested by Blanchard et al. (2004), engaging in dissociative, externally-focused thoughts during exercise may help improve affect by distracting exercisers from negative interoceptive cues. Furthermore, there is evidence that outdoor exercise may increase vitality and decrease exhaustion by facilitating dissociative thinking, as demonstrated by the tendency of participants to report lower RPE and to self-select higher exercise intensities during outdoor exercise than during indoor exercise (Ceci & Hassmen, 1991; LaCaille et al., 2004). Because these cognitive processes are taking place during the course of exercise, researchers would be better able to detect the relationship between affect and attentional focus if they measured affective valence and arousal during acute exercise.

Further support for utilizing dimensional measures of affect in green exercise research comes from Focht's (2009) study comparing the effects of different settings on enjoyment and affective responses to a brief exercise bout. Focht (2009) utilized a counterbalanced repeated measures design; each participant walked for ten minutes at a self-selected pace on an indoor treadmill and on an outdoor path. The FS and FAS measures were used detect changes in basic affect, and the EFI was used to assess changes in categorical affective states. Participants responded to these items before, midway through, immediately following, and then 10 minutes after the walk. When compared to walking on a treadmill, walking outdoors was associated with significantly more pleasant affective states, greater enjoyment, higher revitalization, more positive engagement, and greater intention to engage in similar bouts of exercise. Focht (2009) proposed that the wider array of external sensory cues in the outdoor environment may have distracted the exercisers from task related thoughts, which supports the tenets of ART (Kaplan, 1995) and the distraction hypothesis (Bahrke & Morgan, 1978).

One limitation of Focht (2009) was that it utilized a convenience sample of young, active women. There is a need for research that examines how sedentary or less active individuals experience exercise in different settings, as these are the people who will be targeted in physical activity interventions. Research has suggested that sedentary individuals who experience negative affect and fatigue during exercise have decreased self-efficacy for exercise, which may discourage them from adopting a more physically active lifestyle (Focht, Knapp, Gavin, Raedeke, & Hickner, 2007). Future research could examine whether less active individuals have more positive affect and lower levels of perceived exertion during outdoor exercise, as these constructs have implications for self-efficacy and adherence to regular physical activity (Kwan & Bryan, 2010; Williams et al., 2008). Furthermore, the results of Focht (2009) cannot be generalized to higher intensity or lengthier exercise bouts. Because current PA guidelines (Haskell et al., 2007) recommend at least five bouts of 30 minutes of moderate intensity (60-70% of maximum heart rate reserve) PA per week, future research should structure exercise conditions in accordance with these guidelines.

Another limitation of Focht (2009) and the majority of studies that compare indoor to outdoor exercise (e.g., LaCaille et al., 2004; Plante et al., 2006), is that researchers often do not assess participants' perceptions of the exercise environment's restorative qualities. Future research should utilize the Perceived Restorativeness Scale (PRS; Hartig et al., 1997) to assess how the perceived restorativeness of the exercise environment is related to affective experiences during exercise. Past research has demonstrated that people assign higher PRS ratings to outdoor settings that have greenery, water, and scenic qualities, and that these PRS ratings are positively correlated with positive affect (Korpela & Hartig, 1996). Support for utilizing the PRS within an exercise context comes from the Hug, Hartig, Hansmann, Seeland, & Hornung (2009) finding that the frequency of exercise in a particular exercise setting is strongly predicted by its perceived restorativeness.

To better isolate the effects of the environment, researchers should also control for the possible confounding effects of overground exercise. Traditionally, studies have compared outdoor walking/running to exercise on a treadmill (e.g., Focht, 2009; Kerr et al., 2004; LaCaille et al., 2004). However, Marsh et al. (2006) found that walking overground on an indoor track resulted in more favorable attitudes towards exercise, faster walking speeds, and higher levels of enjoyment than walking on a treadmill. This finding suggests that merely walking through space is more enjoyable than walking in place, regardless of the "naturalness" of the environment. To strengthen the argument that the benefits of green exercise come from being immersed in natural stimuli, researchers should measure affect and perceived environmental restorativeness of overground exercise in various settings (e.g., indoor track vs. outdoor path).

The recent advocacy of green exercise by health organizations in the U.K. and Australia (Maller et al., 2008) indicates that this is a growing field with exciting research directions and meaningful applications. The relatively young research area of green exercise transcends narrowly defined research disciplines, as evidenced by the enriching contributions of environmental psychology and exercise psychology. Although findings have suggested that the psychological benefits of exercise are enhanced by exposure to natural environments, researchers need to utilize more empirically-sound research designs to study the relationship between exercise environment and affect. Findings from these studies could provide insight into how to design parks and gym settings to maximize enjoyment of exercise and to encourage long-term participation in physical activity. Strong scientific evidence in support of green exercise may convince health practitioners to include information on the added health benefits of being outdoors when prescribing exercise to their patients (Maas & Verheij, 2007). Future interdisciplinary efforts are required to better understand the underlying mechanisms of green exercise and its potential to impact physical, psychological, and environmental health outcomes.

CHAPTER III

METHODS

The main purpose of this study was to research the impact of environmental setting on the affective responses that occurred throughout a bout of moderate-intensity exercise. More specifically, the researcher examined the influence of indoor and outdoor environments on affective valence, felt arousal, dimensional affect, RPE, attentional style, and perceived environmental restorativeness.

With the exception of Focht (2009), past research has been focused solely on how the exercise environment influences post-exercise mood states, thus ignoring the affective changes that occur during exercise. Ekkakakis et al. (2008) suggested that in addition to evaluating distinct affective states pre- and post-exercise, researchers should also measure the most basic elements of affect (valence and arousal) with single-item measures during exercise. This methodology is informed by the circumplex model of affect (Russell, 1980), and is intended to capture the full breadth of affective responses that occur in response to exercise. For the current study, the researcher utilized dimensional measures of affect to assess the first research question of whether the environment (indoor vs. outdoor) has an impact on affective valence and arousal during exercise, in addition to the changes in specific affective states that occur from pre- to post-exercise.

The second research question to be addressed was whether the exercise environment would have an effect on ratings of perceived exertion (RPE; Borg, 1998) during exercise. Previous research suggested that RPE is lower during outdoor exercise than during indoor exercise (Ceci & Hassmen, 1991; Harte & Eifert, 1995; LaCaille et al., 2004). This line of thinking led to the next research question, which was whether certain exercise environments encourage the use of certain attentional styles. Outdoor exercise had been theorized to encourage a more externally-focused, dissociative attentional style, which has been theorized to distract exercisers from feelings of over-exertion, thus resulting in more positively valenced affect and mood (Focht, 2009; Harte & Eifert, 1995).

The final research question was in regard to whether outdoor and indoor exercise environments would differ in ratings of perceived restorativeness. Kaplan and Berman (2010) presented substantial evidence to propose that outdoor environments are more restorative than indoor environments, but it is still unclear whether exercisers perceive outdoor exercise to be more restorative than indoor exercise, or whether the perceived restorativeness of these environments augments the mood-enhancing properties of exercise (e.g., Butryn & Furst, 2003; Focht, 2009).

For the current study, the researcher utilized dimensional measures of affect to examine the impact of outdoor and indoor environments on affective responses throughout exercise. The researcher assessed attentional focus (association, dissociation, and distress), RPE, and perceived environmental restorativeness, which were hypothesized to be related to affective responses to moderate-intensity exercise.

Design

The current study featured a repeated measures experimental design, with participants jogging/walking in two exercise conditions: an indoor track and outdoor path. Exercise was performed at a moderate intensity (60-70% of age-predicted maximum heart rate: HRmax) for 30 minutes, with the majority of participants engaging in a brisk walk. This intensity and duration is in accordance with ACSM guidelines for health-enhancing physical activity (PA; Haskell et al., 2007). As mentioned previously, past researchers have typically compared indoor treadmill exercise to outdoor overground exercise (e.g., Focht, 2009; Harte & Eifert, 1995, Plante et al., 2006). To control for the potentially confounding effects of overground movement, an indoor track was used for the indoor condition. This 188-meter track in the student recreation center is suspended above three recreational basketball courts. The track features railings on the inner border and is surrounded by cardiovascular equipment and windows on two of the walls. The windows provide views of a busy street, houses, a softball field, and trees. The track was most crowded during the evening time, with intramural sport activities and a greater number of walkers/joggers on the track. Physical activity classes utilized the courts during the morning hours. For the outdoor condition, participants jogged/walked on the Irwin Belk recreation track, a 636-meter paved path that loops around a well-maintained golf course and recreational basketball and volleyball courts. The path is lined with large trees and grass, runs alongside a stream for roughly 200 meters, and features hilly sections. Trees and vegetation shield the path from nearby roads, and the sounds of traffic are complemented by chirping birds. During the morning hours, nearby fields were utilized by various physical activity classes for soccer and handball. During the afternoon and early evening, the area was busy with soccer practices, pick-up basketball and volleyball games, and walkers/joggers.

The outdoor path was of a greater distance than the indoor track and featured changes in incline, thus the two conditions were not entirely similar in terms of repetition in movement and scenery. However, because each participant exercised in each setting around the same time of day, they were exposed to similar amounts of social activity across conditions. The researcher took careful field notes on each setting's crowdedness, amount of social activity, and climate conditions. Data collection took place from late September to mid-November. The indoor track area was kept at a temperature of 72 degrees Fahrenheit and 50% humidity. During the outdoor exercise sessions, the weather was typically mostly sunny and the average temperature was 63 degrees Fahrenheit and 53% humidity.

Although the repeated measures design was expected to minimize individual differences in baseline measures across conditions, the non-independent nature of the design was anticipated to create possible response biases. To address possible order effects, the exercise conditions were presented in two counterbalanced, randomized orders: AB and BA (A = Indoor, B = Outdoor). Assignment to each order group was determined by flipping a coin. Although no outdoor sessions were cancelled due to inclement weather, there were two instances in which participants were re-assigned to the AB group because there was bad weather during their first scheduled sessions. Each order group ended up with an equal number of participants ($n = 13$).

Participants

A pilot study was conducted to determine feasibility of the recruitment and data collection methods. A power analysis with an alpha value of .05 and expectation of a moderate effect size (*d* = .50) yielded a suggested sample size of *n* = 30. A sample of 26 young adult women, ages 18 - 26, (*M* = 20.5, *SD* = 2.05), was recruited from the University of North Carolina at Greensboro (UNCG), a public, coeducational university with an enrollment of over 18,000 students. UNCG is an ethnically diverse campus, with ethnic minorities comprising 33% of the student population. The current sample reflected this diversity: 57.7% (*n* = 15) were White/Caucasian, 34.6% (*n* = 9) Black/African-American, 3.8% (*n* = 1) Asian/Pacific-Islander, and 3.8% (*n* = 1) Hispanic/Latina.

For the purposes of this study, the researcher recruited women who accrued less than one hour of vigorous intensity cardiovascular exercise per day, five to seven times per week (a.k.a., ≤ 300 minutes of vigorous PA per week). This eligibility criteria was intended to screen out endurance athletes, as these individuals tend to engage in a more associative-style of attention (Kerr et al., 2006). Furthermore, although sedentary and inactive individuals were not specifically recruited, exploratory analyses were utilized to see if self-reported PA levels were related to how participants responded to indoor vs. outdoor exercise.

Variables and Measures

The researcher collected data using self-report measures to assess participant's (a) affect, (b) perceived exertion, (c) perceived restorativeness of the exercise environment,

(d) frequency of associative and dissociative attentional styles and distressing thoughts during exercise, (e) ratings of perceived environmental restorativeness and (e) independent and comparative appraisals of the two exercise environments. Copies of these measures can be found in Appendix A.

Background characteristics. Baseline PA levels and health status were measured with the *Leisure Time Exercise Questionnaire* (LTEQ; Godin & Shephard, 1985) and the *Physical Activity Readiness Questionnaire* (PAR-Q; Thomas, Reading, & Shephard, 1992). The PAR-Q assessed the participants' health status and ensured that they could safely participate in the study. The LTEQ, a valid and reliable PA recall questionnaire, provided an estimate of the participants' average number of minutes of strenuous, moderate, and light intensity PA per week. The number of sessions reported at each intensity levels were entered into an equation to calculate average metabolic equivalent units (METs) expended per week. Additional questions asked participants to list their current outdoor activities, how many times per week they engaged in these outdoor activities, and the settings they typically chose for exercise.

Affect. Affect is a feeling state that is influenced by bodily sensations, cognitive appraisals, and/or instrumental responses. Throughout the exercise conditions, affect was measured in accordance with the dimensional properties of the circumplex model of affect (Russell, 1980). The circumplex posits that affect is composed of two basic, bi-polar dimensions: activation (ranging from high to low arousal) and valence (ranging from pleasure to displeasure). These basic components of affect can be examined separately (as in the current study) or can be combined to yield an orthogonal model with pleasure/displeasure forming the x-axis and activation forming the y-axis (as demonstrated in the work of Ekkekakis et al., 2008; Backhouse et al., 2007). Past studies have utilized the FS (Hardy & Rejeski, 1989) and FAS (Svebak & Murgatroyd, 1985), which are valid, single-item measures, to assess arousal and activation throughout a bout of exercise. These studies have demonstrated that affect changes in a non-linear fashion during exercise, which supports the importance of periodically measuring affect throughout exercise (Backhouse et al., 2007; Ekkekakis et al., 2008). The AD ACL (Thayer, 1989), a multiple-item measure of affect that fits within the circumplex model, has also been utilized to demonstrate changes in specific feeling states from pre- to post-exercise (Ekkekakis et al., 2005; 2008). Looking at both the basic elements of affect and the more distinct feeling states enables the researcher to examine the breadth of affective experience. In the current study, the FS and FAS were used to measure the two dimensions of affect during exercise, and the AD ACL was used to measure specific affective states before and after exercise.

The *Feeling Scale* (FS; Hardy & Rejeski, 1989) is a single-item, 11 point scale that assesses the degree to which participants are experiencing the bipolar dimensions of affective valence (pleasure-displeasure). Responses range from -5 = Very Bad to + 5 = Very Good. The FS has been found to have adequate convergent and discriminatory validity (Backhouse et al., 2007) and has been found to be highly correlated with multiple-item measures of affect (r = .41-.88; Ekkekakis et al., 2008). Furthermore, FS ratings have been found to be significantly correlated ($p < .05$) to the following physiological responses to exercise: HR, ventilation, respiratory rate, and VO_2 (r = - .70,

- .65, - .62, and - .69, respectively; Hardy & Rejeski, 1989).

