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To the Graduate Council:

I am submitting herewith a dissertation written by Pamela Mary Schweighart entitled "The Effects of Exercise Enjoyment and Personality on Mood and Salivary Cortisol with Exercise Activity." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Psychology.

Debora Baldwin, Major Professor

We have read this dissertation and recommend its acceptance:

James Lawler, Rich Saudargas, Jeff Fairbrother

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Mood and Salivary Cortisol with Exercise Activity

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Pamela Mary Schweighart
December 2008

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Abstract

The benefits of exercise are extensive; however, the majority of people do not participate in regular exercise. The problems with adherence may be due to personality factors and/or the of enjoyment of exercise. A pilot study was performed with the purpose of examining the relationship between exercise enjoyment and activity and to provide data for the validation of an enjoyment scale.

The purpose of the main study was to examine the relationships between exercise enjoyment, exercise activity, personality, mood, and salivary cortisol as well as the differences between the variables mentioned. Fifty-three students participated (22 male, 31 female; 11 sedentary, 20 moderately active, 22 highly active) by filling out surveys, rendering saliva samples, and riding a bicycle for 30 minutes. All participants kept their heart rates at a moderate level and perceived the exercise portion as moderate.

Results indicated that exercise enjoyment was positively related to physical activity and that females exercised less often than males. The broad personality traits of Extroversion and Conscientiousness were positively related to enjoyment with Neuroticism only showing a negative trend. Extroversion was positively related and Neuroticism was negatively related to physical activity level. Extroversion predicted enjoyment and activity levels. The specific personality trait of Work Drive was not related to enjoyment and only approached significance with physical activity. Some factors of mood improved with exercise (Revitalization increased and Physical Exhaustion decreased) while other factors of mood showed no relationship to exercise (Tranquility and Positive Engagement). Activity level did not moderate cortisol levels. For all participants, cortisol levels increased from baseline to after the bike ride and

continued to increase 20 minutes later. Cortisol was not related to any broad personality traits. Work Drive predicted cortisol levels after the bike ride, but other results did not support the overall relationship between Work Drive and cortisol levels.

Overall, the study supports the connections between enjoyment and activity, personality and activity, personality and enjoyment, exercise and cortisol, and mood and activity. The methods are reviewed and the implications of the findings are discussed.

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Introduction

The benefits of exercise are extensive and publicly known, though the public does not always follow the recommendations. Regular exercise has numerous cardiovascular, immune system, and psychological benefits. However, an individual's personality type may be related to their desire to exercise and ability to achieve such benefits. The perception or enjoyment of exercise may also be related to the willingness to engage in exercise. These variables will be discussed in an effort to further understand and predict how the enjoyment of exercise and personality may influence the desire to exercise and adhere to an exercise program. Salivary cortisol will also be discussed and studied as a physiological measure of exercise stress.

Benefits of Exercise

Physical activity has numerous benefits, a small handful of which will be discussed in this section. Sedentary lifestyles and physical inactivity are causal factors in many diseases like coronary heart disease (CHD), colon cancer, and diabetes. In fact, it is estimated that death from these conditions could be reduced by 5-6% with exercise (Powell & Blair, 1994). Exercise lowers the risk of CHD, stroke, hypertension, anxiety disorders, diabetes, colon cancer, depression, and even premature death (Centers for Disease Control [CDC], 2007). Sedentary lifestyles cost billions of dollars each year in health care and ultimately reduce an individual's quality of life. Exercise is also an economically favorable strategy compared to other medical interventions (Berlin & Colditz, 1990).

The current recommendations from the CDC regarding health benefits are 30 minutes of moderate intensity activities for 5 days a week, or 20 minutes of vigorous activity for 3 days a week, or both. According to the U.S. Physical Activity Survey of 2005, only 36% of Tennesseans meet the requirements. Forty-one percent have insufficient physical activity, and 23% of Tennesseans are inactive (CDC, 2007).

There have been numerous studies on physical activity and mortality. Lee and Paffenbarger (1996) wrote a review of studies conducted on oarsmen, railroad workers, bus drivers, postal service workers, civil servants, Harvard alumni, longshoremen, Finnish men, Norwegian men, and other men and women of North America. Through meta-analysis, they discovered a significant negative association between physical activity and mortality such that individuals who were more active lived longer. There are possible confounds of total lifestyle and diet, but overall, the association is strong and likely to be causal and dose-dependent (Dubbart, 2002; Lee & Paffenbarger, 1996).

Exercise can also improve brain function as it leads to increased blood flow and oxygen to the brain. Exercise can help generate new nerve cells and improve cognition, learning, and memory. It can even help to prevent stroke, Parkinson's Disease, and Alzheimer's Disease (Cotman & Engesser-Cesar, 2002). Brain-derived neurotrophic factor (BDNF) is important in brain function, neuronal transmission, and plasticity (Ferris, Williams & Shen, 2007). Ferris et al. (2007) studied BDNF to help confirm the relationship between exercise and brain function. Fifteen participants rode a bicycle for 30 minutes, one ride at moderate intensity (20% below ventilatory threshold) and one at high intensity (10% above ventilatory threshold) on separate days. After exercise, BDNF

values were increased and intensity dependent (Ferris et al., 2007). This study supports the positive effect that exercise can have on brain function.

In general, exercise has been shown to be beneficial for overall health and mortality. The following sections will examine the impact of physical activity (exercise) on cardiovascular health, immunity, and psychological well-being.

General Heart Health. One of the main functions of the cardiovascular system is to supply the bodily organs and tissues with oxygen. Through the course of human development, aerobic capacity increases until the teenage years and then begins to decline through old age (Saltin, 1990). In response to exercise training, maximal oxygen uptake may be increased approximately 20%. Saltin (1990) also noted other cardiac changes in response to exercise: increase cardiac output, lower heart rate, increase stroke volume, increased heart size, and lower blood pressure.

Cholesterol levels are also related to general heart health and exercise can help improve those levels. Over one year, 80 women ages 35-40 participated in a study in Finland by Vainionpaa, Korpelainen, Kaikkonen, Knip, Leppaluoto, and Jamsa (2007). Forty-one of the women were in the control group, and 39 were in the exercise group. The exercise group performed 60 minutes supervised high-impact exercises two to three times per week. The control group was asked to continue their daily life and maintain their level of physical activity. Along with decreases in waist and hip measurements and increases in maximal oxygen uptake, the exercise group also lowered their cholesterol. The sample was population based, including some sedentary and some active individuals. The results showed that the most improvement came from those women who went from

sedentary to active (Vainionpaa et al., 2007). These results support exercise as a way to achieve aspects of heart health, such as improved oxygen intake and cholesterol levels.

To confirm the lower blood pressure effect of exercise, Lawler, Naylor, Wang, and Cox (1995) conducted a study on rats. The rats had varying family histories of hypertension: none, borderline or spontaneously hypertensive. The rats (n = 239) were split into exercise conditions of swimming for 2, 6, or 10 months or a control group (no exercise). Overall, exercise training reduced basal blood pressure levels, but it was especially lowered in the rats with histories of hypertension. This is important because the benefits of exercise can be gained by all, but might be especially beneficial to those who need it most.

Overall, there are numerous cardiovascular benefits that come with exercise. All of the underlying benefits including lower heart rate, better vagal tone, and lower blood pressure lead to a lower risk of CHD, which is the leading killer in the United States.

Immune System. In general, the purpose of the immune system is to identify ‘self’ from ‘non-self.’ The foreign materials can include many different types of antigens, such as bacteria, viruses, parasites, and fungi. The immune system is made up of specialized cells that mature in immune system organs (thymus, spleen, lymph nodes) and then travel through the blood (O’Leary, 1990).

Immune function is divided into 2 major types of immunity, natural and specific. Natural immunity works fast with all-purpose cells, namely neutrophils or granulocytes, natural killer cells, and macrophages (Segerstrom & Miller, 2004). These cells ‘eat’ their targets or lyse them with toxic substances while triggering inflammation. Specific immunity takes some time to build the defenses of its cells, lymphocytes. The receptor

cites on lymphocytes are antigen specific, meaning they only respond to one kind of invader. When these cells come in contact with a specific invader they multiply or proliferate, which is why it can take days to build a full defense (Segerstrom & Miller, 2004).

As a part of specific immunity, lymphocytes can be further broken down into two types, B and T cells. Humoral immunity consists of the B cells. These cells produce antibodies which can recognize specific invaders and tag them for destruction (Segerstrom & Miller, 2004). T cells are a part of cell-mediated immunity, named because they help mediate the immune response. Cytotoxic T cells will destroy an invader while helper T cells enhance the immune response and suppressor T cells reduce the immune response (Segerstrom & Miller, 2004).

Exercise is associated with improved immune functioning. The effects may be related to an overall healthier lifestyle (nutrition, less body fat, etc.), but there are also other underlying mechanisms (Woods & Davis, 1994). Moderate exercise improves the lysing capacity of neutrophils, increases numbers of natural killer cells and T cells, as well as increases immunoglobulin (Ig) levels (LaPerriere, Ironson, Antoni, Schneiderman, Klimas, & Fletcher, 1994). Exercise also increases the release of endorphins. During exercise, the hypothalamic pituitary axis (HPA) system is activated leading to the release of glucocorticoids and the suppression of inflammation (Woods & Davis, 1994). Macrophage cytotoxicity has also been shown to increase with both moderate and exhaustive exercise. Glucocorticoids, monocytes, and macrophages may all play a role in slowing or stopping tumor growth and killing cancer cells (Woods &

Davis, 1994). Overall, regular moderate exercise can improve specific parameters of the immune system which can improve general health and possibly prevent major illnesses.

It must be noted that intense, frequent, and long training sessions may actually lead to immune suppression (Nieman, 2000). This brings a distinct dualism to the effects of exercise on health. It seems that moderate exercise (3-4 days/week, 30-60 minutes/day) is beneficial for the immune system while intense exercise (5-7 days/week, > 2 hours/day) may actually suppress immune function. This relationship is described as a J curve. Nieman's (2000) work supports the J curve theory in that endurance athletes, or those who train at very high intensities and frequencies, are at a greater risk for urinary tract infections. For several hours after intense exercise the immune system is suppressed, though this is not found with moderate exercise. Further work by MacKinnon (2000) shows that intense exercise suppresses immune functioning, while moderate exercise may enhance immune functioning.

Psychological Effects. Exercise has many physical effects, but it can also have quite a positive effect on psychological aspects of a person's life. Exercise can be used for stress management and some health care professionals even believe that it can be an effective treatment for some mental health problems (e.g., depression, anxiety, and other clinical disorders) and as a means of relaxation (LePerriere et al., 1994). Exercise may be physically demanding, but most people report feeling good afterwards, which has been assessed by interviews and mood surveys.

Puetz, O'Connor, and Dishman (2006) conducted a meta-analysis of 70 studies on exercise and mood. Overall, regular exercise increases energy, lowers fatigue, and improves mood. A study by Cramer, Nieman, and Lee (1991) showed that a 15 week

walking exercise program improved the general psychological well-being of sedentary, mildly obese women. Thirty-five women were split into exercise and non-exercise conditions. The participants in the exercise condition walked briskly for 45 minutes, 5 days a week and were tested using the General Well-Being Scale and the Spielberger State Anxiety Inventory. The previously sedentary women in the exercise condition showed improved well-being and lessened anxiety compared to the non-exercise group after 6 and 15 weeks of walking (Cramer et al., 1991).

Raedeke (2003) conducted research that supports the positive connection between exercise and mood improvement. Female undergraduates ($n = 105$) who were enrolled in a group aerobics class completed activity and mood questionnaires before class and mood, enjoyment, and exertion scales after class. Results showed decreases in negative mood states and increases in vigor (Raedeke, 2003).

