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A STUDY OF EXERCISE ENVIRONMENT AND ITS EFFECT ON CHANGES IN MOOD: INDOORS VS OUTDOORS

Colin Fannon
Colin Robert Fannon, Cfannon@siu.edu

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by

Colin Fannon

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A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
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RESEARCH PAPER APPROVAL

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Approved by:

Jared M. Porter, Ph.D., Chair

Julie A. Partridge, Ph.D.

Graduate School

Southern Illinois University Carbondale

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TITLE: A STUDY OF EXERCISE ENVIRONMENT AND ITS EFFECT ON CHANGES IN MOOD: INDOORS VS OUTDOORS

MAJOR PROFESSOR: Jared M. Porter Ph.D.

Exercising in a green outdoor environment has been shown to have psychological and physiological benefits when compared to indoor, or non-green, exercise environments. The purpose of this study was to determine whether positive mood traits could be enhanced during a group fitness class in a green outdoor environment. Participants (n = 44) exercised in two separate groups: group A exercised indoors first and outdoors second, and group B exercised outdoors first and indoors second. Each group participated in a total for four exercise classes (i.e., two in each environment) and completed each class at their own pace. The Activation-Deactivation Adjective Check List (AD-ACL) was administered before and after each exercise session to determine changes in mood. Based on previous research it was hypothesized that exercising in a green outdoor environment would better enhance positive changes in mood traits. Results revealed that only the feelings of elatedness and energized were significantly shown to be more enhanced by exercising in a green outdoor environment.

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Introduction

The study of exercise and its wide variety of physiological and psychological benefits have been widely documented (Hassmén, Koivula, & Uutela, 2000; Pollock, Franklin, Balady, Chaitman, Fleg, Fletcher, & Bazzarre 2000). More specifically, research has shown that exercise promotes a wide variety of psychological benefits such as reductions in tension, decreases in negative mood states (e.g., depression, anxiety), increases in energy, vigor, and self-concept. (DiLorenzo, Bargman, Stucky-Ropp, Brassington, Frensch, & LaFontaine 1999; Thayer, Newman, & McClain 1994; Yueng, 1997). In 2007, the American College of Sports Medicine and the American Heart Association created the following standards for physical activity: two moderate-to-high intensity total body muscle-strength training sessions, and five 30-minute sessions of moderate physical activity per week, or three 25-minute sessions of vigorous physical activity (Haskell et al., 2007). Over the years the recommended standards of exercise have increased; yet levels of physical activity have only seemed to decline among Americans (Du Toit, 2012; Po'e, Neureiter, Escarfuller, Gesell, Tempesti, Widman, & Barkin, 2012). With many Americans still not reaching these recommendations for physical activity there have been increases in a number of health related problems such as obesity, type II diabetes, metabolic syndrome, and coronary heart disease (Goldstein et al., 2006; Hamilton, Hamilton, & Zderic 2007; Lakka et al., 2002).

Research has also shown that there is strong evidence that looking at or having had experiences within green environments can be linked with having positive psychological effects (Barton & Pretty 2010; Hartig, Mang, & Evans 1991; Hug, Hansmann, Monn, Krütli, & Seeland 2008; Kaplan 1995; Pretty, 2004). Green environments can be defined as any environment that affords an individual the opportunity to view a more green type of scenery (Kaplan, 1995).

Examples of green environments could be as simple as a group of trees in a backyard or as vast as being in a complete wilderness setting (Barton & Pretty 2010; Kaplan & Berman, 2010; Kaplan & Kaplan, 1995). Some of the effects that green environments have been found to elicit include: lowered stress, increases in one's ability to cope with stress (Van den Berg, Maas, Verheij, & Groenewegen, 2010), reductions in mental fatigue (Pretty, Peacock, Sellens, & Griffin 2005), improvements in concentration (Pretty, Peacock, Hine, Sellens, South, & Griffin, 2007), improvements in cognitive function (Barton & Pretty 2010), feelings of attention restoration (Kaplan & Berman, 2010; Kaplan, 1995), and feelings of being well balanced (Hansmen, Hug & Seeland, 2007).