The *Felt Arousal Scale* of the Telic State Measure (FAS; Svebak & Murgatroyd, 1985) is a single-item, 6 point scale that measures perceived activation. Responses range from 1 = Low Arousal to 6 = High Arousal. The FAS has satisfactory convergent and discriminatory validity (Backhouse et al., 2007) and is correlated with multiple-item measures of arousal (r = .45-.60; Ekkekakis et al., 2008).

The *Activation Deactivation Adjective Check List* (AD ACL; Thayer, 1989) was used to measure more specific feeling states that correspond with the dimensional properties of the circumplex model. This 20-item questionnaire measures momentary mood states associated with the bipolar dimensions of Energetic Arousal (EA; ranging from Energy to Tiredness) and Tense Arousal (TA; ranging from Tension to Calmness). These items have been found to tap the quadrants of the circumplex model (Ekkekakis et al., 2005). The AD ACL's reliability and validity has been established in studies by Thayer (1978, 1986) and Ekkakakis et al. (2005, 2008). Thayer (1978) found high test-retest reliability for the AD ACL, with coefficients for the subscales ranging from .79 to .93. When conducting pilot research for the current study, participants repeatedly expressed confusion over the items “clutched-up” and “placid”. The researcher replaced these items with the more widely used synonyms “anxious” and “relaxed”. Within the current sample, inter-item reliability for the four subscales varied across administration time points, with Energy ranging from (α = .55 - .84), Calmness (α = .52 - .84), Tiredness (α = .81-.89), and Tension (α = -.31-.78). The negative Cronbach’s alpha for the Tension subscale suggests that the added item, “anxious”, was not correlated with the other subscale items after outdoor exercise. The Tension items “fearful” and “intense” were especially problematic for this sample of college students, which mirrors past concerns regarding the appropriateness of these items (Ekkekakis et al., 2005; 2008).

Perceived exertion. For this study, perceived effort during exercise was measured with RPE (Borg, 1998). This 15-point scale is widely used within exercise studies. The scale ranges from 6 = No Exertion to 20 = Maximal Exertion.

Attentional style. Attentional style was assessed with the 31-item *Attentional Focus Questionnaire* (AFQ; Brewer, Van Raalte, & Linder, 1996), a valid and reliable measure of Association (11 items- eg., “Monitoring specific body sensations”), Dissociation (12 items- e.g., “Focusing on the outside environment”), and Distress (7 items- e.g., “Wishing the run/walk would end”). Participants were asked to indicate on a 7-point scale (ranging from 1 = *I did not do this at all* to 7 = *I did this all the time*) how often they engaged in the respective attentional behavior during exercise. The Cronbach’s alpha for the AFQ’s subscales have been previously reported as .79 and .66 for Association, .77 and .66 for Dissociation, and .85 and .88 for Distress (Brewer et al., 1996). In Brewer et al. (1996), Association was positively related to performance on an endurance task ($r = .37$), while Distress was significantly related to RPE ($r = .40$), pain ($r = .58$), and FS (r = - .56). Cronbach’s alphas for the AFQ subscales in the current study ranged from .80-.83 for Association, .48-.63 for Dissociation, and .44-.82 for Distress.

Perceived restorativeness of environment. The restorativeness of the two exercise settings was assessed with the *Perceived Restorativeness Scale* (PRS; Hartig et al., 1997). This 16-item scale measures the four constructs of environmental restorativeness proposed by attention restoration theory (Kaplan, 1995): Being Away (2 items), Fascination (5 items), Coherence (4 items), and Compatibility (5 items). For each item, participants indicated on a 7-point scale (ranging from 0 = Not At All to 6 = Completely) the degree to which the item fit their perception of the current exercise environment. Bodin and Hartig (2003) reported adequate reliability of the PRS, with Cronbach's alphas ranging from .68 in an urban environment to .81 in a park setting When developing and assessing the validity and reliability of the PRS within various settings and populations, Hartig et al. (1997) found that the subscales had high internal consistency (Cronbach's alphas > .75), and that the PRS in its entirety was both valid and sensitive to meaningful differences between environmental settings. Within the current study, inter-item reliabilities for the PRS subscales were: Sense of Being Away (α = .86-.88), Fascination (α = .82-.93), Coherence (α = .72-88), and Compatibility (α = .86-.92). Cronbach's alphas for the PRS' total score ranged from .85 in the laboratory setting to .89 in the outdoor setting and .92 in the indoor setting,

Appraisal of environments. The researcher created a 5-item *Evaluation of Exercise Setting* that asked participants to rate each session's degree of pleasantness, comfort, refreshment, and enjoyment on an 11-point scale (ranging from 0 = *Not At All* to 10 = *Very*). Participants were also asked to indicate how much they "liked" exercising in the respective setting.

An 8-item *Reflection Questionnaire* was created to assess participant's comparative appraisals of the two exercise environments. This measure was administered after the final exercise session. Participants were asked to reflect back on their experiences in the two settings and indicate which environment was the most pleasant, comfortable, refreshing, and enjoyable. They indicated which environment most positively impacted their performance, which environment they preferred, and which environment they would choose for a hypothetical fourth exercise session. Participants also wrote a few sentences about why they preferred one setting over the other.

Procedures

The data collection and recruitment procedures were approved by UNCG's Institutional Review Board. Participants were recruited via flyers placed at various locations on the UNCG campus, such as the student union, classroom buildings, and the student recreation center. The primary researcher also visited classes within the Kinesiology and Public Health Education departments to directly recruit individuals. Recruitment materials specified that women who were currently engaging in more than one hour of vigorous intensity aerobic exercise (e.g., running, biking) per day, 5-7 days per week, were not eligible for participation. Women who expressed interest were contacted to schedule times to come in for an intake/familiarization session and two experimental sessions. Participants were given a $10 gift card to a grocery store upon completion of the study.

Familiarization session. At the beginning of the intake/familiarization session, participants read and signed an IRB-approved informed consent form (see Appendix B). Each participant filled out the demographic questionnaire (age, gender, race/ethnicity) and answered questions from the LTEQ and PAR-Q.

Each participant was outfitted with a Polar heart rate monitor and asked to sit quietly for 5 minutes. At this time, the researcher recorded the participant's resting heart rate and entered the participant's age into the HR monitor to calculate the target HR range corresponding to 60-70% the participant's age-adjusted maximum HR (220-age = HRmax). The HR monitor was programmed to beep when the participant's HR fell outside the targeted range during exercise. The participants then filled out or responded to the AD ACL, FS, and FAS measures of affect. After filling out these pre-exercise measures, participants engaged in a 15-minute exercise session on a laboratory treadmill to become familiarized with the study protocol. To better simulate the physical demands of walking overground, the treadmill was set at a 1% incline (Jones & Doust, 1996). After the participant had warmed up for 2 minutes at 2.5 MPH, the researcher gradually increased the speed of the treadmill until the participant's HR was within the targeted HR range; the speed was then adjusted as needed throughout the 15-minute walk/jog. The average treadmill speed was 3.9 MPH- a brisk walk. Participants were instructed to pay attention to their pace on the treadmill, as this was similar to the pace that they would need to maintain during the experimental sessions. During the exercise bout, the participants were asked to report HR and RPE, and responded to the FS and FAS measures at three different time points: 5 minutes, 10 minutes, and then immediately after the 15-minute walk/jog. For ease of data collection, the researcher held up posters of the RPE, FS, and FAS measures; participants verbalized their responses and/or pointed to the appropriately numbered response. Participants reported an average RPE of 11.5 and an average HR of 131 (67% of the sample's average HRmax). The speed of the treadmill was then lowered for a 2 minute cool-down period. After the cool-down, participants relaxed in a quiet room for 8 minutes. At 10 minutes post-exercise, participants filled out and responded to the affective measures (FS, FAS, and AD ACL) and the Attentional Focus Questionnaire (AFQ), Perceived Restorativeness Scale (PRS), and the Evaluation of Exercise Setting. This order of questionnaire administration was maintained throughout the study. This familiarization protocol introduced the participants to the HR monitor and procedures of the experimental sessions, which was intended to minimize possible testing effects.

Experimental Sessions. Participants came in for two additional experimental sessions within a two-week period. There was a minimum of 24 hours between each session to allow recovery from any potential fatigue. Each participant exercised during the same time of day for each session (no more than 2 hours difference). All of the experimental exercise sessions lasted 30 minutes and were performed at a moderate intensity (60-70% of age-adjusted max HR), which is in accordance with the guidelines for health-enhancing PA from the ACSM and CDC (Haskell et al., 2007; Pate et al., 1995). Participants reported outside the Exercise Physiology lab for every session. To control for possible expectancy effects, they were not informed of the order that the environmental conditions would be presented, and were told that they may participate in both settings or in only one setting. Participants were instructed to bring their student identification card (for entry into the recreation center) and weather-appropriate clothing to both sessions.

Prior to each exercise session, participants were fitted with a HR monitor and were asked to rest for 5 minutes in a quiet room in the sport psychology laboratory to establish baseline HR. At the end of this 5 minute period, the participants filled out the AD ACL and responded to the FS and FAS items. The participant then warmed-up for exercise by walking to the respective environmental condition (indoor track or outdoor path). Because the outdoor path was further away from the lab than the indoor track, the participants walked a lap around the indoor track to complete their warm-up. With this modification, both warm-ups were roughly 310 meters, which took participants roughly four and a half minutes to complete. The researcher started a timer once the participant turned on the target HR function of the HR monitor and began the official exercise session. Participants were reminded to maintain a steady pace and to make sure that the HR monitor did not beep. Participants were asked to report the HR displayed on their monitor's watch face and responded to prompts assessing FS, FAS, and RPE at 10 minute intervals throughout the 30-minute exercise bout (at minutes 10, 20, and 30). The researcher chose not to do these assessments more frequently, as this would have distracted the exerciser from their surroundings and the overall exercise experience. The researcher moved to various locations on the courses to present the FS, FAS, and RPE items at the appropriate time points and asked the participants to either verbally respond or point to the responses that best described their current state. Because the participants briefly slowed down their walk/jog to respond to the items, the researcher asked them to report their HR first.

After completing their respective exercise bouts, the participants walked back to the sport psychology lab (4-5 minutes), where they drank water and relaxed for an additional 5 minutes. At the end of this period, they reported their HR and filled out the

FS, FAS, and AD ACL. They were also asked to fill out the PRS to rate the restorativeness of the respective exercise environment, the AFQ measure to retrospectively report their focus of attention during the exercise bout, and the Evaluation of Exercise Setting to rate the various qualities of the setting. After the final exercise session, participants were additionally asked to reflect back on both experimental conditions to respond to the items on the Reflection Questionnaire.

Data Analysis

Descriptive analyses of sample demographics (age, ethnic background, average minutes of PA per week, typical exercise setting, frequency of participation in outdoor physical activities, resting HR, average HR during exercise bout) were utilized to create a profile of the participants. The researcher performed ANOVAs of baseline characteristics and familiarization session data to ensure that there were no significant differences between the orders (AB and BA) at baseline.

To address the first research question regarding the effect of exercise setting on affective valence and arousal throughout exercise, 2 (Order) X 2 (Setting: indoor track and outdoor path) X 5 (Time: pre-, 10, 20, 30, and 10 min post) repeated-measures ANOVAs were conducted to assess between-setting differences in FS and FAS scores. The effect of setting on AD ACL scores was assessed with a 2 (order) X 2 (setting) X 2 (time: pre- and 10 min. post-exercise) repeated-measures ANOVA.

The second research question regarding the effect of setting on RPE was addressed with a 2 (order) X 2 (exercise setting) X 3 (time: 10, 20, 30) repeated-measures ANOVA. 2(Order) X 2 (Setting) repeated measures ANOVAs addressed the third and fourth research questions regarding the effect of the exercise setting on attentional style and perceived restorativeness.

Additional 2 (Order) X 2 (Setting) ANOVAs compared the ratings of each setting's pleasantness, comfort, refreshment, and enjoyment, and Chi-square analyses were used to determine which setting the participants preferred. Participant’s written explanations of setting preference were coded for dominant themes.

Exploratory analyses assessed the hypothesized relationship between the main outcome variables and affective responses to outdoor exercise. Pearson's correlation analyses were run with data from the outdoor exercise sessions to determine if post-exercise affect (FS, FAS, AD ACL) was related to perceived restorativeness, RPE, and attentional style. Additional exploratory analyses examined the possible relationship between baseline PA levels (as measured by the Godin LTEQ) and psychological responses to exercise. Exploratory 2 (METS) X 2 (Order) X 2 (Setting) X 5 (Time) ANOVAs were conducted to determine whether affective responses to indoor and outdoor exercise differed as a function of participants’ classification as being insufficiently (“less”) active (< 35 METS/wk) or sufficiently (“more”) active ($\geq$ 35 METS/wk).

CHAPTER IV

RESULTS

A series of data analyses were run via SPSS software to address the primary research questions regarding the hypothesized between-setting differences in psychological responses to exercise. Repeated measures ANOVAs and MANOVAs with order as a between-subjects factor were used to test differences in outcome variables as a function of time, setting, and order. Although the two settings were presented in a counterbalanced order, order was included as a between-subjects factor to detect possible order effects. To address the main research question concerning differences in affective responses to indoor and outdoor exercise, ANOVAs were run for FS, FAS, and a MANOVA was run for the four AD ACL subscales (Energy, Tiredness, Calmness, and Tension). Additional analyses investigated the effect of the two settings on perceived exertion (RPE), attentional style (AFQ), and perceived environmental restorativeness (PRS). Bivariate correlation analyses were used to detect relationships between these main outcome variables.

Secondary analyses used ANOVAs to detect between-setting differences in participants' responses to the Evaluation of Exercise Setting, which was filled out after each exercise session to rate each setting's pleasantness, comfort, refreshment, enjoyment, and "likeability". Additionally, participants were asked to indicate which setting was most enjoyable, refreshing, preferred, etc. on the Reflection Questionnaire.

Chi-square analyses were used to compare the frequencies of responses. Open-ended responses to the question, “Why did you prefer this setting?” were coded for dominant themes. Additional analyses stratified participants into two groups, “more active” or “less active”, based on self-reported METS on the LTEQ, and compared their affective responses to the two exercise settings.