Research has also been conducted on the effects of exercise on depression. In a study by McCann and Holmes (1984), 43 depressed women were assigned to an aerobic exercise treatment, a relaxation treatment, or a control group. The women were followed for 10 weeks with depression assessed before, during, and after treatment using the Beck Depression Inventory (BDI). Participants in the exercise treatment had significantly reduced depression levels as compared to both the relaxation and control groups (McCann & Holmes, 1984).

Exercise therapy has not only been studied in relation to moderate depression; it has also been studied with more serious psychiatric disorders. In the treatment of severe depression, exercise has been shown to have results similar to psychotherapy, group therapy, cognitive therapy, and meditation (Dunn & Dishman, 1991; Tkachuk & Martin,

1999). Exercise can also be much less expensive than some other therapy options. For example, walking or jogging in a park or neighborhood is usually free. Blumenthal, Babyak, Moore, Craighead, Herman, Khatri, Waugh, Napolitano, Forman, Appelbaum, Doraiswamy, and Krishnan (1999) compared endurance exercise and antidepressant drugs for the treatment of major depressive disorder in older adults. After 16 weeks of the treatment, both exercise and medicine reduced depression scores on the BDI. However, the exercise group had a lower relapse rate 10 months later. This effect has been found for major and minor depressive disorders and self-rated mood (Dunn & Dishman, 1991).

In studies of patients with panic disorder or diagnosed anxiety disorders, running or aerobic exercise has been found to be an effective treatment (Tkachuk & Martin, 1999). Studies have even been done with exercise as a treatment for schizophrenia. Exercise can help schizophrenics reduce their depression, improve social skills, decrease psychotic symptoms, improve social competence, and reduce hallucinations. Therefore, it appears appropriate to add exercise training to a comprehensive treatment program (Tkachuk & Martin, 1999).

These effects of exercise on mood and depression may be due to the release of endogenous opiates (i.e., endorphins). According to LaPerriere et al. (1994), in response to exercise, fit individuals release more of these endogenous opiates than sedentary individuals. Another theory is that some types of depression are associated with low levels of norepinephrine and that exercise may increase the production of that neurotransmitter (McCann & Holmes, 1984). Also, it is possible that the positive effects are due to achieving goals, increased social contact, or even distraction (Dubbart, 2002).

Yet another theory is that exercise increases core body temperature which has a tranquilizing effect (Brown, 1990).

In summary, numerous studies demonstrate that regular exercise can decrease depression, anxiety and create a positive mood. Exercise can also be used as a treatment or part of a program of treatment for more serious mental health disorders such as schizophrenia and panic disorder.

The enjoyment of exercise as well as personality type might influence the amount or quality of the benefits received, which will be discussed in the following section. In the literature review, the variables of the current study will be examined including: active versus sedentary, salivary cortisol, exercise enjoyment, and personality. These variables could be helpful in creating a pre-screening or intervention program to help individualize exercise programs and improve adherence.

Literature Review

The terms exercise and fitness can be very subjective; thus, they will be defined here. Exercise is any activity used to maintain health (CDC, 2007). This vague definition can include flexibility training, aerobic or endurance workouts (running, cycling, swimming, etc.) or anaerobic or strength workouts (weight lifting, sprinting, etc.). Physical fitness means general health or can be applied to a specific ability or activity (CDC, 2007).

In many experiments, exercise is used as a stressor to measure a variety of responses. During exercise many stress hormones are released (catecholamines, glucocorticoids, etc.), which is consistent with viewing exercise as a stressor (MacKinnon, 1994). Generally, stress is a nonspecific event, internal or external, that produces demands on the organism. Selye was the founder of stress research in the 1930's with his model that stress is immunosuppressive (Vollhardt, 1991). Also, according to his definition, exercise is a good example of a stressor because it definitely produces demands on the organism. Lazarus expanded upon Selye's theories by adding perception to the equation. What this means is that the consequences of a stressful event depend on how the individual perceives it, as a challenge or a stressor (Lazarus & Folkman, 1984). Therefore, exercise can be perceived as eustress or distress.

The body reacts the same way to a stressful experience as it does to exercise; both have a catabolic reaction, which means they mobilize the body's energy (Carlson, 2001). Nutrients in muscles are made available for use, fats are converted for energy, and blood flow is increased along with other reactions. The HPA and the sympathetic-adrenal-medullary pathway (SAM) are both activated which causes the release of

epinephrine, norepinephrine and glucocorticoids (Carlson, 2001). Thus, blood pressure is increased as well as heart rate, respiration, body temperature, and digestion is inhibited. All of these reactions occur during stress and exercise, showing that these two phenomena are similar.

However, regular exercise has numerous benefits as were discussed in the previous section. The benefits received may depend on how one perceives exercise and/or one's personality profile. The following sections will discuss the main variables in the current study: active versus sedentary, salivary cortisol, perception, enjoyment, and personality. The literature review will end with the rationale for the study and the hypotheses.

Active versus Sedentary

There are many differences between active individuals and those who are sedentary. Some of the mortality and cardiovascular results have already been discussed, but a few other studies will be examined here.

Taylor, Klepetar, Keys, Parlin, Blackburn, and Puchner (1962) compared active (switchmen who worked in the rail yard) and sedentary men (clerks) in the railroad industry, a total of 191,609 men. No manipulation was required; they simply followed the men over 4 years and recorded the number and reasons of death. Their results showed that the clerks (sedentary) had a much higher risk of CHD than the switchmen (active) (Taylor et al., 1962). They concluded that the occupational activity of switchmen was helping them live longer lives while the inactive work style of the clerks may actually be shortening their lives.

It has been shown that athletes have higher high-density lipoprotein (HDL, good cholesterol) levels as compared to non-athletes. It has also been shown that, even in sedentary men, the HDL levels increase after exercise training (Powell, Thompson, Caspersen, & Kendrick, 1987).

Regular exercise can be quite helpful during the aging process; specifically, exercise can decrease pain. Bruce, Fries, and Lubeck (2005) studied 866 older adults (over 50 years old) who were sedentary or exercised regularly over 14 years. The main measure in their study was musculoskeletal pain and it was assessed with annual questionnaires that also asked about physical activity, health, medical problems, and demographic information. After adjusting for gender, BMI, and study attrition, Bruce et al. (2005) showed that exercise was associated with lower pain scores. In fact, regular exercisers reported 25% less pain than their sedentary counterparts.

Many studies compare active and sedentary individuals during a physical or psychological stressor to compare their reactions. Jamieson, Flood, and LaVoie (1994) studied 108 women's heart rate recovery from a serial subtraction (active psychological) task. In a first session, exercise and fitness measures were taken. In a second session, the participants completed the serial subtraction task. Overall, fit women had faster heart rate recovery after the stressor (Jamieson et al., 1994). Thus, being fit may also lessen one's reaction to a psychological stressor.

Spalding, Lyon, Steel, and Hatfield (2004) compared aerobic training, weight training and no training for 6 weeks on a psychological stressor task of mental arithmetic. Forty-five participants across the 3 conditions were tested by blood pressure and heart rate before, during and after the mental stressor. Individuals were all sedentary and

normotensive. Participants in the aerobic training group displayed lower blood pressure and heart rate increases during the stressor than the other two groups (Spalding et al., 2004).

Rimmele, Zellweger, Marti, Seiler, Mohiyeddini, Ehlert and Heinrichs (2007) studied 22 trained and 22 healthy but untrained men on their responses to the Trier Social Stress Test (public speaking and mental arithmetic). The participants were measured on mood, heart rate, and salivary cortisol. Rimmele et al. (2007) found that the trained (active) men had lower cortisol levels and heart rate responses to the stressor as compared to the untrained, sedentary men. The trained men also showed better mood and higher levels of calmness during the stress test (Rimmele et al., 2007).

Further support for the idea that exercise improves mood comes from Pinto and Trunzo (2004), who compared active and sedentary women who had survived early-stage breast cancer. The participants were compared on fitness (1 mile walk test), activity (7 day Physical Activity Recall), body esteem (Body Esteem Scale) and mood (Profile of Mood States). Even though the sample was limited to female cancer survivors, the results still support the belief that exercise leads to positive attitude, less fatigue, less depression, and higher vigor (Pinto & Trunzo, 2004).

The results from the studies above indicate that an active lifestyle tends to have a protective effect against disease and stress. Individuals who are sedentary have an increased risk for ill health. This difference will be examined as active individuals may differ from sedentary individuals in exercise enjoyment, baseline personality, and cortisol reactions to exercise.

Salivary Cortisol

Cortisol is a hormone secreted after the Hypothalamic-Pituitary-Adrenal axis (HPA) is activated. The hypothalamus secretes corticotrophin-releasing hormone which stimulates the pituitary gland to secrete adrenocorticotrophic hormone (Levine, Zagoory-Sharon, Feldman, Lewis, & Weller, 2007). This then stimulates the adrenal gland to release cortisol. Cortisol secretion follows a circadian rhythm with levels peaking in the morning and being lowest at night. Cortisol circulates in the body in both free and bound forms. It can be bound to corticosteroid-binding globulin, sex-hormone-binding globulin or albumin (Levine et al., 2007).

Generally, cortisol is a beneficial hormone and an important regulator of physiological systems. It is a biological marker of stress, anxiety and depression (Levine et al., 2007). For example, Armata and Baldwin (2008) had 134 undergraduates fill out stress surveys (College Life Stress Inventory and Cognitive-Somatic Anxiety Questionnaire) and render saliva samples. Participants were categorized into those with digestive problems and healthy individuals. The results showed that overall higher levels of stress were related to higher levels of salivary cortisol (Armata & Baldwin, 2008).

Cortisol helps regulate metabolism by mobilizing energy resources (e.g., conversion of amino acids to glucose in the liver) to provide fuel for the body. However, higher levels of cortisol are associated with depression (Holsboer, 2001), lowered immunity (Dickerson & Kemeny, 2004) and the progression of hypertension and diabetes (McEwen, 1998). Cortisol is said to suppress the immune system because it has an anti-inflammatory effect.

Cortisol is present in blood plasma, urine, and saliva. Researching plasma cortisol can be difficult because it requires medical staff, special equipment, and is more expensive and invasive (Levine et al., 2007). Salivary cortisol is an important non-invasive method for investigating the dynamic function of the HPA axis (Quissell, 1993). Free cortisol in saliva (10-15%) represents the active bio-available form and parallels adrenal activity (Kumar, Solano, Fernandez, & Kumar, 2005). Salivary cortisol also allows for frequent sampling and does not require medical staff.

Salivary cortisol testing is just as effective as plasma cortisol testing. Gozansky, Lynn, Laudenslager and Kohrt (2005) used paired saliva and plasma samples during exercise, intravenous corticotrophin-releasing hormone (CRH), and oral steroid conditions. They studied healthy individuals. The exercise group participated in a 10 minute session at 90 % of their maximal heart rate. Cortisol was measured from blood and saliva at baseline and every 20 minutes after the introduction of exercise, CRH or steroids for 2 hours. The results showed that salivary cortisol follows the same pattern of increase and decrease as plasma cortisol (Gozansky et al., 2005). This is a beneficial result since salivary cortisol is much easier to sample as described above. Due to the connection between cortisol and exercise, discussed in the following section, the current study will measure salivary cortisol levels before and after the exercise protocol.