Kaplan and Kaplan's (1995) theory of attention restoration has been used to explain these benefits experienced by individuals in green environments. Attention restoration is defined as an individual's improved ability to concentration after spending time in a green environment (Kaplan & Kaplan, 1995). Environmental psychologists have also found that having access to large green environments have led to decreases in risks of mental related illnesses (de Vries et al., 2003; Pretty, 2007; Takano, Nakamura, & Watanabe 2002). Attention restoration was first believed to only be achieved in wild-lands (i.e., areas where an individual is completely immersed in a green environment) such as national forests and state parks. However, in 1998, Kaplan et al. found that green environments were not limited to wild-lands, but similar psychological benefits could be found in parks, fields, backyard gardens, and open spaces that had access to trees. Research on green environments continued to find links between being in a green environment and achieving a sort of attention restoration that led to positive changes in total mood disturbance, self-esteem, improved cognitive functioning and even a physiological effect for reductions in blood pressure (Bodin & Hartig 2003; Felsten 2009; Kaplan & Kaplan

1989; Li et al., 2010). Through this research the attention restoration theory (ART) was more fully developed.

With this research we have clearly seen how a green environment can affect attention restoration, but recently the effects of a green environment on exercise has been studied to show how attention restoration can affect an individual's change in mood after physical activity and thus potentially led to a stronger effect on exercise adherence (Pretty et al. 2005). The pursuit of this research has led to the examining of the effects of exercise in nature-based (i.e., green) environments to determine if a green environment might enhance the positive mood altering effects of exercise.

Pretty (2004) was one of the first to study how incorporating green scenery into a physical activity setting could affect the psychological and physiological effects of exercise and found that there are three levels by which individuals have engagement with nature. The first was viewing nature through a painting or window. The second was by being in the presence of nearby nature, this could include activities such as walking or cycling, reading on a seat in a garden or park or talking to friends in a park. The third was by active involvement in nature, such as camping, running, gardening, or horseback riding. The results of the study showed strong evidence that all these levels delivered mental health benefits. Moreover, the study demonstrated that the third level (i.e., being actively involved in the environment) showed the best benefits toward mental health.

A follow-up study conducted by Pretty et al. (2005) hypothesized that there would be a synergistic benefit (i.e., exercise and green environment working together to produce a greater positive affect) of psychological and physical wellbeing when combining exposure to nature and physical activity. This study focused on presenting pictures through a slideshow projector while

participants walked briskly or jogged lightly. The researchers recruited 100 adult participants that were randomly assigned to one of five categories. Four of the categories were based on specific types of scenery: rural pleasant, rural unpleasant, urban pleasant, and urban unpleasant. The fifth category was a control condition in which participants ran without exposure to images. Each condition was exposed to a sequence of 30 scenes that were projected on a wall while individuals exercised on a treadmill. Results showed that rural pleasant (i.e., the most green environment) pictures had the greatest increase in self-esteem and significant decreases in feelings of tension and anxiety. By contrast, both urban and rural unpleasant scenes were found to reduce the beneficial effects on self-esteem. The authors concluded that green exercise was more effective than exercise alone in improving measures relevant to mental health and that more research needed to be done within real green environments.

LaCaille, Masters, and Heath (2004) found similar results when they compared three different exercise settings (i.e., outdoor route, indoor track, & treadmill) through the means of performance times, exercise-induced feeling inventory (EFI), course satisfaction, and rate of perceived exertion (RPE). Each individual was asked to perform the task by themselves. This was the first study to have individuals completely immerse themselves in a green environment while engaging in a moderate to vigorous physical activity. The outdoor route was found to elicit the highest levels of positive engagement, tranquility, revitalization, and course satisfaction, while also having the lowest feelings of physical exhaustion and RPE. Conversely, the treadmill condition had the slowest performance time and highest feeling of RPE. The authors concluded that these types of physical interactions with green environments led an individual toward a greater level of attention restoration, which then allowed the individual to accomplish a similar

task with a decreased degree of effort. The authors also concluded that the effects of attention restoration led to reduced feelings of physical exhaustion (LaCaille, et al., 2004).

