2003

The perception of indoor and outdoor exercise environments and their effect on mood states, heart rate, and running time

Sarah E. Hooper
Ithaca College

THE PERCEPTION OF INDOOR AND OUTDOOR EXERCISE ENVIRONMENTS AND THEIR EFFECT ON MOOD STATES, HEART RATE, AND RUNNING TIME

A Thesis Presented to the Faculty of the

Graduate Program in Exercise and Sport Sciences at

Ithaca College

In Partial Fulfillment

of the Requirements for the Degree of

Master of Science

By

Sarah E. Hooper

May 2003

Ithaca College

Graduate Program in Exercise and Sport Sciences

Ithaca, New York

CERTIFICATE OF APPROVAL

MASTER OF SCIENCE THESIS

This is to certify that the Master of Science Thesis of

Sarah E. Hooper

submitted in partial fulfillment of the requirements for the degree of Master of Science in Exercise and Sport Sciences at Ithaca College has been approved.

Thesis Advisor:

Committee Member:

Candidate:

Chair, Graduate Program in
Exercise and Sport Sciences:

Dean of Graduate Studies:

Date: February 9, 2003

ABSTRACT

It has been shown that aerobic exercise increases positive mood states. Evidence also indicates that various factors surrounding the exercise environment can influence mood states depending on the exerciser's perception of the surroundings. There is scarce information, though, on how the two most basic environments – indoor and outdoor – influence exercise mood states. This study investigated indoor and outdoor exercise environments and their effect on mood states, heart rate, and running time. Male (n=7) and female (n=8) college students capable of running 3.4 miles were recruited for the study. Subjects ran two times indoors on a fitness center treadmill and two times outdoors on a predetermined route around the college campus. Weather conditions were recorded from National Weather Service data. Treadmill and outdoor distance were standardized at 3.4 miles and subjects ran each of the four trials at the same time on each day. Subjects were familiarized with both environments prior to all testing. The order of sessions was balanced to control for potential carry-over effects. Physiological measures were average heart rate and running time recorded by a heart rate monitor and timer worn by the subjects during exercise. Psychological measures were mood states and environmental perceptions. Mood states were measured by the short version of the Profile of Mood States Total Mood Disturbance Score (POMS TMDS). Perception of the surrounding environment was assessed by an Environmental Perception Questionnaire that consisted of a five-point Likert-type scale. All psychological tests were administered pre and post exercise session. A three way analysis of variance was used to assess differences in mood states and in environmental perceptions, and a two-way analysis of variance was used to assess heart rate and running time. Both mood states and environmental perceptions were

significantly more positive outdoors than indoors, that is, the exercisers preferred exercising outdoors. This was reflected in a more positive mood states when exercising outdoors. There were no significant changes in mood states or environmental perceptions from pre-exercise to post-exercise. Participants had faster run times outdoors than indoors, but surprisingly, average heart rates were not significantly different between indoors and outdoors. These findings suggest that when an exercise environment is perceived positively, mood states will be affected more positively than when an exercise environment is perceived less favorably. These data also suggest that an exerciser's performance may be influenced by their perception of the environment, though additional study is needed to rule out potentially confounding factors.

ACKNOWLEDGEMENTS

The investigator would like to express appreciation to the following people for their contributions to this effort:

Dr. Jeffrey Ives, thesis advisor, for your patience. Your energy for my topic and dedication as an advisor was appreciated. I learned a tremendous amount about myself, and the topic with your careful guidance.

Dr. Greg Shelley, second reader, for your knowledge and time. All of your advice and direction was very helpful.

Dr. Janet Wigglesworth, for your knowledge of statistics. Without you, statistics would still be a blur. Thank you for making it comprehensible.

To the rest of the department, each of you contributed to this and guided me in some aspect. Thank you for all your constructive criticism.

To all the subjects that participated in this study, thank you for volunteering your time and energy.

DEDICATION

To my grandmother, Philomenea and the rest of my family, Mom, Dad, Alison, Aunt Fay, Morgan, and Ben. Thank you for all your love and support. I could not have done this without you. I love you very much.

To the friends I made along the way. You made it worthwhile.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

Chapter

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Negative mood states have been associated with stress and the negative effect stress has on the body (Brod, Fencl, Hejl, & Jirka, 1959). Specifically, negative mood states have been associated with an increase in the incidence of high blood pressure, heart disease, depressed immune function, and other illnesses (Blix, Stromme, & Ursin, 1974; Brod et al., 1959; Henry & Ely, 1979; Kasl & Cobb, 1970). Learning to manage mood states is an essential part in managing stress, and therefore, physical well being. Exercise is one way to manage mood states.

Many researchers have examined the exercise effects on mood states. Intensity, type of activity, self-efficacy, and training have been taken into consideration when attempting to assess the impact physical activity has on mood (Berger & Owen, 1998; Dyer & Crouch, 1988; Kauvussanu & McAuley, 1995; McGown, Talton, & Thompson, 1996; Williams, Krahenbuhl, & Morgan, 1991). Abundant psychological evidence has been presented to demonstrate that exercise can increase positive mood states and decrease negative mood states (Henry & Ely, 1979; McGown, Pierce, Eastman, Tripathi, Dewey, & Olson, 1993; Rudolph & McAuley, 1995). Exercise has also been shown to be effective in the treatment of depression in conjunction with medication and psychotherapy (Artal & Sherman, 1998).

The type, or mode, of exercise that has been shown to be most beneficial for increasing positive mood states is aerobic exercises (O'Connor, Morgan, Raglin, Barksdale, & Kalin, 1989; Rudolph & McAuley, 1995). The duration and intensity of exercise are also important factors related to gaining mood state benefits (O'Connor et

al., 1989; Rudolph & McAuley, 1995). Indeed, the longer a person exercises in each exercise session, without over-training, the more psychological benefits are acquired (O'Connor et al., 1989; Rudolph & McAuley, 1995). These findings are useful in prescribing exercise, particularly for people who exercise to reduce depression, anxiety, and stress. Although mode, intensity, and duration are considered the three key factors to be manipulated when prescribing exercise, there are other factors that could also affect the psychological benefits of an exercise session, namely, various environmental factors.

Environmental surroundings affect mood states (Canter, 1961; Shibata & Suzuki, 2002). Feeling uneasy or self-conscious in a certain setting can lead to higher stress levels and negative mood states (McAuley, Mihalko, & Bane, 1996), and even the presence of foliage in office settings influences mood (Shibata & Suzuki, 2002). Because exercise can be completed in various environmental settings, it is important to understand the combined effects of exercise and environment on mood states.

Scope of the Problem

Although exercise has been shown to have positive effects on mood states, there is evidence that some environments may have negative psychological effects. For example, a person may have negative feelings about exercising in a health club due to a constrained and crowded atmosphere. Those perceptions may negate any positive effects of exercise. Thus, how individuals perceive their environment may have an impact on exercise effects and may be an important factor to consider when prescribing exercise. Unfortunately, minimal data exist on the effects of exercise as related to perceived positive and negative environmental surroundings.

bewilderment. Each subscale was scored separately and combined for a total mood disturbance score (TMDS: McNair, Lorr, & Droppleman, 1992).

3. Environmental perceptions: One's assessment of his or her environment is based on individual personality variables, roles, status, as well as other factors that arouse emotion (Henry & Ely, 1979). A custom questionnaire, the Environmental Perceptions Questionnaire, used a Likert-scale to determine if a person perceived his or her exercise environment as positive or negative. Part two of the Environmental Questionnaire tallied subjects' responses to determine their preferred exercise environment.

Delimitations

The following delimitations were noted:

1. Exercise intensity was set at 75% of the individual's maximum heart rate, and heart rate was measured from a telemetered heart rate unit.
2. The Profile of Mood States Total Mood Disturbance Score (POMS TMDS) test was used as an indicator of mood states.
3. Exercise mode was limited to running.
4. Environments were limited to indoor treadmill running in a college fitness center and an outdoor running route that included typical college campus features and some trails in the woods. Outside exercise only took place in the Spring when the temperature was above freezing and there was no precipitation, that is, no extremes in temperature.
5. Participants were male and female college-age students at Ithaca College.

6. Participants were able to complete a 3.4-mile run without difficulty and were in good health as determined by the Physical Activity Readiness Questionnaire (PAR-Q form).

Limitations

The following limitations were noted:

1. These results may not apply to exercise intensities below or greater than 75% of the exerciser's heart rate maximum.
2. Mood states may be influenced by a person's eagerness or excitement to participate in the study. Similarly, a person's stress level and mood may have changed randomly day to day, as some life events could not be controlled.
3. These results may not apply to exercise modes other than running, including other aerobic activities, strength training, and flexibility training.
4. These results may not apply to indoor and outdoor environments other than those used in the study, nor may they apply to environments with temperature extremes.
5. These results may be limited to college-aged persons.
6. These results may be limited to persons of relatively good health and aerobic fitness.

Chapter 2

REVIEW OF LITERATURE

Negative mood states have been associated with physical diseases of the body (Lovallo, 1997). States of depression, anger, confusion, and fatigue can stress the mind and body to the point of dysfunction, such as contributing to diseases like hypertension and heart disease (Ader & Cohen, 1993). Exercise has been shown to manage mood states by increasing positive mood states and decreasing physiological stress responses (Dyer & Crouch, 1987; Morgan, 1984). Many components of an exercise program can impact these findings. Intensity, duration, and exercise setting all play a role in the benefits that may result from exercise. It is well accepted that aerobic exercise can increase positive mood states in all levels of exercisers from beginners to elite (Morgan, 1984). What is not well understood is how a person's surroundings during an exercise session impact the benefits of exercise.

To better understand why or how exercise environments impact mood states management, this section discusses (a) what stress is and why it is detrimental to the body, (b) physiological factors regulating the stress response, (c) the environment and stress, (d) mood states and exercise, and (e) interactions among environment, mood, and exercise.

What is Stress and Why is it Detrimental to the Body?

Stress is a physical or mental tension resulting from factors that tend to alter an existing equilibrium (Lovallo, 1997). Stress can be physical or psychological. Physical stress (e.g., cold, heat) is generally a direct threat to the body. Psychological stress results in an emotional response, which then typically results in a physical response. For

example, if the dark is perceived as scary then being in the dark will cause fear and the heart will begin to beat faster. Modern day lifestyles such as office or computer work generally impact one's psychological stress more than physical stress. Often there are feelings of emotional stress from jobs and rarely feelings of physical stress, such as being chased by predators (Canter, 1961).

Gould and Weinberg (1999) described the stress process in four stages. The first stage is an environmental demand on an individual; this can be physical (e.g., a fitness test) or psychological (e.g., a math test). The second stage is how an individual perceives this environmental demand. Stage three is the psychological and/or physical response to the demand, such as decreased attention or increased heart rate. The fourth stage is the behavioral consequences, or outcomes, to the demand (Gould & Weinberg, 1999). For example, sleeping in a completely dark room could be psychologically demanding for a young child (stage one). The child could perceive darkness as a threat to their safety (stage two). The child could then become anxious, afraid, and begin to cry (stage three). In the future the child may wish to have a night-light on in the bedroom before he goes to sleep (stage four).

There are many physiological factors that can indicate emotional stress. Heart rate, blood pressure, rate of fatigue, and hormone levels in the blood, plasma, and urine have all been found to be good indicators of stress levels in the body. Heart rate has been shown to increase during times of emotional stress (Brod et al., 1959; Raikkonen, Mathews, Flory, & Owens, 1999). For example, in a study of seven aircraft pilots' heart rates and blood pressures during flight, researchers found that the pilots' blood pressures rose from 130/80 mmHg to 170/100 mmHg (Blix et al., 1974). Further, the pilots' heart

rates surpassed what was needed for the level of oxygen they were consuming. Essentially, the pilots' cardiovascular responses were more than what was needed for that physical activity, indicating psychological stress was influencing physiological systems (Blix et al., 1974).