Cortisol and Exercise. Many studies have examined the effects of exercise on cortisol levels; some will be discussed here. Radosevich, Nash, Lacy, O'Donovan, Williams, and Abumrad (1989) studied dogs on treadmills at low (6% incline) and high (20% incline) intensities. The dogs were exercised for 90 minutes and allowed to rest for 90 minutes for each intensity. A third control group was not exercised at all. Cortisol

increased during the low intensity exercise and returned to normal after rest. Cortisol also increased during the high intensity exercise but faster than during the low intensity exercise (Radosevich et al., 1989). This result is common in cortisol and exercise research showing that it is a dose dependent relationship.

An increase in cortisol in response to exercise has also been found in many human studies. Viru, Viru, Karelson, Janson, Siim, Fischer, and Hackney (2007) studied the cortisol response to intense exercise in 10 trained men. They had conditions comparing placebo to β -adrenergic blockers and regular to competitive setting. The participants ran to exhaustion on a treadmill. The competitive setting was achieved by establishing a contest between the participants along with strong verbal encouragement. Viru et al.'s (2007) results show that cortisol increased after exercise in all conditions, but that β -adrenergic blockage and competition may enhance the cortisol response.

The release of cortisol follows a circadian rhythm and this too affects the cortisol response to exercise. Kanaley, Weltman, Peiper, Weltman, and Hartman (2001) studied 10 active men and their responses to 30 minutes of moderate treadmill exercise at 7:00 am, 7:00 pm, and 12:00 midnight. Blood samples were taken 1 hour prior and every hour for 5 hours after each exercise bout. Both baseline and peak cortisol levels were highest at 7:00 am, which supports the circadian rhythm of cortisol fluctuation. Overall, the duration of cortisol response was similar across the times of day (Kanaley et al., 2001). Thus, it may not necessarily matter what time of day the exercise occurs as long as pre and post measurements are taken. In the current study, all data were collected between 10:00 am and 2:00 pm to maintain consistency.

Ten active males were studied by Jacks, Sowash, Anning, McGloughlin, and Andres (2002) to examine the cortisol response to exercise at different intensity levels. Multiple cortisol samples were obtained on 4 separate testing days (resting, low [44.5% VO₂max], moderate [62.3%], and high [76%] intensity). The cortisol response was greater after high intensity exercise, though no significant differences between the other intensities were found (Jacks et al., 2002). Even though they had a small sample size, the results still supported the idea that exercise increases cortisol levels and is possibly dose-dependent.

Usually, exercise will lead to an increase in cortisol; however, with relaxing exercise such as yoga and meditation the results are different. For example, Watanabe, Fukuda, Hara, and Shirakawa (2002) showed that yoga with mediation led to lower levels of salivary cortisol. They studied 25 individuals, some who practiced yoga regularly and some who did not. The study consisted of a 3.5 hour long yoga session as well as the Multiple Mood Scale and Vividness of Imagery Scale. The results showed that those individuals who regularly participated in yoga with meditation had lower salivary cortisol and better moods (Watanabe et al., 2002).

Yoga is a different type of exercise that leads to relaxation. This has been shown by serum cortisol as well as by alpha brain waves by Kamei, Ohno, Kumano, and Kimura (2000). Alpha brain waves are recognized as the relaxed waves. They studied 7 yoga instructors before, during, and after 50 minutes of yoga. Brain waves were measured via electrodes on the forehead and a catheter was used to obtain blood samples. Their results showed that cortisol decreased and alpha waves increased with yoga which demonstrates that this is a relaxing form of exercise (Kamei et al., 2000).

Cortisol is an important physiological marker of stress and is commonly used in exercise research. It may also be a marker of perception of exercise as yoga is known as relaxing and associated with lower levels of cortisol. Salivary cortisol will be used as a physiological measure as a measure of exertion and perception. The following section will examine the importance of perception in exercise.

Health Perception

The perception of events can guide behavior, according to the Attribution of Emotion theory by Weiner (1980). One's attribution, perception, or feelings can provide direction for our actions. Weiner's (1980) studies investigated helping behavior, but this theory can be applied to all behavior, including exercise. He proposes a temporal sequence of attribution – affect – action. He studied whether or not a participant would lend someone else their class notes. Participants were least likely to help a fellow student when the cause was internal and controllable, i.e., lack of effort or did not come to class, because it led to feelings of anger and disgust. However, if the factors were deemed uncontrollable, i.e., health problems, then the participant would feel sympathy and lend their class notes. Thus, how one feels about or perceives an event will then lead them towards their choice of behavior or reaction.

How an individual feels about their fitness and health can actually influence their behavior and physiology. Some of the benefits of exercise may come from believing that one is fit rather than actual aerobic fitness increases (Plante, Chizmar, & Owen, 1999). There are definitely biological forces that contribute, but they cannot fully explain the

benefits of exercise. It might be more beneficial to believe you are fit than to actually be fit. The following studies will show the importance of health perception.

Self-evaluations and perceptions have been shown to predict mortality. Idler and Kasl (1991) used data from 2812 participants of a 4 year follow up study. Their results showed that self-perceptions of health status have an independent effect on mortality after controlling for other psychosocial influences, health problems, and disabilities. Thus, those who rated their health as poor were up to 6 times more likely to die than those who rated their health as good or excellent (Idler & Kasl, 1991).

Shephard and Bouchard (1994) found similar results with 350 individuals. They used simple questions to determine occupational and leisure activities as well as self-perceived fitness. They also measured a number of physiological factors of fitness such as body mass index, circumference, skinfolds, body fat, blood glucose, cholesterol, blood pressure and heart rate. Occupational activities did not relate to actual fitness, but leisure activities and self-perceptions of fitness were positively associated with actual fitness. Higher perceived fitness was related to lower body fat content and better cardiovascular health (Shephard & Bouchard, 1994). Thus, believing you are fit can lead to improved physical conditions.

These studies have shown that beliefs in health are related to actual health. Plante, Lantis, and Checa (1998) furthered this line of reasoning by examining perceived and actual fitness during psychological stressors. Sixty individuals participated in their study by completing personality, mood and perceived fitness questionnaires, measures of cardiovascular health (HR and BP) and aerobic fitness, and performing stressful tasks (Stroop color test and a fake IQ test). Their results showed that perceived fitness was

associated with positive mood and personality, while actual aerobic fitness was not. Participants who had high perceived fitness actually had lower depression, higher self-esteem, hope, and relationship satisfaction. Plante et al. (1998) suggest that the perception of fitness might be as important or more important than actual fitness as related to psychological variables.

Plante et al. (1999) completed a similar study examining perceived fitness and cardiovascular responses to psychological stressors. Ninety participants completed cardiovascular measures (HR and BP) and the Multiple Affective Checklist for anxiety during psychological stressors (Stroop color test and Serial 7's). They also measured aerobic fitness and perceived fitness. Using multiple regression analyses, they found that perceived fitness significantly added to the variance of physiological responses to the stressors (Plante et al., 1999). Thus, the perception of fitness can also be important in physiological responses, not only the psychological effects.

The previous studies have examined an individual's beliefs about their overall fitness, while the following will discuss perceived exertion, which is how hard an individual feels they are working. Perceived exertion is a compilation of psychological variables as well as sensory information, such as heart rate, sweating, breathing rate, aches, and blood pressure (Tenenbaum, 2001). As the intensity of exercise increases, so does the likelihood that these sensations would enter an individual's consciousness. Perceived exertion is subjectively determined by effort, strain, discomfort, or fatigue that occurs during exercise. It depends on a person's personality, the type of task, intensity level, environment conditions and coping skills (Tenenbaum, 2001).

For example, sleep deprivation will affect ratings of perceived exertion. This was shown through experiments by Myles (1985) who used sleep deprived participants. Myles (1985) had the participants exercise for short bouts of 30 seconds or long bouts of 15-50 minutes. The ratings of perceived exertion were dose dependent; thus, perceived exertion increased with sleep deprivation. Also, sleep loss only had an effect when the exercise occurred in longer bouts (15-50 minutes) (Myles, 1985).

Overall, these studies have shown that one's perception of fitness can affect physical and psychological variables. One aspect of exercise perception, enjoyment, will be discussed in the next section.

Exercise Enjoyment. How much an individual enjoys physical activity can affect how often they exercise and adherence levels. Enjoyment is a positive response that includes feelings like pleasure, liking, and fun (Scanlan & Simmons, 1992). Enjoyment may also counteract stress and improve psychological variables (Wankel, 1993).

Few studies have investigated the connection between enjoyment and activity levels. Salmon, Owen, Crawford, Bauman, and Sallis (2003) reported a significant relationship between enjoyment and activity. They surveyed 1,332 adults by mail and found that those who enjoyed exercise more participated in more activities. The two main barriers that were reported were cost and weather.

DiLorenzo, Stucky-Ropp, Vander Wal, and Gotham (1998) conducted a study of 111 families in two phases (5th and 6th grades, 8th and 9th grades). During phase 1, children's enjoyment of physical activity predicted their actual activity levels. Things changed as the children grew older and reached phase 2. During phase 2, exercise knowledge, modeling, and support became predictors of activity for girls while self-

efficacy, exercise knowledge, modeling, and interest in sports media became predictors of activity for boys (DiLorenzo et al., 1998). After a longitudinal analysis, enjoyment emerged as an important factor in activity levels for girls. Thus, enjoyment is a key factor to physical activity beginning at an early age.

Individuals with Multiple Sclerosis (MS) are known to be more sedentary than the general population. McAuley, Motl, Morris, Hu, Doerksen, Elavsky, and Knopack (2007) attempted to change that in 26 participants with MS. Thirteen participants were assigned to the control condition where they discussed general health topics. The other 13 participants were in an efficacy-enhancement exercise condition which included lectures, discussion, and homework assignments pertaining to goals, barriers, feedback, strategies, and social support. Both groups participated in an aerobic exercise program that met for one hour, three times a week. The results showed that those participants in the enhancement condition attended more exercise sessions. Also, those participants that enjoyed exercise more were more likely to adhere to the program (McAuley et al., 2007). Yet again, enjoyment has been connected to exercise adherence.

Exercise enjoyment is comprised of many factors. Raedeke, Focht, and Scales (2007) studied 99 college females who had body image concerns. They investigated leadership style (health or appearance focused) and the presence of mirrors on enjoyment and other variables with a 45 minute step aerobics program. The results showed that the health oriented class had a more positive experience, enjoyed the exercise more, and were more likely to take an exercise class in the future as compared to the appearance oriented class (Raedeke et al., 2007). Having mirrors did not affect any of the variables. Thus, the leadership style of the instructor can affect the enjoyment levels of the participants.

Bray, Millen, Eidsness, and Leuzinger (2005) completed a similar study on leadership style and choreography to examine the effects on enjoyment. Seventy-five females received either motivationally enriched or bland instructions and restricted or varied exercise moves during a 40 minute step aerobics class. The results showed that the enriched leadership style and varied choreography were related to higher enjoyment levels (Bray et al., 2005). These studies can be used to improve exercise programs to create higher enjoyment levels which may lead to improved adherence.

Wininger and Pargman (2003) also studied factors contributing to enjoyment in 282 women in an aerobic dance class. They found that exercise enjoyment was largely based on the participant's satisfaction with the music and secondarily based on their satisfaction with the instructor. Thus, many factors contribute to exercise enjoyment such as leadership style, choreography, and music selection.

Numerous studies have connected exercise to improved mood (Dunn & McAuley, 2000; Gauvin & Rejeski, 1993; Motl, Berger, & Leuschen, 2000). The reason for this connection has not been determined but could partially be due to enjoyment as individuals who enjoy exercise tend to have greater increases in positive mood states compared to those who do not enjoy exercise (Wankel, 1993). Raedeke (2003) had 111 students complete the Profile of Mood States (POMS) before and after a regularly scheduled exercise class. They also completed an enjoyment scale. The participants had decreases in negative mood states following exercise. Also, enjoyment was related to improved vigor (Raedeke, 2003). The connection between enjoyment and mood may be through positive mood states, which the POMS does not focus on.