This idea was expanded upon again by Hug, Hansmann, Monn, Krütli, and Seeland (2008), who looked at the restorative effects (i.e., how they perceived their general well-being) of physical activity in forest and indoor settings. This study surveyed 269 participants (age distribution: 32%-15-25 years old, 45%-26-45, and 23% over the age of 45) who were all members at a local gym. This study followed participants who were only performing typical cardiovascular exercise either indoors (i.e., spin class, cross-training, jogging on a treadmill, and general fitness training) or performed outdoor physical activity (i.e., jogging, Nordic walking, cycling). The study sought to compare participants' perceptions of the effects that the two environments had on their attitude before and after participation in physical activity. The restorative effects were rated on a five-point scale (i.e., 1 = not at all; 5 = very much) based on the following questions: 1) to what extent have you felt stressed before and after exercising? 2) how much do you suffer from every day hassles? 3) how much more mentally balanced did you feel after your work out compared to before? And 4) whether they felt there physical wellbeing had increased. The results found no significant difference between exercise frequency and exercise environment, and no significant relationship between general perception of well-being and exercise environment. However, participants at the outdoor sites gave significantly higher ratings toward their attitude to exercise environment. Follow-up interviews showed that participants' proximity to environments played a significant role in selection of an outdoor exercise environment. This showed that participants were more likely to choose exercise in an outdoor environment if it was closer to their home or place of work. The restorative effects concerning everyday hassles and feeling mentally balanced tended to be higher in outdoor

environments after exercise, and restorative effects concerning stress reduction and physical wellness tended to be higher after exercise in indoor environments. When participants had finished exercising it was found that outdoor exercisers were more eager to return to the environment post-exercise. A noteworthy observation from this study was that the outdoor exercisers reported significantly lower pre-exercise stress levels compared to the indoor environment exercisers even though the two groups did not differ significantly in their ratings of feeling stressed in everyday life. Thus it was concluded the choice to exercise in a green environment lead to an initial stress relief, along with an increased desire to return to the outdoor site when compared to exercising indoors (Hug et al., 2008).

The first comprehensive analysis conducted on green environment exercise settings was a meta-analysis published in 2010 by Barton and Pretty, in which they reviewed 10 different studies that evaluated the effects of green exercise. This review showed that in green environments there were significantly positive increases in self-esteem and total mood disturbance regardless of exercise duration or intensity. Individuals with self-declared mental health problems (i.e., self-declared high anxiety or depression) saw greater increases in self-esteem and mood when compared with apparently healthy participants. Changes in self-esteem and mood were found to be similar for both men and women. The improvement in self-esteem was found to decline with age (>30 years old) and mood changes saw their greatest change in middle-aged populations (31-50 years). The overall conclusion was that participation in green exercise resulted in an increased benefit in self-esteem for adults (Barton & Pretty, 2010). Again the effects of attention restoration through doing cardiovascular exercise in a green environment were observed by the positive changes that took place in mood and self-esteem.

In 2010, Li et al. investigated whether the psychological effects of a green environment might also have an impact on physiological outcomes. Li et al. (2010) reported that walking in forest environments significantly enhanced human immune function and reduced the levels of participants' stress hormones such as urinary adrenaline and noradrenaline. The report confirmed previous literature when they found increases in vigor and decreases for anxiety, depression, fatigue, confusion and anger scores on the Profile of Mood States (POMS) test. This was the first study to document actual physiological effects based on a green environment. The authors conducted a follow-up study, which showed that walking in a forested area compared to walking in an urban environment significantly reduced blood pressure (Li et al., 2011). The authors concluded that the blood pressure decrease was due to urinary noradrenaline (which was reduced in forest walking) because this hormone is linked with increased parasympathetic nerve function. Walking in the forest significantly increased DHEA (didehydroepiandrosterone), a hormone with cardioprotective, anti-obesity, and anti-diabetic properties. It was speculated by Li et al., (2011) that the natural tree fragrance phytoncides (wood essential oils) might be linked with lower levels of noradrenaline and sympathetic nervous function. Li et al., (2011) cited Dayawansa et al. (2003) who had reported that cedrol (cedar wood oil) inhalation led to significant reductions in systolic and diastolic blood pressure. This evidence suggests that nature can make positive contributions to our health, help us recover from pre-existing stressors, and have an immunizing effect by protecting us from future stresses. These studies clearly documented positive physiological effects that occurred because of green exercise (Li et al., 2011). Through the research from Li et al. (2011) we have a physiological effect to potentially quantify the psychological effects of attention restoration when engaged in cardiovascular forms of exercise.