Blood pressure increases were reported in a study that examined men who dealt with a stressful situation like losing a job (Kasl & Cobb, 1970). Authors followed 150 men over a two-year period and found that blood pressure levels were higher during anticipation of job loss and probationary re-employment than during stabilization on new jobs.

Turner & Carroll (1985) compared stress levels in 20 subjects completing mental arithmetic, a video game, and a graded exercise test. The authors measured heart rate, oxygen consumption, and respiration. The results indicated that subjects participating in the exercise test had physiological changes to match their workload, yet the subjects engaging in psychological work (mental arithmetic and video game) had physiological changes that exceeded their workload. These findings confirm that psychological stress impacts physiological performance. This fact, though, does not necessarily mean that stress is negative or harmful to the body.

Stress becomes harmful when it comes in large amounts or is long lasting. At these times the body's regulation of hormones becomes dysfunctional, and systems and organs like the heart may become taxed to the point of harm. For instance, constantly activating the sympathetic nervous system has been shown to lower immune function (McClelland, Floor, Davidson, & Saron, 1980).

McClelland, Ross, and Patel (1985) found that persons with higher levels of stress had depressed immune functions. Researchers collected saliva samples from 46 college students just after taking an exam, one hour and 45 minutes latter, and several days later. Researchers found that lower salivary immunoglobulin A were present just after, and at one hour and 45 minutes after the exam. This result indicated depressed immune function (McClelland, Ross, & Patel, 1985).

Stress is even more of a concern for people already in a diseased state. For instance, people with hypertension may develop greater cardiovascular activity in response to psychological stress than they do to physical stress (Gliner, Bedi, & Horvath, 1979). These authors measured blood pressure in 10 subjects under three different conditions; psychological stress, mild exercise, and control (no stress conditions). Results indicated increases in blood pressure for both psychological stress and exercise conditions in all subjects. Two of these subjects were categorized as hypertensive prior to testing, and both had a greater increase in blood pressure during the psychological stress than during the physical stress. This indicates that subjects in a diseased state are at greater risk for psychological stress than healthy subjects.

Physiological Factors Regulating the Stress Response

The main regulator of homeostasis in the body is the autonomic nervous system (McClelland et al., 1980), particularly under stressful conditions (Scarpace & Lowenthal, 1994). The autonomic nervous system is divided into two branches, the sympathetic division and parasympathetic division. The sympathetic division is activated when a person is experiencing anger or fear, causing a release of norepinephrine, epinephrine,

cortisol, and adrenaline (Henry & Ely, 1979). These hormones play a critical role in the stress response, such as the fight-flight response.

The fight-flight response enables the body to get up and go when it is in danger. When the secretion of epinephrine is increased, the sympathetic nervous system is strongly activated causing pupil dilation, bronchial dilation, increased heart rate, and decreased secretion and peristalsis in the gut (Lovallo, 1997). The parasympathetic nervous system complements the sympathetic. For example, the parasympathetic division causes pupillary constriction, bronchial constriction, decreased heart rate, and increased secretion and peristalsis in the gut (Lovallo, 1997).

Examples of the autonomic nervous system being activated during times of stress include sport competitions, public speeches, and test taking. During a sport competition salivary cortisol levels rise in athletes that feel unsure about their ability (Booth, Shelley, Mazur, Tharp, & Kittok, 1989). When completing mental arithmetic and performing public speeches, Dimsdale (1984) found that the blood plasma catecholamine level rose in his test subjects, and this rise correlated with an increase in the subjects' anxiety. Similar results have been found when examining salivary catecholamine samples (McClelland et al., 1985).

The Environment and Stress

Interpretation of stressful situations varies from person to person. Just as Gould and Weinberg (1999) explained in stage two of the stress process, individuals will have different perceptions to the same environmental demand. Not everyone views the same events in the same way; therefore emotional stress is unique to a person as is their environmental perception (Kiritz & Moos, 1974). Different environments can be a source

of emotional stress to one person, and neutral, or beneficial to another (Canter & Canter, 1979).

The interpretation made by an individual regarding a particular stressor depends on the total context within which the event occurs (Evans, 1982). The context includes aspects of the physical, social, and psychological environment and the interaction that occurs among these three elements (Evans, 1982). These factors are often taken into consideration when building hospitals, offices, therapy rooms, schools, and other places where stressful situations often arise (Canter & Canter, 1979). For example, some people find hospitals to be stressful, while others may find this environment to be unthreatening. To some people being indoors is inhibiting, while to others it can be a positive stimulus (Canter, 1961).

An example of environmental conditions causing physical and psychological stress can be found in a study by Maw, Boutcher, and Taylor (1993). These authors examined male cyclists exercising under different indoor temperature conditions (8, 24, and 40 degrees Celsius at 50% humidity). Warm temperatures caused an increased physical stress and an increased thermal sensation. The subjects also reported that at a given workload they perceived the exercise to be more difficult when exercising in the warm environment, suggesting that the warm environment had a psychological influence as well as a physical influence on the subjects.

Mood States and Exercise

There is a connection between negative mood states and measures of physical health, such as high blood pressure (Raikkonen et al., 1999). Not only has it been shown that exercise can help with problems such as high blood pressure and cardiovascular

disease, but studies have also shown that exercise increases positive mood states (McGowan et al., 1996; Morgan, 1984; Morgan, O'Connor, Ellickson, & Bradley, 1988).

Under normal circumstances people usually report that they feel better after exercise (Morgan, 1984). When comparing anaerobic to aerobic exercise, aerobic exercise generally elicits greater increases in positive mood than anaerobic exercise. Dyer and Crouch (1988) placed subjects into four groups that exercised over an entire semester; running, aerobic dancing, weight lifting, and a control group that did no exercise. A POMS questionnaire was administered at various times throughout the semester. The results showed that the runners and aerobic dancers had similar increases in positive mood states and greater positive mood increases than the weightlifters by the end of the semester. It was also found that runners had a more positive mood profile than the control of nonexercisers. These researchers also reported that the control group and weightlifters had increases in anger, confusion, and tension on the POMS test, whereas the runners and aerobic dancers had decreases in those areas (Dyer & Crouch, 1988).

All levels of runners, from beginners to elite, can experience the benefit of running to increase mood states. In another study done by Dyer and Crouch (1987), 59 subjects were divided by running ability into three groups, a non-running control group, beginning runners, and trained runners. It was found that the beginning runners and trained runners had comparable increases in positive mood states after an exercise session. During the same time frame, the nonexercising controls did not change their positive mood states. These findings suggest that the benefits of exercise to increase positive mood states can be experienced by the beginning exerciser, not just the well-trained exerciser (Dyer & Crouch, 1987). A person can be a marathon runner or a

recreational jogger and reap the exercise benefits of increased mood states (Wilson, Morely, & Bird, 1980).

Mode, duration, and intensity are three basic components of exercise programming. Intensity of exercise is commonly measured by using a percent of maximum heart rate. Higher heart rates have been correlated with an increase in positive mood states in some studies (Kerr & Van-Den-Wollenberg, 1997; McGowan et al., 1996), but in other studies the relationship between intensity level and mood states is unclear (Berger & Owen, 1998; Steptoe & Cox, 1988).

For example, McGowan et al. (1996) examined 28 subjects in a study measuring heart rate and mood states. It was found that subjects achieving higher hearts rate during aerobic exercise had a greater increase in positive mood on a POMS test. Similar results were also found in a study that examined runners (Kerr et al., 1997). Kerr et al. (1997) found that runners that ran at a higher intensity had greater increases in positive mood states than those running at a low intensity.

Data reported by others do not fully support these dose-response data. Berger and Owen (1998) found no difference in POMS scores for persons exercising at a low intensity level compared to persons exercising at a moderate intensity level. Subjects jogged at either a low intensity (50-59% of max heart rate) or a moderate intensity (60-79% of max heart rate) for 20 minutes. Increases in positive mood on the POMS test were found to be equal in the low and moderate groups. None of the subjects were able to maintain a heart rate above 80% of their maximum, therefore high intensity exercise could not be compared. Similar results were found by Dunn and McAuley (2000), who found that over the time course of a single exercise bout there were increases in positive

feeling states and decreases in negative feeling states. These responses were the same whether the subjects ran at low intensity (60% of maximal intensity) or at high intensity (80% of maximal intensity).

Another study comparing low and high running intensity further clouds the relationship between intensity and mood states. Steptoe and Cox (1988) found that subjects who ran at a higher heart rate had increases in tension and anxiety on the POMS and subjects that ran at a low heart rate had increases in vigor and exhilaration. In sum, it is clear that low to moderate intensity exercise provides positive mood state benefits, whereas the relationship between high intensity exercise and positive mood states remains unsettled.

Regardless of mode, duration, or intensity, simply participating in exercise has been shown to increase positive mood states (Kavussanu & McAuley, 1995). Kavussanu and McAuley (1995) surveyed 188 subjects, 19 to 71 years of age, on their level of physical activity, optimism and pessimism, physical self-efficacy, and trait anxiety. Results suggested that moderately active and highly active subjects were more optimistic than inactive subjects. Results also showed that subjects that exercised and felt that they had completed the workout successfully had a greater increase in positive mood states. The feeling of mastery that the participants felt from the workout gave them a feeling of control over their environment, and therefore invoked optimism (Kavussanu & McAuley, 1995).

Aerobic exercise has been shown to be just as beneficial for managing mood and stress when compared to relaxation training (Berger, Friedmann, & Eaton, 1988). Authors placed subjects into different stress management groups; jogging, relaxation,

group interaction, and control groups. For twelve weeks the subjects participated in their assigned program. All groups except the control group had a short-term reduction in stress, but the jogging group and relaxation group had the greatest increase in positive mood states on a POMS test. This study suggested that even though jogging is a vigorous activity it could bring about the same results as a relaxation exercise (Berger et al., 1988)

Interactions Among Environment, Mood, and Exercise

If a person does not feel comfortable in an environment, work productivity suffers (Canter, 1961). Comfort level and other environmental factors such as accessibility and pleasantness of surroundings can influence exercise behavior in much the same way (Sallis, Johnson, Calfas, Caparosa, & Nicholas, 1997). For example, a common factor that may influence exercise behavior is crowdiness, such as may occur in a fitness center. Several studies have found that subjects exercising in a setting where they felt they were being judged or evaluated received less benefit from the exercise as those perceiving the setting to be non-threatening (Harte & Eifert, 1995; Katula & McAuley, 2001; Katuala, McAuley, Mihalko, & Bane, 1998; Spink, 1992). Six studies examining exercise environments are discussed below, and each of these studies supports the notion that environment influences mood states.

Spink (1992) found that a person's anxiety about their physique kept them from participating in a program where they were surrounded by people that they felt judged them. The researcher asked 37 subjects to fill out a questionnaire about the location of the exercise they currently participated in. Subjects also filled out a social physique anxiety scale. After dividing the subjects into either high anxiety or low anxiety groups their exercise locations were compared. People with a high level of anxiety about their body

chose to exercise in a private setting instead of an exercise setting in a public facility (Spink, 1992).

A similar study found that a mirror placed in front of an individual during exercise may affect performance (Katula et al., 1998). Thirty-four male and female subjects participated, and those subjects with low self-efficacy had a less positive experience when the mirror was placed in front of them. Self-efficacy was defined as the feeling of self-assurance or self-esteem when participating in a certain task (Katula et al., 1998). Women were more negatively affected by the mirrors than were men. In contrast, these authors found in a follow-up study that female exercisers improved in self-efficacy following acute exercise in front of a mirror (Katula & McAuley, 2001). Why these data are so conflicting remains unknown. Nevertheless, mirrors are an environmental factor in many workout facilities and these data suggest that they can affect many people's exercise experiences.