However, Robbins, Pis, Pender, and Kazanis (2004) studied this connection using the Feeling Scale, which is directed towards positive exercise mood changes. They studied 168 adolescents, ages 9 to 17, before and after a treadmill exercise task. Positive feelings during the activity predicted greater enjoyment. Robbins et al. (2004) also discovered that African American participants enjoyed the treadmill exercise more than European American adolescents.

Perhaps enjoyment is a mediator between mood and exercise adherence. Motl, Berger, and Leuschen (2000) examined this possibility with 95 participants who completed the POMS and Physical Activity Enjoyment Scale (PACES). Fifty-three participants attended a lecture and video presentation on rock climbing while the other 42 participants actually went rock climbing. The participants who climbed had lower tension and confusion scores as well as higher vigor scores as compared to the lectured participants and enjoyment appeared to mediate these changes (Motl et al., 2000).

Overall, enjoyment, exercise, and mood share a complex relationship that should be investigated further to help understand how to increase adherence. In addition to one's health perception and enjoyment of exercise, personality type may be influential to exercise behavior and adherence. This will be discussed in the next section.

Personality and Exercise

Many studies have examined broad personality traits and their relationship to exercise behavior. Personality may affect an individual's motivation, the barriers they perceive, the type of exercise, and/or the preferred exercise environment (Courneya & Hellsten, 1998). There are a variety of personality tests to choose from, but the most

commonly used is the NEO-Five Factor Inventory (NEO-FFI) developed by McCrae and Costa (1992). The five factors are extraversion (talkative, energetic, assertive), agreeableness (sympathetic, kind, affectionate), conscientiousness (organized, thorough, planful), neuroticism (tense, moody, anxious), and openness (wide interests, imaginative, insightful). The following studies will review what is known about the relationship of personality and exercise.

The theory behind the connection of personality and exercise is that personality affects attitudes, norms, perceptions and self-efficacy beliefs which, in turn, affect exercise behavior (Rhodes & Smith, 2006). From their meta-analysis, Rhodes and Smith (2006) narrowed down specific traits that correlate with exercise using the Five-Factor Model. They found that neuroticism is negatively correlated with exercise, extraversion is positively associated with exercise, and conscientiousness is positively related to exercise. A neurotic individual is emotionally unstable and distressed so they may be more likely to cancel a physical activity, while extroverts are likely to participate in activities so they can be with other people. Conscientious individuals are self-disciplined and purposeful which is why this trait may be important in adhering to an exercise regimen (Rhodes & Smith, 2006).

Courneya and Hellsten (1998) had 264 students complete the NEO-FFI and the Godin Leisure Time Exercise Questionnaire. This basic correlational study supported findings of past research and lays out the basics of the relationship between exercise and personality. Extraversion and conscientiousness were positively related to exercise behavior while neuroticism was negatively related. Extraverts tend to seek out sensory stimulation which sports and exercise activities can provide. They also prefer to exercise

with other people rather than alone. Conscientious individuals may exercise as a way of keeping their lives and bodies orderly. Highly neurotic people may find exercise and gyms full of people to be too stressful and thus avoid them (Courneya & Hellsten, 1998).

Brummett, Babyak, Williams, Barefoot, Costa, and Siegler (2006) performed a 14 year longitudinal study of body mass index (BMI) and personality traits as measured by the NEO on 3401 participants who began in their early forties. Their results suggest that personality can predict BMI during mid-life. Females high in neuroticism tended to have higher BMI's. Increased anxiety or depression related to neuroticism may lead these women to bad habits like overeating and inactivity. Men with high extraversion scores were associated with higher BMI's while the relationship was the opposite with women. This interaction might be due to food and drink accompanying the social aspect of male exercise. Openness was related to lower BMI, possibly because these individuals are open to healthy options and being creative with their food choices. Agreeableness was negatively associated with BMI levels. Individuals high in agreeableness may be more likely to follow the guidelines for healthy eating and exercise. Lastly, conscientious participants tended to have lower BMI's. Conscientious individuals are efficient and deliberate, thus they may keep better eating and exercise habits. Overall, Brummett et al. (2006) showed that personality traits can predict BMI, which is highly impacted by exercise behavior.

Personality traits may also be associated with exercise enjoyment. Lochbaum and Lutz (2005) had 187 college females complete the NEO-FFI and the Activation-Deactivation Adjective Checklist before and after 20 minutes of step aerobics as well as exercise enjoyment after the aerobics class. They found that the women who enjoyed the

exercise were less neurotic and more conscientious than the women who did not enjoy it (Lochbaum & Lutz, 2005). These results support past research and suggest that perhaps interventions could be designed based on personality to enhance exercise enjoyment and adherence (Buckworth, Granello & Belmore, 2002).

Personality type may also affect how hard an individual will push themselves during a training session. Koh, Johnson, Scott, Phelps, Francis, and Cattungal (2006) studied 31 volunteers who filled out personality surveys (Myers-Briggs Type Indicator (MBTI), Trait Anxiety Inventory) and then ran on a treadmill at 80-85 % VO_2 max until self-termination. Four of the treadmill sessions were run for each subject, 1 control and 3 with varying levels of respiration resistance. The levels of respiration modification made it slightly harder to breathe to quite difficult (2.8, 16.8, and 27.3 $\text{cmH}_2\text{O} \cdot \text{sec/L}$). In the end, it seems that certain personality traits might affect exercise behavior. Those individuals who gather information with their senses and make decisions from gut feelings (S and F on the MBTI) terminated the most strenuous test significantly earlier than participants with other personality tendencies (Koh et al., 2006). The severely inhibited respiration had a definite effect on these certain personality types (S and F). Thus, individuals with these traits may exercise at a lower intensity so that they do not reach the sensation of being out of breath.

Extroverts also have been shown to suppress painful stimuli and rate perceived exertion as lower (Morgan, 1973). Morgan (1973) did a number of experiments using the Eysenck Personality Inventory, Spielberger's State-Trait Anxiety Inventory, Somatic Perception Questionnaire, Lubin's Depression Adjective Checklist, and a measure of perceived exertion. The resistance was varied from 300, 450, 700, to 900 kpm on a

bicycle for 1 minute each and participants were asked to rate their exertion. Most participants correctly rated the intensities with increasing exertion ratings. However, extroverts tended to give lower ratings of exertion, and, when asked at what level they would prefer to exercise, usually listed a higher intensity than other participants (Morgan, 1973). The broad trait of extraversion may have a wide variety of effects on exercise behavior.

The intention to exercise based on the theory of planned behavior has also been related to broad personality traits using the NEO-FFI. Rhodes, Courneya and Hayduk (2002) studied 300 students and their exercise behavior over 2 weeks. Again, neuroticism, extroversion, and conscientiousness were the three personality traits that affect exercise intentions. Extroverts and conscientious individuals were more likely to fulfill their intentions to exercise. Those individuals high in neuroticism were more likely to intend to exercise based on social pressures, but they did not act on those intentions. Rhodes et al. (2002) suggest that future research look into more specific personality traits to expand the research base.

Although the majority of research suggests that extraversion is associated with more exercise activity, Yeung and Hemsley (1997) found contradictory results. They followed 46 previously sedentary women through an 8 week aerobics course. They measured personality via the Eysenck Personality Questionnaire (EPQ) and took attendance at the aerobics classes. The EPQ has only three factors: extraversion, neuroticism and psychoticism. Their results showed that extraversion was negatively related to adherence. Perhaps extraverts did not like the structure or constraints of an aerobics class while introverts may have enjoyed the group aspect where attention is

rarely placed on the individual (Yeung & Hemsley, 1997). This finding only emphasizes the need for individualized exercise programs.

The results from broad personality research are interesting and could predict diverse behaviors, but perhaps specific personality constructs could predict more specific behaviors. Only a few studies have examined specific personality traits (activity, Type A, self-motivation, etc.) in relation to exercise. These studies will be reviewed and a new specific trait of work drive will be discussed.

To begin the look into narrow personality traits, the specific factors of extroversion (positive affect, sociability, and activity) were studied by Rhodes, Courneya, and Jones (2002). Three hundred and one female students completed the NEO-FFI, measures of planned behavior and had a follow up 1 month later to measure their exercise behavior. When the facet of activity was freed from the broad trait of extraversion the results suggested that the influence of extraversion on exercise behavior may completely be explained by the facet of activity (Rhodes et al., 2002a). Thus, the global trait of extraversion may lack precision, while the facet of activity measured through extroversion may be a better predictor of exercise intentions and behavior. Perhaps extroverts exercise more simply because they have a predisposition towards activity.

Masters, LaCaille, and Shearer (2003) studied 70 sedentary students who were all identified as Type A and randomly assigned them to a competitive group or a regular exercise group. Each group rode a bicycle for 20 minutes. The competitive group was told to go as fast as they could because their distance would be recorded and compared to the other participants, while the other group was simply told to ride for 20 minutes and that the distance would be recorded. The results showed that the Type A individuals in

the regular group exhibited positive psychological benefits while the competitive group did not as measured by the Profile of Mood States, State Anxiety Inventory and Feeling Scale. The students in the competitive group also exerted themselves more as measured by the distance that they rode. The researchers interpreted this finding to mean that the manipulation was successful. Therefore, it appears that personality (specifically Type A) may be a moderator of the effects of exercise (Masters et al., 2003).

Self-motivation has been shown to discriminate between those who adhere to an exercise program and those who do not. Dishman, Ickes, and Morgan (1980) studied females who entered a crew training program and their self-motivation levels. Those women who dropped out had significantly lower self-motivation levels than those who stayed in the program. Social desirability and ego strength did not account for their findings; therefore, self-motivation might underlie adherence. Dishman et al. (1980) also studied adult males enrolled in organized exercise programs over 20 weeks. Their second study also showed that those with higher levels of self-motivation were more likely to adhere to the exercise program supporting the idea that self-motivation might be a narrow personality trait related to exercise adherence.

So far, work drive has not been studied in relation to exercise. Work drive is a disposition to work hard and push oneself beyond the necessary requirements (Lounsbury, Gibson, & Hamrick, 2004). Work drive is related to job performance and academic performance and could possibly be related to exercise performance. The Work Drive Scale was designed for a broad range of applications and, since it is fairly new, the construct has yet to be studied in relation to exercise.

Lounsbury, Saudargas, and Gibson (2004) compared 233 college freshmen on numerous personality traits, including the Big Five and Work Drive, using the Adolescent Personal Style Inventory, and the intention to withdraw from college. Most of the personality traits were somewhat related to the intention to withdraw, but Work Drive was strongly related to the intention to withdraw.

Of the broad personality traits, it seems that extroversion, conscientiousness, and neuroticism play important roles in exercise intentions and adherence. The NEO-FFI will be used to assess personality type. The study will also examine Work Drive as a narrow personality trait to see how it affects exercise performance and how it relates to the other variables.

The purpose of the pilot study was to examine the relationship between exercise enjoyment and activity while providing base data for the validation of a new enjoyment scale. The purpose of the main study was to examine the relationships and interactions between exercise enjoyment, personality (broad and narrow), mood, and salivary cortisol in active and sedentary individuals. These studies will be discussed in detail in the following sections.

Pilot Study

A pilot study entitled “The Relationship between Exercise Enjoyment and Physical Activity” was completed. The study was approved by the University of Tennessee, Knoxville IRB. The purpose of this study was to determine what connection exists between the enjoyment of exercise and how often one engages in physical activity. It was hypothesized that those who enjoy exercise more will also participate in more physical activity. It was also hypothesized that gender differences would emerge with regard to the study variables.