Baseline Characteristics/Familiarization Session

Participants self-reported their participation in strenuous, moderate, and mild PA on the Godin LTEQ (see Table 1). While analysis of the LTEQ confirmed that participants met the inclusion criteria of engaging in no more than 300 minutes of strenuous PA per week, it should be noted that two of the participants (7.7%) reported 300 minutes of strenuous PA. These women were allowed to participate because their strenuous PA came from basketball and fitness classes, such as weight training and conditioning, which are not endurance activities. Although the overall sample mean for LTEQ METS per week was 39.71, ten of the participants (38.5%) reported expending less than 35 LTEQ METS per week, which is considered to be insufficiently active (Garcia, Bengoechea, Spence, & McGannon, 2005). Five of the 26 participants (19%) did not meet current recommendations for health-enhancing PA (defined as being moderately active for at least 150 minutes or vigorously active for at least 60 minutes per week; Haskell et al., 2007), and 26.9% (n = 7) of the sample reported no strenuous PA. The most commonly reported activities were running, walking, and using cardiovascular machines. Twenty-two of the participants (85%) reported that they usually exercised indoors, and although 16 participants (61%) reported engaging in at least some outdoor exercise, ten participants (39%) reported that they never exercised outside. While most participants typically exercised in the student recreation center (65%) and/or in other gym settings (35%), six participants (23%) reported that they also exercised in outdoor parks. The most commonly reported outdoor activities were running (19%) and walking (19%).

A series of ANOVAs confirmed that there were no significant differences in baseline characteristics between the two order groups (AB and BA) at baseline (see Table 2).

Responses to familiarization session. Although the primary function of the familarization session was to introduce participants to the study protocol and to practice using HR monitors to maintain a moderate pace, data analyses were run to ensure that there were no between-group differences in pre-exercise affect and psychological responses to the familiarization session's 15 minutes of treadmill exercise. A series of repeated measures ANOVAs with order as a between-subjects factor confirmed that there were no significant differences between the two order groups (AB and BA) in baseline measures of affect (see Table 3), nor were there significant between-group differences in post-exercise affect, attentional style (AFQ subscales), or perceived restorativeness (PRS) of the laboratory setting (see Table 4). Descriptive statistics for RPE, AFQ and PRS for the familiarization session are provided in Table 5.

To ensure that there were no between-group (AB vs. BA) differences in affective responses to exercise over time within the familiarization session, the researcher ran separate 2 (Order) X 5 (Time: Pre-, 5, 10, 15, Post) repeated measures ANOVAs for FS and FAS. There were no significant differences in FS or FAS as a function of order group, nor was there a significant Order X Time interaction. There was a significant main effect for time, with both FS, $F(3.20, 79.26) = 2.81$, $p = .05$, and FAS, $F(4, 96) = 17.04$, $p < .001$, increasing over time. There were nonsignificant changes in FS during exercise, with a significant increase in FS after cessation of exercise, $F(1, 24) = 7.45$, $p = .012$. Post-exercise levels of FS were significantly higher than baseline FS, $F(1, 24) = 6.75$, $p = .016$. FAS increased significantly from baseline to minute 5, $F(1, 24) = 22.10$, $p < .001$, and from minute 5 to minute 10 of exercise, $F(1,24) = 10.17$, $p = .004$, but dropped significantly at 10 minutes post-exercise, $F(1, 24) = 15.81$, $p = .001$, to levels that were still significantly higher than baseline, $F(1,24) = 6.88$, $p = .015$ (see Figure 1).

A 2 (Order) X 2 (Time: Pre- and Post-) MANOVA for the 4 subscales of the AD ACL (Energy, Tiredness, Calmness, Tension) revealed a main effect for time, $F(4, 20) = 6.92$, $p = .001$. There was no order effect, nor was there an Order X Time interaction. Follow-up ANOVAs showed a significant increase in Energy, $F(1, 23) = 24.35$, $p < .001$, and decrease in Calmness, $F(1, 23) = 61.22$, $p = .002$, from pre- to post-exercise. There were nonsignificant decreases in Tension and Tiredness over time (see Table 6).

Experimental Sessions

Setting characteristics. During each experimental session, the researcher took careful field notes on a number of variables, such as each setting's crowdedness, amount of social activity, and climate conditions. T-tests confirmed that there were no significant differences in the number of bystanders, meters travelled, humidity, or average HR between the two experimental settings (descriptive statistics provided in Table 7). However, temperature tended to be significantly cooler in the outdoor setting, $t(1, 25) =$

5.75, $p < .001$. Follow-up correlational analyses found that temperature was not significantly related to affect or any other outcome variables, however, there was a significant and negative relationship between humidity and self-reported enjoyment of the outdoor setting, ($r = -.40$, $p = .045$). The average HR reported in each setting fell within the targeted HR zone of 60-70% HRmax for this age group.

What is the effect of environment on affect during and after exercise? Before conducting ANOVAs to test for the impact of time and setting on affective responses to exercise, t-tests confirmed that measures of pre-exercise affect (FS, FAS, and AD ACL) were not significantly different between the two settings.

FS. A 2 (Order: AB and BA) X 2 (Setting: Indoor and Outdoor) X 5 (Time: pre-, min 10, min 20, min 30, and 10 min post) ANOVA for FS found a significant change in scores as a function of time, $F(1.9, 46.1) = 7.1$, $p = .002$, $\eta^2 = .23$, with FS becoming more positive during exercise in both settings (see Table 8 and Figure 2). Follow-up repeated measures contrasts of successive time points indicated that the largest increases in FS occurred from pre-exercise to min 10, $F(1, 24) =$, $p = .003$, $\eta^2 = .32$, and from min 20 to min 30 of exercise, $F(1, 24) = 5.60$, $p = .026$, $\eta^2 =.19$. Although there were no significant differences in scores as a function of setting, $F(1, 24) = 3.17$, $p = .088$, $\eta^2 =$ .12, there was a trend in which FS scores were higher in the outdoor setting. There were no significant order effects, nor were there significant interactions between time, setting, and/or order.

FAS. A 2 (Order) X 2 (Setting) X 5 (Time) ANOVA for FAS revealed a significant change in FAS scores as a function of time, $F(2.29, 55.02) = 21.65$, $p < .001$,

η^2 =.48, with felt arousal increasing throughout exercise (see Table 9 and Figure 3). Repeated measures contrasts indicated that there were significant increases in FAS from pre-exercise to minute 10, $F(1, 24) = 32.60$, $p < .001$, $\eta^2 = .58$, and from min 20 to min 30, $F(1, 24) = 4.41$, $p = .046$, $\eta^2 = .16$. There was a significant decrease in FAS from min 30 to 10 min post-exercise, $F(1, 24) = 11.66$, $p = .002$, $\eta^2 = .33$, but post-exercise FAS remained significantly higher than baseline levels, $F(1, 24) = 22.42$, $p < .001$, $\eta^2 = .48$. There were no significant interaction effects or main effects for setting or order, however, the outdoor session caused greater increases in FAS scores from pre-exercise to min 10 of exercise (mean increase of 1.3) than the indoor session (mean increase of 0.88).

AD ACL. A repeated measures 2 (Order) X 2 (Setting) X 2 (Time: pre- and post-exercise) MANOVA for the 4 subscales of the AD ACL (Calmness, Energy, Tiredness, and Tension) revealed no significant differences as a function of setting or order, nor were there any significant interactions between time, setting, and/or order. There was a significant main effect for time, $F(4, 21) = 4.72$, $p = .007$, with follow-up ANOVAs revealing significant increases in Energy, $F(1, 24) = 15.79$, $p = .001$, $\eta^2 = .40$, and decreases in Tiredness, $F(1, 24) = 11.58$, $p = .002$, $\eta^2 = .33$, from pre- to post-exercise (refer to Table 10). There were no significant changes in Calmness $F(1, 24) = .81$, $p = .38$, $\eta^2 = .03$, or Tension, $F(1, 24) = .83$, $p = .37$, $\eta^2 = .03$, as a function of time.

What is the effect of environment on perceived exertion (RPE)? A 2 (Order) X 2 (Setting) X 3 (Time: 10, 20, 30) repeated-measures ANOVA for RPE found significant main effects for setting, $F(1, 24) = 17.56$, $p < .001$, $\eta^2 = .42$, and time, $F(2, 40.2) = 11.21$, $p < .001$, $\eta^2 = .32$. There was not a significant order effect, nor were there significant interactions between time, setting, and/or order. Contrary to the hypothesis, RPE was significantly higher during outdoor exercise than indoor exercise (see Table 11). To follow up the significant main effect for time, repeated measures contrasts compared RPE at min 10 to min 20, and then from min 20 to min 30. Although RPE increased over time, the only significant increases occurred from min 10 to min 20 of exercise, $F(1, 24) = 10.53$, $p = .003$, $\eta^2 = .31$.

What is the effect of the environment on attentional style? A 2 (Order) X 2 (Setting) repeated measures MANOVA for the 3 AFQ subscales (Association, Dissociation, and Distress) revealed a significant main effect for setting, $F(3, 22) = 29.78$, $p < .001$, $\eta^2 = .80$, and a significant Setting X Order interaction, $F(3, 22) = 5.75$, $p = .005$, $\eta^2 = .44$ (see Figure 4). There were no significant main effects for order. Follow-up ANOVAs indicated that there were significant differences in Distress scores as a function of setting, $F(1, 24) = 87.06$, $p < .001$, $\eta^2 = .78$, with participants reporting significantly less distressing thoughts during outdoor exercise than indoor exercise (see Table 12). There was a significant Setting X Order interaction for Association, $F(1, 24) = 13.90$, $p = .001$, $\eta^2 = .37$, whereby participants used an associative style of attention significantly more during their first experimental session, especially if they were indoors for their first session (AB group). A nonsignificant Setting X Order interaction was also observed for Dissociation, $F(1, 24) = 3.61$, $p = .07$, $\eta^2 = .13$, in which participants tended to use dissociation more during the second session, especially if they were outdoors for the second session.

To what extent do exercise environments differ in perceived restorativeness? A 2 (Order) X 2 (Setting) repeated measures ANOVA revealed a significant difference in PRS scores as a function of setting, $F(1, 24) = 9.68$, $p = .005$, $\eta^2 = .29$. The outdoor condition was associated with higher perceived restorativeness ($M = 62.08$, $SD = 13.30$) than the indoor condition ($M = 50.23$, $SD = 16.54$). There were no significant interactions or order effects.

Exploratory Analyses

Evaluation of exercise setting. After each exercise session, participants were asked to rate the respective setting on a number of characteristics. A 2 (Order) X 2 (Setting) repeated measures MANOVA of the setting evaluation revealed that there was a significant main effect for setting, $F(5, 20) = 4.40$, $p = .007$, $\eta^2 = .52$, but no significant main effect for order. There was also a significant Order X Setting interaction, $F(5, 20) = 3.82$, $p = .014$, $\eta^2 = .49$. Follow-up ANOVAs of the main effect for setting found that the outdoor condition was rated as being significantly more pleasant, $F(1, 24) = 18.45$, $p < .001$, $\eta^2 = .44$, comfortable, $F(1, 24) = 9.48$, $p = .005$, $\eta^2 = .28$, refreshing, $F(1, 24) = 23.69$, $p < .001$, $\eta^2 = .50$, enjoyable, $F(1,24) = 15.56$, $p = .001$, $\eta^2 = .39$, and "likeable", $F(1, 24) = 13.16$, $p = .001$, $\eta^2 = .35$, than the indoor condition (see Table 13). Follow-up ANOVAs of the Setting X Order interaction found that there were no significant differences in the individual item ratings as a function of a Setting X Order interaction.

Reflection questionnaire. Participants made comparative appraisals of the two settings after completing their final session. Chi-square analyses detected significant differences in the frequency with which participants chose "indoor" or "outdoor" as their answer choice for the Reflection Questionnaire items (refer to Table 14).

The majority of participants (92%) indicated that the outdoor condition was both the most pleasant and the most enjoyable setting. Nineteen of the participants (73%) reported that the outdoor condition had the most positive impact on their performance, with 77% of participants indicating that they would choose the outdoor setting over the indoor setting for future exercise. Although participants were almost equally as likely to report that the indoor setting was the most comfortable setting (42% vs. 58%), all 26 participants (100%) indicated that the outdoor setting was the most refreshing. Furthermore, most of the participants (85%) preferred the outdoor setting. Open-ended responses to the question, “Why did you prefer this setting?” were coded for themes, with fresh air, variety in terrain and scenery, and being in nature emerging as common reasons for preferring the outdoor setting. Three participants stated that the natural scenery distracted them from thinking about exercise. Participants also stated that the outdoor path was more open and less crowded than the indoor track, with one participant stating that she liked “being able to work out and not feel intimidated by others exercising.” Conversely, one participant stated that she liked the indoor track because she felt motivated by the other exercisers. Of the four participants who preferred the indoor track, three cited that they liked being able to monitor time, pace, and distance in the more controlled and predictable environment. A complete list of open-ended responses can be found in Appendix E.

Relationships between affect, attentional style, and perceived restorativeness. Bivariate correlation analyses were run to examine the hypothesized relationships between post-exercise measures of affect (FS, FAS, AD ACL), attentional focus (AFQ), ratings of perceived exertion (RPE), and perceived environmental restorativeness (PRS) during outdoor exercise. Exploratory analyses were conducted to see if these responses were related to the degree to which the participants perceived the outdoor environment to be pleasant, comfortable, refreshing enjoyable, and likeable (Evaluation of Exercise Setting). Significant and notable relationships are discussed below, with a corresponding table provided in Table 15.