One study examined the emotional environment of exercisers (McAuley, Talbot, & Martinez, 1999). College females in this study were assigned to a low or high self-efficacy condition, where subjects' self-efficacy was manipulate by bogus feedback and graphical displays. Subjects in the high self-efficacy group were given positive feedback about their performance and shown bogus computer feedback that was positive compared to normative data. Subjects in the low self-efficacy group were given negative feedback about their performance as well as bogus negative computer data. When both groups returned for the next exercise session they were given similar same bogus information. Researchers found that subjects in the low self-efficacy group reported more psychological distress and more fatigue than those in the high self-efficacy group.

McAuley et al. (1996) examined state anxiety among a non-exercising control group, persons exercising in a laboratory, and persons exercising in a natural environment of their choosing. At the end of a single exercise session, both exercise groups scored lower on state anxiety than the control group, but there were no statistically significant differences between the laboratory and natural environment exercise groups. These results suggest that the environment may not have a measurable effect on anxiety. However, the single day of exercise testing employed in this study limits the applicability of these findings.

A feature of the environment shown to affect mood states is attention. That is, what features in the environment draw attention? Harte and Eifert (1995) compared physiological and psychological responses during three different types of exercise environments. The environments were outdoors, indoors with a treadmill and external stimuli, and indoors with a treadmill and internal stimuli. The external stimuli were sounds typically heard in outdoor environments (wind, cars, and birds). The internal stimuli were the subjects' own breathing sounds. Sounds were delivered via a portable cassette player and headphones. All subjects exercised (ran) in all three environments. Mood states were evaluated by the POMS test. Physiological stress was evaluated by blood pressure, adrenaline, nonadrenaline, and cortisol urine samples. Cortisol hormones are indicative of stress when they are present in excess in the blood or urine. The results suggested that the environment causing the most internal focus of attention (listening to breathing) resulted in higher negative mood states and higher levels of hormones in the urine samples. These authors concluded that setting, attentional focus, and cognitive appraisal demands might alter the emotional experiences associated with exercise.

Fillingim and Fine (1986) also manipulated focus of attention during exercise. These authors found that subjects who were asked to focus only on their breathing during exercise had a more negative experience than those subjects that were allowed to listen to a portable music player. When the focus of attention was only on the body the subjects fatigued more quickly. Taken collectively, these results suggest that exercise alone may not decrease negative mood states, but that factors in the exercise environment can influence mood states and must be considered when examining the relationship between exercise and mood.

Summary

When a person is put under too much psychological stress it can lead to physical illness. One way to manage stress and its negative consequences is by increasing positive mood states. One way to increase positive mood states is with aerobic exercise (Berger et al., 1988; Dyer & Crouch, 1987, 1988; Kavussana & McAuley, 1995; McGowan et al., 1993, 1996; Morgan, 1984; O'Connor et al., 1989; Williams et al., 1991).

The environment, including the exercise environment, can play an important role in a person's overall mood. Currently, there is minimal research showing what environmental factors impact exercise, or how environmental factors and exercise interact with respect to affecting one's emotional response to exercise. Indoor and outdoor exercise environments are important environmental considerations, yet only one study has compared these environments when exercise has been used to control mood (Harte & Eifert, 1995). Because indoor and outdoor environments differ markedly, and factor into one's exercise adherence (Sallis et al., 1997), more information about the effects of these exercise environments on mood states is warranted.

Chapter 3

METHODS AND PROCEDURES

Many aspects of exercise have been examined to determine what type of exercise program will be most beneficial for increasing positive mood states. One aspect of exercise that has not been fully explored is the environmental setting where the exercise takes place. Indoor and outdoor environments are among the most basic environmental choices and offer unique experiences for the exercise participant. Yet, only minimal research exists comparing the experiences in these two settings. The methods described herein were designed to 1) assess mood states in persons exercising indoors and outdoors, and 2) compare these findings to physiological indicators and exercise performance.

Participants

Eight female and seven male volunteer participants were recruited from the Ithaca College campus by word of mouth and a recruitment flyer placed around the campus (Appendix A). Average age of participants was 21.2 ± 2.1 years. One female subject dropped out of the study before the first exercise session due to a knee injury. All subjects stated that they were experienced runners of five or more years. Subjects currently exercised and ran either to maintain their physical fitness or as part of an athletic team. All of the subjects felt confident that they could run 3.4 miles without difficulty, and stated that they currently ran at least 3.4 miles during their workouts. All participants were in good health, as established by the Physical Activity Readiness Questionnaire (Appendix B) (PAR-Q; Thomas, Reading, & Shephard, 1992). Based on these data the participant pool can be classified as young adults and experienced in running.

Psychological Measures

The POMS short form questionnaire (Appendix C) was used to measure psychological mood states (McNair et al., 1992). The POMS test is a valid and sensitive measure of mood states for nonpsychiatric populations (McNair et al., 1992). Subjects completed the POMS test in about three to five minutes without interference from others (see testing procedures later in this chapter). For the outdoor trials, subjects filled out the POMS questionnaires outside just before and after their run. For the indoor trials, subjects filled out the POMS questionnaire in the Ithaca College fitness center just before and after exercising.

The POMS test consists of six subscales: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. The POMS short form is a 30 word questionnaire that assesses feelings people have. All six subscales are located on one page in random order. Each "question" is a single word in which respondents provide an answer about how they feel on a 0-4 scale. Zero = not at all; one = little; two = moderate; three = quite a bit; and four = extremely. Subjects are to fill in the circle that they feel best matches the intensity of the words listed. Examples of words for each subscale are: tension-anxiety, tense; depression-dejection, unworthy; anger-hostility, angry; vigor-activity, full of pep; fatigue-inertia, sluggish; and confusion-bewilderment, forgetful. The POMS TMDS was compiled by adding all the subscales scores together, except the vigor factor, which is subtracted from the whole. A lower score represents a more positive mood state. The POMS test was administered pre and post exercise.

A two-part Environmental Perceptions Questionnaire was created by the researcher to assess perceptions of exercise environments. The subjects, without interference, filled out the questionnaire in about two minutes (see testing procedures later in this chapter). Similar to the POMS questionnaire, the Environmental Perceptions Questionnaire was also administered in the environment where the subject exercised.

Part One of the Environmental Perceptions Questionnaire was Likert-type questions given pre and post exercise to determine subjects' perceptions of the exercise environment (Appendix D for Part One and Part Two; Indoor and Outdoor). Separate questionnaires were given for outdoor exercise and indoor exercise trials, but the questions on each differed only in specific features of exercise. For instance, question one (Part One) on the outdoor questionnaire asked, "How would you rate your degree of comfort exercising on the college campus and track"? In contrast, question one (Part One) on the indoor questionnaire asked, "How would you rate your degree of comfort exercising in the fitness center on a treadmill"? Each of the seven questions was scored on a scale from one ("good") to five ("poor"), thus a more favorable perception was scored lower. The total score for indoor perceptions and outdoor perceptions were compared. The questionnaire was given pre and post exercise.

All seven questions were located on one page. The good to poor responses to each question differed depending on the adjective used in the question. For example, responses to the first question (Part One; Indoor), "How would you rate your degree of comfort exercising in the fitness center on a treadmill?" were: one = very comfortable; two = comfortable; three = neutral; four = somewhat comfortable; and five = not comfortable. The second question on the environmental questionnaire (Part One; Indoor), "How would

you describe your motivation exercising in the fitness center on a treadmill?" had the following answer: one = very motivated; two = motivated; three = neutral; four = somewhat motivated; and five = not motivated.

Part Two of the Environmental Perceptions Questionnaire was a checklist type questionnaire, designed to inquire about the participants' preferred exercise environments. The purpose of Part Two was to gain a better understanding and description of the subject pool in terms of what types of exercise they preferred and typically participated in.

An example of a question on Part Two of the Environmental Perceptions Questionnaire for both indoors and outdoors asked participants to describe their ideal exercise environment. They were given choices ranging from warm and sunny to temperature-controlled. Another question asked subjects where they usually exercise and provided choices ranging from an indoor gym to a structured class. This part of the questionnaire was administered to the participants at the same time as the POMS test and part one of the environmental questionnaire, that is, before and after each of the four exercise sessions. For the purpose of this investigation, only the results of the first test administration (i.e., pre-exercise test), were used. The reason for only using the pre-test scores was to get a sense of the preferred exercise environment prior to "contamination" from the exercise sessions. Mean scores from the 15 subjects were used to determine the preferred environment.

Physiological Measures

Heart rate was monitored for each participant during exercise using a Polar heart rate monitor (Protrainer XT Cycle, Polar Electro Inc., 370 Crossways Park Drive,

Woodbury, NY 11797-2050.) The monitors were strapped around each participant's rib cage and a wristband receiver recorded heart rate. An average heart rate during each exercise session was recorded. Participants were educated on appropriate heart rate ranges to control their intensity level throughout the exercise. Run time was also recorded on the wrist band receiver for all trials. Subjects started the wristband timer when they began running and stopped the clock when they finished.

Testing Procedures

The testing and exercise schedule is summarized in Table 1. Participants came to the researcher's office prior to the first exercise session and were given an informed consent form (Appendix E) and the PAR-Q to read and sign. There were no other people in the office at the time each participant and researcher met. The participants were also asked about their ability to complete the 3.4-mile exercise run. If by verbal self-report a participant indicated that 3.4 miles would or could be difficult, then they were excluded from the study. All participants' data were recorded and scored using a letter and number in place of their name to ensure confidentiality.

All participants were familiarized with the indoor and outdoor exercise environments and testing equipment (e.g., heart rate monitor, treadmill controls) prior to testing. The researcher walked with each participant to familiarize each to the route that the he or she would run for the outdoor trials. Each participant had the opportunity to ask questions about the route at that time. All participants had used the Ithaca College fitness center and were familiar with the facility. Participants were also shown how to use the Polar heart rate monitor and wristband receiver and were allowed to try them on.

Table 1

Testing and Exercise Schedule.

Day 1	Days 2,3,4,5			
		Exercise Session (3.4 miles @ 70% max HR)		
Participant Screening	Pretest	Outdoor	Indoor	Post Test
1. PAR-Q 2. Confirmation of Ability to run 3.4 miles 3. Informed Consent	1. Environmental Perceptions Questionnaire 2. POMS Test	1. Campus roads, trails 2. Environmental Data • Temperature • Humidity 3. Criterion Measures • Average HR • Running Time	1. Treadmill @ 1% grade 2. Environmental Data • Temperature • Humidty 3. Criterion Measures • Average HR • Running Time	1. Environmental Perceptions Questionnaire 2. POMS Test

Note: Day one only included participant screening and familiarization. Days 2-5 were actual exercise days.

Each participant exercised two times (two trials) indoors and two times (two trials) outdoors for a total of four exercise sessions (treatment trials). The order of exercise (indoor versus outdoor) was balanced over participants and across days to control for potential order effects. Participants were given the option of performing the four trials on a Monday, Wednesday, Friday, Monday schedule, or a Tuesday, Thursday, Tuesday, Thursday schedule. Participants also picked the time of day they wished to exercise, but were not allowed to pick the order of the trials (i.e., running indoors verses outdoors) to control for bias of one environment over another.

On each exercise day participants were administered the Environmental Perceptions Questionnaire and the POMS test pre exercise. On the hour the exercise session began, the local temperature, humidity level, wind speed, and cloud coverage were recorded from the National Weather Service (2001) website. The indoor environment temperature and humidity levels were also recorded at the start of the indoor exercise sessions. The indoor temperature was recorded using a thermometer located on the wall of the fitness center and a barometer was brought to the facility each exercise day to record humidity. The barometer was placed near the treadmill that each subject used.