The positive physiological and psychological effects of exercising in green environments have clearly been observed. Yet most of the research on outdoor exercise has consisted of walking running and cycling. This research paper aims to build on to the body of research by examining resistance training type exercise in an outdoor setting. In examining this, the author sought to determine whether the positive psychological effects that green exercise has had specifically on mood were also observed in an outdoor resistance exercise training circuit. It was predicted that positive mood traits would be higher and that negative mood traits would be lower after exercising in an outdoor environment compared to exercising indoors.

Method

Participants

Group A consisted of 18 participants and group B consisted of 17 participants, for a total of 35 participants at the beginning of the study. The participants were recruited through various Southern Illinois University Department of Kinesiology classes. Participants were all undergraduate college students. All participants filled out a Physical Activity Readiness Questionnaire (PAR-Q) General Health Questionnaire to ensure readiness for physical activity. Four individuals from group A and six individuals from group B had their results discarded because they didn't complete the first week of participation. Four more participants from group A and two more participants from group B dropped out the following week. The first week of data was still utilized from these six participants. A total number of nineteen individuals participated in the entire four sessions. The participation of the nineteen individuals was counted twice (once for each week) and those that only participated in the first week were counted once.

Apparatus and Task

This study utilized a within-participant design and two different exercise environments indoor (I) and outdoor (O). Each participant alternated between the two environment conditions over four testing sessions. Participants were divided into two groups and were counterbalanced to offset any ordering effects. Group A participated in a total of four exercise classes beginning with an outdoor class (1st and 3rd session) then an indoor class (2nd and 4th sessions). Group B participated in the same exercise routine, but the class environment order was reversed (e.g., outdoor 2nd & 4th and indoor 1st & 3rd).

Procedure

During recruitment, all participants were informed about the location and times of the experiment, and were instructed to wear comfortable clothes and athletic shoes. The day before each session participants were emailed a reminder of the time and place of the upcoming exercise session.

All participants performed the same exercise routine in all four sessions regardless of their group membership. The intensity of the exercise was not monitored, but participants were encouraged to push themselves at their own pace. Before each exercise students were provided with visual demonstrations of how to safely perform each exercise.

The exercise routine began with a five-minute dynamic warm-up consisting of inch-worms, toe touch squats, knee pulls, and ankle grabs. Following the warm-up, ten bodyweight exercises consisting of: jumping jacks, seal jacks, cross jacks, body weight squats, downward facing dog push-ups, speed skaters, dive bombers, crossover lunges, wide grip push-ups, and side lunges were completed. All exercise sessions concluded with a five minute cool down consisting of cross over hamstring stretch, behind the back triceps stretch, and kneeling hip flexor stretch. Each exercise was done for forty-five seconds. After finishing each exercise, a fifteen second

rest/transition period was provided before continuing to the next exercise. Once all ten of the exercises had been completed, a 1-minute recovery period was provided and then the exercises were repeated again. The exercises were repeated a total of two times. The entire routine lasted 45 minutes.

The outdoor environment that was used was a green environment alongside Southern Illinois University's (SIU) Campus Lake walking/running trail. It was roughly a 16 by 16 meters open area that overlooked a portion of the trail and lake and was surrounded by trees in on all three sides. Campus buildings were visible from where participants were exercising, but were not deemed close enough for people in the buildings to actively watch the participants. All outdoor exercises took place on partly sunny days with mild temperatures.

The indoor environment in which the participants exercised was a standard regulation size basketball court (28.651 by 15.4 meters) at the SIU Student Recreation Center. The utilized basketball court was isolated from other basketball courts by a large plastic curtain that was dropped from the ceiling, thereby providing privacy for the participants.