FS after outdoor exercise was positively related to Energy, $r = .65$, $p < .001$, and Association, $r = .55$, $p = .004$, and was negatively related to Tiredness, $r = -.43$ $p = .029$ (see Table 16). FS during exercise was not significantly related to RPE. Post-exercise FAS was positively related to Energy, $r = .62$, $p = .001$, Dissociation, $r = .40$, $p = .041$, and the outdoor path's rating of "refreshment", $r = .58$, $p = .002$. There were no significant relationships between affective responses and the PRS, however the PRS was negatively related to Distress, $r = -.55$, $p = .004$, indicating that higher PRS scores were related to significantly less distressing thoughts in the outdoor setting. Additionally, higher Distress scores were related to greater use of Association, $r = .45$, $p = .022$, and to lower ratings of pleasantness, $r = -.58$, $p = .002$, comfort, $r = -.64$, $p < .001$, refreshment, $r = -.49$, $p = .012$, and enjoyment, $r = -.54$, $p = .005$, of the outdoor path. These correlational results suggest that distressing thoughts during outdoor exercise were related to less positive appraisals of the environment. Greater use of association during outdoor exercise was related to higher Distress scores and to more positive post-exercise affective valence. Possible explanations for these seemingly contradictory findings are examined in the Discussion section. Furthermore, the positive relationships between FAS, Energy, Dissociation, and the "refreshing" rating of the outdoor environment indicate that focusing on the environment during outdoor exercise has an energizing effect.

Relationships between baseline PA and affective responses. Additional exploratory analyses examined the potential relationships between participants' self-reported PA at baseline and their psychological responses to exercise within the two settings. Bivariate correlation analyses revealed that LTEQ METS were significantly and positively related to FS at min 20, $r = .47$, $p = .015$, and min 30, $r = .43$, $p = .029$, of indoor exercise. These relationships suggest that more active participants experienced more positive increases in affective valence during indoor exercise than their less active counterparts. METS were also somewhat related to FS during outdoor exercise, but these associations did not reach significance. METS were positively related to the perceived restorativeness of the outdoor setting, $r = .50$, $p = .01$, indicating that the more active participants rated the path as being more restorative than less active participants. Futhermore, there was a negative relationship between METS and Distress within the outdoor condition, $r = -.43$, $p = .029$, suggesting that less active participants reported more distressing thoughts during outdoor exercise than their more active counterparts.

Based on these observed relationships, exploratory ANOVAs for both FS and FAS were conducted to determine whether affective responses to indoor and outdoor exercise differed as a function of participants' classification as being "less active" (< 35 METS/wk) or "more active" ($\geq$ 35 METS/wk).

FS. A 2 (METS: Less Active vs. More Active) X 2 (Order) X 2 (Setting) X 5 (Time) ANOVA for FS revealed significant main effects for setting, $F(1, 22) = 7.06$, $p = .014$, $\eta^2 = .24$, time, $F(2.13, 46.91) = 8.45$, $p = .001$, $\eta^2 = .28$, and METS group $F(1, 22) = 4.30$, $p = .05$, $\eta^2 = .16$. Pairwise comparisons indicated that, overall, FS was more positive in the outdoor setting, FS increased significantly over time, and FS was more positive among the participants who reported being more active at baseline (see Table 16 for complete descriptive statistics). Of greater interest is that there was a significant difference in FS scores as a function of a METS X Setting interaction, $F(1, 22) = 7.06$, $p = .014$, $\eta^2 = .24$, with less active participants reporting higher FS scores in the outdoor setting ($M = 3.42$, $SD = 1.74$) than in the indoor setting ($M = 2.44$, $SD = 1.19$) (refer to Figure 5). More active participants, on the other hand, had similar overall FS scores in the indoor ($M = 3.65$, $SD = 1.37$) and outdoor ($M = 3.65$, $SD = 0.87$) settings, suggesting that setting did not matter for the affect of these more active participants (Figure 5).

There was also a significant METS X Order X Setting interaction, $F(1, 22) = 4.42$, $p = .047$, $\eta^2 = .17$, indicating that among less active participants, the differences in outdoor vs. indoor FS scores were significantly greater if they were in the AB group than if they were in the BA group. Therefore, although less active participants had more positive FS scores during outdoor exercise than during indoor exercise, these differences were larger if they were outdoors for the second session (see Figure 6). The more physically active group did not experience a significant difference in FS scores as a function of Order or an Order X Setting interaction.

Although there was not a significant METS X Setting X Time interaction effect for FS, $F(4, 88) = 1.59$, $p = .185$, $\eta^2 = .07$, there was a trend in which less active participants' FS scores increased from min 10 to min 20 of outdoor exercise, ($M = 3.20$ to $M = 3.60$), but decreased from min 10 to min 20 of indoor exercise ($M = 2.60$ to $M = 2.10$) (see Figure 7).

FAS. A 2 X 2 X 2 X 5 repeated measures ANOVA for FAS revealed a significant main effect for time, $F(2.36, 57.48) = 21.62$, $p < .001$, $\eta^2 = .50$, but no other significant interaction effects or main effects for setting, order, and/or METS (shown in Table 17).

CHAPTER V

DISCUSSION

Past research has suggested that environmental setting can influence enjoyment and post-exercise mood (Barton & Pretty, 2010; Focht, 2009), but findings have been inconsistent and often do not explore the environment's impact on affect during exercise. Because affect during exercise is a better predictor of adherence than post-exercise mood states (Williams et al., 2008), the main purpose of the current study was to compare the impact of indoor vs. outdoor settings on affective responses throughout a 30-minute bout of moderate-intensity exercise. Additional research questions examined the impact of environmental setting on: ratings of perceived exertion (RPE), attentional focus, and perceived environmental restorativeness. It was hypothesized that outdoor exercise would result in more positive affect, lower RPE, higher use of dissociative attentional strategies, and greater perceived environmental restorativeness than indoor exercise. Exploratory analyses examined the relationships between post-exercise affect, attentional style, and evaluations of the outdoor environment (e.g., perceived restorativeness, pleasantness, enjoyment). Additional analyses evaluated the impact of baseline PA level on affective responses to the two exercise settings.

Affect

Within the current study, 30 minutes of moderate-intensity exercise had a revitalizing effect, regardless of setting, as indicated by positive increases in affective valence (pleasure), felt arousal (perceived activation), and energy. The largest increases in pleasure and activation occurred during the first ten minutes of exercise and from minute 20 to minute 30. Participants also reported feeling significantly less tired after exercise in both settings. The main hypothesis regarding the greater mood-enhancing effects of outdoor exercise was partially supported, as evidenced by a trend in which affective valence was more positive during outdoor exercise. There was also a greater increase in felt arousal during the first ten minutes of outdoor exercise compared to indoor exercise, suggesting that brief exposure to the outdoors can boost the energizing properties of exercise. These findings are in line with the Plante et al. (2006) observation that a brief outdoor walk resulted in greater vitality and energy than treadmill exercise. Similarly, Focht (2009) and Barton and Pretty (2010) suggested that outdoor settings can enhance exercise-induced increases in pleasure, perceived activation, and positive mood in as little as five minutes.

In regard to the current study, the lack of significant between-setting differences in affect may be due in part to the use of an indoor track condition instead of a laboratory treadmill condition. Past research has almost exclusively focused on comparing treadmill exercise in a laboratory setting to outdoor exercise (e.g., Focht, 2009; Harte & Eifert, 1995; Kerr et al., 2006), with the exception of Lacaille et al. (2004). An indoor track was intentionally chosen for the current study to improve the ecological validity (i.e., making comparisons across two commonly used exercise settings), and to control for the possibly confounding effects of overground movement. Because overground movement on an indoor track has been shown to be more enjoyable than treadmill exercise (Marsh et al., 2006), the use of two overground conditions improved the ability to conclude that it was the experience of being outdoors, and not simply moving overground in an environment with visual distractions, that was responsible for the trend in which affective responses were more positive during outdoor exercise. The presence of windows in the indoor track condition may have reduced between-setting differences, as there is the possibility that participants could have experienced some of the restorative benefits of nature by looking out the windows (Ulrich, 1984).

Attentional Style

Based on attention restoration theory (Kaplan, 1995) and research on attentional focus during exercise (Ceci & Hassmen, 1991; LaCaille et al., 2004), it was hypothesized that the natural stimuli within the outdoor environment would encourage a more dissociative style of attention that would distract exercisers from feelings of fatigue and overexertion- thus leading to lower ratings of perceived exertion (RPE). Although analyses did not find direct support for these hypotheses, there were other significant findings that merit discussion. Participants' responses on the AFQ indicated that although they engaged in similar levels of dissociation and association in both settings, they had significantly less distressing thoughts (e.g., "Wishing the run/walk would end.") during outdoor exercise. Open-ended responses suggested that distress during indoor exercise may have been related to the indoor track's crowdedness and repetitiveness. Participants completed an average of 15 laps on the indoor track, compared to only 4.5 laps on the outdoor path. One participant stated, "…it was the same circle over and over again, which got a little boring for a 30 min. walk/jog." Conversely, one participant stated that she preferred the outdoor setting because "There were many things to look at and enjoy. A lot of the scenery outdoors will take my mind off of exercise." Even though there was no support for the hypothesis regarding between-setting differences in the use of dissociation, the finding that there were less distressing thoughts during outdoor exercise may have greater implications for future intervention research, since distress during exercise would presumably play a role in a person's decision/ability to adhere to an exercise program.

Further analysis of AFQ responses revealed that participants engaged in significantly more association during their first experimental session, especially if they were indoors for their first session (AB). Furthermore, there was also a trend in which dissociation was slightly higher in the second session if participants were outdoors for their second session (AB). Anecdotally, the experimenter observed that the participants grew more comfortable with maintaining their target pace over the course of the study, and thus were able to dissociate more and focus less on internal sensations as the study progressed. This observation suggests that the familiarization session on the treadmill may not have adequately prepared participants to efficiently self-select and maintain a pace within the target HR zone (60-70% HRmax) while walking overground. Because the incline of the treadmill was set to 1% to mimic overground movement on a flat surface (Jones & Doust, 1996), it did not prepare the participants to adjust their speed to navigate the inclines of the outdoor path. Furthermore, only a few of the participants reported prior experience with HR monitors.

Although the use of HR monitors ensured that intensity was similar across conditions, attending to the beeps of the monitor may have encouraged participants to engage in a more associative style of attention (LaCaille et al., 2004) and may have caused them to have higher RPE because they were more aware of increases in HR. However, the finding that AB participants used association more during their first session than BA participants suggests that their attentional style was impacted by factors other than just attending to the HR monitor. It could be that AB participants were more internally focused during their first session because the novel experience of monitoring HR and pace for an exercise study was intensified by the repetitiveness of the indoor track. Participants may have focused more on the HR monitor because there were not as many external distractions within the indoor track setting. Furthermore, because many (65%) of the participants reported that they worked out in the student recreation center regularly, their familiarity with the setting may have made them even less likely to be interested in their external surroundings. It could also be that participants appreciated the natural scenery and the variety in terrain of the outdoor path even more if they were able to compare it to the previous indoor session, thus suggesting that attentional style can be impacted by prior exercise experiences in different environments. Future research can address these order effects by incorporating familiarization sessions that take place within the respective experimental conditions and by using settings that are similarly novel and unfamiliar to the participants.

Perceived Exertion

Although exercise was performed at a similar intensity in both settings (60-70% HRmax), RPE was significantly higher during outdoor exercise than during indoor exercise. This unanticipated finding most likely reflects the presence of hills in the outdoor condition, as many of the participants had to slow their paces while going uphill to stay within their target HR zone. However, even though outdoor exercise resulted in higher RPE, participants experienced less distress and had somewhat more positive affect during outdoor exercise. This sample of young, moderately active women appeared to enjoy the additional challenges of the outdoor path's hills, as suggested by their self-reported enjoyment of variety in terrain. To better isolate the effects of being indoors vs. outdoors on RPE, future research should make an effort to utilize paths/tracks that are more similar in distance and terrain.

Perceived Restorativeness and Setting Evaluations

As expected, participants perceived the outdoor setting to be more restorative than the indoor setting, and rated it as being more refreshing, pleasant, and enjoyable. Most of the participants (85%) stated that they preferred the outdoor setting, and would choose this setting for a future exercise session. Reasons given for preferring the outdoor setting included: fresh air, sun, openness, scenery to look at, variety in terrain, enjoyment of nature, and less repetition than the indoor track. Conversely, the four participants who preferred the indoor setting stated that they felt motivated by other exercisers and that their performance was positively impacted by being in a more controlled and predictable environment.

Participants' responses regarding distractions appeared to be contradictory, with one participant stating that, "I feel like I could stay more focused if I were running indoors. When I was outside, my mind was prone to wonder a lot faster because of the different things going on", whereas another participant stated that "I preferred the track because it was easier for me to keep the same pace and it had more stuff going on around me to keep me from being bored." These results suggest that exercisers' evaluations of exercise settings are influenced by the goals and outcome expectations that they have for exercise. Whereas the indoor track may have been more compatible with performance goals, the outdoor path appeared to be more compatible with the goal of stress relief or enjoyment, as evidenced by statements such as, "There was more to look at, it provided natural inclines and the track was easier to walk on. The fresh air allowed me to breathe easier and let my mind wander away from exercise and stress." These qualitative findings suggest that future research may focus on differences in exercisers' outcome expectations for indoor and outdoor exercise.

Exploratory Findings and Implications for Future Research

The hypothesized relationships between attentional style, affect, and perceived restorativeness were informed by attention restoration theory's (Kaplan, 1995) assertion that restoration and revitalization are facilitated by attending to natural stimuli. In the current study, participants who reported greater use of dissociation during outdoor exercise also reported higher levels of post-exercise arousal. There was also a trend in which the perceived restorativeness of the outdoor path was positively related to the use of dissociation, suggesting that participants were more likely to attend to the environment if they perceived it to have restorative qualities. Contrary to what was expected, the perceived environmental restorativeness of the outdoor setting was not related to post-exercise affect. Furthermore, although there was a positive relationship between felt arousal and the outdoor path's "refreshing" quality, there were no other significant correlations between FS or FAS and other evaluations of the outdoor setting. However, it was found that post-exercise energy (as measured by the AD ACL) was positively related to the outdoor setting's ratings of pleasantness, comfort, and refreshment. This suggests that positive appraisals of the exercise environment can enhance the energizing effects of exercise. Furthermore, self-reported frequency of distressing thoughts was inversely related to perceived restorativeness and positive appraisals of the exercise setting. Together, these findings reinforce the importance of measuring participants' perceptions, cognitive appraisals, and individual preferences for exercise settings, as these factors may mediate how the environment impacts affective responses.