Participants ran 3.4 miles indoors on a 1% grade treadmill, or outdoors on the predetermined route on campus roads and trails. Research has shown that a 1% grade accurately reflects the energy cost of running outdoors with the added factor of wind (Jones & Doust, 1996). Participants were instructed to maintain an average intensity level of at least 70% of their maximal heart rate and use the heart rate monitor as heart rate

feedback. Maximum heart rate was determined as 220 minus age. Participants regulated their own exercise intensity by voluntarily modifying running speed over ground or by changing treadmill speed.

The time it took to complete the 3.4 miles was recorded and an average heart rate for the entire exercise bout was recorded from the heart rate monitor. After each exercise session the Environmental Perceptions Questionnaire and POMS test were again administered.

Statistics and Criterion Measures

Descriptive statistics for the participants and environmental conditions were calculated. A 2 x 2 x 2 repeated measures analysis of variance (ANOVA) was used to compare the POMS TMDS and Environmental Perceptions Questionnaire scores across condition (indoors vs. outdoors), trial (exercise session 1 vs. exercise session 2 for each treatment condition), and time (pre exercise versus post exercise). A 2 x 2 repeated measures ANOVA was used to analyze the physiological dependent measures (average heart rate and run time) across condition and trial. Tukey's HSD post hoc tests were used to locate the source of confounding interactions. All hypotheses were tested at $\alpha = .05$.

Chapter 4

RESULTS

The purpose of this investigation was to compare indoor and outdoor exercise environments to assess if individuals responded differently with respect to mood states, heart rates, and running times. The relationship between preferred environment and mood states was also examined. This chapter is divided into the following sections: (a) descriptive data of environmental conditions and participants, (b) analysis of mood states and environmental perceptions, and (c) analysis of physical performance measures.

Descriptive Data of Environmental Conditions and Participants

Weather statistics for the outdoor trials are presented in Table 2 and Figure 1. Raw data for temperature, humidity, and wind is located in Appendix F. These data were collected for the hour each participant began exercising, and were obtained from the National Weather Service (2001) website. As indicated in Table 2, the average outdoor temperature of 61.9° F was 18.3° F colder than the average indoor temperature of 80.2° F. The outdoor conditions also had an average windspeed of 9.4 mph. On the other hand, the humidity only differed by 2 percentage points between indoors (51.7%) and outdoors (53.5%).

According to the National Weather Service data, only three days of the total 30 exercise days were classified as cloudy (see Figure 1). The rest of the days were somewhat equally divided among mostly cloudy, mostly clear, and clear. In general, the outdoor exercise conditions had moderate to chilly temperatures and were somewhat cloudy, compared to a warmer indoor environment.

Table 2

Average Temperature, Humidity, and Wind Speed for Indoor and Outdoor Exercise Sessions.

	Indoor		Outdoor		
	Temperature (degrees F)	Humidity (Relative %)	Temperature (degrees F)	Humidity (Relative %)	Wind Speed (mph)
Mean	80.2	51.7	61.9	53.5	9.4
SD	2.0	14.6	9.8	14.3	3.3

Note: Means and standard deviations (SD) are for a total of 30 trials; 15 participants, each completing two trials indoors and two trials outdoors.

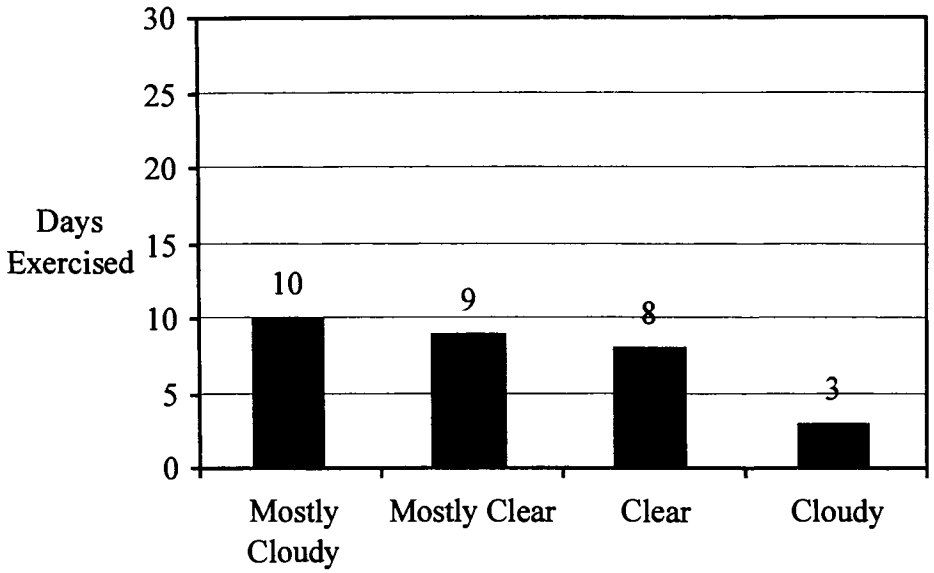


Figure 1. Cloud Coverage for the 30 Outdoor Exercise Trials. Data are from the National Weather Service.

As already discussed, Part Two of the Environmental Perceptions Questionnaire contained five questions about ideal and preferred exercise environments. The tallied scores from these questions are shown in Table 3. The first question asked about the subject's ideal exercise environment. The participants preferred exercising in warm outdoor environments filled with trees and "fresh air," rather than cold and wet conditions or indoors in a controlled temperature environment.

The second question asked if the participants preferred exercising indoors or outdoors. All participants answered that they preferred outdoors. The third question asked where the subjects usually exercised and the conditions surrounding their usual exercise sessions. The participants reported that they usually exercised on trails or exercised alone, and rarely exercised at home or in a structured class.

The fourth question asked what mode of exercise the participants usually engaged in. The participants reported that they usually ran and/or weight trained for their physical activity. The final question asked why the participants exercised. The participants reported that they exercised for fun, stress relief, and to strength train rather than for depression management, physical therapy, or cosmetic reasons.

Based on these responses from Part Two of the Environmental Perceptions Questionnaire, it can be inferred that the subject pool was composed of subjects who preferred to run outside and who were accustomed to running by themselves and on outdoor trails.

Table 3

Preferred Exercise Environments. Total Tallied Scores to Part Two of the Environmental Perceptions Questionnaire.

Check all that apply:	
1. **My ideal exercise environment includes:**	
lots of people	2
landscape/trees	**15**
fresh air	**15**
dry weather	9
wet/wind	1
warm/sun	9
chilly/clouds	0
temperature controlled room	1
solitude/quiet	5
music/noise	9
other	0
2. **I prefer to jog or run**	
indoor treadmill	0
outdoor on campus	**15**
3. **I usually exercise: Check all that apply**	
with people around	7
by myself	**13**
indoor gym	6
at home	1
outdoors track	8
outdoor trails	**11**
in a structured class	1
with friends	8
streets	8
other	1
Check all that apply:	
4. **I usually (in a normal week in April)___when I exercise.**	
run/jog	**14**
bike	5
weight lift	**10**
swim	2
aerobics	2
rollerblade	1
other	3
5. **Rank the top three reasons why you exercise:**	
weight management	7
physical therapy	0
stress relief	**10**
manage depression/mood	1
strength training	8
socialize/meet people	1
medical/health reasons	3
sport/team requirement	3
cosmetic	2
fun, I like to exercise	**9**
other	1

Note: All Questions Were Answered on the First Exercise Day for all 15 Subjects. The Highest Score Possible is Fifteen. The Lowest Score Possible is Zero. The Total for all 15 Subjects is Reported.

Analysis of Mood States and Environmental Perceptions

Psychological measures were calculated by summing the scores (total score) from the POMS test and Part One of the Environmental Perceptions Questionnaire. Raw data for TMDS are located in Appendix G. The TMDS is calculated by adding the six subscales together with the exception of vigor which is subtracted from the whole. The six subscales are: tension-anxiety, Appendix H; depression-dejection, Appendix I; anger-hostility, Appendix J; vigor-activity, Appendix K; fatigue-inertia, Appendix L, and confusion-bewilderment, Appendix M. Means and standard deviation for the POMS TMDS are presented in Table 4 and the analysis of variance results in Table 5. Three way analysis of variance results for the POMS TMDS test for the main effect of condition indicated that the total mood disturbance score was significantly lower outdoors (M = –.95, SD = 10.9) than indoors (M = 3.1, SD = 2.4), $F(1,14) = 7.88$; $p = .014$. The main effect of trial was not statistically significant, $F(1,14) = 3.10$, $p = .10$, although the mean data revealed a tendency for participants to report a lower POMS TMDS on the second exercise session. Similarly, the main effect for time approached but did not reach statistical significance, $F(1,14) = 4.37$, $p = .055$, suggesting a tendency for better moods to be reported after exercise than before exercise. None of these findings were confounded by significant interactions. That is, the main effect condition showed no significant difference for Condition x Trial, Condition x Time, Trial x Time, or Condition x Trial x Time.

Table 4

Means and Standard Deviations for the POMS TMDS for the Indoor and Outdoor Exercise Trials.

	Indoor Exercise				Outdoor Exercise			
	Trial 1		Trial 2		Trial 1		Trial 2	
	Pretest	Post Test	Pretest	Post Test	Pretest	Post Test	Pretest	Post Test
Mean	7.60	2.40	2.13	0.27	3.53	-4.20	0.87	-4.00
SD	8.55	15.10	8.64	15.48	11.89	10.06	9.52	11.05

Note: Pretest is Prior to an Exercise Bout; Post Test is After an Exercise Bout. A Lower Score Suggests a More Positive Mood State.

Table 5

ANOVA Table for POMS TMDS.

	df	SS	MS	F	p-value
Condition	1	525.008	525.008	7.879*	0.014
Error	14	932.867	66.633		
Trial	1	170.408	170.408	3.102	0.100
Error	14	768.967	54.926		
Time	1	765.075	765.075	4.365	0.055
Error	14	2453.800	175.271		
Condition x Trial	1	39.675	39.675	0.409	0.533
Error	14	1356.700	96.907		
Condition x Time	1	46.875	46.875	0.441	0.518
Error	14	1489.000	106.357		
Trial x Time	1	60.208	60.208	0.975	0.340
Error	14	864.167	61.726		
Condition x Trial x Time	1	.0083	.0083	0.000	0.989
Error	14	551.367	39.383		

Note: Condition is Indoor Versus Outdoor, Trial is Trial 1 Versus Trial 2, and Time is Pre-Exercise Versus Post Exercise.

* $p < .05$

Means and standard deviations for Part One of the Environmental Perceptions Questionnaire are presented in Table 6 and the analysis of variance results in Table 7. Raw data for this questionnaire are located in Appendix N. Three way analysis of variance results for the environmental questionnaire for the main effect of condition indicated that the total environmental perception score was significantly higher indoors ($M = 18.4$, $SD = 4.1$) than outdoors ($M = 13.6$, $SD = 3.4$), $F(1, 14) = 40.02$, $p = .000$.

These results indicate that the participants had a more positive perception of the outdoor environment than the indoor environment. The main effect of trial was not statistically significant, $F(1,14) = 1.513$, $p = .239$. The main effect for time also was not statistically significant $F(1,14) = .535$, $p = .476$. The condition and trial main effects were confounded by a significant Condition x Trial interaction $F(1,14) = 5.806$, $p = .030$. This clouded the issue on inferring the outdoor environment to be perceived more positively than the indoor environment. A Tukey HSD post hoc test revealed that this interaction was due to statistical significance between trial 1 and trial 2 of the indoor condition only (Table 8). That is, the subjects' perception of the environmental conditions during the second indoor running session was more favorable than in the first indoor running session. Therefore, these results do not confound the findings that the perception of outdoor exercise was more favorable than indoor exercise.