Dependent Measures and Statistical Analysis

Activation-Deactivation Adjective Check List (AD-ACL; Thayer, 1986)**.** The AD-ACL is a short self-report checklist designed to measure momentary mood states that has been used frequently to study a variety of arousal-related characteristics, including physiological changes, sleep-wake cycles, exercise effects, cognitive and information processing functions, and various mood states. The AD-ACL has been found to have a competent reliability and validity between 0.89-0.92 (Thayer, 1978). The questionnaire consisted of twenty different moods (i.e., Carefree, Serious, Leisurely, Jittery, Energetic, Calm, Tired, Regretful, Elated, Fearful, Lively, Self-Centered, Overjoyed, Active, Grouchy, Tense, Focused, Relaxed, Refreshed, and Depressed),

which were scored with for symbols (vv = you definitely feel that mood at the moment, v= meaning you slightly feel that mood at the moment, ? = that mood doesn't apply to you or you can't decide if you feel that mood in that moment, and no = you definitely do not feel that mood at the moment). A question would consist of stating the mood with all four potential answers. The questions went as follows: Carefree vv, v, ?, and no. If the individual was feeling very carefree they answer by circling "vv." If the individual felt slightly carefree they would answer by circling "v." If the individual wasn't sure if they were feeling carefree they would answer by circling "?". If the individual knew that they didn't feel carefree they would answer by circling "no." The questionnaire was distributed before and after exercise in both environments. While filling out the questionnaire participants had questions on the meaning of the words "elated" and "jittery". For all participants elated was defined as a strong sense of accomplishment and jittery was defined as feeling anxious.

The following moods were removed from the short form: placid, sleepy, intense, vigorous, at-rest, drowsy, still, wide-awake, clutched-up, quiet, full-of-pep, and wakeful. The following moods were added in belief that they better related to the participants: carefree, serious, leisurely, regretful, elated, self-centered, overjoyed, focused, grouchy, relaxed, refreshed, and depressed. It was the author's intention to assess specific mood traits that were believed to be relevant to the body of research.

A two tailed *t*-test was used to compare AD-ACL scores pre- and post-exercise in each condition. An independent sample *t*-test was used to assess differences in pre- and post-test means for each environment. Finally a paired sample *t*-test was used to compare pre- and post-test scores independent of environment.

Results

A series of data analyses were run via the Statistical Package for Social Sciences (SPSS) software in order to address whether the positive psychological effects that green exercise had on mood might be observed in an outdoor resistance exercise training circuit. There first test (Table 1) to be conducted was a two tailed *t*-test to compare AD-ACL scores pre- and post-exercise in order to find which environment may have had an influence on mood. Only the feelings of being elated and energetic were found to be significantly different between indoor and outdoor conditions ($p < .05$). Specifically, elation and energetic were both found to be significantly better after exercising outdoors.

Table 1

Two Tailed t-Test			
Mood	Significance	Mean Value Indoors	Mean Value Outdoors
Elated*	0.038	-0.1364	-0.7955
Energetic*	0.043	0.455	-0.1818
Serious	0.058	-0.0909	0.1136
Calm	0.146	0.25	-0.1364
Refreshed	0.246	-0.4545	-0.8636
Depressed	0.246	0.0682	0
Lively	0.292	0.1136	-0.2045
Jittery	0.311	0.1136	0.4318
Grouchy	0.36	0.1591	0.0682
Overjoyed	0.405	-0.0909	-0.4318
Fearful	0.43	0.0455	0.1818
Tired	0.54	0.682	0.4091
Tense	0.605	-0.0455	0.25
Regretful	0.692	-0.0455	0.1136
Focused	0.729	-0.2045	-0.2273
Carefree	0.755	-0.0227	-0.0455
Relaxed	0.786	0.0682	-0.2955
Leisurely	0.844	0.227	-0.3182
Active	0.894	-0.4545	-0.4545
Self-centered	0.902	-0.1591	0.0227

* Significant at $p < .05$

Table 1 Caption: Results of changes in mood for each environment.