Participants

Two-hundred and forty one students of the University of Tennessee, Knoxville participated. Twenty-six were university athletes and their data were not included, leaving 215 participants. They received class participation points in their Introduction to Psychology class for participating. The participants’ ages ranged from 17 to 35 with a mean age of 19.24 (SD = 1.79) years. There were 96 (44.7%) males and 118 (55.3%) females. The ethnic distribution was as follows: 168 (78.6%) Caucasian, 28 (13%) African-American, 9 (4.2%) Hispanic, 5 (2.3%) Asian, and 4 (1.9%) of mixed heritage.

Participants included 148 freshman (68.8%), 39 sophomores (18.1%), 19 juniors (8.8%), and 9 seniors (4.2%). A wide range of college majors were represented in the sample. Forty-one undecided (19.1%), 27 Business (12.6%), 21 Pre-medical/Pre-veterinary (9.8%), 16 Psychology (7.4%), 15 Journalism/Communications (7%), 12 Nursing (5.6%), 12 Chemistry/Biology (5.6%), and 11 Engineering majors (5.1%). The

rest of the participants had various other majors. Only 3 participants were married (n = 212 single).

Materials

Copies of all instruments can be found in Appendix A.

Demographic Sheet. A self-report questionnaire was used to obtain data on age, sex, grade, major, marital status, and ethnicity.

Exercise Enjoyment. The Physical Activity Enjoyment Scale (PACES) was used to assess how participants feel about exercise (Kendzierski & DeCarlo, 1991). It consists of 18 statements rated 1 to 7 (e.g., “I enjoy it” to “I hate it”; “I find it energizing” to “I find it tiring”). Internal consistency was found to be .92. Construct validity was demonstrated by Motl, Dishman, Saunders, Dowda, Felton, and Pate (2001).

The Enjoyment of Exercise Scale (EES) was also used to assess the participants’ exercise enjoyment. It consists of 10 questions, 2 of which are reverse scored (e.g. “I like to exercise,” “If I sit all day long, I feel bad”). Each question is rated on a 5 point scale, strongly disagree to strongly agree. Reliability was found to be .83 using a Cronbach’s alpha test. This scale was included as the first step in the validation process. It was developed by Dr. David Bassett of the University of Tennessee, Knoxville as a shorter complement to the PACES. The scale would be included in the main study if it showed good convergent validity.

Physical Activity. The International Physical Activity Questionnaire (IPAQ) was used to assess the level of activity of each participant (Craig, Marshall, & Sjostrom, 2003). It consists of 7 questions (e.g. “During the last 7 days, on how many days did you

do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?") and has been shown to be reliable ($r = .80$) and valid. This questionnaire categorizes participants as sedentary, moderate, or high level exercisers.

Procedure

Participants were asked to complete the survey packet. Completion and return of the questionnaire package indicated informed consent. Participation in this study was strictly voluntary, and no names/student ID numbers were obtained.

Results

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 16 and the level of significance was set at .05. The data were analyzed with respect to relationships among variables and differences between physical activity levels. Pearson correlations and independent t tests were used. A Cronbach's alpha test was used to measure reliability of the EES. All data fell within range of the scales. Scales that were not completed correctly were removed from the data analysis, and there were no outliers. Tables 1 and 2¹ show the descriptive statistics for the enjoyment scales and gender differences. The main correlations are presented in Table 3.

It was hypothesized that participants who enjoyed exercise more via the PACES and EES would have higher activity levels via the IPAQ. Correlations revealed a positive

¹ All Tables and Figures are located in the Appendices.

relationship between enjoyment via the PACES and activity via the IPAQ, $r = .573, p < .0005$ as well as enjoyment via the EES, $r = .631, p < .0005$. These results indicate that those who enjoy exercise are more likely to be active.

Furthermore, independent t tests revealed that sedentary individuals significantly differed from moderate exercisers such that participants with moderate activity levels enjoyed exercise more, PACES: $t_{(1, 148)} = -3.704, p < .0005$, EES: $t_{(1, 148)} = -6.161, p < .0005$. Moderate exercisers also differed from those with high activity levels, PACES: $t_{(1, 177)} = -9.143, p < .0005$, EES: $t_{(1, 176)} = -7.679, p < .0005$, and sedentary individuals significantly differed from those with high activity levels, PACES: $t_{(1, 99)} = -11.85, p < .0005$, EES: $t_{(1, 98)} = -12.118, p < .0005$. These results indicate that sedentary individuals enjoyed exercise the least and those with a high level of activity enjoyed exercise the most.

It was hypothesized that gender differences would emerge. Thirty-five participants were sedentary (8 male, 27 female), 114 participants were in the moderate group (52 male, 62 female), and 65 participants reported a high level of activity (36 male, 29 female). Independent t tests confirmed that females enjoyed exercise less than males, PACES: $t_{(1,212)} = 2.91, p = .004$, EES: $t_{(1,211)} = 3.42, p = .001$, and that females tended to report less physical activity, $t_{(1,212)} = 3.04, p = .003$.

Discussion

The purpose of this study was to examine the association between the enjoyment of exercise and physical activity levels in college students. The findings were consistent with previous research (e.g., DiLorenzo et al., 1998; McAuley et al., 2007; Salmon et al.,

2003) that reported a positive relationship between exercise enjoyment and physical activity. Furthermore, it was hypothesized that gender differences would emerge with regard to the study variables. The pilot study found support for this hypothesis. Enjoyment levels were significantly higher for men than for women, and the women tended to be less physically active.

The mechanism underlying the predicted relationship between exercise enjoyment and physical activity level is complex. One explanation for this is that exercise can lead to an increase in positive feelings and psychological well-being (Csikszentmihalyi, 1991; Wankel, 1993). From the perspective of classical conditioning theory, if one feels happy, revitalized, and calm after exercise, then one is more likely to repeat the activity. Similarly, Wankel and Berger (1990) reported that physical activity was related to positive social change, personal growth, and social integration. The by-product from these outcomes could logically foster a positive relationship between exercise enjoyment and physical activity. There are also studies indicating that vigorous physical activity produces the release of endorphins which alter mood (Wankel, 1993). According to Phillips, Kieran, and King (2002), however, the biological link with well-being has not been clearly established.

With regard to the gender differences, women tend to be less active than men. Thus, the finding of lower physical activity in women was not surprising. Jones, Ainsworth, Croft, Macera, Lloyd, and Yusuf (1998) also reported high rates of inactivity among women in a national cross-sectional study. Barnett and Spinks (2007) found that scheduling, difficulty in getting to an exercise location, and weather were the main barriers that prohibited their female participants from exercising. Kruger, Carlson, and

Kohl (2007) found that the cost of a gym membership was the main barrier to exercise participation in their study. Brittain, Baillargeon, McElroy, Aaron, and Gyurcsik (2006) also reported that feeling tired and not having an exercise partner were barriers to female exercise participation.

Research evidence is scant with regard to gender issues and exercise enjoyment. The finding that women tend to enjoy exercise less than men is intriguing. Perhaps females enjoy exercise less because of a social stigma. Vartanian and Shaprow (2008) found that women would avoid exercise if they perceived weight stigmas. Thus, a woman's belief that she is overweight or her feelings of self-consciousness may actually prevent her from engaging in activity. Cultural issues may also be important. D'Alonzo and Fischetti (2008) found that Latina women viewed exercise as 'unfeminine' and that African-American women felt pressure to conform to White standards of beauty, although they enjoyed the competition and camaraderie of exercise. Although the present results are preliminary, it seems plausible that enhanced enjoyment of exercise would facilitate adherence to programs specifically targeted for women.

Enjoyment emerged as a factor of physical activity and gender differences were found in our study. Our findings lend support to the continuation of providing diverse interventions for enhancing physical activity levels in adults. More specifically, interventions should be developed for both men and women to increase exercise enjoyment and tested to determine if they increase activity and reduce risk factors for chronic illnesses. In addition, future research should investigate methods of increasing enjoyment and study where lack of enjoyment ranks with other barriers.

Methods

Purpose and Hypotheses

The purpose of this study was to examine the relationships and interactions between exercise enjoyment, personality (broad and narrow), mood, and salivary cortisol in active and sedentary individuals. It was hypothesized that active participants would 1) have lower post exercise cortisol levels, 2) have higher levels of enjoyment, and 3) have lower ratings of perceived exertion than sedentary participants. It was hypothesized that extroverted, conscientious, and non-neurotic participants would 4) have higher levels of enjoyment and 5) have lower cortisol levels than individuals who score lower on these personality traits. It was hypothesized that work drive would influence 6) levels of enjoyment, 7) activity levels, 8) and cortisol levels. 9) It was hypothesized that all participants would show positive mood improvements.

Participants

Sixty-four individuals signed up; 53 undergraduate students from the University of Tennessee, Knoxville actually participated. Participants were recruited through Psychology classes and they received class credit or extra credit for their participation. They were informed prior to signing up that they would be required to wear exercise clothing and footwear and bring a water bottle. The age of participants ranged from 16 to 36 years with the average being 21.83 ($SD = 3.33$). Twenty-two participants were male (41.5%), 31 were female (58.5%). Forty-one participants were Caucasian (77.4%), 8 were African-American (15.1%), 2 were Asian-American (3.8%), 1 was Hispanic (1.9%) and 1 was bi-racial (1.9%). BMI ranged from 17.7 to 34.2 with the average being 23.8

($SD = 4.07$) which is classified as normal. Eleven participants (20.8%) were classified as sedentary (as described below), 20 (37.7%) were classified as moderately active, and 22 (41.5%) were classified as highly active. See Figure 1 for the breakdown of activity level by gender. These percentages were expected based on the demographics of the students of the University of Tennessee, Knoxville.

Participants were removed from the study if their resting blood pressure exceeded 150/90 mmHg, self-reported use of steroids within the past month, or they answered yes to any questions on the Physical Activity Readiness Questionnaire (PAR-Q). Furthermore, if the participant had eaten, drank, or smoked in the hour prior or exercised on the day of the experiment, they were excused from the study. One participant was excluded by the PAR-Q, as described below, but no others were excluded for the reasons listed above. These exclusion factors were needed to protect participants from possible exercise exertion and to reduce contaminants in the salivary cortisol samples. The study was approved by the University of Tennessee's Institutional Review Board.

Materials

All instruments can be found in Appendix A.

Demographic Sheet. A self-report questionnaire was used to obtain information on age, gender, ethnicity, and medications.

Physical Activity Readiness. The PAR-Q was used to assess the participants ability to complete the exercise portion of the experiment (Thomas, Reading, & Shephard, 1992). It consists of 7 yes/no questions that determine whether or not the participant is able to continue (e.g., Do you feel pain in your chest when you do physical

activity?). One participant was undergoing testing for chest pain and only filled out the surveys.

Physical Activity. The International Physical Activity Questionnaire (IPAQ) was used to assess the level of activity of each participant. It consists of 7 questions (e.g., “During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?”). This survey was developed for the purpose of having an international measure of physical activity and it has been shown to be psychometrically sound as a result of testing in 21 countries (Craig et al., 2003). Following the scoring instructions, participants were classified as sedentary, moderate, or high level exercisers. Information on number of days and hours of exercise are also given.

Blood Pressure Cuff. An automatic blood pressure cuff was used to take each participants BP (CVS Brand, Model CVSBPAUTO). If a participants’ BP was equal to or above 150/90 mm/Hg, the participant could not continue with the study. No one was excluded due to high BP.