Table 6

Means and Standard Deviations for Part One of the Environmental Perceptions Questionnaire Comparing Indoor and Outdoor Exercise.

	Indoor Exercise				Outdoor Exercise			
	Trial 1		Trial 2		Trial 1		Trial 2	
	Pretest	Post Test	Pretest	Post Test	Pretest	Post Test	Pretest	Post Test
Mean	19.3	18.9	17.5	18.0	14.1	12.9	13.9	13.6
SD	4.4	4.6	2.1	5.1	2.6	3.3	3.6	4.1

Note: Pretest is Prior to an Exercise Bout; Post Test is After an Exercise Bout. A Lower Score Suggests a More Positive Environmental Perception.

Table 7

ANOVA Table for Part One of the Environmental Perceptions Questionnaire.

	df	SS	MS	F	p-value
Condition	1	691.200	691.200	40.020**	0.000
Error	14	241.800	17.271		
Trial	1	8.533	8.533	1.513	0.239
Error	14	78.967	5.640		
Time	1	3.333	3.333	0.535	0.476
Error	14	87.167	6.226		
Condition x Trial	1	19.200	19.200	5.806*	0.030
Error	14	46.300	3.307		
Condition x Time	1	4.800	4.800	0.900	0.359
Error	14	74.700	5.336		
Trial x Time	1	4.800	4.800	1.631	0.222
Error	14	41.200	2.943		
Condition x Trial x Time	1	0.000	0.000	0.000	1.000
Error	14	32.000	2.286		

Note: Condition is Indoor Versus Outdoor, Trial is Trial 1 Versus Trial 2, and Time is Pre-Exercise Versus Post Exercise.

* $p < .05$, ** $p < .001$

Table 8

Results From the Tukey HSD Post Hoc Test.

Condition	Group Means	Tukey HSD Critical Values	
Indoor Trial 1	19.10	ANOVA Mean Square Error	3.307
Indoor Trial 2	17.75	Observations per group	30
Outdoor Trial 1	13.50	Critical q	4.11
Outdoor Trial 2	13.75	Critical difference	1.346

Absolute Differences Between Means.

	Indoor Trial 1	Indoor Trial 2	Outdoor Trial 1	Outdoor Trial 2
Indoor Trial 1				
Indoor Trial 2	1.35*			
Outdoor Trial 1	5.60*	4.25*		
Outdoor Trial 2	5.35*	4.00*	0.25	

*Absolute differences between means greater than the critical difference of 1.346 indicates a significant difference between the groups.

Analysis of Physical Performance Measures

Two way analysis of variance results for heart rate were not significantly different between the outdoor (M = 176.1, SD = 12.5) and indoor (M = 175.2, SD = 12.2), $F(1,14)$ = .248; p = .626, exercise conditions, nor were there differences between the first (M = 176.5, SD = 12.0) and second (M = 174.8, SD =12.7) exercise trials $F(1,14) = 1.08$; p = .361. The means and SDs for the 30 trials are listed in Table 9 and the analysis of variance results in Table 10. Raw data for average heart rate are located in Appendix O.

A two way analysis of variance was also conducted for run time. Outdoor running time was significantly faster outdoor (M = 25.1, SD = 3.1) than indoor (M = 28.1, SD = 3.6), $F(1,14) = 67.487$; p = .000. There were no significant trial to trial differences or condition by trial interactions (see Table 11 for means and standard deviations and Table 12 for the analysis of variance results table). Raw data for run times are located in Appendix P.

Summary

Participants reported more positive mood states for the outdoor exercise sessions compared to the indoor exercise sessions; mood states were more positive before and after outdoor exercise compared to indoor exercise. The Environmental Perceptions Questionnaire also revealed that the participants perceived the outdoor environment as being more positive than the indoor environment. These data suggest that even the expectation of outdoor exercise was sufficient to elevate mood states. Heart rate did not differ between indoor and outdoor exercise, but running time averaged nearly three minutes faster in the outdoor condition. Part II of the Environmental Perceptions Questionnaire indicated that participants exercised primarily for fun and stress relief.

Table 9

Means and Standard Deviations for Average Heart Rate During the Indoor and Outdoor Exercise Trials.

	Indoor Exercise		Outdoor Exercise	
	Trial 1	Trial 2	Trial 1	Trial 2
Mean	176.2	174.2	176.7	175.5
SD	11.1	13.6	13.1	12.2

Note: Heart Rates are in Beats Per Minute

Table 10

ANOVA Table for Average Heart Rate.

	df	SS	MS	F	p-value
Condition	1	12.150	12.150	0.248	0.626
Error	14	684.600	48.900		
Trial	1	40.017	40.017	1.080	0.316
Error	14	518.733	37.052		
Condition x Trial	1	2.017	2.017	0.040	0.843
Error	14	697.733	49.838		

Note: Condition is Indoor Versus Outdoor, Trial is Trial 1 Versus Trial 2.

Table 11

Means and Standard Deviations for Run Time for the Indoor and Outdoor Exercise Trials.

	Indoor Exercise		Outdoor Exercise	
	Trial 1	Trial 2	Trial 1	Trial 2
Mean	28.4	27.9	25.4	24.8
SD	3.8	3.6	3.6	2.6

Note: Time is recorded in minutes.

Table 12

ANOVA Table for Run Time.

	df	SS	MS	F	p-value
Condition	1	136.595	136.595	67.487**	.000
Error	14	28.336	2.024		
Trial	1	3.815	3.815	1.832	.197
Error	14	29.163	2.083		
Condition x Trial	1	.069	.069	.044	.836
Error	14	21.642	1.546		

Note: Condition is Indoor Versus Outdoor, Trial is Trial 1 Versus Trial 2.

** $p < .001$

Chapter 5

DISCUSSION

It has been shown that aerobic exercise increases positive mood states (McGowan et al., 1993; Morgan, 1984; Rudolph & McAuley, 1995) and that the exercise environment can affect mood states by either inhibiting positive mood states or encouraging them (Canter, 1961; Fillingim & Fine, 1986; Katula et al., 1998). Results from the current study support these data as exercisers had a more positive mood states when exercising outdoors compared to indoors.

Participants reported more positive mood states on the POMS TMDS both before and after outdoor exercise as compared to indoor exercise. Thus, it appears that even the expectation of outdoor exercise was sufficient to raise mood states and create a positive exercise experience. This finding supports the hypothesis that positive exercise environments increase positive mood states, and adds new information about the value of environmental expectations on mood state. For example, Harte & Eifert (1995) reported more positive mood states after exercise in outdoor trials compared to indoor exercise trials, but did not report on mood states at the start of the exercise sessions. Katula et al. (1998) also reported that subjects had greater increases in self-efficacy in an exercise environment of their choice but did not report feelings of self-efficacy prior to the exercise session.

In the current study, it appears that subjects' mood states were more positive before exercising when it occurred in the subjects' preferred environment. This suggests that the environment strongly impacted mood state, not just the exercise alone.

The more positive mood states reported for outdoor exercise could be due to the participants' reports that they usually exercised outdoors rather than at home or in a structured class, and that they preferred the outdoor environment rather than a temperature controlled indoor environment. Thus, it is difficult to determine if the more positive mood states were a result of outdoor exercise *per se*, or simply that the participants exercised in their preferred environment. However, the participants also described their ideal exercise environment as one that was warm. This is in contrast to the average outdoor temperature during the outdoor trials of 61.9 degrees Fahrenheit (this is best described as chilly). The subjects, thus, preferred the outdoor environment even though the temperature was not as warm as they would have liked. From these data it can be inferred that moderate differences in temperature (i.e., the difference between warm and chilly) may have little influence on environmental perceptions or exercise mood states.

On the other hand, previous research has shown that wide differences or extremes in temperature may markedly alter one's environmental perception. Maw et al. (1993) manipulated environmental temperatures in a controlled laboratory setting, and found that their subjects felt worse and worked harder in a hot environment compared to a cool environment. In the current study, although subjects stated in the questionnaire that they preferred a warm environment, they actually had a greater increase in positive mood states in the cooler of the two environments. Clearly, further research is needed to examine indoor and outdoor temperatures ranges and their effect on mood states. This current study was not designed to look at temperature specifically but rather the overall surroundings.

Mood states generally became more positive after exercise for both indoor and outdoor exercise, but this effect was not statistically significant ($p = .055$). A larger sample size may have resulted in a statistically significant effect, as many other studies have shown an increase in mood states following moderate intensity exercise (McGowan et al., 1993; Morgan, 1984; Rudolph & McAuley, 1995). Examples of studies with larger sample sizes that did have a significant increase in positive mood states after exercise were Berger et al. (1988) with 387 subjects, Berger and Owen (1998) with 91 subjects, and McGowan et al. (1996) with 28 subjects.

Following outdoor exercise, positive mood states were enhanced when compared to indoor exercise, suggesting that exercise alone was not able to compensate for a less preferred environment. Current data also indicate that a non-preferred exercise environment need not promote a negative exercise experience. This finding is in contrast to earlier studies showing a decrease in positive mood states during exercise in unfavorable environments. A reason for these differences probably lies in the specific nature of the environments. In the current study, the indoor environment was not necessarily unfavorable, it was simply not preferred. In contrast, Spink (1992) and Katula et al. (1998) found that participants with a low self-image did not like exercising in public or in front of mirrors. In addition, studies in which the environment has forced an internal focus of attention, such as attending to breathing sounds, reported less positive mood states during exercise (Fillingim & Fine, 1986; Harte & Eifert, 1995). It appears that these data indicate is that specific features of the environment that influence mood states are dependent on individual preferences.

Average heart rate for the 3.4 mile run did not differ between the indoor and outdoor exercise. This is surprising considering that participants completed the outdoor course nearly three minutes faster than the indoor course. This could be due to a few factors. First, courses may not have been equivalent. For example, downhill sections of the outdoor run may have enabled the runners to speed up the time without an increase in heart rate. The overall change in elevation for the outdoor trail, though, was zero. Second, some runners might have cut corners outdoors, effectively decreasing the distance. Both of these explanations seem insufficient to fully explain a three minute differential. Third, it may be that the more positive experience outdoors had a psychophysiological effect on the runners, enabling them to run faster without a concommitant increase in heart rate (or just the opposite for the indoor environment). Indeed, many of the participants admitted to slowing the treadmills down during their run as they did not enjoy their time on the treadmill. Last, the warm indoor temperature could have also been a factor in the slower running speed indoors. Maw et al. (1993) reported that subjects felt they worked harder in a hot environment, which is consistent with thermoregulatory stress. If subjects felt they were becoming overheated or working harder, they may have slowed the treadmills down. This is speculation because this study was not designed determine why subjects slowed the treadmill, or if they felt the 80.2 average indoor temperature was too warm.

In sum, with this participant group, the outdoor environment created a more positive exercise experience than the indoor environment in relation to mood states and running time. Whether these results would hold true for less fit persons or persons of a different age category, is yet to be determined.

Chapter 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Overall, the participants in this study perceived outdoor environments more positively than indoor environments. In accord, participants had more positive mood states both before and after running outdoors than indoors. The average heart rates were the same outdoor and indoor but running performance was faster outdoor.

Conclusions

When individuals perceive their exercise environment positively they generally will have more positive mood states than when they perceive the environment less favorably. In the current study participants had more positive mood states when running outside than when running indoors on a treatmill. Participants may perform better in an environment they perceive more positive. Indoor and outdoor running environments, especially treadmill versus trail running, are perceived differently. The act of running or performing aerobic activity is not the only component in exercise prescription for managing mood states. The location where exercise takes place can influence the benefits of aerobic exercise for managing mood states.

