AN EXPLORATION OF THE RELATIONSHIP OF EXERCISE, MOOD, AND WEATHER IN NON- DEPRESSED REGULAR EXERCISERS

by

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(Under the Direction of Alan Stewart)

ABSTRACT

The associations between the variables of exercise, mood, and weather in non-depressed regular exercisers has received scant attention in the research literature. To better understand the role of exercise on mood, the effect of environmental conditions, and the type of exercise on mood improvement, physically active college-aged participants (N=90) provided twice daily ratings of their mood and exercise habits for seven days. Sensitivity to weather conditions was assessed with the Inventory of Seasonal Variation, Weather Affect Questionnaire, Weather Affect Questionnaire, and Seasonal Pattern Assessment Questionnaire, current mood and depressive symptoms with the Center for Epidemiologic Studies-Depressed Mood Scale and Profile of Mood States, and reported engagement in physical activity with the Godin Leisure Time Physical Activity Questionnaire. **A**nalysis revealed a significant difference from the first mood rating to the second mood rating: $F(1, 449)= 76.57$, $p<.001$, $N^2=.15$. Additionally, analysis indicated that there was a significant difference in overall mood improvement from the first to the second rating based upon whether an individual had exercised, $F(1, 449)= 23.80$, $p<.001$, $Np^2=.05$.

Contrary to prediction, individuals sensitive to seasonal variation did not self-select into outdoor exercise more frequently and did not experience a greater improvement in daily mood as a result of outdoor exercise than individuals who did not report being sensitive to weather variations. Secondary analysis indicated that there was a significant difference by gender in the number of individuals identified as being seasonally sensitive. Findings from this study support the central role that exercise plays with regard to daily mood, and as a result, recommendations are given emphasizing the role of exercise as a means of social justice. Further research is recommended to further delineate the mechanism of action exerted on mood by the type of exercise, the environment in which exercise is performed, and the effect of prevention of exercise for specific reasons.

INDEX WORDS: Exercise, Mood, Weather, Seasonal Variation

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DEDICATION

I would like to dedicate my dissertation to my loving husband, Kevin Kroll. Thank you for being the first to celebrate with me in victory and the first to comfort me in defeat. I love you, and I look forward to what the future will bring us.

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Exercise, Mood, and Weather

Exercise, mood, and weather: three separate variables that can play a large role in a person's life. While numerous studies have shown that exercise can help to alleviate depressive symptoms (Wykoff, 1993; He et al., 2012) and other studies have shown how mood can be affected by weather (Hakkarainen et al., 2003; Hsin-Chien, Shang-Ying, & Herng-Ching, 2006), this study explored the overall relationship among all three variables of exercise, mood, and weather within a normal population. Specifically, how is the relationship between exercise and mood affected by the current weather?

This focus upon the influence of mood, exercise, and weather in a normal and healthy population is a reflection of the values inherent in the field of counseling psychology. As defined by the American Psychological Association's Division 17, Society of Counseling Psychology, the mission of counseling psychologists is to help individuals improve their well-being and to help individuals increase their ability to better function in all domains of their life ("Society of Counseling Psychologists," n.d.). Smith indicated that a major goal of counseling psychology is to "facilitate human growth by focusing on individuals' sturdy roots" (Smith, 2006, p. 19). As such, counseling psychologists emphasize focuses upon prevention and individuals' strengths, such as biological strengths (Gelso & Fretz, 2001; Fuertes, Spokane, & Halloway, 2012; Vera, 2012). With regard to such biological strengths, Tucker et al. specifies that counseling psychologists can help patients adhere to treatment regimens such as exercise adherence due to strategies that are in keeping with an individual's cultural identity (2007).

Moreover, Wilfrey suggests that counseling psychologists can help clients identify strategies that motivate clients to engage in therapeutic exercise in conjunction with stress management treatment (1986).

Despite this understanding that counseling psychologists are in a unique position based upon their emphasis upon prevention and client strengths, there have been few studies conducted by counseling psychologists which explore the influence of exercise upon prevention of pathological symptoms and the maintenance of mental health. Only two studies were indicated following an electronic search of the two main journals in counseling psychology, *The Counseling Psychologist* and *The Journal of Counseling Psychology*, using the search query "mood and exercise." With this study, a contribution to the counseling psychology research literature will be made that is in keeping with its espoused values. Specifically, this study focused upon utilizing clients' strengths for the promotion of mental health in normal populations.

Statement of Purpose

The purpose of this study was to examine how comparatively healthy individuals with active lifestyles are affected by weather conditions and changes in their daily exercise habits. While many studies have focused upon exercise and sedentary adults or exercise and those who are just beginning exercise programs, few studies have utilized healthy adults with active lifestyles as participants in a study such as this. This specific group is not usually studied with respect to exercise-related changes in mood. Moreover, this study sought to examine the interrelatedness of mood, exercise, and weather conditions, as opposed to solely examining mood and exercise or examining mood and weather. Thus, the study seems to make a new and novel contribution to the research literature. This exploratory and descriptive study

seeks to provide building blocks for subsequent theories, as opposed to building upon older and more established theories.

In addition to focusing upon the association among these three variables, the effects of disruption in planned daily exercise as a result of weather-related events were studied. This study will help contribute to a better understanding of the roles that daily exercise and meteorological variables occupy in affecting the emotional functioning and daily life activities of active adults.

Significance of the Study

This study is significant in its focus upon non-sedentary individuals and upon the relationships of exercise, mood, and weather conditions. This study is significant in that instead of regulating which type of exercise must be practiced, participants are observed engaging in their daily exercise routine which allows for them to self-select each day the type of environment in which they exercise, as well as the intensity, frequency, and duration of exercise.

While many studies have provided support for exercise as a means of alleviating depressive symptoms and bolstering mood in sedentary individuals, there is again a lack of research on how an active individual's lifestyle already impacts their overall psychological health (Hallgren, Moss, & Gastin, 2010; Myrna-Bekas, Małgorzata, Stefaniak, & Kulmatycki, 2012). It is important to utilize active individuals as participants as research suggests that individuals who are less fit physiologically prior to exercise may show the most improvement in terms of mood (Folkins & Sime, 1981). Specifically, Lennox, Bedell, and Stone reported that exercise does not appear to have any long-term beneficial emotion-related effects for non- depressed individuals (1990). Moreover, Tillman indicated that

increases in fitness may not produce as significant psychological gains when participants are young and already physically fit (1965). Further research is needed to examine to what extent exercise has on the mood of non- sedentary individuals. Therefore, this study sought to examine the effect of exercise and weather on the mood of non-depressed individuals with active lifestyles. It is important to note that although individuals with past or current diagnoses of Major Depressive Disorder were not included in this study, individuals who exhibited some sensitivity to the seasonal changes in the weather were included in hopes of drawing participants who possess a range in sensitivity to seasonal changes. Furthermore, the research literature contains no examination of the extent to which different types of disruptions of their daily exercise routines affect their mood and overall personal schema.

Research Questions and Hypotheses

The present study investigated the following research questions and hypotheses:

1) Do individuals' moods significantly improve after exercise in comparison to the moods of individuals who have not exercised?

    Hypothesis: It is expected that there will a moderate to large difference in individuals' mood rating scores after exercising in comparison to mood rating scores after not exercising that day, and that this difference will fall within the 95% confidence interval that does not include zero.

2) Is there a significant difference in the mood of individuals dependent upon whether they engaged in aerobic or anaerobic exercise?

   Hypothesis: It is expected that there will be a small to moderate difference in individuals' mood rating scores depending upon whether individuals engaged in anaerobic or aerobic exercise.

3) Is mood more adversely affected when exercise is interrupted by weather conditions or when exercise is interrupted by other events?

   Hypothesis: It is expected that there will be a small to moderate difference in mood rating scores when exercise is interrupted due to weather conditions as opposed to when exercise is interrupted by other events.

4) Are individuals who tend to experience seasonal-related decreases in mood more likely to self-select into outside exercises in comparison to individuals without sensitivity to seasonal variations?

   Hypothesis: It is expected that there will be a small to moderate difference in preference for outdoor versus indoor exercise in individuals who experience seasonal-related decreases in mood.

5) Are individuals who are sensitive to seasonal changes in weather more likely to experience an improvement in their mood after exercising outside as opposed to exercising indoors?

   Hypothesis: It is expected that individuals will exhibit a small to moderate difference

in mood rating scores after exercising outside compared to exercising indoors.

Definition of Terms

1) *Regular Exercisers:* Individuals are considered to be regular exercisers if they exercise for a minimum of three times a week for a minimum of six months (Rodgers et al., 2010).

2) *Mood*: For the purposes of this study, the construct of mood will be defined as "a pervasive and sustained emotion that colors the person's perception of the world" (*Diagnostic and statistical manual of mental disorders : DSM-IV-TR*, 2000).

3) *Weather:* The National Snow and Ice Data Center refers to weather as the daily state of the atmosphere as it refers to the temperature, humidity, precipitation, and other variables (NSIDC, 2012).

4) *Unfavorable weather*: For the purposes of this study, unfavorable weather is defined as the weather endorsed as: 1) threatening, severe, and violent weather; 2) drab, dismal, and dark; 3) cold and wintry; and 4) blowing and blustery (Stewart, 2007).

5) *Favorable weather:* For the purposes of this study, favorable weather is defined as the weather endorsed as: 1) tranquil and pleasant; 2) bright and clear; 3) wet and stormy; and 4) cool and cloudy (Stewart, 2007).

6) *Climate:* The World Meteorological Organization defines climate the weather of an area in terms of the mean and variability of temperature, precipitation, wind, and other periods for approximately 30 years (WMO, 2012).

7) *Seasonality:* Seasonality is referred to in this study as "the degree to which seasonal changes affect mood, energy, sleep, appetite, food preference, or the wish to socialize with other people" (Sher, Goldman, Ozaki, & Rosenthal, 1999).

8) *Physical Activity:* As defined in the "2008 Physical Activity Guidelines for Americans," physical activity is referred to as bodily movement that enhances health ("2008 Physical Activity Guidelines for Americans," 2008). In this study, physical activity will be considered as bodily movement that is not planned or structured as seen in exercise.

9) *Exercise*: As defined by the Center for Disease Control and Prevention, exercise is "a subcategory of physical activity that is planned, structured, repetitive, and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective" (2011).

10) *Aerobic Exercise*: Physical activity that is "of sufficient duration to require oxygen consumption" (p. 691). Examples include: running, cycling, swimming, etc. (Olaitan et al., 2012).

11) *Anaerobic Exercise*: Physical movement that is not of sufficient duration to require oxygen and consists of short and intense physical activity. Examples include: weight lifting, plyometric movements, sprinting, etc. (Olaitan et al., 2012).

Limitations

1) This study used a convenience sample of undergraduate students in a large

university setting. Therefore, the ages of the participants were not normally distributed across the lifespan.

2) The data collected in this study may have been affected by participants being voluntary but encouraged by incentives.

Assumptions

3) It is assumed that participants answered self-report participants questionnaires in a forthcoming and thoughtful manner.

4) It is assumed that participants provided accurate ratings and estimates of their daily mood and exercise habits.

5) It is assumed that the participants spent the majority of their time participating in this study in the general vicinity of the university they are enrolled in, so that there were no significant differences in weather conditions for all participants.