Heart Rate Monitor. An electronic heart rate monitor was used to measure heart rate. Heart rate was assessed every 5 minutes during the exercise portion of the experiment using a Polar monitor, model A1.

Stationary Bicycle. A stationary bicycle was used for the exercise portion of the experiment (Monark brand, model 818E). The bicycle seat height was adjusted for each participant. Resistance was kept at a moderate level, 65% maximum heart rate. Participants were instructed to keep their heart rate between 120-140 beats per minute by

using the heart rate monitor. The average HR was 129.6 ($SD = 10.6$) so participants were effective in maintaining a moderate pace.

Exercise Enjoyment. The Physical Activity Enjoyment Scale (PACES) was used to assess how participants feel about exercise (Kendzierski & DeCarlo, 1991). It consists of 18 statements rated 1 to 7 (e.g., “I enjoy it” to “I hate it,” “I find it energizing” to “I find it tiring”). Internal consistency was found to be .92. Construct validity was demonstrated by Motl, Dishman, Saunders, Dowda, Felton, and Pate (2001).

The Enjoyment of Exercise Scale (EES) was also used to assess the participants’ exercise enjoyment. This scale is in the development phase although pilot data showed good reliability ($\alpha = .83$) and convergent validity ($r = .775, p < .0005$). It consists of 10 questions, 2 of which are reverse scored (e.g. “I like to exercise,” “If I sit all day long, I feel bad”). Each question is rated on a 5 point scale, strongly disagree to strongly agree. This scale was included to provide further validation data.

Personality. The NEO-Five-Factor Inventory (NEO-FFI) was used to assess broad personality traits (McCrae & Costa, 1992). It consists of 60 questions that participants rate on a scale from 0 - strongly disagree to 4 - strongly agree. The NEO-FFI examines the five broad personality traits of Neuroticism (e.g., “I am not a worrier”), Extroversion (e.g., “I laugh easily”), Openness to Experience (e.g., “I often try new and foreign foods”), Agreeableness (e.g., “I try to be courteous to everyone I meet”), and Conscientiousness (e.g., “I keep my belongings clean and neat”). Higher scores in each category indicate that the individual is more likely to show that particular trait. The reliability ranges from .68 to .86 and validity ranges from .77 to .92 (McCrae & Costa, 1992).

In addition, participants completed the Work Drive Scale for students (WDS) as a measurement of a specific personality trait (Lounsbury, Gibson, & Hamrick, 2004). This scale assesses an individual's disposition to work hard, perhaps beyond what is necessary, to achieve success. Participants were asked to rate the degree to which they agreed with 9 statements on a scale ranging from 1 - strongly disagree to 5 - strongly agree. The average of the 9 items becomes the work drive score; higher scores indicate higher work drive. Cronbach's alpha coefficient of reliability ranged from .80 to .83 in the studies used to create the scale, while the criterion validity ranges were $r = .23, p < .01$ to $r = .49, p < .01$. Construct validity ranged from $r = .23, p < .01$ to $r = .55, p < .01$ as compared to work ethic, Type A personality, Workaholism, job involvement, NEO-FFI, and the MBTI (Lounsbury et al., 2004). Due to copyright issues, the survey cannot be attached but can be obtained by contacting Dr. Lounsbury of the University of Tennessee, Knoxville.

Mood. The Exercise-Induced Feeling Inventory (EFI) was used to assess mood state before and after the exercise portion (Gauvin & Rejeski, 1993). It consists of 12 items that measure four feeling states: revitalization, tranquility, positive engagement, and physical exhaustion. Other mood scales focus on negative mood states though exercise may be more related to positive mood states. The scale was designed for use with exercise and has participants rate how strongly they are feeling an adjective (e.g., refreshed, calm, happy) on a scale from 0 – do not feel to 4 – feel very strongly. Internal consistency ranges from .72 to .91 and Gauvin and Rejeski (1993) demonstrated concurrent, discriminant, and construct validity.

Perceived Exertion. The Perceived Exertion Scale (RPE) was administered at the 15 minute mark of the bike ride and after the bike ride to assess the participants' perception about their physical exertion (Borg, 1962). Participants choose a number from 6 (no exertion at all) to 20 (maximal exertion) to rate their exertion.

Saliva Sampling. Participants were seated comfortably in a chair and expectorated into a sanitized 50 mL collection tube once per minute over a three minute period (Navaresh, 1993). They did this before, after, and 20 minutes after the exercise portion of the protocol. Once collected, saliva samples were centrifuged for ten minutes and then aliquoted in microtubes (two per sample) and stored at 20 degrees Celsius for subsequent analysis.

Salivary Analysis. Supernatants were analyzed for total cortisol concentration using the High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics Inc., PA). The assay can detect cortisol levels from 0.003 to 3.0 µg/dL. The samples were run in duplicate. No samples were acidic or basic and all standard curves were normal.

Procedures

The data were collected in the Health and Physical Education Building (HPER) in a separate room (315) so that the participants were not distracted. All data were collected after participants read and sign the informed consent form. The data were collected between 10:00 am and 2:00 pm to facilitate proper cortisol measurement. Participants did not eat, drink, or smoke for 1 hour prior and had not exercised on the day of the experiment. No one was excused for violating this restriction. All participants wore exercise clothing and shoes. The data were collected in the summer of 2008.

Participants completed the PAR-Q and had their blood pressure taken. BP must have been below 150/90 mm/Hg to continue. The pre-test saliva sample was rendered following the procedure outlined above. Participants filled out the survey packet (Demographic, PACES, EES, IPAQ, EFI), and then began a 30 minute bike ride while wearing a heart rate monitor; this included a 5 minute warm-up and 5 minute cool-down. They were allowed to drink water during the exercise. Every 5 minutes heart rate was recorded to obtain the participants' average. Participants were also instructed to keep their heart rate at approximately 120-140 beats per minute to maintain a moderate intensity (about 65% of maximum). At the 15 minute mark, participants were asked to give their rating of perceived exertion using the RPE scale. No participants became fatigued or needed to stop. After exercising, participants rested for 5 minutes. They then gave their post-exercise cortisol saliva sample and then completed the RPE and EFI again, and the NEO-FFI and WDS. After 20 more minutes of rest, participants gave a third saliva sample. They were thanked and dismissed. Participants were run individually, and each took one and a half hours to complete.

Results

All data were analyzed using SPSS version 16.0. The data were checked for outliers and any scales that were not fully completed were removed from the analyses. The level of significance was set at .05 for all analyses. Cohen's d tests were used to determine effect sizes. Pearson correlations were performed on all of the variables. T tests and one-way ANOVA's were also used with Tukey post hoc tests to examine differences between groups. Due to the skewed relationship between gender and activity level shown in Figure 1, analyses were performed on females separately. However, the results did not differ so only the results including both genders are reported.

Hypothesis 1

It was hypothesized that highly active participants would have lower cortisol levels as compared to other participants. An ANOVA revealed that sedentary, moderate, and highly active participants did not differ from one another on baseline, $p = .65$, post bike ride, $p = .81$, or 20 minutes post bike ride cortisol levels, $p = .37$, indicating that activity level did not affect cortisol levels.

However, paired samples t tests revealed that all participants showed an increase in cortisol levels from baseline to after the bike ride, $t_{(1,49)} = -3.94$, $p < .0005$, $d = -.34$, indicating that the exercise was a stressful experience. Cortisol levels continued to rise from after the bike ride to 20 minutes later, $t_{(1,49)} = -3.22$, $p = .002$, $d = .29$, which shows that the peak cortisol level may not have been reached yet and levels were not yet returning to baseline. See Figure 2. There were no gender differences in baseline, $p = .49$, post bike ride, $p = .56$, or 20 minutes after the bike ride, $p = .06$, cortisol levels.

Hypothesis 2

It was hypothesized that participants who enjoyed exercise more would have higher levels of regular activity. Both the EES and PACES correlated with the IPAQ, EES: $r = .756, p < .0005$, PACES: $r = .682, p < .0005$, indicating that those who enjoy exercise tend to do more of it.

ANOVA's revealed that activity level did vary with enjoyment on both the PACES, $F_{(2,50)} = 23.23, p < .0005$, and the EES, $F_{(2,50)} = 33.51, p < .0005$. Tukey post hoc tests showed that sedentary participants enjoyed exercise less than moderate participants, PACES: $p < .0005, d = -1.47$, EES: $p = .003, d = -1.17$, and less than highly active participants, PACES: $p < .0005, d = 2.37$, EES: $p < .0005, d = -2.57$. Moderate participants also enjoyed exercise less than highly active participants, PACES: $p = .015, d = .95$, EES: $p < .0005, d = -1.76$. See Table 4.

Significant gender differences emerged similar to those found in the pilot study. Females were less active than men, $t_{(1,51)} = 2.88, p = .006, d = .83$. See Figure 3. Males and females did not differ on their levels of enjoyment as they did in the pilot study, PACES: $p = .56$, EES: $p = .32$.

Hypothesis 3

It was hypothesized that active participants would have lower ratings of perceived exertion. An ANOVA revealed that activity level did not relate to exertion ratings, $p = .29$. The average rating on the RPE was 11.9, ($SD = 1.5$) thus the variability was too low to find differences. All participants viewed the exercise as moderate, no matter what

their normal activity level was. This finding suggests that activity level does not affect the perception of exertion.

Hypothesis 4

It was hypothesized that extroverted, conscientious, and non-neurotic participants would have higher levels of enjoyment. A median split was performed on Neuroticism such that participants with less than a 32 were classified as having low Neuroticism and those with a 32 or higher were classified as having high Neuroticism. The t test analysis revealed that enjoyment levels did not differ as a function of neuroticism, PACES, $p = .13$, or the EES, $p = .09$. A median split was performed on Extroversion such that participants with less than a 44 were classified as introverted and those with a 44 or higher were classified as extroverted. A t test revealed that extroverted individuals enjoyed exercise more via the PACES, $t_{(1,51)} = 2.73$, $p = .009$, $d = .75$, although only a trend was found with the EES, $p = .053$. See Figure 4. A median split was performed on Conscientiousness such that participants with less than a 44 were classified as having low Conscientiousness and those with a 44 or higher were classified as having high Conscientiousness. T tests showed that conscientious individuals enjoyed exercise more via the EES, $t_{(1,51)} = 2.58$, $p = .013$, $d = .73$, although only a trend was found with the PACES, $p = .089$. See Figure 5.

A regression analysis was also performed to determine if personality could predict enjoyment. Extroversion was the only trait to predict enjoyment, PACES: $\beta = .485$, $p = .002$, EES: $\beta = .423$, $p = .005$. Neuroticism and Conscientiousness did not predict

enjoyment, PACES: $p = .69$ and $p = .82$ respectively, EES: $p = .24$ and $p = .14$ respectively.

It was also hypothesized that extroverted, conscientious, and non-neurotic participants would have higher levels of activity. An ANOVA revealed that extroverted participants reported more exercise participation, $F_{(2,50)} = 4.03$, $p = .024$. A Tukey post hoc test showed that the significant difference was only found between the sedentary and highly active participants, $p = .024$, $d = -.90$, showing that extroverts exercise more often. See Table 5. Those participants with low neuroticism also tended to report more activity, although the relationship was not quite significant, $p = .053$. However, Tukey post hoc tests revealed that sedentary individuals did differ from highly active participants, $p = .04$, $d = .98$, in that highly active participants were less neurotic than sedentary participants. See Table 5. ANOVA tests did not reveal a relationship between conscientiousness and activity, $p = .36$.

A regression analysis was also performed to determine if personality could predict activity levels. Extroversion predicted activity level, $\beta = .306$, $p = .027$. Neuroticism nearly predicted, $p = .079$, and Conscientiousness did not predict activity levels, $p = .76$.