When writing an exercise prescription for the purpose of managing a client's mood states, it is important to consider the client's preferred exercise environment. When exercising, it is important to feel positive about the surroundings. Exercising in an environment that is perceived negatively could result in decreased mood states and, ultimately, poor performance.

Recommendations For Further Study

Several questions were left unanswered by the current study. First, what was it about the outdoor exercise that led to faster run times? Whether this was a psychophysiological consequence of an increased mood state, or a methodological problem, is worth examining more closely. In conjunction with this suggestion, it would be important to assess the running of persons whose most preferred exercise environment is indoors. That is, would the running times be faster for persons running indoors on a treadmill (i.e., compared to outside) if their preferred environment were indoors?

Second, would the current findings differ if the exercise mode and other environmental factors were changed? For instance, would bicycling outdoors versus ergometer cycling indoors change these results? Would exercising outdoors only on warm and sunny days enhance positive mood states to an even greater degree? Third, it would be useful to examine different populations such as elders versus youth, or persons with depression or anxiety. For example, would elders have the same preferred exercise environments as young adults, and would this make a difference in mood states benefit of exercise?

Last, Gould and Weinberg (1999) stated that the perception of an environmental demand is different from person to person. One child may perceive the dark as scary, another child may perceive the dark to be non-threatening. This is also the case for exercise environments. One person may perceive an indoor fitness center negatively while another may perceive it positively. For future study, rather than changing the environment to please the individual, it would be of interest to change the individual's

perception of the environment. That is, instead of finding the ideal exercise environment for an individual, could individuals be taught to see every exercise environment as ideal?

Appendix A

RECRUITMENT FLYER

Can you run at least 30 minutes

a day/ four days a week?????????????

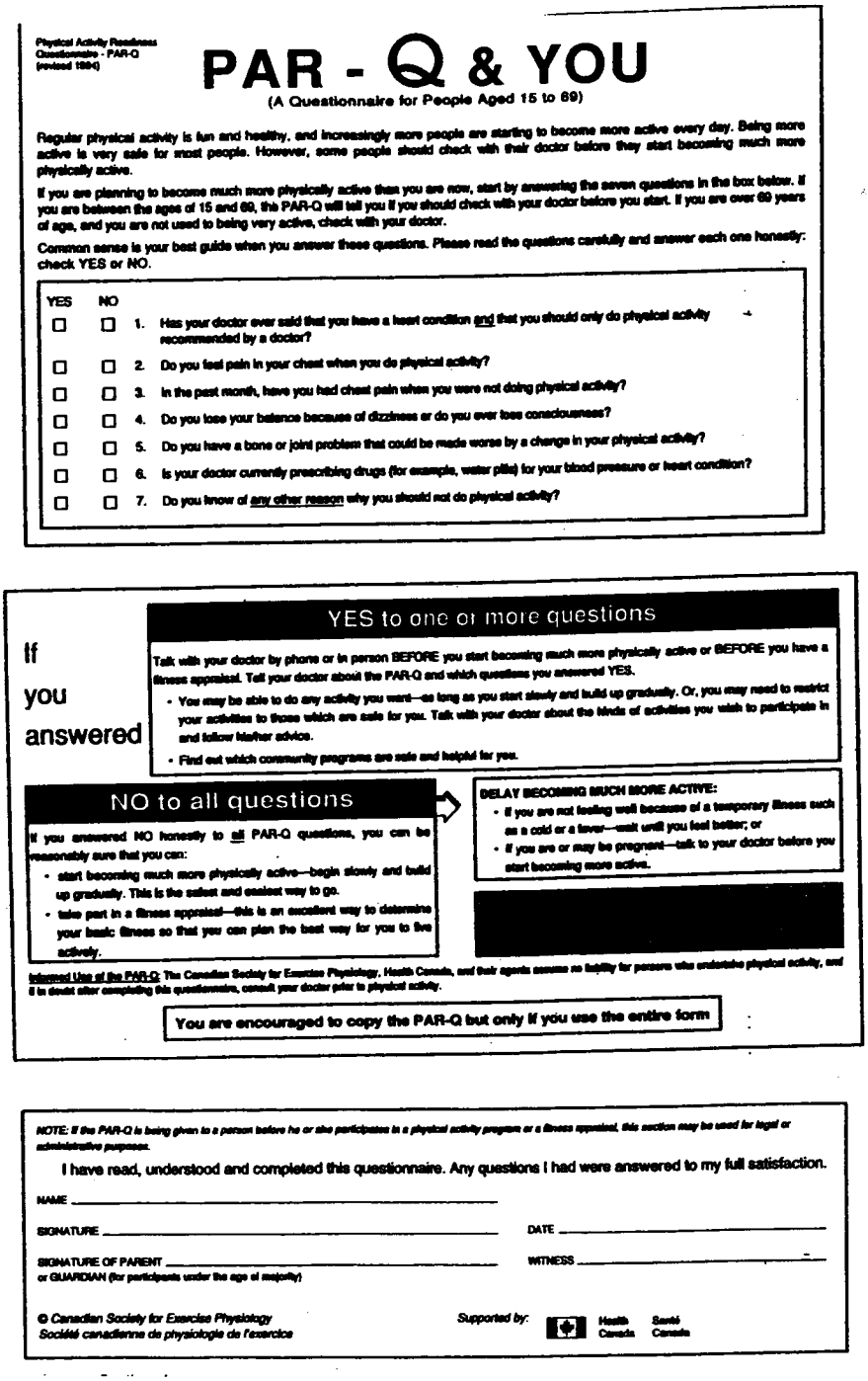
Want to participate in a study?

I am looking for subjects for my Masters Thesis. I need runners to run indoors and outdoors about 30 minutes for a total of four workouts. If you want to learn more about the field of exercise physiology and my thesis check it out.

With any type of exercise there is a risk. Participants will be screened to establish good health before participation. For further details call Sarah 256-8133 or stop by the Exercise Science Department. You can e-mail questions to shooper1@ic3.ithaca.edu or look on http://www.ithaca.edu/courses/es710/gsc to learn more.

Appendix B

THE PHYSICAL ACTIVITY READINESS QUESTIONNAIRE — PAR-Q



Physical Activity Readiness Questionnaire - PAR-Q (revised 1994)

PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	Has your doctor ever said that you have a heart condition and 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 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 any other reason why you should not do physical activity?

If you answered YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active—begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal—this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever—wait until you feel better; or
- if you are or may be pregnant—talk to your doctor before you start becoming more active.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

You are encouraged to copy the PAR-Q but only if you use the entire form

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Supported by: Health Canada / Santé Canada

Appendix C

PROFILE OF MOOD STATES QUESTIONNAIRE – POMS

NAME _____ DATE _____

SEX: Male ⓜ Female ⓕ Identification No. _____

Below is a list of words that describe feelings people have. Please read each one carefully. Then fill in ONE circle under the answer to the right which best describes HOW YOU HAVE BEEN FEELING DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases.

⓪ = Not at all
① = A little
② = Moderately
③ = Quite a bit
④ = Extremely

	Not at all	A little	Moderately	Quite a bit	Extremely
1. Tense	⓪	①	②	③	④
2. Angry	⓪	①	②	③	④
3. Worn out	⓪	①	②	③	④
4. Lively	⓪	①	②	③	④
5. Confused	⓪	①	②	③	④
6. Shaky	⓪	①	②	③	④
7. Sad	⓪	①	②	③	④
8. Active	⓪	①	②	③	④
9. Grouchy	⓪	①	②	③	④
10. Energetic	⓪	①	②	③	④
11. Unworthy	⓪	①	②	③	④
12. Uneasy	⓪	①	②	③	④
13. Fatigued	⓪	①	②	③	④
14. Annoyed	⓪	①	②	③	④
15. Discouraged	⓪	①	②	③	④
16. Nervous	⓪	①	②	③	④
17. Lonely	⓪	①	②	③	④
18. Muddled	⓪	①	②	③	④
19. Exhausted	⓪	①	②	③	④
20. Anxious	⓪	①	②	③	④
21. Gloomy	⓪	①	②	③	④
22. Sluggish	⓪	①	②	③	④
23. Weary	⓪	①	②	③	④
24. Bewildered	⓪	①	②	③	④
25. Furious	⓪	①	②	③	④
26. Efficient	⓪	①	②	③	④
27. Full of pep	⓪	①	②	③	④
28. Bad-tempered	⓪	①	②	③	④
29. Forgetful	⓪	①	②	③	④
30. Vigorous	⓪	①	②	③	④

MAKE SURE YOU HAVE ANSWERED EVERY ITEM.

Appendix D

ENVIRONMENTAL PERCEPTIONS QUESTIONNAIRE

(Indoor) Part One: Perceptions of Exercise Environment.

Pre ____Post _____

Circle the answer you feel best describes your feelings today.

How would you rate your degree of comfort exercising in the Fitness Center on a treadmill?

1	2	3	4	5
very comfortable	comfortable	neutral	somewhat comfortable	not comfortable

How would you describe your motivation exercising in the Fitness Center on a treadmill?

1	2	3	4	5
very motivated	motivated	neutral	somewhat motivated	not motivated

How self-confident are you exercising in the Fitness Center on a treadmill?

1	2	3	4	5
very confident	confident	neutral	somewhat confident	not confident

How relaxed and calm do you feel in exercising in the Fitness Center on a treadmill?

1	2	3	4	5
very relaxed	relaxed	neutral	somewhat relaxed	not relaxed

How nervous do you feel in the Fitness Center on a treadmill?

1	2	3	4	5
very nervous	nervous	neutral	somewhat nervous	not nervous

Is the Fitness Center treadmill your ideal place to run/jog?

1	2	3	4	5
absolutely	mostly	neutral	somewhat	not really

Do you normally (during a week in April) exercise in a setting like the one you are in today?

1	2	3	4	5
all the time	mostly	sometimes	rarely	never

Appendix D (Continued)

ENVIRONMENTAL PERCEPTIONS QUESTIONNAIRE

(Indoor) Part Two: Exercise Preferences.

Check all that apply:

1. **My ideal exercise environment includes:**
   - lots of people _____
   - landscape/trees _____
   - fresh air _____
   - dry weather _____
   - wet/wind _____
   - warm/sun _____
   - chilly/clouds _____
   - temperature controlled room _____
   - solitude/quiet _____
   - music/noise _____
   - other _____

2. **I prefer to jog or run**
   - indoor treadmill _____
   - outdoor on campus _____

3. **I usually exercise: Check all that apply**
   - with people around _____
   - by myself _____
   - indoor gym _____
   - at home _____
   - outdoors track _____
   - outdoor trails _____
   - in a structured class _____
   - with friends _____
   - streets _____
   - other _____

Check all that apply:

4. **I usually (in a normal week in April)_____when I exercise.**
   - run/jog _____
   - bike _____
   - weight lift _____
   - swim _____
   - aerobics _____
   - rollerblade _____
   - other _____

5. **Rank the top three reasons why you exercise:**
   - weight management _____
   - physical therapy/rehab _____
   - stress relief _____
   - manage depression/mood_____
   - strength training _____
   - socialize/meet people _____
   - medical/health reasons _____
   - sport/team requirement _____
   - cosmetic _____
   - fun, I like to exercise _____
   - other _____

Appendix D (Continued)

ENVIRONMENTAL PERCEPTIONS QUESTIONNAIRE

(Outdoor) Part One: Perceptions of Exercise Environment.

Pre _____Post _____

Circle the answer you feel best describes your feelings today.

How would you rate your degree of comfort exercising on the college campus and track?

1	2	3	4	5
very comfortable	comfortable	neutral	somewhat comfortable	not comfortable

How would you describe your motivation exercising on the college campus and track?