CHAPTER 2

REVIEW OF LITERATURE

Exercise and Mood

Research upon the association between exercise and mood has developed since the mid- 20th century. In 1953, Secord and Jourard first began focusing upon the relationship between psychological constructs and physical health in their study on body-cathexis and self-concept. Body-cathexis, or the degree of feelings of satisfaction or dissatisfaction with parts of processes of the body, was indicated as corresponding with self-concept. This focus on the association between physical health and self-concept continued with studies with both children and adults. Collingwood and Willett followed five obese teenagers enrolled in a three week obesity program to evaluate the effect of physical training on self-attitude changes (1971). From this small sample, the researchers determined that the participants experienced significant increases in physical fitness, positive body attitude, positive self-attitude, and self-acceptance. This effect of physical fitness on self-concept in children was also observed in "disturbed" children and adults (Gary & Guthrie, 1972; Johnson, Fretz, & Johnson, 1968).

In addition to research suggesting the association between exercise and self-concept, research also focused upon the effect of exercise on psychological states. Numerous research studies have associated the efficacy of exercise with psychological benefits for non-clinical populations (Wykoff, 1993), as well as individuals with state anxiety and depression (Knapen, 2009; He et al., 2012). Cureton followed 2500 adults through a physical conditioning program and inferred from these results that exercise helped people make friends and relieve tension (1963). A later study by Carl Folkins found a significant

decrease in anxiety and depression; however, he did not find that physical training created a significant change in self-confidence, adjustment, or body image (1976).

The effect of exercise of psychological states has also been explored with individuals categorized as having either a sedentary or active lifestyle. Sedentary and obese adults, (adults who exercised less than 20 minutes per week and who had an average Body Mass Index of 41.6 kg/m^2), were assessed over six months after initiating an exercise and nutrition treatment (Annesi, 2012). Annesi found that the change in exercise-related self-efficacy was a better independent predictor of change than volume of exercise (2012). Instead of sedentary individuals, fit and physically active adults were the focus of a study completed by Myrna- Bekas, Malgorzata, Stefaniak, and Kulmatycki (2012). The Mood Adjective Check List (UMACL) was administered to fit university students after completing a course in different physical activities. Results indicated that participants experienced positive improvement in mood regardless of the type of physical activity or duration of exercise (Myrna-Bekas et al.,2012).

Active individuals, also referred to as regular exercisers, reported having significant post- exercise improvements in mood and anxiety (Hallgren et al., 2010). Conversely, non-regular exercisers exhibited an initial decline in post-exercise mood as well as increased anxiety. This initial increased anxiety was then followed by mood and anxiety returning to pre-exercise levels. Hallgren et al. indicated that their findings suggest that previous exercise participation mediates mood responses to vigorous exercise (2010).

In addition to previous exercise participation, the intensity and frequency of exercise may affect mood responses. A study conducted by Groom and O'Connor indicated that intensity and frequency of exercise possibly affects the efficacy of exercise therapy (1996).

However, experimental data with regard to the effect of intensity of exercise on depressive symptoms are mixed. For example, in one study in which exercise intensity varied, participants in the group of aerobic activity of moderate intensity improved on measures of self-esteem but did not show any differences on depression scores with regard to the control group (Daley, Copeland, Wright, Roalfe, & Wales, 2006). These results are similar to results also found in research conducted upon continuous and high-intensity interval training (Oliviera, Slama, Deslandes, Furtado, & Santos, 2013).

However, in another randomized control trial where Hispanic students were randomly assigned to an intervention group of moderate intensity activity aerobic exercise or a control group of low intensity physical activity over six weeks, depression scores were significantly lower in the intervention group than in the control group (Crews, Lochbaum, & Landers, 2004). While many studies have firmly established the correlation between improved mood with exercise, research has yet to definitely determine that mood is directly affected by exercise. According to Sexton et al., it is unclear whether this relationship is purely correlational and is a result of other factors including the environment, personality characteristics, and lifestyle habits (2001). The idea that exercise directly causes changes in mood was argued by these researchers to be unproven as it was hypothesized that a better mood might increase exercise.

While a causal relationship has not been established, further research has demonstrated the biological effects of exercise on mood. Farrell demonstrated that plasma endorphins increased with acute exercise while other participants showed that mood was also improved after exercise (1982). Decades later, Boecker measured brain opioid binding and provided evidence that the human brain released endogeneous opioids after exercise (2008).

How Exercise Affects Mood.

Several theories have attempted to explain how exercise affects mood. Solomon's opponent-process theory espouses that the first physiological or psychological response (the *a* process) to a stressor is followed by a secondary response (the *b* process). With regard to exercise, the *a* process would be identified as the sympathetic activation and parasympathetic withdrawal during exercise, and the *b* process as the physiological process that occurs after exercise has ended (Solomon, 1991). From this theory, Solomon also reports that some changes do not stop immediately with the cessation of exercise. Another theory introduced to explain the effect of exercise on mood was proposed by Ekkekakis' Dual-Mode Model. In this model, cognitive factors were thought to be responsive for affective responses to low and moderate exercise (Markowitz & Arent, 2010). As exercise intensity increased, interoceptive cues resulting from physiological changes from exercise.

Another theory of how exercise affects mood involves the brain and a "runner's high." For example, long-distance running has been found to increase the availability of opioid receptor binding in cortical and limbic areas and runners with the greatest activation were associated with the greatest increase in euphoria (Boecker et al., 2008). By this theory, runners or other people who exercise may engage in exercise due to the activation of the endogenous opioid system and the resultant feeling of euphoria.

Aerobic and Anaerobic Exercise.

Most psychological research has focused upon aerobic exercise and overall mental health. Dyer and Crouch indicated in their study on the effect of different types of exercise on moods that aerobic exercise (e.g. running) reported more positive mood profiles than non-aerobic exercisers, in this case, running as opposed to weight-lifting (1988). These researchers

also indicated that there is a paucity of research on the psychological benefits of anaerobic exercise. One study by Myrna-Bekas et al. compared mood changes in individuals who regularly participate in different forms of exercise, specifically, boxing, bodybuilding, total body conditioning, dance aerobics, and step aerobics (2012). Results indicated that although there were slight variations in mood changes from different physical activities, none of these differences were statistically significant for either gender or type of exercise performed.

Mood and Weather

Seasonal Affective Disorder.

Rosenthal et al. first introduced the concept of seasonal variations in mood and further defined the concept of Seasonal Affective Disorder (1984). Seasonal Affective Disorder (SAD) was first defined by Rosenthal et al. (1984) as a "condition characterized by recurrent depressions that occur annually at the same time each year." According to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision, SAD is classified as major depression with "seasonal pattern" (American Psychological, 2000). Symptoms associated with SAD include increased need for sleep, increased appetite, decreased energy, and fatigue (Peiser, 2009). Rosenthal denoted that SAD was a result of genetic vulnerability and environmental considerations, such as light deprivation and stressful events (2006). SAD is generally characterized as occurring in the fall and winter months, however, approximately one out of five instances of SAD occur in the summer with symptoms consistent with agitation and atypical depressive symptoms (Rosenthal, 2006).

Not all individuals who suffer from seasonal variations in their mood meet criteria for SAD. Individuals who appear to experience less severe seasonality are characterized as experiencing "winter blues" (N. Rosenthal, 2006). This seasonality differs in severity from

individual to individual, as some people may experience mild seasonal changes whereas other people may experience more severe seasonal changes (Sher et al., 1999). Treatment for seasonal variations in mood include increased light exposure, increased physical activity, Vitamin D supplementation, psychotherapy, and psychopharmacology (*Seasonal affective disorder: practice and research*, 2010). Rosenthal, Wehr, Sack, and Gillin performed the first controlled study of light therapy for SAD in 1982. From this study, light treatment appeared to alleviate seasonal depressive symptoms of individuals who had been depressed during the fall and winter (N. Rosenthal, 2006). Wehr identified two patterns of seasonal influences on affective symptoms, with one pattern of symptoms starting in spring and peaking in summer, and the other pattern beginning in the fall and peaking in winter (1989).

Other Seasonal Effects.

In addition to SAD, seasonal variations have also been found in other psychiatric conditions such as eating disorders, anxiety disorders, and alcoholism (*Seasonal affective disorder : practice and research*, 2010). Patients with SAD also appear to have comorbidity with other psychiatric conditions including: anxiety disorders (Halle & Dilsaver, 1993), eating disorders (Gruber & Dilsaver, 1996), and personality disorders (Reichborn-Kjennerud, Linjaerde, & Dahl, 1994).

Studies have examined different weather conditions and variability in mood disorders (Hakkarainen et al., 2003; Hsin-Chien et al., 2006), anxiety disorders (Brodeur St-James, 2010; Bulbena et al., 2005), and psychotic disorders (Sung Tzu, Chen, Lin, Lung, & Su, 2011). In addition to SAD, mood difficulties such as mania and depression appear to be adversely affected by seasonality, with psychiatric admission rates spiking in spring/summer for manic episodes, early winter for depressive episodes, and early spring for mixed/unspecified episodes

(HsinChien et al., 2006). Sleep changes also appear to shift by season within individuals diagnosed with Bipolar I Disorder. Seasonal changes in sleep length and mood in same-sex Finnish twins were compared between the twin diagnosed with Bipolar I Disorder and the other twin without this diagnosis (Hakkarainen et al., 2003). The differences between twins were compared, and results indicated that twins diagnosed with Bipolar Disorder exhibited significant seasonal changes in sleep length and mood compared to their non-diagnosed twin.

While most research has focused upon seasonality and mood disorders, some research has studied the variation of anxiety and psychotic symptoms with seasonality and weatherrelated events. Bulbena et al. exclusively studied panic attacks and "non-panic attacks" in contrast with meteorological data examining wind speed, temperature, rainfall, etc. (2005). In particular, psychiatric admissions for panic attacks were more likely to occur with poniente wind and the autumn season but less likely to occur with rainfall. Other anxiety-related disorders and weather have been explored such as Posttraumatic Stress Disorder and phobias (Brodeur StJames, 2010). The onset of weather phobia and the development of Posttraumatic Stress Disorder following weather-related trauma appears in part to be explained by specific cognitive vulnerability, previous exposure to trauma, and anxiety sensitivity (2010).

The association between temperature change and schizophrenia was explored by Sung Tzu, Chen, Lin, Lung, and Su (2011). Again, psychiatric admissions were examined in concordance with meteorological data. Admission rates for schizophrenia increased within the temperature range of 3.2°C and 12.1°C. Surprisingly, no significant effect of temperature variation was found for admission rates of individuals diagnosed with Schizoaffective Disorder (2011).

Numerous research studies have been conducted into the effect of various weather conditions on psychological states (Tselebi et al., 2008; Karkanis et al., 2008; Salib & Sharp, 2002). Most research has either concentrated upon the effect of weather conditions on mood or of the psychological effect of specific weather conditions (e.g. air pollution or extreme heat). In a study on the association between meteorological conditions on inpatient admission, psychiatric hospitals in Greece observed an increase of voluntary hospitalizations during the spring, which is a finding identified in similar international studies (Karkanias et al., 2008). Specifically, the number of involuntarily hospitalized patients did not differ by season, but there was a significant increase in the number of voluntary male admissions in spring. Karkanias et al. recognized potential risk factors of increased sunlight and environmental temperature for these voluntary admissions (2008). Likewise, Tselebis et al. (2008) also recognized a positive correlation between temperature and overall psychiatric admissions, psychosis-related admissions, and male- gender of admissions. Unlike the significant finding for voluntary admissions in the study conducted by Karkanias et al. (2008), this study found a significant difference between temperature and involuntary admissions.