The second test (Table 2) was an independent sample *t*-test which assessed potential differences in pre-exercise means for each environment. Only the feeling of being calm was found to be significant on the activation deactivation adjective checklist ($p < .05$) in pre-exercise scores with the indoor environment eliciting greater feelings for calmness before exercise.

Table 2

Independent Sample t-Test			
Mood	Significance	Mean Value Indoors	Mean Value Outdoors
Calm*	0.034	1.1364	0.7045
Jittery	0.114	-0.4545	-0.1364
Serious	0.255	0.4545	0.2045
Energetic	0.265	0.4545	0.7045
Fearful	0.325	-0.8636	-0.7273
Grouchy	0.349	-0.5455	-0.7045
Relaxed	0.503	0.7727	0.6364
Leisurely	0.506	0.4773	0.3409
Regretful	0.673	-0.8936	-0.08182
Depressed	0.68	-0.9091	-0.8636
Self-Centered	0.715	-0.4773	-0.4091
Focused	0.727	0.75	0.6818
Tense	0.729	-0.4318	-0.3636
Tired	0.851	0.2273	0.2727
Overjoyed	0.906	-0.1818	-0.2045
Carefree	0.91	0.9545	9773
Lively	0.91	0.75	0.7727
Active	0.915	0.7273	0.7045
Elated	0.916	0	0.0227
Refreshed	1	0.1818	0.1818

* Significant at $p < .05$

Table 2 Caption: Results of pre-exercise means of each environment

The third test conducted was another independent *t*-test using the post-exercise mean scores between both environments (see Table 3 below). The results showed that after exercise in an outdoor environment the feelings of being elated and energetic were found to increase significantly ($p<.05$) on the AD-ACL. The feeling of being serious was also found to be significantly decreased on the AD-ACL with the participants reporting lower levels of seriousness in the outdoor environment.

Table 3

Independent Sample t-test			
Mood	Significance	Mean Value Indoors	Mean Value Outdoors
Elated*	0.001	0.1364	0.8182
Energetic *	0.034	0.4091	0.8864
Serious*	0.047	0.5455	0.0909
Refreshed	0.076	0.6364	1.0455
Lively	0.103	0.6364	0.9773
Overjoyed	0.151	-0.0909	0.2273
Depressed	0.192	-0.9773	-0.8636
Relaxed	0.22	0.7045	9318
Tired	0.23	0.1591	-0.1364
Regretful	0.239	-0.8182	-0.9318
Tense	0.25	-0.3864	-0.6136
Leisurely	0.313	0.4545	0.6591
Self-Centered	0.592	-0.3182	-0.4318
Grouchy	0.606	-0.7045	-0.7727
Carefree	0.681	0.9318	1.0227
Focused	0.818	0.9545	0.9091
Calm	0.826	0.8864	0.8409
Active	0.904	1.1818	1.1591
Jittery	1	-0.5682	-0.5682
Fearful	1	-0.9091	-0.9091

* Significant at $p < .05$

Table 3 Caption: Post exercise means for each mood in each environment.

The final test was a paired sample *t*-test that was used to compare pre- and post-exercise scores independent of environment (see Table 4 below). The results showed exercise itself did produce significant ($p < .05$) increases in the positive mood traits of feelings of being active, refreshed, elated, overjoyed, and focused and significant ($p < .05$) decreases in negative mood traits (i.e., feeling of being jittery) on the AD-ACL.

Table 4

Paired Sample t-test			
Mood	Mean Before	Mean After	Significance
Active*	0.7159	1.1705	0
Refreshed*	0.1818	0.8409	0
Elated*	0.0114	0.4773	0.001
Overjoyed*	-0.1932	0.0682	0.017
Jittery*	-0.2955	-0.5682	0.03
Focused*	0.7159	0.9318	0.048
Tired	0.25	0.0114	0.079
Leisurely	0.4091	0.5568	0.174
Fearful	-0.7955	-0.9091	0.183
Grouchy	-0.625	-0.7386	0.198
Relaxed	0.7045	0.8182	0.254
Self-Centered	-0.4432	-0.375	0.369
Tense	-0.3977	-0.5	0.408
Regretful	-0.8409	-0.875	0.535
Energetic	0.5795	0.6477	0.612
Depressed	-0.8864	-0.9205	0.634
Calm	0.9205	0.9636	0.647
Lively	0.7614	0.8068	0.682
Carefree	0.9659	0.9773	0.916
Serious	0.3295	0.3182	0.928

* Significant at $p < .05$

Table 4 Caption: Pre- and post-exercise scores independent of environment.