1	2	3	4	5
very motivated	motivated	neutral	somewhat motivated	not motivated

How self-confident are you exercising on the college campus and track?

1	2	3	4	5
very confident	confident	neutral	somewhat confident	not confident

How relaxed and calm do you feel in exercising on the college campus and track?

1	2	3	4	5
very relaxed	relaxed	neutral	somewhat relaxed	not relaxed

How nervous do you feel exercising on the college campus and track?

1	2	3	4	5
very nervous	nervous	neutral	somewhat nervous	not nervous

Is the college campus and track your ideal place to run/jog ?

1	2	3	4	5
absolutely	mostly	neutral	somewhat	not really

Do you normally (during a week in April) exercise in a setting like the one you are in today?

1	2	3	4	5
all the time	mostly	sometimes	rarely	never

Appendix D (Continued)

ENVIRONMENTAL PERCEPTIONS QUESTIONNAIRE

(Outdoor) Part Two: Exercise Preferences.

Check all that apply:

1. **My ideal exercise environment includes:**
   - lots of people _____
   - landscape/trees _____
   - fresh air _____
   - dry weather _____
   - wet/wind _____
   - warm/sun _____
   - chilly/clouds _____
   - temperature controlled room _____
   - solitude/quiet _____
   - music/noise _____
   - other _____

2. **I prefer to jog or run**
   - indoor treadmill _____
   - outdoor on campus _____

3. **I usually exercise: Check all that apply**
   - with people around _____
   - by myself _____
   - indoor gym _____
   - at home _____
   - outdoors track _____
   - outdoor trails _____
   - in a structured class _____
   - with friends _____
   - streets _____
   - other _____

Check all that apply:

4. **I usually (in a normal week in April)_____when I exercise.**
   - run/jog _____
   - bike _____
   - weight lift _____
   - swim _____
   - aerobics _____
   - rollerblade _____
   - other _____

5. **Rank the top three reasons why you exercise:**
   - weight management _____
   - physical therapy/rehab _____
   - stress relief _____
   - manage depression/mood_____
   - strength training _____
   - socialize/meet people _____
   - medical/health reasons _____
   - sport/team requirement _____
   - cosmetic _____
   - fun, I like to exercise _____
   - other _____

Appendix E

INFORMED CONSENT FORM

The Perception of Indoor and Outdoor Exercise Environments and Their Effect on Mood States, Heart Rate, and Running Time

Sarah E. Hooper

Purpose of the study:
This study has been designed to investigate the effect indoor and outdoor environment perceptions have on psychological mood states.

Benefits of the study:
You may gain a better understanding of the way the environment affects your mood and stress levels while exercising. This can be beneficial to you if you exercise for the purpose of managing stress.

What you will be asked to do:
You will have to commit one hour of your time for four days. This will begin on a day of your choice, then continue every other day until all four trials are complete. Each time you will fill out the environmental questionnaire and take a Profile of Mood States (POMS) Test. This will determine mood states and environmental perceptions. Heart rate will be taken and monitored by a heart rate monitor during exercise. A pedometer will be worn to track the distance that you run.

Risk associated with participation in this study:
The physical risks of this study are as any that may come about with aerobic exercise when exercising at a moderate to intense level. Heart failure, though uncommon in healthy adults, is possible. You will be supervised by a CPR certified researcher and have a heart rate monitor to monitor heart rate on your own. You will be educated about what a normal increase and steady state heart rate is before testing begins. You will not exercise outdoors when the weather is below freezing, or when it is precipitating.

You will also be educated to the signs and symptoms associated with over exertions and reasons for stopping exercise, such as dizziness, rapid change in heart rate, chest pains, shortness of breath, etc. You will be asked to answer questions about medical history and fill out the Physical Activity Readiness Questionnaire – PAR-Q form before exercising. The psychological concerns are minimal. You will be asked to describe your feelings about the environment and answer the Profile of Mood States Test.

Initials_____

For more information:
Please feel free to call or e-mail me at 256-8133 or shooper1@ic3.ithaca.edu. You may also contact Dr. Ives or Dr. Shelley with any question regarding this study.

Withdrawal from study:
You are not obligated to participate in this study. It is completely voluntary and you may stop at any time. If at any time you do not feel comfortable with the study, you are free to discontinue.

Confidentiality of the Data:
Once you have been assigned to a group your name will no longer be used and you will then be identified by a letter and number (A-F and 1-3). Names will not be associated with any data and will be erased from data sheets.

Debriefing:
You will have the opportunity at the end of the study to examine your results and ask any questions to the researcher that you might have about their individual results.
I have read and understand the Informed Consent Document and hereby give my consent for participation in this investigation. I also sign that I am at least 18 years old.

_____
Print or Type Name

_____
Signature Date

_____
Investigator Date

Appendix F

TEMPERATURE, HUMIDITY, AND WIND DATA

Complete Dataset for Temperature, Humidity, and Wind for the 30 Trials. Temperature is Reported in Fahrenheit, Humidity in Percent, and Wind in Miles per Hour.

	Outdoors			Indoor	
Trial #	Temp	Wind	Humidity	Temp	Humidity
1	75	9	46	81	49
2	78	5	57	80	30
3	75	9	46	80	49
4	78	7	57	80	30
5	64	9	34	80	30
6	53	11	46	80	34
7	55	13	47	81	45
8	53	0	76	81	70
9	55	13	54	80	30
10	55	13	47	82	45
11	75	9	46	81	63
12	53	11	46	86	64
13	55	13	46	80	70
14	68	6	39	82	45
15	55	13	47	78	55
16	51	5	81	80	30
17	55	11	47	81	43
18	53	11	46	81	49
19	55	13	47	81	45
20	53	11	46	82	70
21	55	13	47	80	50
22	53	11	46	81	40
23	55	13	47	78	70
24	75	9	46	76	46
25	75	9	46	80	76
26	53	9	100	81	64
27	73	9	73	81	63
28	73	9	73	81	65
29	66	4	63	76	65
30	66	4	63	76	65

Appendix G

POMS TMDS DATA

Complete Dataset for the Profile of Mood States Question Total Mood Disturbance Score (POMS TMDS) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	5	40	-4	44	-5	17	16	-4
2	5	-4	10	-2	6	-4	8	-3
3	5	-2	8	0	3	-1	-4	-5
4	-8	-12	-14	-17	-8	-15	-17	-22
5	14	-7	6	-10	-3	-16	3	-8
6	-2	-10	4	-5	6	-4	-3	2
7	7	3	-4	0	-9	-7	-9	17
8	6	-12	6	-12	-2	-2	1	-3
9	13	8	-3	-10	-2	-17	-14	-13
10	13	-9	-2	-9	-6	-11	14	-1
11	-6	8	0	6	28	7	3	-19
12	11	-1	-5	-10	-2	-10	-3	-10
13	9	13	-4	-3	3	1	3	-7
14	23	-7	18	19	29	-12	4	-3
15	19	28	16	13	15	11	11	19

Note: A lower score represents a more positive mood state.

Appendix H

POMS TENSION-ANXIETY DATA

Complete Dataset for the Profile of Mood States Question Tension-Anxiety Score (POMS Tension-Anxiety) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	4	11	1	10	0	5	4	5
2	3	1	2	0	1	0	1	1
3	0	0	0	0	2	0	1	0
4	4	3	3	2	0	2	1	0
5	6	0	1	0	1	0	2	0
6	1	0	3	1	1	0	0	0
7	5	2	5	4	3	0	6	2
8	1	0	1	0	0	0	3	1
9	10	2	1	0	4	0	0	0
10	4	0	0	0	0	0	0	0
11	2	1	1	1	3	5	3	0
12	0	1	4	0	1	1	3	1
13	2	3	0	0	4	1	4	1
14	3	0	4	2	7	0	0	0
15	12	6	8	5	4	1	9	10

Note: A lower score represents a more positive mood state.

Appendix I

POMS DEPRESSION-DEJECTION DATA

Complete Dataset for the Profile of Mood States Question Depression-Dejection Score (POMS Depression-Dejection) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	4	11	0	6	0	2	0	0
2	1	1	6	2	2	2	2	0
3	5	0	2	2	0	0	0	0
4	0	0	0	0	1	0	0	0
5	1	0	0	0	0	0	0	0
6	0	0	0	0	1	0	0	0
7	7	2	0	1	0	0	1	2
8	2	0	2	0	0	0	0	0
9	3	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0
11	3	3	1	2	7	1	2	0
12	2	1	1	0	0	0	0	0
13	1	1	0	0	0	0	0	0
14	2	0	1	2	4	0	0	0
15	2	4	6	1	4	2	1	3

Note: A lower score represents a more positive mood state.

Appendix J

POMS ANGER-HOSTILITY DATA

Complete Dataset for the Profile of Mood States Question Anger-Hostility Score (POMS Anger-Hostility) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	4	11	1	12	1	4	2	5
2	1	0	1	0	4	0	1	0
3	1	0	1	0	2	0	0	0
4	5	5	2	1	2	0	0	0
5	5	0	1	0	0	0	0	0
6	0	0	2	0	3	0	0	0
7	3	0	0	1	0	0	0	2
8	1	0	1	0	0	0	0	0
9	5	0	0	0	2	0	0	0
10	0	0	0	0	2	0	0	0
11	0	0	0	2	7	0	1	0
12	2	0	0	0	0	0	0	0
13	0	0	0	0	3	1	4	2
14	3	0	7	3	7	5	4	0
15	15	4	3	1	1	0	1	1

Note: A lower score represents a more positive mood state.

Appendix K

POMS VIGOR-ACTIVITY DATA

Complete Dataset for the Profile of Mood States Question Vigor-Activity Score (POMS Vigor-Activity) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	5	7	8	5	7	6	9	8
2	7	9	2	8	8	11	3	11
3	3	4	3	4	5	5	7	6
4	17	17	18	19	13	17	17	19
5	3	9	3	9	8	15	3	7
6	4	9	2	6	7	7	4	2
7	16	12	16	10	12	10	18	3
8	4	13	6	13	5	6	4	6
9	10	13	4	8	16	17	16	14
10	7	8	4	9	5	9	0	3
11	12	3	5	16	1	4	5	2
12	1	7	7	10	3	9	7	12
13	4	1	8	7	12	10	8	10
14	2	10	4	2	4	14	4	5
15	8	7	9	10	5	8	8	6

Note: A higher score represents a more positive mood state.

Appendix L

POMS FATIGUE-INERTIA DATA

Complete Dataset for the Profile of Mood States Question Fatigue-Inertia Score (POMS Fatigue-Inertia) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	3	16	4	15	3	12	0	10
2	3	1	1	2	3	4	5	4
3	5	3	5	3	4	5	3	3
4	4	3	2	2	1	0	0	2
5	4	3	8	0	4	1	5	0
6	3	1	1	0	8	4	2	4
7	9	12	7	5	1	5	5	16
8	8	2	8	2	4	5	3	3
9	7	2	2	0	7	2	4	4
10	12	1	3	1	0	0	12	3
11	1	9	4	5	9	6	2	0
12	9	7	0	2	3	1	1	4
13	10	11	5	5	6	7	4	2
14	14	4	9	15	12	1	5	3
15	7	14	13	13	11	14	8	10

Note: A lower score represents a more positive mood state.