Specific Weather Conditions and Psychological Effects.

Specific and more immediate weather conditions have been implicated as affecting various psychological conditions (Salib & Sharp, 2002); (Rotton & Frey, 1984); (Yang, Tsai, & Huang, 2011). It is important to note that the research studies discussed in this section focus upon weather, or the conditions of the atmosphere over a short period of time, as opposed to climate, or the behavior of an atmosphere over a longer period of time (NASA, 2005).

The connections between psychological states and specific weather-related conditions such as humidity, air pollution, and extreme heat have also been investigated. An inverse relationship between admissions for affective disorders and relative humidity in the week prior to admission was found in a study analyzing the number of psychiatric admissions with meteorological data (Salib & Sharp, 2002). Additionally, air pollution has been associated with psychiatric emergencies and treatment. Air pollution, which has been found to induce medical conditions and increase mortality, appears to increase the risk of suicide with time (Yang et al., 2011). Some air pollutants appear to be greater risk factors for impaired mental health than others. In particular, high levels of photochemical oxidants have been implicated with psychiatric emergencies (Rotton & Frey, 1984).

Besides humidity and air pollution, the moderating effect of heat has been studied. Tian, Zhu, Zheng, and Wei examined university students who were asked to exercise on the stair stepper at various speeds in an extremely hot environment (2011). Both physiological and psychological effects of the performed exercise were discussed. Participants reported feeling increased fatigue as the time of exposure to the extreme heat increased. In addition to negative effects of heat on normal participants, heat exposure appears to adversely affect individuals diagnosed with cognitive and/or psychological disorders. In 2008, a study was conducted on the relationship between hospital admission for psychological disorders and heat waves (Hansen et al., 2008). A positive association was absent between hospital admissions in South Australia and temperature above 26.7°C. It should be noted that in addition to increased hospital admissions, deaths related to psychiatric disorders increased with the changing temperature in people with psychotic disorders and people between the ages of 65 and 74 (Hansen et al., 2008).

While some studies focus upon the temperature changes as it affects seasonal variations in mood and other psychological changes, seasonal changes result from more than just the single variable of temperature or of being a specific season. A study conducted on the association between seasonal variations in day length, sleep timing, sleep quality, and mood in two distinctly different latitudes found changes in the northern latitude with regard to sleep efficiency, sleep latency, insomnia, fatigue, and depressed mood (Friborg, Bjorvatn, Amponsah, & Pallesen, 2012). This finding lends support to there is a direct association between seasonal variation in mood and daylight exposure. While many different meteorological factors are associated with certain seasons, other factors (e.g. such as the daylight exposure in different latitudes) play a role in variations in mood and other psychological states throughout the year.

Exercise and Weather of the Season

Weather has been identified as a significant moderator for daily physical activity (Tucker & Gilliland, 2007). Much of the research literature has focused upon weather as a potential barrier for consistent engagement in exercise or potential problems that may arise during exercise as a result of extreme weather conditions. Specifically, the effect of unfavorable weather on participants' daily physical activity (Tucker & Gilliland) and health problems resulting from exercising in extreme heat or cold (Wallace et al., 2005); (Butcher, 2006) has been explored within the research literature.

Many studies suggest a causal relationship between seasonality and exercise adherence (Burchfieid, Fitzhugh, & Bassett, 2012; Eisenberg & Okeke, 2009); Badland, 2011). A study conducted by Wolff and Fitzhugh examined the relationship between weather

and outdoor physical activity (2011). Results indicated that the trend in outside trail activity increases in warm temperatures and decreased in colder temperatures, which is supported by a similar study conducted by Hamilton, Clemes, and Griffiths (2008).

A study conducted by Feinglass et al. followed over 200 participants over a three year period as part of an arthritis physical activity trial (2011). Daylight hours, mean daily temperature, and rainfall were significantly associated with lower physical activity. Tu et al. also had similar results suggesting that non-attendance for indoor exercise was also affected by a heat index above 90°F, wind-chill index below 20°F, overcast skies, and snow (2004). Although most studies support this relationship between weather and exercise adherence, Badland, Christian, Giles-Corti, Knuiman found that variation in weather conditions was not a significant predictor of overall physical activity in adults living in a temperate climate (2011). Weather also plays a large role in determining the type of exercise performed by individuals and the environment in which this exercise occurs. A particular temperature range was identified as being most associated with outdoor trail running in a study monitoring trail usage over three seasons. Specifically, every 1°F increase in temperature until 76° F was associated with an increase of 1.1 trail counts per hour (Burchfield, Fitzhugh, & Bassett, 2012).

Several studies have examined the specific effect of exercising outdoors or indoors. For example, a meta-analysis on 10 United Kingdom studies studied dose-responses of "green" exercise, or activity in the presence of nature (Barton & Pretty, 2010). While both men and women exhibited similar improvements in self-esteem, men appeared to experience a more significant change in mood (2010). Stella-Maria et al. investigated indoor or outside exercise settings as predictors of exercise (2009). From their survey of over 300 members of fitness members in Zurich that offered both indoor and outdoor exercise formats, outdoor exercise

settings were indicated as being more restorative than indoor settings (2009). Moreover, results point toward the restorative quality of the exercise environment predicting exercise frequency. It should be noted that although exercise environment did have a predictive effect on exercise frequency, personal barriers (e.g. time restrictions and scheduling constraints) were the strongest predictors for exercise frequency (Stella-Maria et al., 2009).

Summary of the Literature

While the research literature appears consistent in finding that exercise has a beneficial impact of mood and depressive symptoms, the specific mechanisms of this relationship remain unknown. Most of the research indicates that sedentary individuals tend to show the most improvement with regard to mood. Moreover, the existing research on mood and exercise has conflicting results on the effect of intensity and frequency of exercise on mood.

The research literature on mood and weather has focused upon the seasonal variations in mood and other psychiatric conditions, as well as the influence of weather conditions on psychiatric disorders. The research literature has emphasized that seasonal variations in mood and psychiatric disorders appear to fall upon a continuum as opposed to discrete categories.

The research literature upon exercise and weather has identified weather as a significant moderator for physical activity with weather seen as a salient barrier for exercising in extreme heat and cold. Surprisingly, research indicates that both indoor and outdoor exercise is affected by adverse weather conditions. Some research indicates the restorative nature of outdoor exercise over indoor exercise as well as the exercise environment being predicative of exercise frequency.

From the existing literature on mood, weather, and exercise, it can be seen that there is a paucity of research on the effect of exercise on the daily mood on regular exercisers, the exact mechanism through which exercise affects mood, and the influence of outdoor exercise on mood as opposed to indoor exercise.

CHAPTER 3

METHODOLOGY

Participants were asked to complete the Inventory of Seasonal Variation, Seasonal Pattern Assessment Questionnaire, the Center for Epidemiologic Studies-Depressed Mood Scale, the Weather Affect Questionnaire, the Profile of Mood States, the Godin Leisure-Time Exercise Questionnaire, and the Mood, Weather, and Exercise Questionnaire.

The participants were undergraduate students from the University of Georgia who voluntarily participated in exchange for course credit. To be included in this study, participants must not have currently competed in collegiate athletics, participated in professional bodybuilding events, or have been receiving any sort of financial compensation for their physical activity (e.g. endorsements or sponsors). Participants must not have been currently involved in counseling/psychotherapy or have been prescribed psychotropic medication within the last six months prior to participation. Moreover, individuals were excluded who were currently on a daily regimen of antihistamines, muscle relaxants, opiates, or other drugs with sedating side effects. Individuals who had prior or current diagnoses of Major Depressive Disorder or Bipolar Disorder were not included in this study. However, in order to study the effect of seasonal variations on mood, individuals were included who endorsed seasonal changes in mood but had not been diagnosed with either of the aforementioned mood disorders.

Participants also met criteria for being a regular exerciser and were encouraged to

maintain their usual diet and exercise habits throughout the duration of this study. To participate in the study, participants remained within 50 miles of Athens, Georgia, for at least five of the seven days in which they participate. Participants were required to report to the researcher if they were outside 50 miles of Athens, Georgia, during the seven consecutive days when they rated their mood and exercise habits.

Research Questions

To explore the relationship of exercise with mood using weather as a moderating variable, the following research questions were investigated:

1) To what extent do individuals' moods improve after exercise in comparison to the moods of individuals who have not exercised?
2) To what extent are individuals' moods impacted by anaerobic or aerobic exercise?
3) To what extent is mood affected when exercise is prevented, delayed, or interrupted due to weather in comparison to when exercise is interrupted by other events?
4) Are individuals who tend to experience seasonal-related decreases in mood more likely to self-select into outside exercises in comparison to individuals without sensitivity to seasonal variations?
5) Are individuals who are sensitive to seasonal changes in weather more likely to experience an improvement in their mood after exercising outside as opposed to exercising indoors?

Instruments

All participants completed the Inventory of Seasonal Variation, Seasonal Pattern Assessment Questionnaire, the Center for Epidemiologic Studies-Depressed Mood Scale, the Profile of Mood States, the Godin Leisure-Time Exercise Questionnaire, the Weather

Affect Questionnaire, and the Mood, Weather, and Exercise Questionnaire. Counterbalancing of the assessments was utilized to prevent testing effects. The correlations among all assessment instruments can be found in Table 2. The ISV, SPAQ, POMS, and LTEQ all exhibited high reliabilities, with the resulting Cronbach's alpha of .89, .84, .89, and .81, respectively. However, the CES-D had relatively low reliability within this study, Cronbach's alpha of .48.

Inventory of Seasonal Variation. The Inventory of Seasonal Variation (ISV) was utilized to help assess seasonality in mood and behavior on a dimensional scale that is sensitive to seasonal differences (Spoont, Depue, & Krauss, 1991). The Inventory of Seasonal Variation consists of 13 items to which each participant responded by rating each item on a 9-point scale for each of the four seasons. Internal consistency on the IVE, assessed by coefficient α, is 0.88. Moreover, all items correlated with the total ISV score, except for the "bogus" item of Entertainment Preference. The ISV has exhibited sound psychometric properties, as demonstrated by good two-month test retest reliability (0.83) and good internal consistency (α= 0.83) (Young, Blodgett, & Annemarie, 2003).

ISV reports a seasonal deviation score that can range from 0.00 to 8.00 with the higher the score indicating more seasonal sensitivity seasonal deviation score. Within this sample, the seasonal deviation scores ranged from 0.46 to 7.69 (M= 2.38, SD= 1.21). This distribution was not normally distributed, and the data exhibited positive skewness and leptokurtic kurtosis. Scores on the ISV were significantly correlated with scores on the SPAQ, r =.62, $p < .01$.