Hypothesis 5

It was hypothesized that extroverted, conscientious, and non-neurotic participants would have lower cortisol levels. A median split was performed on Neuroticism such that those with less than a 32 were classified as having low Neuroticism and those with a 32 or higher were classified as having high Neuroticism. A t test showed that Neuroticism did not relate to cortisol levels at any of the 3 data points, baseline: $p = .19$,

post exercise: $p = .35$, 20 minutes later: $p = .96$. A median split was performed on Extroversion such that those with less than a 44 were classified as being introverted while those with a 44 or higher were classified as extroverted. Extroversion did not relate to cortisol levels at any of the 3 data points using a t test, baseline: $p = .95$, post exercise: $p = .38$, 20 minutes later: $p = .95$. A median split was performed on Conscientiousness such that those with less than a 44 were classified as having low Conscientiousness and those with a 44 or higher were classified as having high Conscientiousness. A t test revealed that Conscientiousness did not relate to cortisol levels at any of the 3 data points, baseline: $p = .32$, post exercise: $p = .49$, 20 minutes later: $p = .94$. Therefore, it seems that personality does not influence cortisol levels.

Hypothesis 6

It was hypothesized that work drive would influence levels of enjoyment. A median split was performed on the WDS such that those with less than a 3.13 were classified as having low Work Drive and those with a 3.13 or higher were classified as having high Work Drive. There was no significant difference on enjoyment between those with high and low Work Drive using a t test, PACES: $p = .54$, EES: $p = .60$. To test if Work Drive predicted enjoyment regression analyses were performed. Work Drive did not predict enjoyment using the PACES, $p = .11$, or the EES, $p = .14$.

Hypothesis 7

It was hypothesized that Work Drive would influence activity levels. A median split was performed on the WDS such that those with less than a 3.13 were classified as

having low Work Drive and those with a 3.13 or higher were classified as having high Work Drive. A trend toward significance was found using a t test, $p = .053$, indicating that those with high Work Drive might exercise less often. To test if Work Drive predicted activity regression analyses were performed. Work Drive was not a predictor of activity level, $p = .98$.

Hypothesis 8

It was hypothesized that Work Drive would influence cortisol levels. A median split was performed on the WDS such that those with less than a 3.13 were classified as having low Work Drive and those with a 3.13 or higher were classified as having high Work Drive. T tests revealed no significant differences between Work Drive and salivary cortisol levels, baseline: $p = .13$, post exercise: $p = .14$, 20 minutes later: $p = .35$. To test if Work Drive predicted cortisol levels regression analyses were performed. Work Drive did not predict baseline cortisol levels, $p = .104$. Work Drive did predict cortisol levels after the bike ride, $\beta = .331$, $p = .019$, and showed a trend for prediction 20 minutes after the bike ride, $p = .05$. Therefore, Work Drive may influence cortisol levels, but the data are inconsistent.

Hypothesis 9

It was hypothesized that all participants would show positive mood improvements. The EFI measures Positive Engagement (PE), Revitalization (R), Tranquility (T), and Physical Exhaustion (PhE). Overall, mood did not differ before the bike ride and after. However, some changes were found with the specific factors of

mood. The differences in PE and T from before and after the bike ride were not significant, $p = .165$, $p = .381$. Revitalization increased after the bike ride, $t_{(1,50)} = -2.75$, $p = .008$, $d = -.43$, indicating that participants felt refreshed and invigorated after the bike ride. Physical Exhaustion decreased after the bike ride, $t_{(1,50)} = 2.34$, $p = .023$, $d = .35$, showing that participants had more energy and vigor after the bike ride. See Table 6. This hypothesis was partially confirmed.

Discussion

The purpose of this study was to examine the relationships and interactions between exercise enjoyment, personality, mood, and salivary cortisol in active, moderately active, and sedentary individuals. Results from this investigation add to the growing body of literature identifying barriers associated with the adoption of a physically active lifestyle. The implications of the findings are discussed below.

In the present study, exercise enjoyment was significantly related to reported activity indicating that those who enjoy exercise will do more of it. This finding is consistent with past research (e.g., DiLorenzo et al., 1998; McAuley et al., 2007; Salmon et al., 2003) and also supports the findings of the pilot study. As described in the pilot study, this relationship is complex but may be due to the increase in positive feelings that occurs with exercise (Csikszentmihalyi, 1991; Wankel, 1990), although the biological basis of this theory has not been determined (Phillips et al., 2002). This connection should be studied further and intervention programs should be developed to increase exercise enjoyment.

While the pilot study found gender differences on enjoyment and activity level, the current study only found gender differences in activity such that women exercised less often than men. As discussed in the pilot study, past research has shown that women do tend to be less active than men (Jones et al., 1998). Also, women have listed numerous barriers to their participation in exercise such as lack of time, scheduling, difficulty in getting to an exercise location, weather, cost of gym memberships, fatigue, and not having a partner (Barnett, & Spinks, 2007; Brittain et al., 2006; Kruger et al., 2007; Sherwood & Jeffrey, 2000).

The lack of a significant gender difference on enjoyment may be due to the smaller sample size (53 vs. 215). However, a more plausible explanation is that of seasonal variation. Past research has shown that people enjoy physical activities and perform more of them during the warm summer months (CDC, 1997; Matthews, Freedson, & Herbert, 2001; Uitenbroek, 1993). The data from the current study were collected during the summer months and the pilot data were collected during late winter months. Therefore, the level of exercise enjoyment may vary between the sexes as a function of the seasons. Further studies are warranted regarding this issue.

It was hypothesized that active participants would have lower ratings of perceived exertion because they would be used to exercise and might think a moderate bike ride was easy. However, this hypothesis was not confirmed. In the current study, participants perceived the bike ride as moderate regardless of activity level. This finding shows that the perception of exertion may not change as a function of physical activity. Tenenbaum (2001) described perceived exertion as depending on heart rate among other variables. In the current study, all participants had an average heart rate that was kept at the moderate level. Moreover, Faulkner and Eston (2007) reported that fitness level did not effect ratings of exertion and that exertion ratings were highly correlated with heart rate. Therefore, this finding simply confirms that all participants were kept at a moderate level during the bike ride.

Regarding personality, it was hypothesized that extroverted, conscientious, and non-neurotic participants would have higher enjoyment levels compared to their counterparts. This hypothesis was partially supported. Extroverted and conscientious individuals reported significantly higher levels of exercise enjoyment. The relationship

with Neuroticism was nearly significant. Furthermore, extroversion predicted exercise enjoyment. These findings are consistent with past research (Lochbaum, & Lutz, 2005). One explanation for these findings is that extroverts tend to exercise in groups which may enhance ones sensory stimulation, thus, increasing the enjoyment factor (Courneya & Hellsten, 1998). Also, conscientious individuals tend to be self-disciplined and purposeful (McCrae & Costa, 1992). As a consequence of this focus, they may derived satisfaction and pleasure from participation in physical activity which has health and psychological benefits. Future research should investigate this complex triangle to determine if personality is a mediator of the exercise enjoyment-activity relationship.

In the current study, extroverted and non-neurotic participants were more physically active compared to their counterparts. Surprisingly, there was no difference in activity levels as a function of Conscientiousness. The Extroversion and Neuroticism results were expected as past research has often connected these personality traits with exercise (Brummett et al., 2006; Courneya, & Hellsten, 1998). Extroversion predicted and Neuroticism nearly predicted activity levels. The present study found partial support for this hypothesis. Extroverted individuals are more likely to exercise so that they can be around other people. Neurotic individuals tend to be emotionally unstable and less likely to commit to an exercise program (Courneya & Hellsten, 1998).

One explanation for the non-significant finding of Conscientiousness with activity level is that of a smaller sample size. A second explanation is that activity levels tend to increase in the summer months. Less Conscientious individuals may also increase their activity levels during this time which would perhaps negate differences regarding this personality construct on this dependent variable (CDC, 1997; Matthews, Freedson, &

Herbert, 2001; Uitenbroek, 1993). The hypothesis regarding Conscientiousness and physical activity level was not supported in the current study and contradicts other reports regarding this issue (Rhodes & Smith, 2006).

The specific personality trait of Work Drive did not predict exercise enjoyment or activity levels. However, there was a trend for those individuals who scored high on Work Drive to exercise less often. Therefore, these hypotheses were not supported. Past studies have compared Work Drive to job and academic performance (Lounsbury et al., 2004; Lounsbury et al., 2004a); however, this relationship did not transfer to the phenomenon of exercise.

According to Lounsbury et al. (2004), Work Drive is a narrow personality trait that is defined as a disposition to work long hours and extend oneself for one's job. The instrument designed to measure this disposition reflects, of course, this theoretical position. However, physical activity or exercise is often viewed as a leisure activity. Therefore, the concept of working long hours in order to fulfill a company's goal may not correlate with exercise as a leisure activity. Furthermore, the Work Drive inventory contains items that ask about schoolwork, grades, and study habits. It is plausible that individuals who score high on Work Drive may find physical activity or exercise as time wasted since they could be working. The marginally significant trend that was found in this current study supports this explanation. Although, there is some evidence that exercise can enhance academic performance (Tomprowski, Davis, Miller, & Naglieri, 2008), it does not seem that Work Drive, as described by Lounsbury et al. (2004), is related to exercise.

It was hypothesized that activity level would relate to cortisol levels; however, no relationship was found in the current study. The connection between activity level and cortisol is inconsistent in the literature. For example, Rimmele et al. (2007) showed that trained men had lower cortisol responses than untrained men, although the stressor was psychological and not physical. However, in support of our findings, Blaney, Sothmann, Raff, Hart, and Horn (1990) reported no cortisol differences between active and sedentary individuals on a psychological stressor. Our findings are further supported by Marc, Parvizi, Ellendorff, Kallweit, and Elsaesser (2000) who found no training effect on cortisol levels in response to exercise. Finally, Struder, Hollmann, Platen, Rost, Weicker, and Weber (1998) reported that pre- and post-exercise levels of plasma cortisol did not differ between elderly distance runners and sedentary individuals. More research is warranted on activity level differences and cortisol levels to determine if there is a true connection in response to psychological and physical stressors.

Overall, cortisol levels increased after the moderate bike ride and continued to increase 20 minutes later. This is consistent with past research that has found cortisol increases with exercise (Hackney & Viru, 1999; Nielsen, Boesgaard, Sweeting, McKeown, & Rosenkilde, 1994; Radosevich et al., 1989). In the current study, salivary cortisol was still increasing after 20 minutes post exercise and this is also consistent with past research (Kanaley & Hartman, 2002; Levine et al., 2007; Radosevich et al., 1989). However, Jacks et al. (2002) showed that cortisol levels began to decline 20 minutes after exercise. Some studies have not found increases in cortisol in response to moderate exercise (Davies & Few, 1973; Jacks et al., 2002; Stephensen, Kolka, Francesconi, & Gonzalez, 1989), while others have (Hackney & Viru, 1999; Nielsen et al., 1994;

Radosevich et al., 1989), including the current study. The relationship appears to be dose-dependent meaning that the greater the intensity of the exercise, the greater the increase in cortisol (Hackney & Viru, 1999; Kanaley & Hartman, 2002; Radosevich et al., 1989). The increases in cortisol that were found in the current study support the view that moderate exercise is strong enough to elicit a stress response.