Appendix M

POMS CONFUSION-BEWILDERMENT DATA

Complete Dataset for the Profile of Mood States Question Confusion-Bewilderment Score (POMS Confusion-Bewilderment) for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	-1	3	-2	6	-2	2	-1	4
2	3	2	2	2	4	1	2	2
3	0	-1	0	-1	0	-1	-2	-2
4	-1	-1	-1	-2	-2	-4	-3	-4
5	1	-1	-1	-1	0	-2	-1	-1
6	-1	-2	0	0	0	-1	-1	0
7	-1	-1	0	-1	-1	-2	-2	-1
8	-2	-1	0	-1	-1	-1	-1	-1
9	2	1	-2	-2	1	-2	-2	-3
10	-1	-2	-1	-1	-1	-2	0	-1
11	-2	-1	-1	-2	-2	-2	-1	-3
12	-2	-3	-2	-3	-2	-2	-1	-3
13	0	-1	-1	-1	2	-1	-1	-2
14	3	-1	1	-1	3	-2	-1	-1
15	4	8	4	3	0	1	1	2

Note: A lower score represents a more positive mood state.

Appendix N

ENVIRONMENTAL PERCEPTIONS DATA

Complete Dataset for the Environmental Questionnaire for the 15 participants.

	Indoors				Outdoors			
	Trial 1		Trial 2		Trial 1		Trial 2	
Subject #	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	28	31	20	32	18	18	20	24
2	23	21	19	18	13	9	13	11
3	18	21	18	17	11	14	11	11
4	11	21	12	11	13	10	10	10
5	20	21	18	15	12	11	10	10
6	21	21	16	15	16	10	13	11
7	15	21	17	15	15	13	13	16
8	16	21	16	13	14	16	16	14
9	20	21	19	19	11	9	11	10
10	15	21	15	15	9	9	9	9
11	24	21	19	19	14	14	14	13
12	24	21	19	19	17	16	17	15
13	16	21	19	18	16	17	15	15
14	18	21	18	25	17	11	21	17
15	20	21	18	19	15	17	16	18

Note: A lower score represents a more positive environmental perception.

Appendix O

AVERAGE HEART RATE DATA

Complete Dataset for Average Heart Rate for the 15 participants.

	Indoors		Outdoors	
	Trial 1	Trial 2	Trial 1	Trial 2
Subject #				
1	173	168	174	178
2	194	200	205	204
3	151	170	179	170
4	162	164	166	167
5	174	164	158	172
6	171	186	167	164
7	180	173	182	182
8	166	166	166	161
9	188	186	187	185
10	185	176	171	176
11	174	151	160	161
12	178	157	182	168
13	189	195	196	195
14	181	177	185	179
15	177	180	173	170

Note: Heart rate is beats per minute.

Appendix P

RUNNING TIME DATA

Complete Dataset for Running Time for the 15 participants.

	Indoors		Outdoor	
	Trial 1	Trial 2	Trial 1	Trial 2
Subject #				
1	0:29:50	0:28:46	0:25:56	0:25:29
2	0:30:47	0:27:40	0:24:33	0:24:12
3	0:27:09	0:26:52	0:25:52	0:23:20
4	0:21:53	0:20:48	0:18:51	0:19:09
5	0:27:08	0:26:37	0:24:56	0:24:32
6	0:30:40	0:28:30	0:27:57	0:26:42
7	0:35:06	0:33:47	0:34:36	0:27:28
8	0:28:18	0:27:59	0:27:09	0:27:17
9	0:29:40	0:29:48	0:26:38	0:25:37
10	0:27:10	0:29:53	0:25:16	0:25:07
11	0:26:33	0:29:43	0:25:54	0:26:14
12	0:33:00	0:30:35	0:25:31	0:27:13
13	0:29:51	0:29:09	0:24:02	0:24:17
14	0:28:16	0:29:11	0:25:13	0:26:30
15	0:20:07	0:19:37	0:18:49	0:19:32

Note: Running time is reported in minutes: seconds.

REFERENCES

Ader, R., & Cohen, N. (1993). Psychoneuroimmunology: Conditioning and stress. Annual Review of Psychology, 44, 53-85.

Artal, M., & Sherman, C. (1998). Exercise against depression. The Physician and Sportmedicine, 26, 55-70.

Berger, B., Friedmann, E., & Eaton, M. (1988). Comparison of jogging, the relaxation response, and group interaction for stress reduction. Journal of Sport and Exercise Psychology, 10, 431-447.

Berger, B., & Owen, D. (1998). Relation of low and moderate intensity exercise with acute mood change in college joggers. Perceptual and Motor Skills, 87, 611-621.

Blix, A., Stromme, S., & Ursin, H. (1974). Additional heart rate – An indicator of psychological activation. Aerospace Medicine, 45, 1219-1222.

Booth, A., Shelley, G., Mazur, A., Tharp, G., & Kittok, R. (1989). Testosterone, and winning and losing in human competition. Hormones and Behavior, 23, 556-571.

Brod, J., Fencl, V., Hejl, Z., & Jirka, J. (1959). Circulatory changes underlying blood pressure elevation during acute emotional stress (mental arithmetic) in normatensive and hypertensive subjects. Clinical Science, 18, 260-279.

Canter, D. (1961). Attitudes and perception in architecture. Architecture Association Quarterly, 1, 24-31.

Canter, D. & Canter, S. (Eds.). (1979). Designing for therapeutic environments. A review of research. New York: John Wiley & Sons, Ltd.

Dimsdale, J. (1984). Generalizations from laboratory studies to field studies of human stress physiology. Psychosomatic Medicine, 46, 463-469.

Dunn, E.C., & McAuley, E. (2000). Affective responses to exercise bouts of varying intensities. Journal of Social Behavior & Personality, 15, 201-214.

Dyer, J., & Crouch, J. (1987). Effects of running on moods: A time series study. Perceptual and Motor Skills, 64, 783-798.

Dyer, J., & Crouch, J. (1988). Effects of running and other activities on mood. Perceptual and Motor Skills, 67, 43-50.

Evans, G. (Ed). (1982). Environmental stress. New York: Cambridge University Press.

Fillingim, R., & Fine, M. (1986). The effects of internal versus external information processing in symptom perception in an exercise setting. Health Psychology, 5, 115-123.

Gliner, J., Bedi, J., & Horvath, M. (1979). Somatic and non-somatic influences on the heart: hemodynamic changes. Psychophysiology, 16, 358-362

Gould, D., & Weinberg, R.S. 1999. Foundations of sport and exercise psychology. 2nd Edition. Champaign, IL: Human Kinetics Publishers, Inc.

Harte, J., & Eifert, G. (1995). The effect of running, environment, and attentional focus on athletes' catecholamine and cortisol levels and mood. Psychophysiology, 32, 49-54.

Henry, J., & Ely, D. (1979). Physiology of emotional stress: Specific response. Journal of The South Carolina Medical Association, 75, 501-509.

Jones, A., & Doust, J. (1996). A 1% treadmill grade most accurately reflects the energetic cost of outdoor running. Journal of Sports Sciences, 14, 321-327.

Kasl, S., & Cobb, S. (1970). Blood pressure changes in men undergoing job loss: A preliminary report. Psychosomatic Medicine, 32, 19-38.

Kavussanu, M., & McAuley, E. (1995). Exercise and optimism. Are highly active individuals more optimistic? Journal of Sport and Exercise Psychology, 17, 246-258.

Katula, J., & McAuley, E. (2001). The mirror does not lie: Acute exercise and self-efficacy. International Journal of Behavioral Medicine, 8, 319-326.

Katula, J., McAuley, E., Mihalko, S., & Bane, S. (1998). Mirror mirror on the wall...exercise environment influences on self-efficacy. Journal of Social Behavior and Personality, 13, 319-332.

Kiritz, S., & Moos, R. (1974). Physiological effects of social environment. Psychosomatic Medicine, 36, 96-113.

Kerr, J., & Van-Den-Wollenberg, A. (1997). High and low intensity exercise and psychological mood states. Psychology and Health, 12, 603-618.

Lovallo, W. (1997). Stress and health. Thousand Oaks, CA: Sage Publication Inc.

Maw, G., Boutcher, S., & Taylor, N. (1993). Rating of perceived exertion and affect in hot and cool environments. European Journal of Applied Physiology, 67, 174-179.

McAuley, E., Talbot, H., & Martinez, S. (1999). Manipulating self efficacy in the exercise environment in women: influences on affective responses. Health Psychology, 18, 288-294.

McAuley, E., Mihalko, S., & Bane, S. (1996). Acute exercise and anxiety reduction: Does environment matter? Journal of Sport and Exercise Psychology, 18, 408-419.

McClelland, D., Floor, E., Davidson, R., & Saron, C. (1980). Stressed power motivation, sympathetic activation, immune function and illness. Journal of Human Stress, 11-19.

McClelland, D., Ross, G., & Patel, V. (1985). The effects of an academic examination on salivary norepinephrine and imnunoglobulin levels. Journal of Human Stress, 52-57.

McGowan, R., Pierce, E., Eastman, N., Tripathi, H., Dewey, T., & Olson, K. (1993). Beta-endorphins and mood state during resistance exercise. Perceptual and Motor Skills, 76, 376-378.

McGowan, R., Talton, B., & Thompson, M. (1996). Changes in scores on the Profile of Mood States following a single bout of physical activity: Heart rates and changes in affect. Perceptual and Motor Skills, 83, 859-866.

McNair, D., Lorr, M., & Droppleman, L. (1992). Profile of Mood States. Educational and Industrial Testing Services. San Diego, CA.

Morgan, W. (1984). Affective beneficence of vigorous physical activity. Medicine and Science in Sport and Exercise, 17, 94-100.

Morgan, W., O'Connor, P., Ellickson, K., & Bradley, P. (1988). Personality structure, mood states, and performance in elite male distance runners. International Journal of Sport Psychology, 19, 247-263.

National Weather Service. (2001). Telecommunication Operations Center. Current Weather Conditions: Ithaca / Tompkins County, NY, United States. Retrieved Spring, 2001, from http://weather.noaa.gov/weather/current/KITH.html

O'Connor, J.P., Morgan, W., Raglin, J., Barksdale, C., & Kalin, H. (1989). Mood state and salivary cortisol levels following overtraining in female swimmers. Psychoendocrinology, 14, 303-310.

Raikkonen, K., Mathews, K., Flory, J., & Owens, J. (1999). Effects of hostility on ambulatory blood pressure and mood during daily living activities in healthy adults. Health Psychology, 18, 228.

Rudolph, D., & McAuley, E. (1995). Self-efficacy and salivary cortisol responses to acute exercise in physically active and less active adults. Journal of Sport and Exercise Psychology, 17, 206-21.

Sallis, J., Johnson, M., Calfas, K., Caparosa, S., & Nicholas, J. (1997). Assessing perceived physical environments variables that may influence physical activity. Research Quarterly for Exercise and Sport, 68, 345-51.

Scarpace, N., & Lowenthal, D. (1994). Sympathetic nervous system; aging and exercise. Southern Medical Journal, 87, S42.

Shibata, S., & Suzuki, N. (2002). Effects of the foliage plant on task performance and mood. Journal of Environmental Psychology, 22, 265-272.

Spink, K. (1992). Relation of anxiety about social physique to location of participation in physical activity. Perceptual and Motor Skills, 74, 1075-1078.

Steptoe, A., & Cox, S. (1988). Acute effects of aerobic exercise on mood. Health Psychology, 7, 329-340.

Thomas, S., Reading, J., & Shepard, R. (1992). Revisions of the Physical Activity Readiness Questionnaire (PAR-Q). Canadian Journal of Sport Science, 17, 338-345.

Turner, R., & Carroll, D. (1985). Heart rate and oxygen consumption during mental arithmetic, a video game, and graded exercise; further evidence of metabolically-exaggerated cardiac adjustments. Psychophysiology, 22, 261-267.

Williams, T., Krahenbuhl, G., & Morgan, D. (1991). Mood state and running economy in moderately trained male runners. Medicine and Science Sport and Exercise, 23, 721-731.

Wilson, V., Morley, N., & Bird, E. (1980). Mood profiles of marathon runners, joggers, and nonexercisers. Perceptual and Motor Skills, 50, 117-118.