The Seasonal Pattern Assessment Questionnaire. The Seasonal Pattern Assessment Questionnaire (SPAQ) developed by Rosenthal et al. was utilized as a screening instrument

to identify individuals who might meet criteria for seasonal affective disorder (1987). While the SPAQ has 40% fewer items than the ISV, these measures were correlated 0.83 (Young et al., 2003). Like the ISV, the SPAQ also exhibited good test-retest reliability (0.76) and internal consistency (0.81). The Seasonal Pattern Assessment Questionnaire created by Norman Rosenthal has been the most commonly used measure for SAD (Thompson et al., 2004). On the SPAQ, participants will be asked to indicate to what extent specific behaviors change with the seasons, (from no change to extremely marked change), in which month or cluster of months specific behavioral changes occur, and what changes occur with regard to weight, food preference, and sleeping habits. Based upon guidelines suggested by N. Rosenthal, most individuals with overall seasonality scores of less than seven do not experience seasonal problems, while individuals with higher scores usually have more significant seasonal mood variation (2006). The SPAQ and ISV will both be completed by participants in order to gain an overall seasonality score, as well to gather data from a more dimensional measure which is less focused upon diagnosis. The overall seasonality score on the SPAQ will be used to help categorize individuals' general seasonal sensitivity, while the ISV will help assess seasonal variations in mood by focusing upon different symptoms such as sensory vividness, sensation seeking, and physical movements (Spoont et al., 1991).

The SPAQ reports a global seasonality score (GSS) that can range from 0.00 to 24.00, with the higher score again indicating more seasonal sensitivity. Within this sample, the GSS ranged from 0.00 to 22.00 (M= 9.88, SD= 4.55). The data was not normally distributed, and although it was negatively skewed, it did not exhibit significant kurtosis. Based upon the scoring guidelines suggested by Rosenthal (2006), approximately 8.9% of the participants report experiencing symptom severity associated with seasonal affective disorder, which is

higher than the typical range of 0.4 to 2.9% of the general population that meet criteria for seasonal affective disorder (Westrin & Lam, 2007). It is hypothesized that the number of people in this study who meet criteria for seasonal affective is higher than seen in the general population due to the overrepresentation of females, as females are more likely to endorse seasonal variations in mood than males (Rosenthal, 2006).

The Weather Affect Questionnaire. The Weather Affect Questionnaire (WAQ) is an assessment focused upon evaluating individuals' emotions or feelings when a particular weather event occurs. This assessment differs from the aforementioned assessments as it focuses upon the emotions and feelings elicited by weather situations as opposed to an emphasis upon the behavioral changes that occur with seasonal variations. Moreover, the salience of weather conditions overall upon people's emotions is assessed in comparison to the SPAQ or ISV's assessment of specific seasons' affect upon individuals' changes in mood and behavior by each season or month. In contrast to the ISV and SPAQ, the WAQ measures the effect of synoptic weather upon affect over short periods of time rather than providing a broad measure of season- related changes that may be less sensitive to daily weather variations. As such, the WAQ is designed to be a more high resolution measure that is designed to assess mood-related symptoms at the level of weather that occurs on a day-to-day basis.

The WAQ, which assesses individuals' emotions or feelings when a particular weather event occurs, has scores that can range from 22 to 110. Within this study, scores on the WAQ ranged from 43 to 100 (M=71.21, SD=10.59). The data was not normally distributed, as it evidenced negative skewness and platykurtic kurtosis. These scores were significantly correlated with scores on the SPAQ, r = .58, p<.01, as well as with scores on the ISV, r = .68, p<.01.

The Center for Epidemiologic Scale-Depressed Mood Scale. The third questionnaire completed by participants was the 20-item Center for Epidemiologic Scale-Depressed Mood Scale (CES-D), which has been utilized to measure depression in the general population (Corcoran & Fischer, 1987). In comparison to other depression scales, the CES-D focuses upon measuring current levels of depression with a specific emphasis upon the affective components of depression (Radloff, 1977). The CES-D has been found to have good concurrent validity and good internal consistency which ranges from .85 to .90 in the general and psychiatric populations, respectively, (Corcoran & Fischer, 1987). Participants were asked to rate the number which best describes how often they felt or behaved during the past week, which the ratings ranging from rarely or none of the time to most or all of the time (Corcoran & Fischer, 1987).

The two instruments measuring overall mood, the POMS and CES-D, had scores that respectively ranged from 28 to 107 (M=55.19, SD=16.02), and from 10 to 31 (M=18.23, SD= 4.39). On the CES-D, approximately 31.1% of participants exhibited response patterns consistent with no clinically significant symptoms, 64.8% with subthreshold depressive symptoms, and 3.3% with possible major depressive episode. Scores on the POMS were significantly correlated with scores on the CES-D, r =.37, p <.01.

The Profile of Mood States. The Profile of Mood States (POMS) was used to evaluate participants' current mood states as it has been utilized to measure mood over a variety of populations, including healthy subjects. Individuals were asked to rate the intensity of their mood on a five-point scale based upon a list of 65 adjectives that describe mood or feelings (Spielberger, 1972). The POMS has demonstrated good internal reliability ($\alpha \geq 0.84$), good internal consistency reliability, and acceptable test-retest

reliability (Wyrwich & Yu, 2011); (Spielberger, 1972).

The Leisure-Time Exercise Questionnaire. The Leisure-Time Exercise Questionnaire (LTEQ) was utilized to help evaluate participants' self-reported physical activity (Godin & Shepherd, 1985). With this assessment, individuals were asked to estimate how many times a week they engage in strenuous, moderate, and mild exercise. Participants whose computed total leisure exercise score of 24 units or more were classified as active, 14 to 23 units as moderately active, and less than 14 units as insufficiently active (Godin, 2011). The LTEQ has a reported test-retest reliability of 0.74 (Ng, Cuddihy, & Fung, 2003). Within this sample, the LTEQ had scores that ranged from 24 to 469 (M=67.78, SD=53.04). The descriptive statistics for the LTEQ suggests that the exercise habits of the participants in this study were well above the cutoff to be qualified as regular exercisers.

The participants were asked to identify their exercise habits in the "Mood, Weather, and Exercise" questionnaire. Specifically, participants were asked to identify their typical frequency and duration of exercise, the type of exercise they usually engage in, and the environment in which this exercise takes place. Participants were asked to classify how their mood and exercise habits affected by the seasons and the inability to exercise for both weather-related reasons and reasons unrelated to weather.

Administration of the Instruments

Participants completed the Inventory of Seasonal Variation, Seasonal Pattern Assessment Questionnaire, the Weather Affect Questionnaire, the Center for Epidemiologic Studies- Depressed Mood Scale, the Profile of Mood States, the Godin Leisure-Time Exercise Questionnaire, and the "Mood, Weather, and Exercise Questionnaire" upon meeting with the researchers for approximately 45 to 60 minutes between the beginning of September 2013 and

end of February 2014. Participation in the study was voluntary, and individuals were required to consent to their participation prior to completing the instruments. A copy of the consent form was then provided to them for their records. Although full confidentiality was unable to be guaranteed as a result of the participants providing daily information via an internet website, the participants were only identified by means of an identification number, with the only link between participant name and identification number remaining locked in a secure room.

Participants were asked to track their mood and exercise habits for a period of seven days. This naturalistic observation of daily exercise with an activity diary is based on a study evaluating the use of accelerometry in adolescents (Ottevaere et al., 2011). Participants checked in twice daily with their current mood and exercise information. The data was to be entered once upon awakening each morning. The second rating occurred either after the participant had exercised, or if the participant has not exercised, the second rating occurred before the participant went to bed. Therefore, the first rating occurred in the morning and asked for the participant to rate their mood, and the second rating occurred either after exercise or right before bed. The data gathered in this manner was modeled after ecological momentary assessment, which refers to the collection of real-time data about current states such as physical activity and mood (Moskowitz & Young, 2005). This particular method of ecological momentary assessment is event- contingent as opposed to signal-contingent.

Individuals' exercise was categorized as anaerobic, aerobic, or a combination of anaerobic and aerobic by the researcher based upon the information provided in their ratings. Based upon cutoff guidelines from similar research studies focused upon mood and exercise, data from 14 participants were excluded because they did not complete at least 50% of the

daily ratings (Dunton, Liao, & Intille, 2012). Moreover, six participants were excluded because their reported weekly exercise, as measured on the LTEQ, met criteria for guidelines for regular physical activity (Rodgers et al., 2010). As a result, the total sample size was 90, with 20 participants' data being excluded from the original 110 based upon these aforementioned guidelines.

Therefore, overall it is thought that the participants in this study were actually regular exercisers who provided consistent information throughout the specified time period. The time period in which data was collected was mostly throughout the fall and early winter months. As such, the exercise patterns observed in this study are thought by the researcher to demonstrate the mood and exercise patterns consistent with months in the year usually associated with lower mood and lower overall physical activity.

The participants' daily exercise habits indicated that 55.8% of exercise was aerobic, 18.3% was anaerobic, and 25.9% was a combination of both aerobic and anaerobic exercise. In this sample, the participants exercised 65.1% of the days throughout the seven day period for a mean duration of 53.37 minutes (*SD*=32.53). Of this time, 62.3% of the total exercise was conducted indoors and 24.6% of the total exercise was conducted outdoors. Exercise that was conducted both indoors and outdoors (e.g. running outside and lifting weights outdoors) made up 9.2% of the total exercise engaged in by participants.

The first and second mood rating when participants did and did not exercise on a given day are indicated in Table 3. When participants did exercise, their first mood rating (*M*= 6.55, *SD*= 1.59) was slightly higher than their second mood rating (*M*=7.81, *SD*=1.55). When participants did not exercise, their first mood rating (*M*=6.58, *SD*=1.83) was again slightly higher than their second mood rating (*M*=6.97, *SD*=1.76).

When participants did not exercise, the most frequently reason was that it was a "rest day" in which they had not planned to exercise, and this reason accounted for 50.4% of the days in which exercise was not conducted. Weather-related variables (i.e. icy roads or intense heat) accounted for only 8.5% of the days in which a scheduled exercise session was delayed, interrupted, or prevented.

Statistical Analyses

Demographic Information

Non-depressed college students who were regular exercisers were the chosen participants for this study, and specific information was gathered based upon their demographic characteristics. Specifically, the demographic information that was obtained for the study included gender, age, academic degree attainment, and race/ethnicity. This information was subsequently analyzed through frequencies and descriptive statistics, and the sample size and percentage of participants in each category are reported in Table 1.

Within this study, the participants tended to be female and Caucasian, as evidenced by 84.4% of the participants identifying as female (n=76) and 76.7% of the participants identified as Caucasian (n=7). In this particular sample, 7.8% (n=8) of the participants identified as Asian, 12.2% (n=12) as African American/Black, 1.1% (n=1) as Latino/a, 2.2% (n=2) as "Other." None of the participants identified as Native Hawaiian/Pacific Islander or American Indian/Alaskan Native. The majority of the participants in this study tended to be upper classmen, as seen by 10.0% (n=10) of the participants identifying as fifth-year students or graduate students, 54.5% (n=54) identifying as fourth-year students, and 28.9% (n=29) as third-year students. Only 6.7% (n=7) of the participants identified as second-year students, and no participant identified as a first-year student. The age of the participants ranged from 19 to 29

years old (*M*=21.1, *SD*=1.3).

Statistical Power Analysis

Statistical power was assessed through the utilization of the computer application G*Power 3 (Faul, Erdfelder, Lang, & Buchaner, 2007). Based upon effect size estimates from related research studies, a moderate to large effect size was factored (Hallgren et al., 2010; Nabetani & Tokunaga, 2001). Therefore, a sample size that ranged from 26 to 74 was needed to conduct all statistical analyses. For example, a sample size of 74, an effect size of .50, statistical power of .80, and an alpha of .05 were needed to conduct a between-groups analysis of variance, while a sample of 52 was needed to conduct a Chi Square test, respectively, with similar parameters regarding alpha, statistical power, and effect size. The sample size in this study included 90 participants, which is indicative of slightly higher power than observed in similar studies (Dyer & Crouch, 1988; Myrna-Bekas et al., 2012).