Discussion

The purpose of this study was to investigate whether the positive psychological effects that green exercise has had specifically on mood might be observed in an outdoor resistance exercise training circuit. The study showed that exercise itself was found to elicit mild changes in mood regardless of environment. Additionally, the results of this study suggest that exercising outdoors verses indoors had virtually no effect on mood.

The findings suggest three noteworthy conclusions. First, elatedness was significantly stronger after participating in the outdoor resistance exercise training circuit when compared with the same type of exercise in an indoor environment. Future studies should seek to assess what specifically elicits a feeling of elatedness by having participants qualify why they feel elated in order to determine if a sense of being in a green environment is something that can be tied to feelings of being elated.

The second notable conclusion can be seen through participants reporting a greater sense of feeling energetic following an exercise routine outdoors compared against the same exercise routine done indoors. The reason for participants' increased feelings of being energetic following outdoor exercise could come from the direct impact of the sun itself. Vitamin D deficiency has been shown to be a factor that can cause fatigue in men and women and that supplementation of vitamin D has been documented to show increase of energy within the cells by enhancing the activity of the mitochondria (Sinha et al., 2013). A previous study in 2007 found that obese individuals had a greater likelihood to have hypovitaminosis D (low vitamin D) and that by supplementing outdoor exercise there was a significant effect on reducing the prevalence of hypovitaminosis D in obese individuals (Florez et al., 2007). Adequate amounts of vitamin D run

between 600 international units (IU) and 4000IU per day and 45 minutes of moderate sunlight exposure can give an individual as high as 1000IU of vitamin D (DeNoon, 2009). Each outdoor exercise session was conduction between 10am and 3pm when sun exposure is typically strongest. The weather each day was mostly sunny. It would appear the exposure to natural sunlight could explain the reasoning in feeling more energized. Future research could address this by comparing AD-ACL with vitamin D levels.

A third noteworthy observation drawn from this study is that the findings did not show a meaningful relationship between feelings of calmness and exercise environment. This finding is contrary to previous research (Plante Gores, Brecht, Carrow, Imbs, & Willemsen, 2007). One potential reason for the lack of a significant difference between indoor and outdoor exercise environments for mood change is based on findings reported in previous research on the intensity of green exercise. A systematic review conducted by Barton and Pretty (2010) found a dose-response between the effects of outdoor exercise intensity on self-esteem (i.e., low intensity having the strongest effect) and total mood disturbance (i.e., low and vigorous activity had the strongest benefits related to the amount of exposure to green exercise). Based on the results of this systematic study it appears that there is a potential for maximizing psychological benefits through exercise intensity (Barton & Pretty, 2010). Studies have used circuit type training to elicit a vigorous type of intensity (Nikander, Sievänen, Ojala, Oivanen, Kellokumpu-Lehtinen, & Saarto, 2007; Ruth, Asheal, & Michael, 2006). To the author's knowledge the present study is the first to use a circuit training type of exercise in a green environment to determine its effects on mood. Further research is needed to better understand how circuit training and even strength training could be affected by exercise environment.

Participants' responses on the AC-ADL for feeling regretful, self-centered, grouchy, fearful, and depressed were most characterized with responses of "no" or "?" before and after exercise, meaning that participants in both environments definitely did not feel that way or that the feeling was not relevant. The likely reason for the lack of significance with the feelings of self-centered, fearfulness, and regretfulness would be that those specific types of feelings were feelings that individuals did not have prior to or post exercise. In regards to the feeling of depression specifically, existing research shows that exercise does positively impact levels of state depression and that there are clear positive mental health outcomes from green exercise and exposure to green environments, but again that result was dependent upon individuals having been diagnosed or self-diagnosed with depression (Bowler et. al., 2010; Pretty et al., 2005; Rimer Dwan, Lawlor, Greig, McMurdo, Morley, & Mead, 2012). The reason for the lack of improvements in levels of depression can be found in how the study did not screen for depression and individuals did not self-diagnosed feelings of depression on the AD-ACL.