There was an unanticipated finding in which the use of association during outdoor exercise was not only related to a higher frequency of distressing thoughts, but was also associated with more positive post-exercise affect and energy. Furthermore, participants who reported more distress during outdoor exercise perceived the environment to be less restorative and enjoyable. These findings suggest that participants who experienced distress while exercising outdoors may have been overly focused on the increases in HR and effort that occurred while walking up hill, and perhaps experienced more positive post-exercise affect and energy because they were relieved and/or proud to have completed the session. Although these explanations are purely speculative and anecdotal in nature, past research has demonstrated that recreational runners feel more pride after completing an outdoor run than after an indoor run (Kerr et al., 2006). Past research also suggests that participants who experience negative affect and fatigue during vigorous exercise exhibit more positive affect after cessation of exercise, indicating that post-exercise affect may be related more to relief associated with completing exercise than to feelings of pleasure and enjoyment that may occur during exercise (Ekkekakis et al., 2008; Focht et al., 2007).

A synthesis of the observed relationships between attentional style, perceived restorativeness, and affect suggests that within the outdoor condition, participants who perceived the outdoor path to be a restorative environment were more likely to engage in dissociative attention, experienced less distress, and had greater energy following outdoor exercise. Overall, these findings provide support for ART's (Kaplan, 1995) assertion that attending to stimuli within the external environment has a positive effect on energy and mood.

Additional correlational analyses found that women who reported higher levels of PA at baseline (as measured in LTEQ METS) rated the outdoor path as being significantly more restorative and experienced less distressing thoughts during outdoor exercise than their less active counterparts. To further explore the relationship between baseline PA and affective responses to indoor vs. outdoor exercise, participants were stratified into two groups: "Less Active" (n = 10, < 35 METS) and "More Active" (n = 16, $\geq$ 35 METS). Comparisons across settings found that the less active participants' affect was significantly more positive outdoors than indoors. Also, while less active participants experienced a decrease in affective valence from minute 10 to minute 20 of indoor exercise, they actually reported an increase in affect from minute 10 to minute 20 of outdoor exercise. Although these findings seem counterintuitive, as one would expect less active individuals to respond negatively to the higher intensity of the hilly path, they provide support for the idea that being outdoors enhances mood and can make a repetitive and solitary task (such as walking or exercising alone) more enjoyable. Although this analysis was exploratory in nature, and was not the main purpose of this study, it suggests that less active individuals experience more positive affect during outdoor exercise. The distraction provided by external stimuli in the environment may be especially important to less active individuals, as they are more likely to negatively evaluate feelings of exertion (Focht et al., 2007). Furthermore, one individual reported that she preferred the less crowded outdoor path because "…I like being able to work out and not feel intimidated by others exercising." While there were a similar number of bystanders in each setting, the activities in the outdoor setting were more leisurely in nature than the activities in the more fitness-oriented student recreation center. This suggests that women with body image concerns or low self-efficacy for exercise may feel more comfortable exercising outdoors.

The aforementioned findings could have important implications for PA interventions, as affect during exercise predicts adherence (Williams et al., 2008). Future research might investigate ways to manipulate exercise environments (both indoors and outdoors) to be more enjoyable for less active individuals. This could be done by examining the relationships between perceived restorativeness, attentional style, and affect among older, less active individuals who have low self-efficacy for exercise, as results from these studies could have important implications for interventions, exercise prescriptions, and the design of exercise environments. Furthermore, the current findings provide support for campaigns, such as Healthy Parks, Healthy People (Maller et al., 2008) who advocate the physical and mental health benefits of increasing access to and availability of parks and other outdoor recreational facilities. Environmentally-based PA interventions, such as building sidewalks and greenways to make neighborhoods and communities more walkable, can help to increase PA among less active individuals, but perhaps only if they feel safe in these facilities and have the self-efficacy to use these facilities.

Because Butryn and Furst (2003) suggested that women feel unsafe or vulnerable exercising in more isolated outdoor environments, and because women enjoy the social aspects of PA (Buckworth & Dishman, 2002; Plante et al., 2006), researchers might examine the efficacy of group-based outdoor PA interventions, such as outdoor walking groups. This type of intervention could orient women to the walking trails and routes in their community, provide them with positive social interaction, provide them with peer modeling and mastery experiences to increase their self-efficacy for exercise, and help them to feel safer during outdoor exercise (i.e., strength in numbers). To maximize effectiveness, this type of intervention would need to help women brainstorm ways to remain active when the weather is not conducive to outdoor exercise or if they are travelling and are unfamiliar with the outdoor exercise facilities in the area. In a long-term intervention of this nature, researchers could use accelerometers to objectively measure changes in PA, assess personal, social, and environmental factors impacting adherence rates, and evaluate physical and mental health benefits. This type of research would not only provide insight into ways to maximize the effectiveness of PA interventions, but would also lend further support for the preservation of green spaces.

Strengths

Unlike past research samples comprised of self-selected outdoor exercise groups (e.g., Barton & Pretty, 2010; Mackay & Neill, 2010), 85% of the current sample reported usually exercising indoors, thus suggesting that this group was not biased towards preferring outdoor exercise. The use of open-ended responses in the current study is another strength, as it gives context to quantitative results and provides insight into possible research directions for future green exercise research. Furthermore, the use of a familiarization session, an indoor track condition, and an exercise stimulus that was in accordance with ACSM guidelines for health-enhancing PA (Haskell et al., 2007) are additional improvements over previous research methodologies. The measurement of affect during indoor and outdoor exercise was informed by the work of Focht (2009), in which he used the FS, FAS, and EFI to compare affective responses to 10 minutes of treadmill vs. outdoor exercise. The current study differed from Focht (2009) in that it included a lengthier bout of exercise, used HR monitors to standardize exercise intensity, and used a multiple-item, dimensional measure of affect (AD ACL). This method of affective measurement was chosen in accordance with the recommendations of Ekkekakis et al. (2008) and Williams et al. (2008), who have suggested that affect during exercise is more predictive of long-term adherence than studies that only evaluate specific mood states at pre- and post-exercise. By evaluating factors that influence affect during exercise, acute exercise studies (such as the current study) can inform the design of more effective interventions to increase exercise among less active populations.

Limitations

The main limitations of this study included issues with the quantitative measures, lack of uniformity in the distance and terrain of the two exercise settings, the use of HR monitors, a possible ceiling effect for affect, and lack of generalizability to other populations. Firstly, the lack of significant between-setting differences in post-exercise affective states may have been related to reliability issues with the AD ACL. The Tension subscale was found to have especially low inter-item reliability (ranging from .44 to .78) within the current sample, and there were particular reliability issues with the items "fearful", "intense", "still", and "active". Issues with certain items of the AD ACL have been observed elsewhere (Ekkekakis et al., 2005). During pilot testing, participants expressed confusion with the items "clutched up" and "placid", and so they were replaced with the synonyms "anxious" and "relaxed". Although this change improved the readability of the questionnaire within this particular sample, the need to modify the AD ACL suggests that it may be dated and calls to question the appropriateness of the items for measuring exercise-related affect. Furthermore, because all of the psychological measures were self-report, and because the FS, FAS, and RPE measures were administered face-to-face, there is the possibility that participants' responses reflected a social desirability bias. In future research, the biases of face-to-face survey methods could be addressed through the use of smartphone applications or other handheld devices that participants could use to directly report affect and RPE during exercise.

Although using the indoor track addressed the limitations of past research comparing treadmill exercise to outdoor exercise, there were major structural differences between the indoor track and outdoor path that limit the ability to conclude that any between-setting differences in psychological responses were due entirely to the experience of being outdoors or indoors. The outdoor path was longer and had hills, meaning that it provided more variety in stimuli and was more physically challenging. Participant's qualitative responses indicated that these between-setting differences impacted their preferences for one setting over the other. Furthermore, the presence of windows in the indoor track may have had unintended restorative benefits, as evidenced by previous studies in which window views reduce stress and promote psychological restoration (Ulrich, 1984).

As previously mentioned, although the use of HR monitors ensured that participants maintained a moderate intensity in both settings, the act of attending to the monitor to stay within the target HR zone appeared to have caused a greater use of association, especially within participants' first experimental sessions. The use of HR monitors may have prevented the exercisers from engaging in more externally focused attention. These challenges may be addressed by including familiarization sessions with HR monitors in the respective experimental settings, or by asking participants to self-select a "comfortable, yet slightly challenging" intensity in both settings (Focht, 2009). In this modified study design, HR monitors would be used to provide data on average HR and intensity, but would not be programmed to beep if participants exercised outside of their target zone. Furthermore, because most casual exercisers (such as the participants in the current study) do not use HR monitors and typically exercise at a self-selected intensity, asking participants to exercise at an enjoyable and appropriately challenging pace may improves the ecological validity and practical applications of research.

The sample used for this study was comprised of young, healthy women in a university setting. This limits the types of population that these results can be generalized to, particularly in regards to gender, age, and education. The strength of this sample was that it was ethnically diverse and included people who were not regularly active. However, there was a wide range of baseline PA levels (0-85 LTEQ METS/wk), and results indicated that baseline PA was related to how participants experienced exercise in the two settings. Larger sample sizes of less active individuals are needed to explore this observation. Furthermore, affective valence was relatively high at baseline in both conditions (indoor: M = 2.68; outdoor: M = 2.88), meaning that there may have been a ceiling effect for affect.

Additionally, because outdoor exercise was performed in early fall on days in which the weather was conducive to exercise (with the exception of one day when the participant walked in light rain), the results of this study cannot be generalized to outdoor exercise that is performed during other times of the year or during less pleasant weather. Weather clearly has an impact on the outdoor exercise experience, as evidenced by participant's open-ended responses and the finding that humidity was negatively correlated with enjoyment of the outdoor setting. However, these are the inherent challenges of conducting research in the outdoors.

Conclusion

The current findings suggest that being in a restorative, outdoor environment can make exercise more invigorating and enjoyable. Affect appears to be more positive during outdoor exercise, but future studies with larger sample sizes and more uniform exercise conditions are needed to identify the potential psychophysiological mechanisms underlying the differences in affective responses to outdoor and indoor exercise. Future research might examine the environment's impact on longer-term adherence and mood, and explore ways to manipulate exercise settings to promote enjoyment and positive affect. As suggested by Coon et al. (2011), one of the logical next steps in green exercise research would be to design and implement intervention studies that compare the long-term physical and mental health benefits of outdoor and indoor exercise. Research among populations who are in need of greater restoration, such as individuals with seasonal affective disorder, depression, and/or anxiety can provide additional insights into the therapeutic benefits of outdoor exercise and inform the development of evidence-based wilderness therapy and physical activity programs. By researching how specific variables (such as exercise environment) are related to the mood-enhancing effects of exercise within less active individuals or individuals with mood disorders, researchers may gain a better understanding of how to design more effective PA interventions to encourage adoption and maintenance of PA behaviors for the promotion of mental and physical wellness.

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APPENDIX A. QUESTIONNAIRES

Background Questionnaire

1. Gender *(circle)*: Female Male **2. Age: _____________**

3. Race/Ethnicity (*circle*): White/Caucasian African-American/Black Native American
Asian/ Pacific Islander Hispanic/Latina/o Other/Mixed _______________

PAR-Q

Please read the questions carefully and answer each one honestly by checking YES or NO.

	YES	NO
1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?	☐	☐
2. Do you feel pain in your chest when you do physical activity?	☐	☐
3. In the past month, have you had chest pain when you were not doing physical activity?	☐	☐
4. Do you lose your balance because of dizziness or do you ever lose consciousness?	☐	☐
5. Do you have a bone or joint problem (for example, back, knee, or hip) that could be made worse by a change in your physical activity?	☐	☐
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?	☐	☐
7. Do you know of <u>any other reason</u> why you should not do physical activity?	☐	☐

Godin Leisure Time Exercise Questionnaire

Considering a **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (write on each line the appropriate number). Also, please report average number of minutes you engage in **EACH** exercise session.

	Times Per Week	Average # of Minutes Per Session
a) STRENUOUS EXERCISE (HEART BEATS RAPIDLY) (e.g., running, soccer, basketball, judo, racquetball skating, vigorous swimming, vigorous long distance biking)	________________	__________________

	Times Per Week	Average # of Minutes Per Session
b) MODERATE EXERCISE (NOT EXHAUSTING) (e.g., fast walking, baseball/softball, tennis, easy biking, volleyball, badminton, easy swimming, dancing)	_________________	____________________

	Times Per Week	Average # of Minutes Per Session
c) MILD EXERCISE (MINIMAL EFFORT) (e.g., yoga, archery, fishing, bowling, golf, easy walking)	_________________	____________________

Please list the exercise activities that you do on a regular basis:

Where do you usually exercise? Indoors ☐ Outdoors ☐

In what setting? (e.g. gym, student rec center, park):

Please list any outdoor activities (e.g., hiking, soccer, road biking, gardening) that you participate in on a regular basis:

How many times per week do you engage in these outdoor physical activities?

FS

Please estimate how “good” or “bad” you feel right now.

-5	-4	-3	-2	-1	0	1	2	3	4	5
Very Bad		Bad			Neutral			Good		Very Good

FAS

Please estimate how aroused you feel.

1	2	3	4	5	6
Low Arousal					High Arousal

RPE

Rate of Perceived Exertion

This is a scale used to determine exertion, which is intensity of effort, stress, or discomfort felt during exercise. You will be asked to rate your current level of exertion on a scale from 6-20, with 7 = No Exertion at All and 19 = Maximal Effort. There are no right or wrong answers.