CHAPTER 4

RESULTS

1) Do individuals' moods improve after exercise in comparison to the moods of individuals who have not exercised?

In order to test the hypothesis of whether individual's moods improve after exercise in comparison to the moods of individuals who have not exercised, a mixed model ANOVA was utilized to test to examine the extent to which individuals' moods are altered as a result of exercise. For the mixed ANOVA, the repeated measures variables were the first and second mood ratings, and the between-subjects variable was whether the participants had exercised on that day. Mauchley's test indicated that the assumption of sphericity had been violated, (χ^2 (2) = .00, p <.001), therefore, degrees of freedom were calculated using Greenhouse-Geisser estimates of sphericity (ε= 1.00). The analysis revealed a significant difference from the first mood rating to the second mood rating that was qualified by whether an individual had exercised, F(1, 449)= 23.80, p<.001, N_p^2 = .05. (See Figure 1.) These results indicate that the moods of individuals did change based upon whether they had exercised. Specifically, the mood improvement from the first rating to the second rating was significantly higher in people who had exercised rather than people who had not exercised that day.

A linear regression was then conducted to determine whether the difference in mood ratings could be explained by the number of minutes spent exercising. Results indicated that the number of minutes spent exercising explained 0.4% of the variance of the difference in

mood ratings, (R^2= .004, F(1, 310)= 1.38, p=.24. Therefore, even though the results from the mixed model ANOVA did indicate that people's moods improved after exercise, the results of the linear regression indicate that the variance in the improvement of mood of people after exercise is not significantly explained by the amount of time spent exercising.

2) Are individuals' moods more altered by anaerobic or aerobic exercise?

To examine whether individuals' moods are altered depending upon the type of exercise engaged in by the individual (i.e. aerobic, anaerobic, or a combination of both anaerobic or anaerobic), a one-way independent ANOVA was utilized with the independent variable of type of exercise (e.g. aerobic, anaerobic, or a combination of aerobic and anaerobic exercise) and the dependent variable of the difference between the first and second mood rating. However, before this analysis, a paired samples t-test was used to determine whether there was a significant difference between the first mood rating and the second mood rating. There was a significant difference in the scores for the first mood rating (M=6.55, SD=1.66) and second mood rating (M=7.55, SD=1.62); t(459)= -11.69, p=.001. Due to this significant difference in mood ratings, the dependent variable was identified as the difference between the first and second mood rating scores.

A Kruskall-Wallis test was utilized to test this hypothesis given that the assumption of the homogeneity of variance had been violated, and results indicated that there was not a statistically significant difference between types of exercise: H(2)= .16, p= .92, with a mean rank of 158.95 for aerobic exercise, 153.55 for anaerobic exercise, and 158.91 for a combination of both aerobic and anaerobic exercise. Therefore, these results indicate that mood improvement did not significantly differ as a result of the type of exercise that was engaged in by the participants.

3) To what extent is mood affected when exercise is prevented due to weather?

It was hypothesized that individuals' mood would be more altered when exercise was prevented as a result of weather-related factors as opposed to other factors. To test this hypothesis and since the assumption of homogeneity of variance had not been violated, a mixed model ANOVA was utilized to determine whether the difference in mood from the first to second daily ratings were more adversely affected when weather-related factors prevented exercise or when other reasons prevented exercise. The between-subject variable was the reason exercise was interrupted and the within-subject variable were the two time points (the first and second mood ratings).

Results indicated that there was not a statistically significant effect on mood depending upon whether exercise was prevented due to weather-related factors or other reasons, $F(1, 110) = .82$, $p = .37$. Therefore, it can be surmised from the results that the reason why a person's exercise had been interrupted (i.e. weather or other factors) did not significantly affect a person's change in mood from the first rating to second rating.

4) Are individuals who tend to experience seasonal-related decreases in mood more likely to self- select into outside exercises in comparison to individuals without sensitivity to seasonal variations?

For this analysis, a median split was employed to categorize individuals with scores above the median on the ISV, SPAQ, and WAQ as being sensitive to seasonal variations in the weather. Specifically, participants who fell above the median scores of 2.23, 10.00, and 74.00 respectively for the aforementioned instruments were identified as being seasonally sensitive. All three of these instruments were used to help identify an individual as being

seasonally sensitive in order to fully capture sensitivity to weather on a daily basis (i.e. the WAQ) as well as sensitivity to weather with regard to overall seasonal change (i.e. the ISV and SPAQ). With this categorization method, 28% of the participants (N=25) were identified as being seasonally sensitive.

It was hypothesized that individuals who demonstrate greater weather-sensitivity (i.e. their scores fell above the median split) would exhibit a greater preference for outdoor exercise than those who do not exhibit such weather sensitivity. Since there was so much missing data when looking at when individuals had exercised and when they had not, only two days of data were used for this analysis. A chi-square statistic was calculated to examine whether seasonally sensitive individuals were more likely to exercise outdoors than non-seasonally sensitive individuals. The test was not statistically significant, χ^2 (2) = 1.246, p = .264. As such, seasonally sensitive individuals were not more likely to self-select into outdoor exercise settings in comparison to non-seasonally sensitive individuals.

5) Are individuals who are sensitive to seasonal changes in weather that can lead to depressive symptoms more likely to experience an improvement in their mood after exercising outdoors as opposed to exercising indoors?

For this analysis, a median split, as explained in the aforementioned analysis, was again utilized to categorize individuals as being seasonally sensitive or non-seasonally sensitive. An analysis of variance (ANOVA) was utilized to assess whether individuals who report being sensitive to seasonal changes in weather were more likely to experience an improvement in mood upon the exercise setting. This analysis was conducted with the independent variables of exercise setting, (i.e. outdoor exercise, indoor exercise, and combination exercise setting),

and the dependent variable of mean difference in mood. The dependent variable of mood difference for each day was calculated by taking the difference between these participants' first and second mood ratings. There appeared to be no significant difference in the mood of individuals sensitive to seasonal changes based upon exercise environment, $F(2, 459) = 2.36$, $p = 0.59$, with the mean mood ratings by environment being 7.58 (SD= 1.60) for indoors, 7.70 (SD= 1.56) for outdoors, and 8.00 (SD=1.80) for both indoors and outdoors exercise.

As a follow-up, the association between weather sensitivity status and where individuals chose to exercise was also assessed through a Pearson's chi-square analysis. Unlike the previous analysis, individuals were categorized as seasonally sensitive if their scores fell above the median on the WAQ. By solely using the WAQ to assess seasonal sensitivity, it was hypothesized that the association between weather sensitivity status and exercise setting may be affected differently when looking at weather sensitivity on a daily basis. With this categorization method, 42.6% (N=32) of the participants were categorized as being seasonally sensitive. Based on a Pearson's chi-square analysis, there was not a significant association between seasonal sensitivity and exercise setting preference, $X^2(1) = 0.009$, p=.92. Therefore, in this study, seasonally sensitive individuals were not more likely to exercise outdoors rather than indoors.

Subsidiary Analyses

Several additional analyses were pursued in addition to those utilized for addressing the main research questions. The purpose of these analyses were to further understand how mood, exercise, and weather affect regular exercisers and their daily life. Specifically, further questions remained regarding whether factors besides weather significantly influence an individual's change in mood ratings when exercise is prevented, whether an individual's

perception of their relationship between mood and exercise affected the observed influence of exercise on weather, whether an individual's perceptions of how their mood is affected by weather is consistently reflected by scores on the WAQ, and whether there were gender differences in this study regarding weather sensitivity.

Analyses were pursued following the end of data collection, and the first subsidiary analysis revealed that the other specified reasons (i.e. work obligations, family obligations, health, etc.) for not engaging in exercise did not appear to significantly determine an individual's change in mood ratings. However, when participants failed to specify a specific reason for their prevented exercise and indicated "Other" (15.9% of the reasons indicated by participants for why exercise did not take place), this relationship was significant, F (1, 119), = 3.65, p = .06, r= .17. Further assessment revealed a negative trend in the second mood rating when "Other" was indicated for the reason for exercise prevention as opposed to the specific reasons of work, family, or health.

A second subsidiary analysis was conducted on the self-reported perception of how much an individual looks forward to exercise and how much their mood improves following exercise. This analysis was of interest because it was hypothesized that mood improvement from exercise may in part be influenced by how much an individual believes that this effect will take place, and therefore, the perceptions leading to a self-fulfilling prophecy. A one-way ANOVA suggested that mood improvement after exercise differed as a result of how much an individual anticipates or looks forward to exercising, F (7, 448), = 1.98, p = .06, r= .03.

A third subsidiary analysis was conducted on the self-reported perception of how much an individual believes their mood is affected when weather prevents planned exercise and their WAQ score. This analysis was conducted to assess whether the total score on the WAQ was consistent with participants' self-reported perception of how much their mood is affected by the weather. Specifically, is the WAQ, which assesses individuals' emotions or feelings when a particular weather event occurs, associated with an individual's perception of their own seasonality? Due to the non-normal distribution of the data, a Spearman's correlation coefficient was conducted to assess the relationship between WAQ scores and individual's self-reported perception of the extent their mood is affected when exercise is prevented by weather. WAQ scores were correlated with self-reported perception of how much they felt their mood is affected when exercise is prevented by weather, r_S= -.15, p=.01.

A fourth subsidiary analysis was conducted on whether women and men differed with regard to WAQ scores. This analysis was conducted to determine whether women and men tend to differ regarding their perception of how much their mood is affected by weather. As a result of the non-normal distribution of the data, a Mann-Whitney test was conducted to determine whether men and women differed with regard to WAQ scores. WAQ scores in women (*Mdn*=74.00) differed from men (*Mdn*=66.00), U=9996.00, z= -6.018, p<.001, r=-.24. This finding that more women tended to perceive themselves as seasonally sensitive in comparison to men is consistent with the research literature that women tend to exhibit higher degrees of weather sensitivity than men (Rosenthal, 2006).

CHAPTER 5
SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary of Study

Statement of Problem and Procedures

The purpose of this study was to examine how the daily mood and exercise habits of relatively healthy individuals with active lifestyles are affected by their attributions and experience of weather. In building upon the previous research, this study explored the relationship of mood, exercise, and individuals' experience and attributions about the weather as opposed to examining only two of these three variables together (i.e. mood and exercise, mood and weather, or exercise and weather). This difference is significant in that weather has been shown to play a key role in people's reported moods and exercise habits, yet previous research has not focused upon how these three important factors are associated with each other. Specifically, weather has been shown to have an influence on mood (Rosenthal, 2006; Hsin & Chien et al., 2006), exercise has been shown to affect mood (Boecker, 2008), and weather has been shown to affect exercise (Tucker & Gilliland, 2007). How then do all of these factors come into play in the daily lives of physically active individuals?

In this study, participants were undergraduate students from the University of Georgia who voluntarily participated in exchange for course credit. These participants had to meet specific inclusion and exclusion criteria which mandated a pattern of regular exercising and helped to exclude participants from the study with habits, medical conditions, or other variables that might have led to confounding with the constructs being studied. Participants were asked to complete the Inventory of Seasonal Variation, Seasonal Pattern Assessment

Questionnaire, the Center for Epidemiologic Studies-Depressed Mood Scale, the Weather Affect Questionnaire, the Profile of Mood States, the Godin Leisure-Time Exercise Questionnaire, and the "Mood, Weather, and Exercise Questionnaire."