Contrary to previous literature the feeling of tension was not significantly reduced through exercise in an outdoor environment compared to exercising in an indoor environment (Pretty et al., 2005; 2007). The types of green exercise studied by Pretty et al. (2005; 2007) including walking, running, cycling, horse-riding, fishing, canal-boating and conservation activities. With that said, the difference in findings could have potentially been due to the different type of physical activities that were studied in those investigations and the present study. Circuit training tends to be a more vigorous form of exercise, while the previous listed exercises tend to be more moderate. Apparently, the exercise environment did not have a meaningful impact on reducing tension in the participants that volunteered for this study.

A limitation to this study was that no consideration was taken on participants' perceptions of each exercise environment (Focht, 2009). The Perceived Restorative Scale (PRS) has been used in previous research to assess how participants perceived specific environments of restorative qualities by measuring ART's four constructs of restorativeness: the sense of being away, fascination, extant, and compatibility with needs. Research has shown that when exercise is experienced in outdoor environments participants have a greater sense of perceived restoration, which in turn has had correlating effects with the exercise experience (Hartig et al., 1991; Korpela & Hartig, 1996). Hug et al. (2009) even found that participants' frequency of exercise in a particular exercise setting could be predicted by participants' perceived restorativeness of the environment. Furthermore, to the author's knowledge the PRS scale has not been used in a circuit training fitness setting and further research is needed in order to determine if the same perceptions and benefits that occurred would be found in a circuit training fitness setting.

Previous literature has shown that the greener an environment that people exercise in, the greater likelihood of increases in attention restoration (Hug et al., 2008; Pretty et al., 2005). The green environment utilized in the present study was chosen more so for its perceived convenience, as it was on campus. With that said, the green environment used in this study was not 'ideal' in that school buildings were clearly visible, the environment was behind a parking lot, and at times sounds of motorized vehicles and construction work were heard. Yet the environment fully met all the necessary qualities to be called 'green' (Barton & Pretty 2010; Thompson Coon, Boddy, Stein, Whear, Barton, & Depledge, 2011). Research has shown that even viewing a picture of a green environment positively affected mood during exercise (Pretty et al., 2005). Further research could be conducted to determine if a greener environment could

potentially increase the benefits found in this study. Also, for future research a pilot test of words that individuals associate with exercise may prove to be helpful, such as proud, happy, anxious, distressed, uneasy, rested, engaged, revitalized, and reinvigorated. It is possible that some of the lack of significance in results reported in this study could have been due simply to participants' inability to relate to the feelings being assessed pre- and post-exercise. This is purely speculative, this possibility needs to be validated in future research.

In conclusion, the current research suggests that exercising outdoors gives participants a stronger sense of accomplishment and leaves them feeling more energized. However, the overall findings of this study suggest that there were virtually no meaningful effects on mood when exercising outdoors verses indoors. As is the case with most research, future studies would do well to be conducted with larger sample sizes. Additionally, a more accurate scale of mood traits may need to be developed and tested to more effectively evaluate the potential benefits of exercising outdoors. This type of research is crucial to any exercise practitioner in that if an exercise can be manipulated in such a way that it promotes greater levels of mood improvement, it could have a drastic impact on exercise adherence and long-term psychological benefits for participants.

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VITA

Graduate School
Southern Illinois University

Colin R. Fannon Date of Birth: June 25, 1986

905 East Park St., Carbondale IL, 62901

colinfannon86@gmail.com

Western Illinois University
Bachelor of Science, Exercise Science with a minor in Religious Studies, December 2009

Research Title:
A Study of Exercise Environment and its Effects on Changes in Mood: Indoors vs. Outdoors

Major Professor: Jared M. Porter, Ph.D.