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	

AD ACL

Following are some adjectives that describe people's feelings. Please read each of the adjectives and then indicate how you are feeling *at this particular moment* by circling the appropriate response. There are no right or wrong answers, so do not spend too much time on any one item. (Thayer 1986)

	Definitely Feel	Feel Slightly	Cannot Decide	Definitely Don't Feel
1. Active	vv	v	?	no
2. Relaxed	vv	v	?	no
3. Sleepy	vv	v	?	no
4. Jittery	vv	v	?	no
5. Energetic	vv	v	?	no
6. Intense	vv	v	?	no
7. Calm	vv	v	?	no
8. Tired	vv	v	?	no
9. Vigorous	vv	v	?	no
10. At rest	vv	v	?	no
11. Drowsy	vv	v	?	no
12. Fearful	vv	v	?	no
13. Lively	vv	v	?	no
14. Still	vv	v	?	no
15. Wide-awake	vv	v	?	no
16. Anxious	vv	v	?	no
17. Quiet	vv	v	?	no
18. Full of pep	vv	v	?	no
19. Tense	vv	v	?	no
20. Wakeful	vv	v	?	no

Attentional Focus Questionnaire

Please rate how much you engaged in the following activities during the exercise session you **just completed.**

1----------2----------3----------4----------5---------6----------7

I did not do this at all — I did this all the time

_______1. Letting your mind wander
_______2. Monitoring specific body sensations (e.g., leg tension, breathing rate)
_______3. Trying to solve problems in your life.
_______4. Paying attention to your general level of fatigue
_______5. Focusing on how much you are suffering
_______6. Singing a song in your head
_______7. Focusing on staying loose and relaxed
_______8. Wishing the run/walk would end
_______9. Thinking about school, work, social relationships, etc.
_______10. Focusing on your performance goal
_______11. Wondering why you are even running/walking in the first place
_______12. Making plans for the future (e.g., grocery list)
_______13. Getting frustrated with yourself over your performance
_______14. Writing a letter or paper in your head
_______15. Paying attention to your form or technique
_______16. Reflecting on past experience
_______17. Paying attention to your rhythm
_______18. Thinking about how much you want to quit
_______19. Focusing on the environment (e.g., scenery)
_______20. Thinking about competitive strategy or tactics
_______21. Counting (e.g., objects in the environment)
_______22. Monitoring your pace
_______23. Thinking about how much the rest of the run/walk will hurt
_______24. Meditating (focusing on a mantra)
_______25. Encouraging yourself to run/walk fast
_______26. Trying to ignore all physical sensations
_______27. Concentrating on the run/walk
_______28. Wondering whether you will be able to finish the run/walk
_______29. Thinking about pleasant images
_______30. Monitoring the time of the run/walk
_______31. Other: ____

(Brewer, Van Raalte, & Linder, 1996)

PRS

On a scale from 0-6, with **0 = Not at all** and **6 = Completely**, please circle the number that **BEST** represents the extent to which each statement fits your experience of the environment that you **JUST** exercised in.

1. It is an escape experience.

0 = Not at all	1	2	3	4	5	6 =Completely

2. Spending time here gives me a good break from my day-to-day routine.
3. The setting has fascinating qualities.
4. My attention is drawn to many interesting things.
5. I would like to get to know this place better.
6. There is much to explore and discover here.
7. I would like to spend more time looking at the surroundings.
8. There is too much going on.
9. It is a confusing a place.
10. There is a great deal of distraction.
11. It is chaotic here.
12. I can do things I like here.
13. I have a sense that I belong here.
14. I have a sense of oneness with this setting.
15. Being here suits my personality.
16. I could find ways to enjoy myself in a place like this.

(Hartig, Korpela, Evans, Garling, 1997)

Evaluation of Exercise Setting

For the following items, please refer to the setting in which you **JUST** exercised. Please indicate your ratings of the exercise setting by circling the appropriate response.

1. How pleasant was this setting?

0 1 2 3 4 5 6 7 8 9 10
Not at all Somewhat Very

2. How comfortable was this setting?

0 1 2 3 4 5 6 7 8 9 10
Not at all Somewhat Very

3. How refreshing was this setting?

0 1 2 3 4 5 6 7 8 9 10
Not at all Somewhat Very

4. How enjoyable was this setting?

0 1 2 3 4 5 6 7 8 9 10
Not at all Somewhat Very

5. How much did you like exercising in this setting?

0 1 2 3 4 5 6 7 8 9 10
Not at all Somewhat Very

Reflection Questionnaire

For the following items, please refer to your experiences in the 2 exercise settings (indoor track and outdoor path). Please answer the following questions about the exercise settings by marking an "X" on the appropriate box.

1. Which setting was the **most** pleasant? Indoor Track ☐ Outdoor Path ☐

2. Which setting was the **most** comfortable? Indoor Track ☐ Outdoor Path ☐

3. Which setting was the **most** refreshing? Indoor Track ☐ Outdoor Path ☐

4. Which setting was the **most** enjoyable? Indoor Track ☐ Outdoor Path ☐

5. Which setting **most positively** impacted your performance?
Indoor ☐ Track Outdoor Path ☐

6. Which setting did you prefer? Indoor Track ☐ Outdoor Path ☐

7. If you were asked to choose between these two settings for an exercise session in the future, which one would you choose?

Indoor Track ☐ Outdoor Path ☐

APPENDIX B. CONSENT FORM

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT: Long Form

Project Title: Perceived Environmental Restorativeness and Affective Responses to Indoor vs. Outdoor Exercise
Project Director: Amanda Williams
Participant's Name:

What is the study about?

This is a research project. The purpose of this study is to determine the influence of exercise setting on feeling states during exercise in outdoor and indoor environments.

Why are you asking me?

The current study is recruiting healthy women between the ages of 18 and 35 who can safely engage in 30 continuous minutes of moderate intensity exercise. A screening tool will be used to assess health status; individuals will be asked to complete a physical activity readiness questionnaire, which will give them the opportunity to self-report any physical or health limitations (such as heart conditions, chest pain, bone or joint problems, issues with balance) that would make them ineligible for participation. Because the study is interested in how casual exercisers respond to exercise, individuals who are currently engaging in over 1 hour of intense aerobic exercise per day, 5-7 times per week, are not considered eligible for this study.

What will you ask me to do if I agree to be in the study?

Individuals who agree to participate in this study will be asked to report to the Exercise Physiology Lab on 3 separate days. On the first day, participants will be asked to fill out questionnaires assessing physical activity behaviors, health status, and mood. Participants will also be asked to walk/jog on a treadmill at a moderate intensity (55-70% of maximum heart rate-MHR). During the remaining two days, participants will be asked to walk/jog for 30 minutes at a moderate intensity (55-70% MHR) in indoor and outdoor settings on campus. During exercise, participants will be wearing a heart rate monitor and will be asked to respond to questions assessing current mood states. Participants will also be asked to fill out questionnaires assessing mood states before and after exercise. Each experimental session is expected to last no more than 1 hour (3 sessions X 1 hour each = 3total participation hours). Participants are expected to experience very mild physical discomfort (such as sweating and accelerated heart rate) in response to exercise. Questions regarding the nature of this study can be directed to Amanda Williams (770)355-9546.

Are there any audio/video recording?

There will not be any audio/video recording.

What are the dangers to me?

The Institutional Review Board at the University of North Carolina at Greensboro has determined that participation in this study poses minimal risk to participants. Because participants will be screened for any health conditions that would prevent them from safely exercising, it is not anticipated that participants will have an adverse health reaction to the exercise sessions. However, there is still a very slight risk that participants may experience muscle fatigue, dizziness, or abnormal changes in heart function. If you experience any pain during exercise you should immediately notify the researcher. In the unlikely event of an emergency, the researcher, who is certified by the Red Cross to provide Cardio-Pulmonary Resuscitation (CPR) and Automatic External Defibrillator (AED), will administer CPR and/or AED if appropriate and will call 4-4444 for emergency assistance. In the event that these adverse reactions occur, participants may voluntarily withdraw from the study without penalty.

If you have any concerns about your rights, how you are being treated or if you have questions, want more information or have suggestions, please contact Eric Allen in the Office of Research Compliance at UNCG at (336) 256-1482. Questions, concerns or complaints about this project or benefits or risks associated with being in this study can be answered by Amanda Williams who may be contacted at (770)355-9546 or at alwill23@uncg.edu.

Are there any benefits to me for taking part in this research study?

There are no direct benefits for participation in this research study.

Are there any benefits to society as a result of me taking part in this research?

Results from this study may lead to an increased understanding of factors influencing mood during exercise. Findings from this study may help researchers and practitioners design more enjoyable physical activity programs.

Will I get paid for being in the study? Will it cost me anything?

Upon completion of the study, you will be given a $10 Harris Teeter gift card.

How will you keep my information confidential?

Information will be kept confidential through the use of password protected computer programs and storage in a locked office. All questionnaires will be coded for confidentiality and will be stored in an on-campus location separate from the consent forms. Participant names will never be used in any papers or reports. All information obtained in this study is strictly confidential unless disclosure is required by law.

What if I want to leave the study?

You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state.

What about new information/changes in the study?

If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:

By signing this consent form you are agreeing that you have read it, or that it has been read to you and you fully understand the contents of this document and are openly willing to consent to take part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are 18 years of age or older and are agreeing to participate, or have the individual specified above as a participant participate, in this study described to you by Amanda Williams.

Signature: ________________________ Date: ________________

APPENDIX C. TABLES

Table 1.

Baseline Characteristics: Self-Reported PA and Resting HR

Measure	*M*	*SD*	*Range*
LTEQ (sessions/week)			
Strenuous	2.17	1.71	0-5
Moderate	2.58	1.90	0-7
Mild	2.42	2.23	0-7
Total Minutes of PA/week	259.52	160.32	0-825
LTEQ (METS/week)			
Strenuous	19.56	15.38	0-45
Moderate	12.88	7.27	0-35
Mild	7.27	6.68	0-21
Total METS/week	39.71	20.71	0-85
Outdoor PA (sessions/week)	2.25	2.32	0-7
Resting HR (bpm)	79.77	10.51	63-105

Table 2.

Baseline: Between-Group Differences in Baseline PA and Resting HR

Measure	Group	*M*	*SD*	*F*	*p*
LTEQ METS/wk	AB	41.85	19.36	.27	.609
	BA	37.58	22.55		
Outdoor PA (sessions/wk)	AB	2.85	2.45	1.78	.195
	BA	1.65	2.10		
Resting Heart Rate:	AB	76.77	9.06	2.22	.149
	BA	82.77	11.33		

Table 3.

Familiarization: Between-Group Differences in Pre-Exercise Affect

Measures	Order	*M*	*SD*	*F*	*p*
AD ACL: Energy	AB	11.00	2.89	.02	.880
	BA	11.15	2.19		
AD ACL: Calmness	AB	16.00	2.65	.13	.718
	BA	15.62	2.72		
AD ACL: Tiredness	AB	10.62	4.05	.00	.964
	BA	10.69	4.55		
AD ACL: Tension	AB	7.62	2.69	.06	.817
	BA	7.38	2.33		
FS	AB	2.62	1.90	.52	.478
	BA	3.08	1.32		
FAS	AB	3.69	1.03	.15	.698
	BA	3.54	.97		

Table 4.

Familiarization: Between-Group Differences in Post-Exercise Measures

Post Measures	Order	*M*	*SD*	*F*	*p*
AD ACL: Energy	AB	13.00	2.38	1.03	.319
	BA	14.08	2.99		
AD ACL: Calmness	AB	13.15	3.69	.78	.387
	BA	14.25	2.30		
AD ACL: Tiredness	AB	10.15	3.83	.35	.560
	BA	9.23	4.13		
AD ACL: Tension	AB	7.38	2.53	.42	.525
	BA	6.85	1.63		
FSPost_F	AB	3.38	1.94	.14	.713
	BA	3.62	1.12		
FASPost_F	AB	4.15	1.41	.00	1.00
	BA	4.15	1.28		
AFQ: Dissociation	AB	33.46	5.83	.01	.915
	BA	33.15	8.47		
AFQ: Association	AB	44.15	11.99	.00	.986
	BA	44.08	10.36		
AFQ: Distress	AB	11.08	4.79	.02	.886
	BA	10.77	5.95		
PRS	AB	36.15	15.68	.13	.721
	BA	38.23	13.58		

Table 5.

Familiarization: Descriptive Statistics for AFQ, RPE, PRS

Measure		*M*	*SD*	*Range*
RPE	Min 5	11.04	1.43	8-13
	Min 10	11.69	1.19	9-14
	Min 15	11.69	1.54	8-14
AFQ	Association	44.12	10.36	22-62
	Dissociation	33.31	7.13	18-45
	Distress	10.92	5.29	7-29
PRS		37.19	14.41	17-71

Note. RPE = Rating of Perceived Exertion, AFQ = Attentional Focus Questionnaire, PRS = Perceived Restorativeness Scale.
AFQ and PRS only taken post-exercise.

Table 6.

Familiarization: Changes in AD ACL Subscales from Pre- to Post-Exercise

Subscale	*M*	*SD*
Energy		
Pre	11.08	2.51
Post	13.54	2.20
Calmness		
Pre	15.81	2.65
Post	13.58	3.07
Tiredness		
Pre	10.65	4.22
Post	9.69	3.93
Tension		
Pre	7.50	2.47
Post	7.12	2.10

Table 7.

Indoor and Outdoor Setting Characteristics

	Indoor		Outdoor	
	M	*SD*	*M*	*SD*
Number of Bystanders	24.08	16.23	19.85	15.53
Meters Travelled	2778.42	382.60	2837.54	341.59
Average HR	129.23	4.41	128.61	4.63
Temperature	72.00	0.00	62.65	8.29
Humidity	50.00	0.00	52.46	19.06

Note. HR data not available for one outdoor session due to HR monitor malfunction.

Table 8.

Experimental Sessions: FS by Time and Setting

	Indoor Track		Outdoor Path		Combined	
	M	*SD*	*M*	*SD*	*M*	*SD*
FS						
Pre	2.69	1.93	2.88	1.28	2.78	1.61
10	3.15	1.41	3.54	0.95	3.35	1.18
20	3.12	1.58	3.69	0.88	3.40	1.23
30	3.46	1.18	3.88	0.99	3.67	1.09
Post	3.50	1.14	3.81	0.90	3.65	1.02
Total FS	3.19	1.45	3.56	1.00	3.38	1.23

Note. Combined = Scores for each time point, collapsed over settings.
Total= Overall scores for each setting, collapsed over time.

Table 9.

Experimental Sessions: FAS by Time and Setting

Time	Indoor Track		Outdoor Path		Combined	
	M	*SD*	*M*	*SD*	*M*	*SD*
Pre	3.35	1.33	3.27	0.96	3.31	2.29
10	4.23	0.95	4.58	0.99	4.40	1.94
20	4.38	1.17	4.58	0.99	4.48	1.08
30	4.65	0.98	4.62	1.06	4.63	2.04
Post	4.00	1.02	4.12	1.14	4.06	2.16
Total FAS	4.12	1.09	4.23	1.03	4.18	1.06

Note. Combined = Scores for each time point, collapsed over settings.
Total = Overall scores for each setting, collapsed over time.

Table 10.