Conclusions

In this study, non-depressed regular exercisers provided information regarding their daily mood and exercise habits. Contrary to the current research literature which focuses either exclusively upon mood and weather, weather and exercise, or mood and exercise, this study tested five hypotheses associated with all three of the aforementioned variables. Physically active individuals who had consistently exercised for at least six months provided daily data in order to assess the relationships of mood, exercise, and weather with individuals who already have consistent exercise regimens and to observe the fluctuations that occur in their mood in association with weather conditions and daily exercise.

Results from the data analysis identified a consistent trend in the mood ratings of all participants which indicated that participants' mood improved from the first mood rating to the second mood rating. This improvement or change from the first rating to the second rating was then further affected by whether the participant had exercised that day. This small to moderate effect size appears to indicate that mood improvement from exercise has significant clinical and practical applications (Rosenthal & Rosnow, 1984; Thompson, 2011). Specifically, this finding supports the use of exercise as an intervention for alleviating depressive symptoms, or as a means of preventing depressive symptoms (Gullette & Blumenthal, 1996).

Why is this finding important? The result that exercise improves mood has been well documented with sedentary individuals (Annesi, 2012; Crews, Lochbaum, & Lander,

2004; Hasson et al., 2011; Passos et al., 2011). Despite the lack of research on physically active individuals, it does appear that exercise does seem to improve the mood of individuals who are already accustomed to habitual physical activity (Myrnas-Bekas et al., 2012; Hallgren et al.,2010). This study's finding supports this latter result in the research literature and allows for the results from these studies to generalize to participants in the United States and non-sports science/physical education majors. Specifically, in the study conducted by Myrnas-Bekas et al., the participants were college students majoring in physical education in Poland. Likewise, the study conducted by Hallgren et al., 2010 utilized a smaller sample size than the present study with 16 participants as opposed to the 90 participants in this study, and utilized participants who predominantly majored in a sports science program in Sweden.

This study appears to be one of the first in finding support that exercise improves mood improvement in physically active individuals in the Southeastern United States who represent many different majors and programs. Moreover, the previously mentioned studies only looked at the subsequent change in affect immediately following exercise about one session of exercise in a pre-selected form of exercise, whereas, this study followed participants over the course of a full-week in their regular exercise routine. As a result of participants not providing enough information for the entire seven day period, two days of data from individuals were utilized during which they had both exercised and not exercised. Therefore, it is hypothesized that the mood of the participants in this study may be more representative of their actual daily mood than seen in other studies based upon the longer duration of data collection (i.e. one day versus two days) and the choice of exercise (i.e. ergometer at a particular day and time versus any choice/day/time).

The effect of exercise on improvement on mood does not appear to have a dose-response effect with regard to how long a person exercises. In particular, although individuals who performed both aerobic and anaerobic exercise during a single exercise session exercised for longer periods of time than individuals who performed either aerobic or anaerobic exercise alone, they did not experience more of an improvement in their reported mood. Therefore, it appears that the duration of exercise does not impact mood improvement as much as had be expected.

Similarly, improvement in mood did not appear to be affected by the environment in which the exercise took place (i.e. outdoor or indoors). Based upon the finding that individuals find exercising outdoors in comparison to indoors as being more "restorative" (Stella-Maria et al., 2009), it was hypothesized that individuals sensitive to seasonal variations would be more likely than their counterparts to exercise outdoors to improve their overall mood. In this study, results did not support findings from similar research studies that outdoor exercise was more significantly associated with mood improvement (Barton & Pretty, 2010; Stella-Maria et al., 2009). However, it is important to note that since the outside weather was not assessed during data collection, it may be that this lack of support for the association between outdoor exercise and mood improvement may have resulted from inclement weather during data collection. Additionally, during several weeks of data collection, unseasonal weather in the form of ice storms and snow may have affected the results in such a way that the findings would be different in weather more typical for the region.

Several differences in research design may factor into why results from this study differed from the aforementioned studies. In the research conducted by Barton and Pretty,

only men exhibited a significant improvement in mood based upon outdoor exercise. Since the participants in the current study were mostly female (65% of the sample), it is unclear whether a significant effect of mood improvement resulting from outdoor exercise over indoor exercise may have been found with equal samples between male and female participants. Likewise, the type of exercise performed (i.e. aerobic or anaerobic exercise) does not seem to particularly influence the reported mood of individuals. This improvement in mood based upon exercise, regardless of the type of exercise, has been a consistent finding within research studies focused upon this area of research (Myrnas-Bekas et al., 2012; Hallgren et al., 2010; Crews et al., 2004).

Interestingly enough, the finding that mood improvement after exercise differed as a result of how much they anticipate or look forward to exercise lends support for the self-determination theory. Self-determination theory as it relates to exercise adherence posits that intrinsically motivated individuals exercise for "the satisfaction one gains from engaging in the activity itself" (Ryan et al., 1997, p. 336). As such, these individuals look forward to the act of exercising and the stimulation or enjoyment it provides. This finding that mood improvement after exercise differs as a result of expectations is particularly important in light of the consistent finding that approximately 50% of the adults who start an exercise program will drop out within a few months (Dishman et al., 1988). As such, a new focus of research should be opened up to explore how to raise individuals' expectations of how much their mood improves with exercise, and subsequently, to help individuals receive greater reinforcement from exercise in the form of greater mood improvement.

Participants in this study rated their anticipation of exercise on a Likert scale from 1 to 7, with the higher number indicating the greater anticipation for exercise. In this study, the

mean score of 5.18 (1.08) indicates that the participants tended to greatly anticipate exercise than would have been expected. In theory, the participants in this study may have seen a larger improvement in their mood after exercise due to their greater anticipation or "looking forward to" exercise. It could be hypothesized that a self-fulfilling prophecy of one's belief that exercise that exercise will improve your mood can be seen by individuals believing that their mood will improve after exercise and then subsequently reporting that their mood had improved. It follows then that individuals may become more likely to regularly exercise as opposed to individuals who do not look forward to exercising and do not expect mood improvement.

While results from the current study firmly point to an association between mood improvement and exercise, there does not appear to be an association between an individual's change in mood based upon the reason for their planned exercise being prevented. The hypothesis that weather-related reasons for the prevention or disruption of an individual's exercise routine did not appear to more significantly impact an individual's moods than other reasons, such as health, family obligations, or work obligations. However, this lack of an association between an individual's change in mood and the reason their planned exercise was interrupted was determined through patient self-report rather than on an analysis of weather conditions.

Interestingly, a subsidiary analysis indicated that when participants indicated "Other" as the reason for not exercising, the difference in mood was significantly different than the other reasons specified for not exercising (i.e. family, work, and health). It is unclear at this time why the lower second mood rating when participants indicated "Other" as opposed to the other three main reasons. It can by hypothesized that "other" reasons for prevented exercise

may have some certain factor that missing exercise for work obligations, family obligations, or health reasons does not. Further research is necessary to determine what this unknown factor is that causes such a difference in mood ratings such as testing whether "other" reasons tend to be more spontaneous and allow for less planning or for other myriad reasons.

From this study, it appears that individuals who are seasonally sensitive are not more likely to choose outdoor exercise over indoor exercise, nor are they more likely to experience a greater improvement in mood when they do exercise outdoors. Conversely, research conducted by Graw et al. indicates that women with seasonal affective disorder spend approximately the same amount of time outdoors during the fall and winter months as participants without this disorder; however, women with seasonal affective disorder are more likely to spend a greater amount of time outdoors in the summer than the control group (1999). The findings from this study appear to partially support the results from the previous research study, as seasonally sensitive individuals tended to exercise indoors during the fall and winter months when data was collected. It is hypothesized that if data collection had occurred in the spring and summer months, participants with seasonal sensitivity in this study would have chosen to exercise outdoors more than non-seasonal individuals if data collection had occurred in the spring and summer months.

Overall, it would appear that exercise environment (i.e. indoor, outdoor, or a combination of both indoor and outdoor exercise) or the number of minutes exercised does not seem to play a significant role in the degree of mood improvement. Although sensitivity to weather conditions was not found to be predictive of preference for outdoor exercise, all forms of physical exercise did appear to indicate a significant difference in individuals' mood. It seems that the most important factor regarding exercise and mood improvement is just having

people exercise, without overt emphasis on the type of exercise, where exercise is performed, and the duration of the exercise session. It is unclear at this time if the relationship between mood and exercise can best be explained by Sexton et al.'s theory that a better mood leads to increased exercise or by Boecker's theory that exercise improves mood based upon increased opioid receptor binding in the cortical and limbic areas of the brain (2001; 2008).

Implications

Overall, this research emphasized the importance of exercise for mood improvement for individuals. In particular, the results emphasized how mood improvement from exercise appears to be an important factor for individuals who already lead active lifestyles (Rodgers et al., 2010). While sensitivity to seasonal variations or weather-related conditions does not appear to be associated with a preference for outdoor exercise or to lead to a more significant improvement in mood as a result of exercising outdoors, exercise as a whole was associated with daily improvement in mood.

This is particularly important when considering the clinical applications of this finding. In particular, with the prevalence of depression having increased over the past three decades and with depression "predicted to be the predominant cause of disability in the developed world," exercise as treatment and prevention for depression is becoming of increasing importance (Sarris et al., 2014, p. 5). Although psychological interventions and medication are the first line of treatments for depression, exercise as treatment has been shown to have a moderate to large effect size in the research literature (Sarris et al., 2014).

Aside from depression, research has demonstrated the efficacy of a regular exercise regimen on reducing stress reactivity and as a positive coping strategy in individuals diagnosed with various conditions such as bipolar disorder and epilepsy (Edenfield, 2008;

Vancini, de Lira, & Arida, 2013), it is thought that results from the current study offers support for the idea that physically active individuals may use exercise as a daily coping strategy or as a means to alleviate mental health symptoms.

Most importantly, the use of exercise for the alleviation of depressive symptoms or for use as a positive coping activity can be viewed as a form of social justice. Exercise as both a preventative measure and as a treatment is a relatively cheap and safe intervention which can be accessed by numerous people. The importance of these factors are magnified when viewed in light of the underutilization of mental health services by racial and ethnic minorities in the United States by reasons such as inaccessibility or stigma (Kurtz & Street, 2006). Exercise could help to alleviate or prevent depressive symptoms for these individuals who may not have the financial resources or community support to pursue traditional depression treatments.

Lastly, due to the result that exercise of any type, duration, or setting led to mood improvement, mental health clinicians should make a more concerted effect on helping individuals learn to utilize exercise as a positive coping skill. This emphasis upon just exercising, regardless of the different preferences for how this exercise is performed, should be recommended to patients as a first-line treatment. In particular, exercise should strongly be encouraged when working with individuals who may be hindered in pursuing traditional mental health treatments (i.e. counseling and psychiatric medications). Exercise as a means of social justice should be encouraged by all health care providers to assist in eliminating both the physical and mental health disparities in the United States.

Recommendations for Future Research

Further research is recommended to further explain the associations among mood,

daily exercise regimen, and weather conditions for regular exercisers. Future studies should focus upon the relation of weather to the mood improvement of physically active individuals who live in climate zones that differ significantly from the warm temperate climate zone in which this study was conducted. Moreover, it is recommended that future studies utilize technology to more precisely capture the mood of participants at specific intervals, in accordance with the principles of ecological momentary assessment.

Further studies should focus upon how other exercise variables may influence the extent of mood improvement after exercise. In particular, further research should explore whether intensity and frequency of exercise may mediate this relationship between outdoor exercise and mood improvement in individuals sensitive to seasonal changes, as the research literature is mixed regarding the effect of exercise intensity (Groom & O'Connor, 1996; Crews et al., 2004; Daley et al., 2006). Additionally, this study should be replicated in the spring and summer season to see whether participants with greater seasonal sensitivity were more likely to exercise outdoors. If so, these results would support findings from Graw et al. and lend credence to the hypothesis that individuals high in seasonal sensitivity are more likely to exercise outdoors than individuals low in seasonal sensitivity solely during the spring and summer months (1999).

Moreover, based upon the post-hoc finding that mood improvement did differ when exercise was prevented for an unidentified reason in comparison to other specified reasons (i.e. weather conditions, family obligations, work obligations, illness or poor health, or a specified day off from exercise), future studies should identify what these different reasons are for exercise prevention and why these specific reasons affect mood differently than the commonly cited reasons of weather, illness, family obligations, or work obligations. What

other types of reasons often prevent consistent exercise participation?

Limitations

The current research study was limited by several different variables. Several concerns arise with regard to generalizability. Due to the low number of ethnic minority participants, the overrepresentation of female participants, and the relatively young mean age of the participants (mean age= 21.11), this study's results have limited generalizability to the general population. Also, as this study was conducted in the southeastern United States, this study's findings may not be generalizable to other areas of the United States with differing climate patterns. The Southeastern setting is thought to limit the generalizability due to the humid subtropical climate, which is not representative of the other climate zones within the contiguous United States. These factors prevent the results from this study to from replicated in situations other than participants that are college students from a large Southeastern university setting. The Southeastern setting is thought to limit the generalizability due to the humid subtropical climate, which is not representative of the other climate zones within the contiguous United States. Along these lines, although people self-reported whether or not the weather was a reason for their not exercising, the ambient weather conditions during the study interval were not taken into account. Thus, the role of the actual weather on peoples' behavior was not assessed.

Several threats to validity were identified in this research study. Construct validity may have been negatively impacted due to the mono-operation bias in the form of exclusive self- report measures. It is hypothesized that the results may also have been impacted by the inconsistent responding throughout the week by participants, as not all participants consistently provided information for the fourteen data points during the seven consecutive

day reporting period. Internal validity may have been threatened due to history as the student's moods may have been significantly affected by outside events (e.g. final exams and holiday breaks) that may have added variance. A threat to statistical conclusion validity that was identified by researchers was the small sample size and resulting low statistical power with regard to individuals who were prevented from exercising due to weather-related variables may have reduced the power to find more a significant finding in testing the hypothesis that the prevention of exercise due to weather-related variables would lead to significant decline in mood in comparison to other reasons.

Potential external validity threats that were identified include reactivity to the experimental situation and novelty effects, as participants may have changed their exercise routines due to the novelty of tracking their exercise and mood habits. Additionally, it is possible that specific procedural aspects of the study may have led to self-report artifacts, as the participants may have had difficulty providing reliable ratings of their mood immediately following exercise if they did not have immediate access to the internet to provide their second mood rating each day. This study is also limited by the potential interaction between the pre-test variable upon the post-test variable. Specifically, the participants' first mood rating may have influenced their second mood rating (e.g. choosing to rate themselves at a particular level based upon their first rating).

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Table 1

Participant Characteristics

Variable	*n*	Percent
Gender		
Females	76	84.4
Males	14	15.6
Other Specified Gender	0	0
Race/Ethnicity		
Asian	8	7.8
African American/Black	12	12.2
Caucasian/White	77	76.7
American Indian/ Native American	0	0
Native Hawaiian/ Pacific Islander	0	0
Latino/a	1	1.1
Other	2	2.2
Academic Degree Standing		
Freshman	0	0
Sophomore	7	6.7
Junior	29	28.9
Senior	54	54.5
$5^{th}/6^{th}$ year student	9	8.9
Graduate Student	1	1.1

Table 2

First and Second Mood Ratings as a Function of Whether Participant Engaged In Exercise

	Mood Rating	First Mood Rating (%)	Second Mood Rating (%)
Exercised			
	1	---	0.3
	2	---	0.3
	3	2.9	---
	4	7.8	1.2
	5	14.5	5.5
	6	15.6	9.0
	7	23.7	20.8
	8	18.5	32.7
	9	7.5	18.8
	10	1.4	11.3
Did Not Exercise			
	1	0.8	---
	2	---	---
	3	1.5	2.0
	4	11.3	6.0
	5	18.8	14.0
	6	16.5	20.7
	7	15.8	20.0
	8	17.3	15.3
	9	15.0	19.3
	10	3.0	2.7

Figure 1.

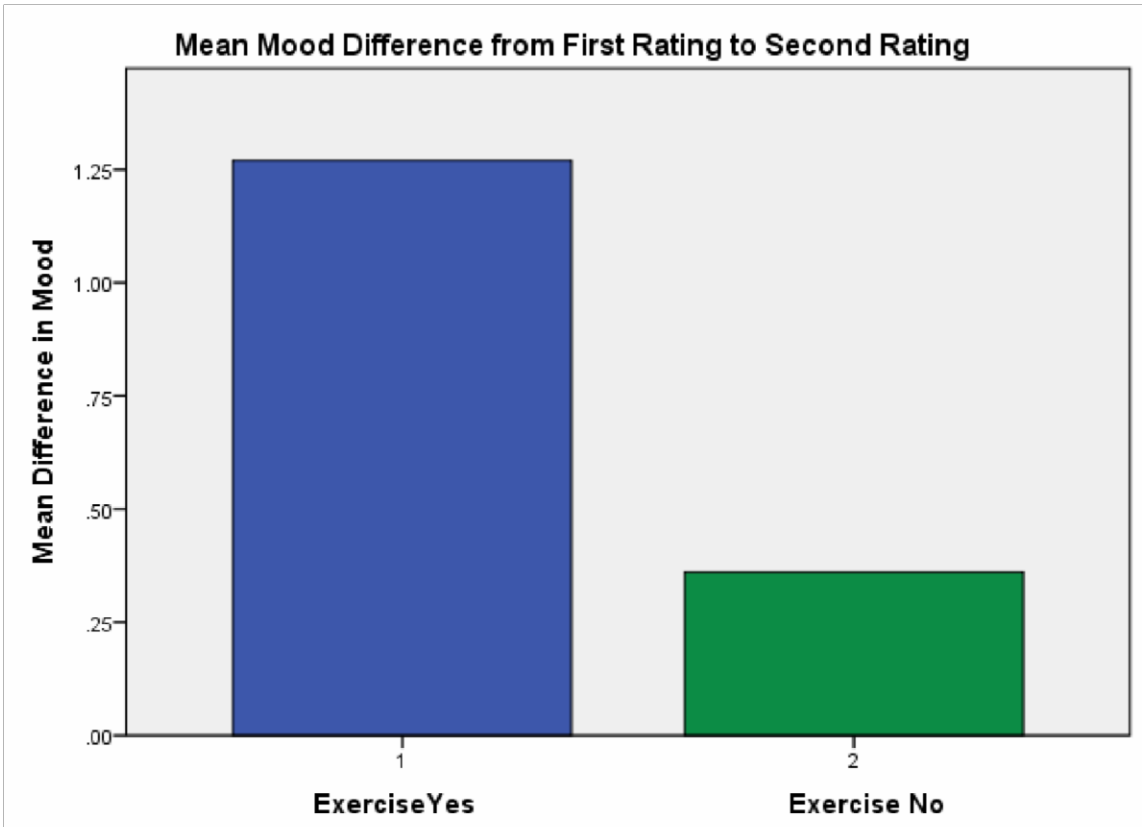

Figure 1. Chart depicting the mean difference in mood that occurs from the first rating to the second rating of mood as determined by the presence of exercise

APPENDIX A

Consent Form

I, _____, agree to participate in a research study titled "An Exploration of the Relationship of Exercise to Mood with Weather as a Moderating Variable on Non-Depressed Individuals with Active Lifestyles" conducted by Kristin Hunter from the Department of Counseling and Human Development at the University of Georgia (404-519- 3621) under the direction of Dr. Alan Stewart, Department of Counseling and Human Development, University of Georgia (706-542-1263). I understand that my participation is voluntary. I can refuse to participate or stop taking part at anytime without giving any reason without giving any reason, and without penalty or loss of benefits to which I am otherwise entitled. I can ask to all of the information about me returned to me, removed from the research records, or destroyed.

The reason for this study is to observe the relationship between exercise and weather on active individuals' moods. If I volunteer to take part in this study, I will be asked to do the following things:

1) Answer questions about mood, exercise habits, and demographic information (e.g. age, race, year in school, etc.) which will take approximately 10 minutes.
2) Complete assessments on mood symptoms and mood related to weather conditions which will take approximately 20 minutes.
3) Record my daily exercise habits and mood every day by sending in this information via emailing, texting, or logging in to web site which will take approximately 5 minutes each day for two months.
4) Someone from the study may call me to clarify my information or to remind me to fill out the required daily information.

INCENTIVE: As an incentive for participating, I will receive 2.0 units (2 hours) of credit in the Counseling and Human Development Research Pool. Alternately, I understand that there are other studies in the CHDS research pool that I can complete for credits or I can see my instructor for alternative non-research assignments for credits.

BENEFIT: A benefit of participating is the possibility of developing a greater understanding of how mood is affected by weather and exercise. Further, at the conclusion of my participation, I will be provided with an explanation of the topics that were investigated in this study.

RISK/STRESSES: No risks, discomforts, or stressors are expected, except for the possible adverse consequences that might result from an erroneous dissemination about their scores on the mental health assessments.

CONFIDENTIALITY: Once you complete the questionnaires and set up an internet

account with the website chosen for data gathering, my responses will only be available to be viewed by the researchers. Internet communications are insecure and there is a limit to the confidentiality that can be guaranteed due to the technology itself. However, once the materials are received by the researcher, standard confidentiality procedures will be employed. You may discontinue your participation at any time simply by closing your account with the website and informing the researcher that you no longer desire to participate, and you will not be penalized for this withdrawal.

No individually-identifiable information about me, or provided by me during the research, will be shared with others without my written permission, except if it is necessary to protect my welfare or if required by law.

The investigator, Kristin Hunter, will answer any further questions about the research, now or during the course of the project. If you have any questions, you can contact the researcher at khunter1@uga.edu or call (404) 519-3621.

I understand that by signing this form, I am indicating that I understand the procedures described above, my questions have been answered to my satisfaction, and I agree to participate in this study. I understand that I will receive a signed copy of this consent form for my records.

Kristin Hunter
(404) 519-3621

_____ Signature

_____ Date

_____
Name of Participant

Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia, 30602; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu

APPENDIX B

Debriefing Form

An Exploration of the Relationship of Exercise with Mood Using Weather as a Moderating Variable in Non-Depressed Adults with Active Lifestyles

The purpose of this study is to examine how comparatively healthy individuals with active lifestyles are affected by weather conditions and daily exercise habits. In addition to focusing upon the association among mood, exercise, and weather, the effects of disruption in planned daily exercise as a result of weather-related events will be studied. This study will help contribute to a better understanding of the roles that daily exercise and meteorological variables occupy in affecting the emotional functioning and daily life activities of active adults.