Experimental Sessions: AD ACL Subscales at Pre- and Post-Exercise

	Indoor Track		Outdoor Path		Combined	
	M	*SD*	*M*	*SD*	*M*	*SD*
Energy						
Pre	10.04	3.65	10.15	3.40	10.10	3.53
Post	12.15	3.41	12.88	3.86	12.52	3.64
Calmness						
Pre	13.04	4.07	13.85	4.07	13.44	4.07
Post	13.04	3.41	12.96	3.29	13.00	3.35
Tiredness						
Pre	11.58	4.36	11.54	4.08	11.56	4.22
Post	9.73	3.75	8.42	4.06	9.08	7.81
Tension						
Pre	6.85	2.59	6.69	2.19	6.77	2.39
Post	6.65	2.33	6.38	1.33	6.52	1.83

Note. Combined = AD ACL scores at pre- and post-exercise, collapsed across the two settings.

Table 11.

Experimental Sessions: RPE by Time and Setting

	Minute 10		Minute 20		Minute 30		Total RPE	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Indoor Track	9.73	2.01	10.50	1.90	10.69	1.72	10.31	1.88
Outdoor Path	10.73	1.91	11.27	1.82	11.50	1.84	11.17	1.86
Combined	10.23	1.96	10.89	1.86	11.10	1.78	10.74	1.87

Note. Total RPE = RPE in each setting, collapsed across time.
Combined = RPE at min 10, 20, and 30, collapsed across settings.

Table 12.

Experimental Sessions: AFQ Subscales by Order and Setting

		Indoor Track		Outdoor Path	
		M	*SD*	*M*	*SD*
Association	AB	47.08	10.84	39.31	11.62
	BA	38.62	10.64	43.31	11.82
	Total	42.85	11.37	41.31	11.66
Dissociation	AB	36.23	8.94	41.54	7.94
	BA	36.23	8.72	35.54	9.54
	Total	36.23	8.65	38.54	9.13
Distress	AB	10.85	5.30	1.18	.22
	BA	9.85	4.71	1.42	.51
	Total	10.35	4.94	1.30	.40

Note. Total = AFQ subscale scores for each setting, collapsed across order.

Table 13.

Experimental Sessions: Evaluation of Exercise Setting

	Indoor Track		Outdoor Path	
	M	*SD*	*M*	*SD*
Pleasant	6.54	2.34	8.85	1.38
Comfortable	7.27	2.27	8.73	1.22
Refreshing	6.00	2.97	9.08	1.20
Enjoyable	6.77	2.37	8.81	1.47
How much did you like exercising in this setting?	7.50	2.32	9.23	0.95

Note. Items were rated on a scale of 1-10, with 1= “Not at all” and 10= “Totally”.

Table 14.

Frequencies and Pearson's Chi-Square Values for Reflection Questionnaire

	Indoor	Outdoor	χ^2
Which setting was the most pleasant?	2 (8%)	24 (92%)	18.62***
Which setting was the most comfortable?	11 (42%)	15 (58%)	.62
Which setting was the most refreshing?	0	26 (100%)	N/A
Which setting was the most enjoyable?	2 (8%)	24 (92%)	18.62***
Which setting most positively impacted your performance?	7 (27%)	19 (73%)	5.54*
Which setting did you prefer?	4 (15%)	22 (85)	12.46***
If you were asked to choose between these two settings for an exercise session in the future, which one would you choose?	6 (23%)	20 (77%)	7.54**

Note. *p≤.05 **p≤.01 ***p≤.001
N/A= Chi-Square Test not performed because the variable was constant.

Table 15.

Outdoors: Correlations between Post-Exercise Affect and AFQ, PRS, and Setting Evaluations

	Energy	Tired	Assoc	Dissoc	Distress	PRS	Pleas	Comfort	Refresh	Enjoy	Like
FS	.65***	-.43*	.550**	.27	-.03	.15	.27	.21	.31	.09	.29
FAS	.62***	-.31	.219	.40*	.01	.16	.32	.20	.58**	.30	-.14
Energy		-.61***	.45*	.28	-.11	.17	.48*	.46*	.60***	.38	.11
Tired			-.32	-.03	-.23	.09	-.12	-.24	-.30	-.13	.04
Assoc				.06	.45*	-.15	-.09	-.12	-.02	-.19	.01
Dissoc					-.08	.38	.28	.17	.33	.34	.17
Distress						-.55**	-.58**	-.64***	-.49*	-.54**	-.33
PRS							.50**	.46*	.52**	.55**	.14

Note. *p<.05 **p<.01 ***p<.001
Tired= Tiredness, Assoc=Association, Dissoc=Dissociation, PRS=Perceived Restorativeness Scale, Pleas=Pleasantness, Refresh=Refreshing
The Calmness and Tension subscales have been omitted

Table 16.

FS Scores by METS Group, Order, and Setting

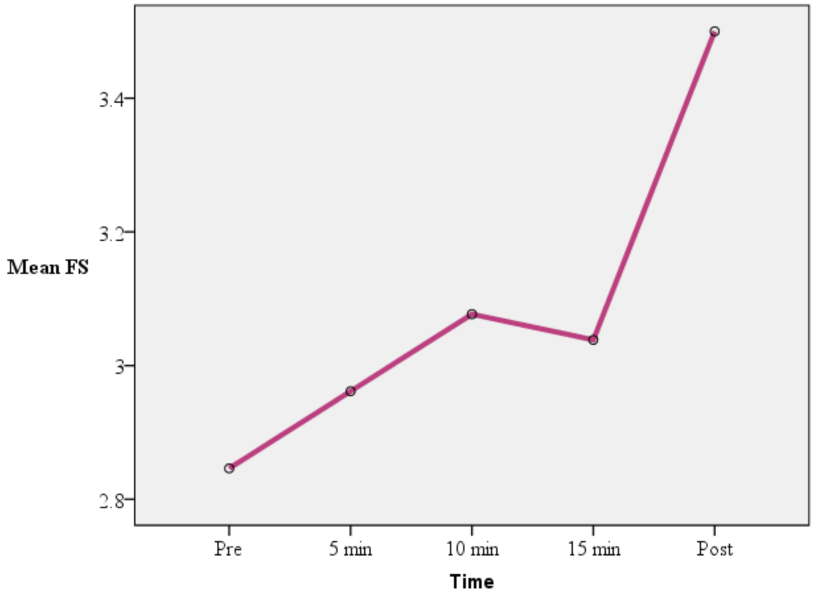
		More Active				Less Active			
		Indoor		Outdoor		Indoor		Outdoor	
FS	Order	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre	AB	3.13	1.46	3.00	1.07	1.60	2.61	3.20	1.30
	BA	3.50	1.20	3.25	0.89	1.80	2.49	1.80	1.79
	Total	3.31	1.30	3.13	0.96	1.70	2.41	2.50	1.65
10	AB	3.75	1.49	3.88	0.84	2.60	1.95	3.60	0.89
	BA	3.25	0.89	3.63	0.74	2.60	1.34	2.80	1.30
	Total	3.50	1.21	3.75	0.78	2.60	1.58	3.20	1.14
20	AB	3.88	0.99	3.88	0.84	1.40	2.30	3.60	1.14
	BA	3.63	0.92	3.63	0.74	2.80	1.30	3.60	1.14
	Total	3.75	0.93	3.75	0.78	2.10	1.91	3.60	1.08
30	AB	4.13	0.64	3.75	1.28	2.00	1.41	4.00	1.00
	BA	3.75	0.71	4.00	0.54	3.40	1.14	3.80	1.30
	Total	3.94	0.68	3.88	0.96	2.70	1.42	3.90	1.10
Post	AB	3.75	1.04	3.75	1.04	2.40	1.52	4.00	0.71
	BA	3.75	0.89	3.75	0.71	3.80	0.84	3.80	1.30
	Total	3.75	0.89	3.75	0.86	3.10	1.37	3.90	0.99
Total	AB	3.73	1.41	3.65	1.01	2.00	1.96	3.68	1.01
	BA	3.58	0.92	3.65	0.72	2.88	1.42	3.16	1.37
	Total	3.65	1.37	3.65	0.87	2.44	1.74	3.42	1.19

Table 17.

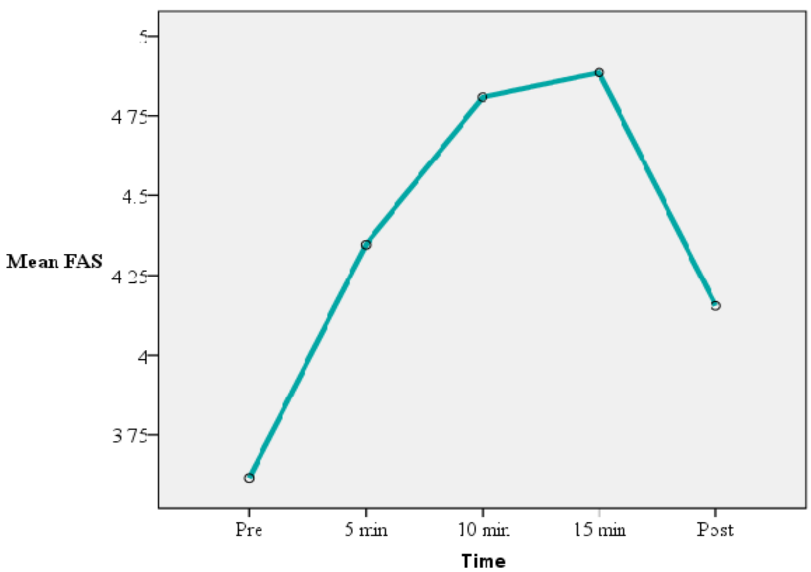
FAS Scores by METS Group, Time, and Setting

	More Active				Less Active			
	Indoor		Outdoor		Indoor		Outdoor	
FAS	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Pre	3.56	1.32	3.44	0.73	3.00	1.48	3.00	1.25
10	4.44	0.89	4.56	0.81	3.90	0.99	4.60	1.27
20	4.56	0.89	4.69	0.70	4.10	1.52	4.40	1.35
30	4.88	0.72	4.69	0.95	4.30	1.25	4.50	1.27
Post	4.00	0.82	4.19	0.91	4.00	1.33	4.00	1.49
Total	4.29	0.93	4.31	0.82	3.86	1.31	4.10	1.33

APPENDIX D. FIGURES



A



B

Figure 1. Familiarization FS (A) and FAS (B)