Your effort and willingness to participate in this study are greatly appreciated. Your effort will help contribute to the advancement of the research literature on mood, weather, and exercise. If you have any complaints or concerns about your participation in this study, please feel free to contact the co-investigators: Kristin Hunter at khunter1@uga.edu or Dr. Alan Stewart at aeswx@uga.edu. Moreover, the Institutional Review Board (IRB) for the University of Georgia can be contacted at irb@uga.edu.

Thank you again for your participation in this research study!

Appendix C

Center for Epidemiological Studies- Depressed Mood Scale (CES-D)

Using the scale below, indicate the number which best describes how often you felt or behaved this way—DURING THE PAST WEEK.

1= Rarely or none of the time (less than one day)
2= Some or a little of the time (1-2 days)
3= Occasionally or a moderate amount of time (3-4 days)
4= Most or all of the time (5-7 days)

DURING THE PAST WEEK:

___ 1. I was bothered by things that usually don't bother me.

___ 2. I did not feel like eating; my appetite was poor.

___ 3. I felt that I could not shake off the blues even with help from my family or friends.

___ 4. I felt that I was just as good as other people.

___ 5. I had trouble keeping my mind on what I was doing.

___ 6. I felt depressed.

___ 7. I felt that everything I did was an effort.

___ 8. I felt hopeful about the future.

___ 9. I thought my life had been a failure.

___ 10. I felt fearful.

___ 11. My sleep was restless.

___ 12. I was happy.

___ 13. I talked less than usual.

___ 14. I felt lonely.

___ 15. People were unfriendly.

___ 16. I enjoyed life.

___ 17. I had crying spells.

___ 18. I felt sad.

___ 19. I felt that people disliked me.

___ 20. I could not get “going.”

Appendix D

Godin Leisure-Time Exercise Questionnaire

INSTRUCTIONS

In this excerpt from the Godin Leisure-Time Exercise Questionnaire, the individual is asked to complete a self-explanatory, brief four-item query of usual leisure- time exercise habits.

CALCULATIONS

For the first question, weekly frequencies of strenuous, moderate, and light activities are multiplied by nine, five, and three, respectively. Total weekly leisure activity is calculated in arbitrary units by summing the products of the separate components, as shown in the following formula:

Weekly leisure activity score = (9 × Strenuous) + (5 × Moderate) + (3 × Light)

The second question is used to calculate the frequency of weekly leisure-time activities pursued
"long enough to work up a sweat" (see questionnaire).

EXAMPLE

Strenuous = 3 times/wk

Moderate = 6 times/wk

Light = 14 times/wk

Total leisure activity score = (9 × 3) + (5 × 6) + (3 × 14) = 27 + 30 + 42 = 99

Godin Leisure-Time Exercise Questionnaire

1. During a typical 7-Day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).

a) STRENUOUS EXERCISE (HEART BEATS RAPIDLY) **Times Per Week**

_____

(e.g., running, jogging, hockey, football, soccer,
squash, basketball, cross country skiing,
judo, roller skating, vigorous swimming,
vigorous long distance bicycling)

b) MODERATE EXERCISE
(NOT EXHAUSTING) _____

(e.g., fast walking, baseball, tennis, easy bicycling,
volleyball, badminton, easy swimming, alpine skiing,
popular and folk dancing)

c) MILD EXERCISE
(MINIMAL EFFORT) _____

(e.g., yoga, archery, fishing from river bank, bowling,
horseshoes, golf, snow-mobiling, easy walking)

2. During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

OFTEN	SOMETIMES	NEVER/RARELY
1. |_|	2. |_|	3. |_|

Appendix E

Weather Affect Questionnaire

Instructions: On this and the following pages you will read questions about how various kinds of weather affect your emotions. We are using the word *emotions* here to mean the typical kinds of *feelings* that you experience and are aware of when a particular kind of weather occurs. Sometimes people experience *feelings* immediately when they see, know about, or experience something. At other times, people realize they are experiencing a *feeling* after they observe their own behavioral reactions or notice some change in how their bodies *feel* (i.e., after some sensation occurs...a smell, a taste, a sound, or a sensation such as warmth or coolness, etc.). We refer to all of these things as *emotions* or *feelings* and are interested in them for the purposes of this measure. There are no right or wrong answers to the things we will ask about here. We realize that everyone differs when it comes to the relationships between weather and the emotions that people might experience. Just respond as carefully and honestly as you can. Thank you.

Part I

1. Please write a few sentences (or even a short paragraph, if you would like) to describe the ways that the weather affects your emotions. If it seems to you that the weather does not have any effects on the way that you feel, then it is OK to say this.

2. What percentage of the TIME (again, thinking of your life as it typically is) are your feelings affected by the day-to-day weather where you live?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. Of the percentage that you just indicated above, how much of this is due to your DRIVING to and from work/school in a particular kind of weather?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. Considering your life in general, what percentage of the time would you say that you are able to KNOW or RECOGNIZE what emotions you are feeling?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. During your typical TYPICAL WEEKDAY (Monday's through Friday's), what percentage of the time would you estimate that you are OUTSIDE and exposed to the weather that is occurring?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. During your TYPICAL WEEKEND (Saturday, Sunday or holidays), what percentage of the time would you estimate that you are OUTSIDE and exposed to the weather that is occurring?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

7. If there is a particular kind (or kinds) of weather that leads to feelings that you *LIKE*, then ..
   a. Please describe these feelings that you *like*:

   b. Please describe the *kinds of weather* that seem to you associated with these feelings:

□ I just cannot think of or remember any particular kinds of weather that lead to feelings that I *like* (please check the box if this is the case).

c. To what extent do you need to be outside, exposed to this weather that you *like*, for it to have an effect on your feelings?

d. To what extent is it enough to just see or know that the weather leading to feelings that you *like* is occurring outside? (i.e. Knowing what the weather is outside without experiencing it)

8. If there is a particular kind (or kinds) of weather that leads to feelings that you *DISLIKE*, then...

a. Please describe these feelings that you *dislike*:

b. Please describe the kinds of weather that seem to you associated with these feelings:

□ I just cannot think of or remember any particular kinds of weather that lead to feelings that I *dislike* (please check the box if this is the case).

c. To what extent do you need to be outside, exposed to this weather that you *dislike*, for it to have an effect on your feelings?

d. To what extent is it enough to just see or know that the weather leading to feelings that you *dislike* is occurring outside?

Part II

Instructions: Please read each of the items below and indicate the extent to which you agree or disagree with each item using the following rating scale:

1=Strongly disagree
2=Disagree
3=Neither agree nor disagree

4=Agree
5=Strongly agree

1. The weather or changes in the weather really do not matter to me.
2. How the weather makes the outside environment appear tends to affect my mood (**or feelings**) during that weather.
3. The changes in the weather cause my mood to change.
4. There is a particular kind of weather that makes me feel good emotionally.
5. The weather affects my mood from day to day.
6. Certain types of weather make me feel better emotionally than other types of weather.
7. There is a particular kind of weather that makes me feel bad emotionally.
8. There is a particular kind of weather that makes me feel sleepy.
9. For question 8, if you agreed (rated 4 or 5) with this item, what is the kind of weather that makes you feel sleepy? □ N/A
10. There is a particular kind of weather that makes me feel more energetic.
11. For question 10, if you agreed (rated 4 or 5) with this item, what kind of weather makes you feel more energetic? □ N/A
12. There is a particular kind of weather that seems to increase my appetite for food.
13. If you agreed with question 12 (rated 4 or 5), what kind of weather seems to increase your appetite for food? □ N/A
14. There is a particular kind of weather that seems to decrease my appetite for food.
15. If you agreed with question 14 (rated 4 or 5), what kind of weather seems to decrease your appetite for food? □ N/A
16. There is a particular kind of weather during which I feel more interested in interacting with other people.
17. If you agreed with question 16 (rated 4 or 5), what kind of weather seems to make you feel more interested in interacting with others? □ N/A
18. There is a particular kind of weather during which I feel less interested in interacting with others.
19. If you agreed with question 18 (rated 4 or 5), what kind of weather seems to make you feel less interested in interacting with others. □ N/A
20. There is a particular kind of weather that I like to go outside and to experience.
21. If you agreed with question 20 (rated 4 or 5), what kind of weather do you like to go outside and to experience? □ N/A
22. There is a particular kind of weather that makes me want to remain inside.
23. If you agreed with question 22 (rated 4 or 5), what kind of weather makes you want to remain inside? □ N/A
24. The weather affects the kinds of foods that I prefer to eat.
25. The weather affects the amount of time that I sleep.
26. The weather affects how much I eat.
27. The weather affects how much I tend to interact with other people.
28. The weather affects how much energy I have.

Appendix F

Profile of Mood States

Directions: Describe HOW YOU FEEL RIGHT NOW by checking one space after each of the words listed below:

FEELING	Not at all	A little	Mod.	Quite a bit	Extremely
Friendly	1	2	3	4	5
Tense	1	2	3	4	5
Angry	1	2	3	4	5
Worn Out	1	2	3	4	5
Unhappy	1	2	3	4	5
Clear-headed	1	2	3	4	5
Lively	1	2	3	4	5
Confused	1	2	3	4	5
Sorry for things done	1	2	3	4	5
Shaky	1	2	3	4	5
Listless	1	2	3	4	5
Peeved	1	2	3	4	5
Considerate	1	2	3	4	5
Sad	1	2	3	4	5
Active	1	2	3	4	5
On edge	1	2	3	4	5
Grouchy	1	2	3	4	5
Blue	1	2	3	4	5
Energetic	1	2	3	4	5
Panicky	1	2	3	4	5
Hopeless	1	2	3	4	5
Relaxed	1	2	3	4	5
Unworthy	1	2	3	4	5
Spiteful	1	2	3	4	5
Sympathetic	1	2	3	4	5
Uneasy	1	2	3	4	5
Restless	1	2	3	4	5
Unable to concentrate	1	2	3	4	5
Fatigued	1	2	3	4	5

Helpful	1	2	3	4	5
Annoyed	1	2	3	4	5
Discouraged	1	2	3	4	5
Resentful	1	2	3	4	5
Nervous	1	2	3	4	5
Lonely	1	2	3	4	5
Miserable	1	2	3	4	5
Muddled	1	2	3	4	5
Cheerful	1	2	3	4	5
Bitter	1	2	3	4	5
Exhausted	1	2	3	4	5
Anxious	1	2	3	4	5
Ready to fight	1	2	3	4	5
Good-natured	1	2	3	4	5
Gloomy	1	2	3	4	5
Desperate	1	2	3	4	5
Sluggish	1	2	3	4	5
Rebellious	1	2	3	4	5
Helpless	1	2	3	4	5
Weary	1	2	3	4	5
Bewildered	1	2	3	4	5
Alert	1	2	3	4	5
Deceived	1	2	3	4	5
Furious	1	2	3	4	5
Effacious	1	2	3	4	5
Trusting	1	2	3	4	5
Full of pep	1	2	3	4	5
Bad-tempered	1	2	3	4	5
Worthless	1	2	3	4	5
Forgetful	1	2	3	4	5
Carefree	1	2	3	4	5
Terrified	1	2	3	4	5
Guilty	1	2	3	4	5
Vigorous	1	2	3	4	5
Uncertain about things	1	2	3	4	5
Bushed	1	2	3	4	5