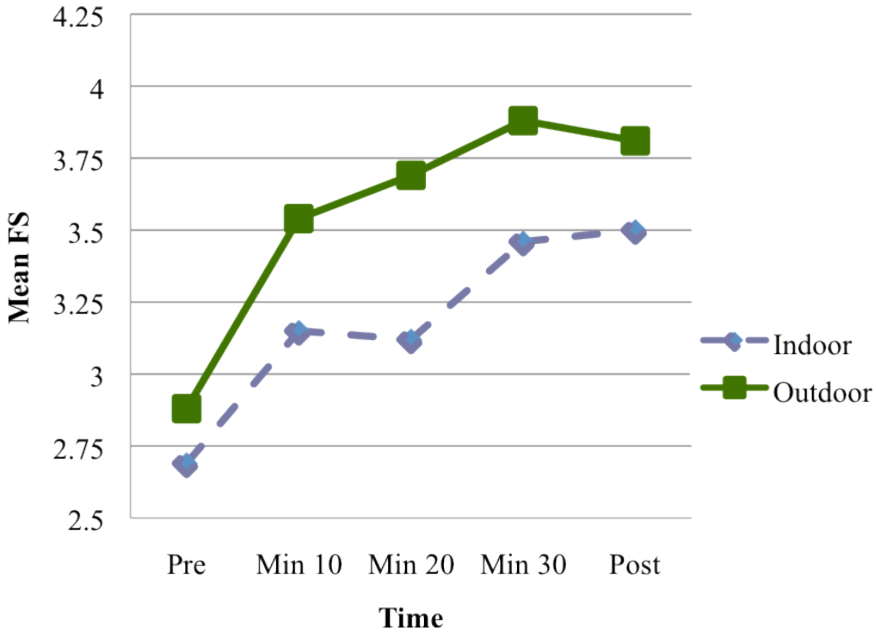


Figure 2. Responses throughout Indoor and Outdoor Exercise

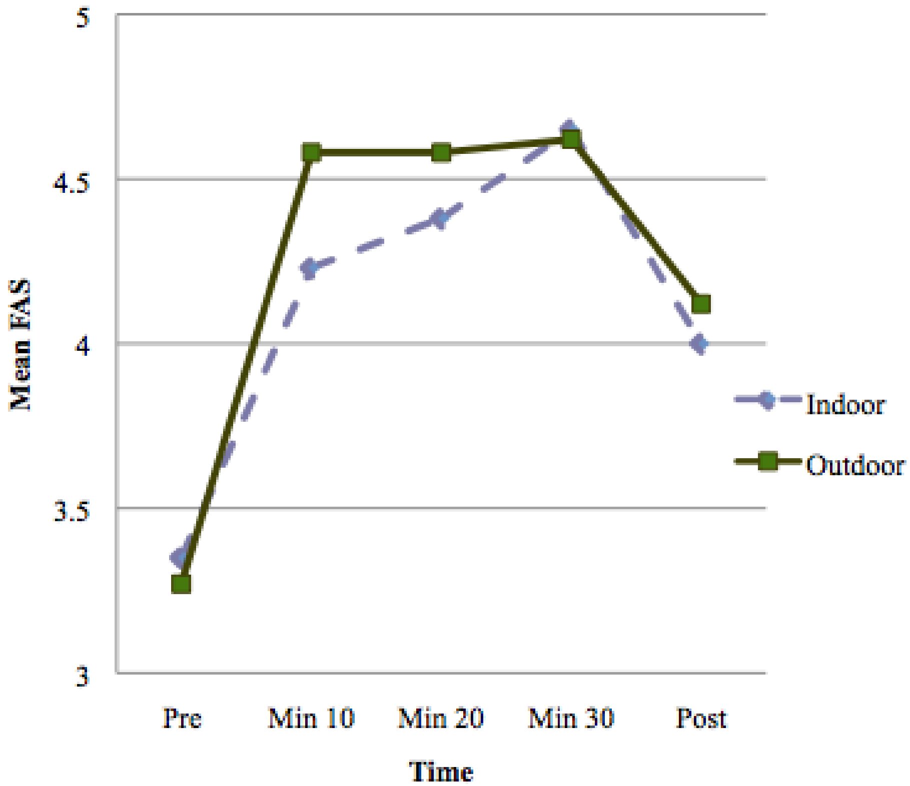


Figure 3. FAS Responses throughout Indoor and Outdoor Exercise

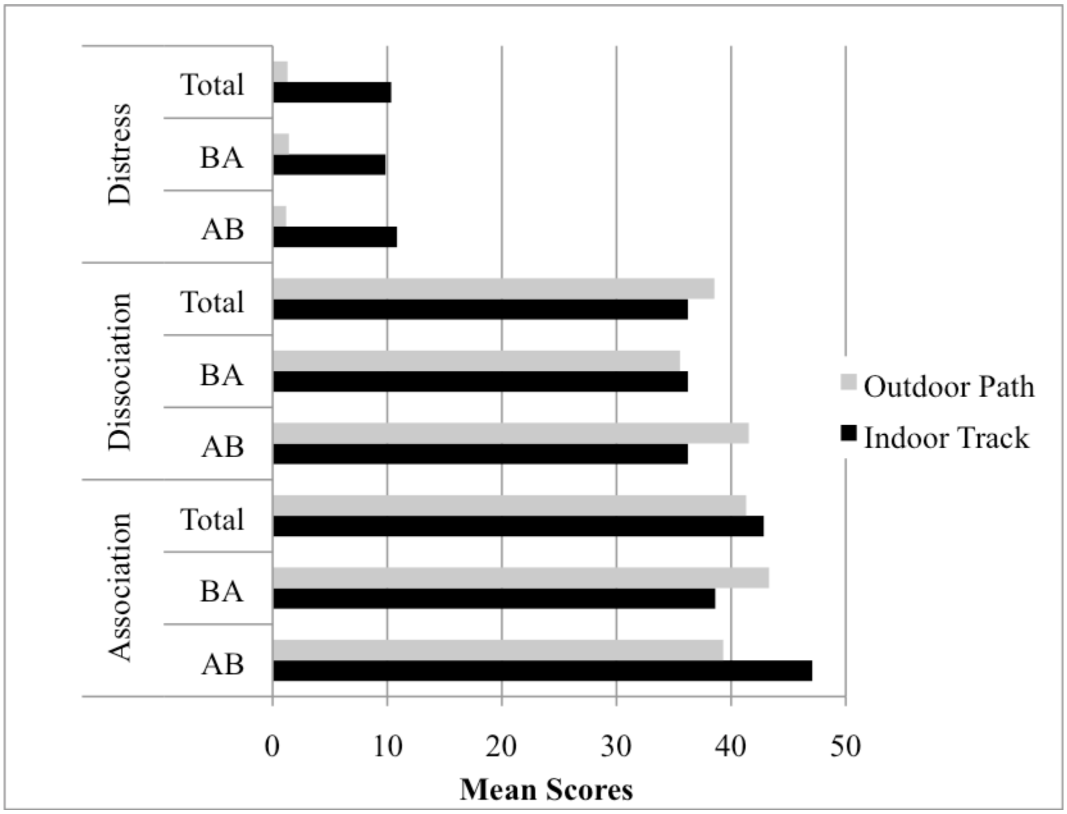


Figure 4. Experimental Sessions: AFQ Subscales by Order and Setting

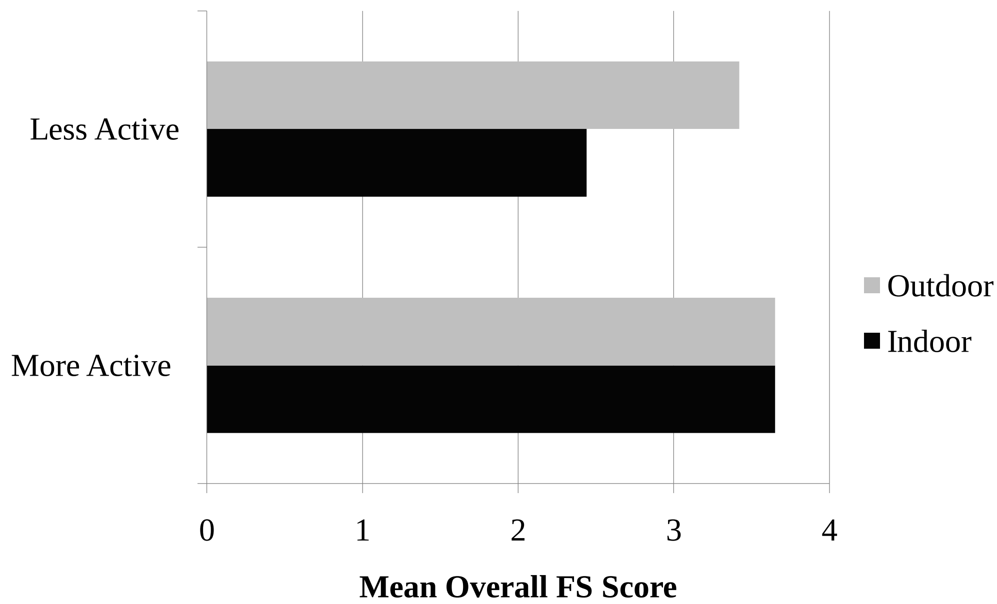


Figure 5. Overall FS Scores by METs Group and Setting

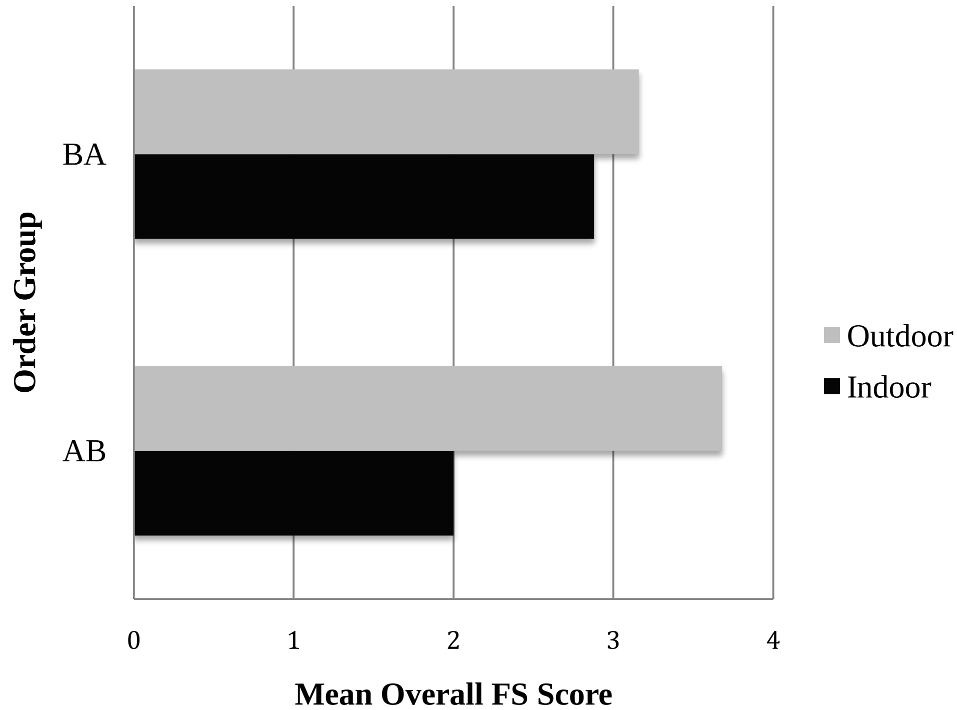
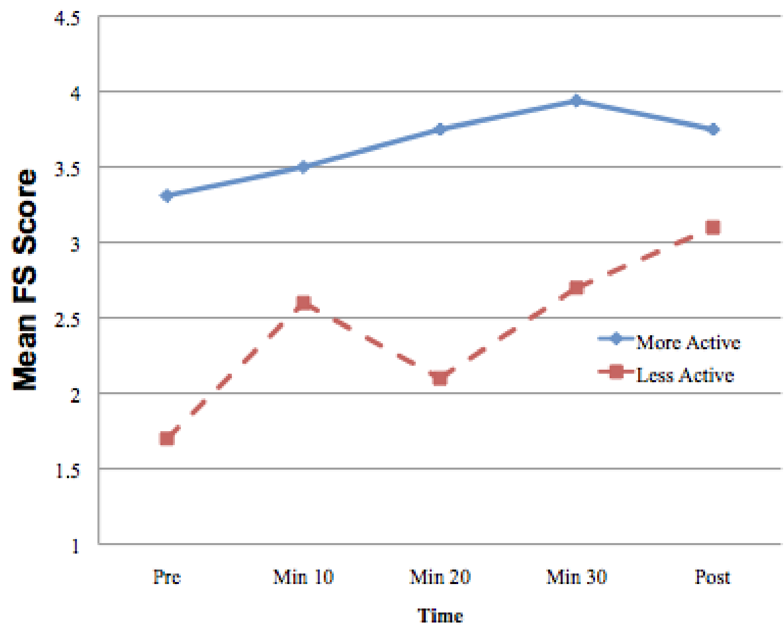
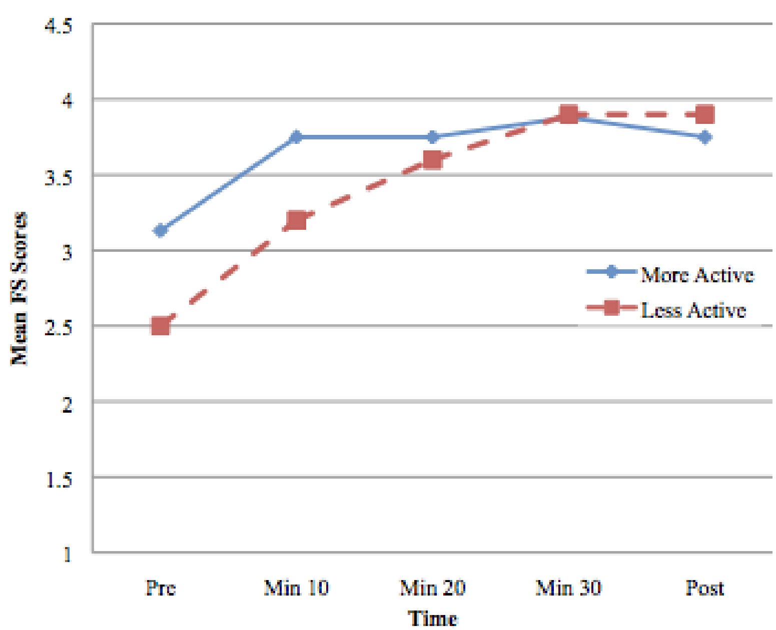


Figure 6. Overall FS Scores for Less Active Participants by Order and Setting



A.



B.

Figure 7. FS: Less Active vs. More Active: Indoor (A) and Outdoor (B)

APPENDIX E. OPEN-ENDED RESPONSES

QUESTION: "Why did you prefer this setting?"

Outdoor Path

"It was outside in the fresh air and there wasn't any people outside. The track was different so it wasn't the same thing all around me."

"I like being outside better. There's more to look at and enjoy. Time goes by faster on the outdoor path."

"Less repetitive, more things to look at, fresh air, and I usually run in settings similar to this so it was comfortable to me."

"There was more to look at, it provided natural inclines and the track was easy to walk on. The fresh air allowed me to breathe easier and let my mind wander away from exercise and stress. Where the indoor track was small, level, and crowded with nothing to look at."

"The scenery was inviting and there was always something pleasant to focus on. Also, the different slopes added variety."

"The outdoor path didn't seem as endless. In the indoor track, seeing the same things was boring and the outdoor path was more appealing."

"You got to breathe fresh air, enjoy nature, not go on the exact same path (if you didn't want/need to), environment was more open and available to many people. There was also more space and you didn't have to worry about running into anyone."

"I prefer this setting because it is relaxing to see nature and its beauty as I walked. I really enjoyed the breeze of fresh air also."

"I love being outdoors. The feeling of fresh air while exercising was so refreshing, you don't get that indoors. There were many things to look at and enjoy. A lot of the scenery outdoors will take my mind off the exercise."

"Fresh air positively affects my mood and performance level. Trees, squirrels, and sun make me feel good in general and walking/running was very enjoyable in this setting. Thank you. I enjoyed this study."

"This is where I started jogging so it comes naturally to me to jog outside. There is more to see and more space and different trails to take. I'm naturally an outdoors type of girl because I love warm weather (sun)."

"The outdoor track had more scenery and the fresh air was very inviting. Also, the outdoor path had hills and slopes. I liked the fact there was a difference in the path not just all one straight line like the indoor track."

"I preferred this setting because of the scenery around made it more enjoyable. It was more relaxing."

"I enjoyed the scenery and different elements of the outdoor path. Also, it was longer, so I did not repeat the loop as many times."

"Depends on the weather. It was nice outside and the indoor track has too many distractions causing me to lose focus sometimes."

"There is a bigger range of walking/jogging. Unlike the track, it was the same circle over and over again, which got a little boring for a 30 min. walk/jog."

"I preferred this setting because there was much more to see and different paths to take, the cool air was refreshing too."

"Since it's fall there are so many colors to be seen outdoors. I loved the scenery and being outside in the fresh air."

"I liked the outdoor path best because I felt that it was quiet the same thing over and over again like the indoor track. It was refreshing and enjoyable to be outside while exercising."

"The scenery was beautiful! The temperature was perfect and it was nice to get outside for a change."

"I prefer the outdoor path because I was able to see a lot of different things. Also I like being able to work out and not feel intimidated by others exercising."

"The outdoor path has different elevations and it allows me to see different things. The indoor track is only flat and I see the same exact thing the whole time."

Indoor Track

"I preferred the inside track because it is a more motivating environment. There are not only athletes who are working out in the rec center but people of all types, so it gives off a sense of belonging which makes me wanna work out more."

"I preferred the track because it was easier for me to keep the same pace and it had more stuff going on around me to keep me from being bored. Plus it is a controlled environment. The outdoors is nice when the weather is perfect, but we know that's almost a rare occasion now."

"I feel like I could stay more focused if I were running indoors. When I was outside, my mind would prone to wander a lot faster because of the different things going on."

“Indoors, I am able to monitor time and distance easier and things like temperature and incline stay constant or if I was on a machine I would be in control of the incline and speed. Outdoors I’m at the mercy of the way nature lays out a trail or path.”