Personality traits were not related to cortisol levels at any of the 3 data points. Past research is limited with this relationship. Individuals high in Neuroticism have shown higher baseline cortisol levels in some studies (Lindfors, & Lundberg, 2002; Wust, Federenko, Hellhammer, & Kirschbaum, 2000); however, most of the research relating personality to cortisol is with clinical populations identified as having affective disorders instead of healthy individuals (Grossman, Yehuda, New, Schmeidler, Silverman, Mitropoulou, Sta. Maria, Golier, & Siever, 2003; Weinstein, Diforio, Schiffman, Walker, & Bonsall, 1999). Therefore, the research on this relationship (cortisol and personality) in a non-clinical population is scarce. However, Preussner, Gaab, Hellhammer, Lintz, Schommer, and Kirschbaum (1997) found differences emerging after the first day of testing, on days 2-5, when non-clinical participants knew what to expect from the study and the novelty had worn off. Perhaps repeated exposure to the exercise manipulation would yield personality differences with respect to salivary cortisol. In a non-clinical population, the findings from the present study suggest that cortisol is not related to personality. Further studies are warranted regarding this issue.

Some mood changes were found in participants as a result of the bike ride. In the current study, participants had more energy and vigor after the bike ride which is supported by past studies (Dunn & McAuley, 2000; Gauvin & Rejeski, 1993; Motl et al.,

2000; Robbins et al., 2004). However, no significant changes were found in Tranquility or Positive Engagement. Mood, as measured by the POMS, has an unstable relationship with exercise since it measures mostly negative mood states (Raedke, 2003). That is precisely why Gauvin and Rejeski (1993) developed the EFI to measure positive mood states in relation to exercise. Dunn and McAuley (2000) showed that intensity (moderate or vigorous) does not matter and mood will improve in either condition. The hypothesis was partially supported.

Although mood changes were detected, all participants were tested indoors in a lab room with no windows. Some research has indicated that outdoor exercise increases the mood improvements found and that indoor activities may have little or no effect on overall mood (Bodin & Hartig, 2003; Ceci & Hassmen, 1991; Harte & Eifert, 1995). The current study adds to the literature regarding the incorporation of a positive mood instrument with regard to exercise studies which examine the psychological aspect of this activity.

The data from the current study were also used to begin validation of the EES as described in the pilot study. The EES was found to have good reliability ($\alpha = .83$) and convergent validity ($r = .775, p < .0005$). This enjoyment scale is similar to the PACES, which was also used in the current study, although it is shorter and somewhat easier to fill out. Further studies should add to the validation process by investigating content and discriminant validity.

Limitations and Future Directions

The current study was not without limitations. First, the investigation was correlational in nature and self-reported measures were used. Studies which include objective measures of physical activity (e.g. pedometers etc.) are warranted, and there is a need to determine how much of the physical activity is derived from leisure-time activities, as opposed to other domains (occupation, household chores, etc.). Similarly, an objective measurement of the participant's fitness level (e.g. $\dot{V}O_2\text{max}$) was not monitored in the current study. The incorporation of this measurement would increase the sensitivity of the current study to perhaps detect greater differences in psychological and physiological variables.

Secondly, the participants were college students and thus are not completely representative of the general population. All of the participants had full access on campus to a gym, pool, aerobic classes, etc. This variety of activity is not usually available to the general public without paying a membership fee at a local gym, which was found to be a main barrier to exercise participation by Kruger et al. (2007). Only 3 cortisol samples were rendered with the last taken 20 minutes post-exercise. The current study did not find a return to baseline values, and the inclusion of further samples after more rest (e.g. 60, 90, 120 mins post exercise) are warranted. Furthermore, the data were collected in the summer which may have been a confounding factor as studies have shown people exercise more in warm weather (CDC, 1997; Matthews, Freedson, & Herbert, 2001; Uitenbroek, 1993). Lastly, the data were collected in a lab environment which may have led to the inconsistent mood findings as described above.

Overall, the study confirms the relationships between enjoyment and activity, personality and activity, personality and enjoyment, and mood and activity. The study also showed that cortisol levels will increase in response to moderate exercise. Our findings lend support to the need for diverse interventions for enhancing physical activity levels in adults. Specifically, interventions should be developed for men and women separately to increase exercise enjoyment, thus increasing physical activity and reducing a risk factor for chronic illnesses. Future research should investigate methods of increasing enjoyment and determine the ranking of lack of enjoyment as a barrier. In addition, future research should clarify the relationships between personality and cortisol, mood and exercise, and activity level and cortisol reactions.

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Appendices

Appendix A

INFORMED CONSENT FORM

The Effects of Exercise Enjoyment and Personality on Mood and Salivary Cortisol with Exercise Activity.

INTRODUCTION

The purpose of this study is to examine the effects of exercise enjoyment and personality type on mood and the physiological measure of salivary cortisol. This study will also examine possible differences between physically active and inactive groups on the above variables.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT

Prior to coming to the experiment, you will be asked to avoid smoking, eating, and drinking for at least 1 hour. You will also be asked not to exercise on the day of the experiment. After providing consent, your resting blood pressure will be taken. You will sit comfortably and rinse your mouth with water. While relaxing in the sitting position, you will let saliva pool in your mouth and expectorate into a tube once a minute for three minutes. You will then be instructed to fill out a survey packet. You will then ride a bike for 30 minutes at moderate intensity while wearing a heart rate monitor; this includes a 5 minute warm-up and 5 minute cool-down. You will then rest for 5 minutes and render a second saliva sample following the same procedure. You will also give a rating of perceived exertion and fill out another survey. The above procedures should take approximately one and a half hours to complete. The saliva sample will be stored in an ultra cold freezer for analysis later regarding salivary cortisol concentrations. Once the samples have been analyzed, they will be discarded.

RISKS and BENEFITS

The risks to you are minimal and your participation is strictly voluntary. During the saliva collection, gloves will be provided for all participants. If any discomfort occurs, you may withdraw from the study at any time without penalty. If you become fatigued at any point you may slow down or stop. If you withdraw from the study before data collection is completed your data will be destroyed. You will be given class credit or extra credit for your participation in this study. No monetary incentives will be given. Participation will provide useful information regarding the effects of enjoyment and personality on mood and cortisol levels.

CONFIDENTIALITY

The information from this study will be kept confidential. All data will be coded, and your name will not appear on any questionnaire. Only group data will be presented, and the consent form will be stored separate from the data. The data will be locked in the Biopsychology Laboratory in Walters Life Science A308. These records will only be accessed by the researchers in this study. No reference will be made in oral or written reports which could link participants to the study.

CONTACT INFORMATION

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the Principal Investigator, Pamela Schweighart at parmata@utk.edu or the Faculty Advisor, Dr. Debora Baldwin at dbaldwin@utk.edu or 974-3357. If you have questions about your rights as a participant, contact Research Compliance Services or the Office of Research at 974-3466.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Demographic Information

The following information is needed so that we can describe the group that participated in the study. Please fill in or make a check in the blank that best describes you.

Please be honest, and complete the survey to the best of your ability. Your information will remain confidential. Thank you!

Age: _____

Height: _____ feet and _____ inches

Weight: _____ pounds

Gender (Please circle one): Male Female

Ethnic Group (Please check one):

___ European-American (Caucasian)

_____ African-American

___ Native-American

_____ Hispanic-American

___ Asian-American

_____ Bi-Racial

Please list any medications you are currently taking:

On average, how many hours of sleep do you get per night? _____

On average, how many caffeinated beverages do you drink per day? _____

Do you smoke cigarettes? (Circle one) Yes No

Physical Activity Readiness

Please circle yes or no to reflect your choice.

- | | | |
|-----|----|---|
| Yes | No | 1. Has a doctor ever said you have a heart condition and recommended only medically supervised physical activity? |
| Yes | No | 2. Do you have chest pain brought on by physical activity? |
| Yes | No | 3. Have you developed chest pain within the past month? |
| Yes | No | 4. Do you tend to lose consciousness or fall over as a result of dizziness? |
| Yes | No | 5. Do you have a bone or joint problem that could be aggravated by the proposed physical activity? |
| Yes | No | 6. Has a doctor ever recommended medication for your blood pressure or a heart condition? |
| Yes | No | 7. Are you aware, through your own experience or a doctor's advice, of any other physical reason against your exercising without medical supervision? |

If you have answered Yes to any of the questions, please notify the experimenter.

Physical Activity Enjoyment Scale

Please rate how you feel about exercise (physical activity).

| | | | | | | | | |
|---------------------------------------|---|---|---|---|---|---|---|--|
| I enjoy it | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I hate it |
| I feel bored | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I feel interested |
| I dislike it | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I like it |
| I find it pleasurable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I find it unpleasurable |
| I am very absorbed with exercise | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I am not at all absorbed with exercise |
| It's no fun at all | 1 | 2 | 3 | 4 | 5 | 6 | 7 | It's a lot of fun |
| I find it energizing | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I find it tiring |
| It makes me depressed | 1 | 2 | 3 | 4 | 5 | 6 | 7 | It makes me happy |
| It's very pleasant | 1 | 2 | 3 | 4 | 5 | 6 | 7 | It's very unpleasant |
| I feel good physically while doing it | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I feel bad physically while doing it |
| It's very invigorating | 1 | 2 | 3 | 4 | 5 | 6 | 7 | It's not at all invigorating |
| I am very frustrated by it | 1 | 2 | 3 | 4 | 5 | 6 | 7 | I am not at all frustrated by it |

| | | |
|----------------------|---|----------------------------|
| It's very gratifying | 1 2 3 4 5 6 7 | It's not at all gratifying |
| <hr/> | | |

| | | |
|------------------------|---|------------------------------|
| It's very exhilarating | 1 2 3 4 5 6 7 | It's not at all exhilarating |
| <hr/> | | |

| | | |
|-----------------------------|---|-----------------------|
| It's not at all stimulating | 1 2 3 4 5 6 7 | It's very stimulating |
| <hr/> | | |

| | | |
|---|---|---|
| It gives me a strong sense of accomplishment | 1 2 3 4 5 6 7 | It's does not give me a strong sense of accomplishment |
| <hr/> | | |

| | | |
|----------------------|---|----------------------------|
| It's very refreshing | 1 2 3 4 5 6 7 | It's not at all refreshing |
| <hr/> | | |

| | | |
|--|---|--|
| I feel as though I would rather be doing something else | 1 2 3 4 5 6 7 | I feel as though there was nothing else I would rather be doing |
| <hr/> | | |

Enjoyment of Exercise Scale

Please circle the choice that applies to you.

Strongly Disagree = SD, Disagree = D, Neutral = N, Agree = A, Strongly Agree = SA

- | | | | | | |
|--|----|---|---|---|----|
| 1. I like to exercise. | SD | D | N | A | SA |
| 2. I enjoy breathing hard and sweating. | SD | D | N | A | SA |
| 3. Exercise relieves stress, for me. | SD | D | N | A | SA |
| 4. Exercise is boring. | SD | D | N | A | SA |
| 5. When I get done exercising, I feel good. | SD | D | N | A | SA |
| 6. I enjoy participating in athletic competition. | SD | D | N | A | SA |
| 7. If I sit still all day long, I feel bad. | SD | D | N | A | SA |
| 8. Exercise is one of my top 3 priorities. | SD | D | N | A | SA |
| 9. Exercise is painful. | SD | D | N | A | SA |
| 10. I would rather exercise than use the computer. | SD | D | N | A | SA |

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities → **Skip to question 3**

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities → **Skip to question 5**

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking → **Skip to question 7**

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

Don't know/Not sure

Feeling Inventory

Please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time. Circle the corresponding number.

0 = Do not feel, **1** = Feel slightly, **2** = Feel moderately, **3** = Feel strongly, **4** = Feel very strongly

| | Do not feel | | | Feel very strongly | |
|-----------------|-------------|---|---|--------------------|---|
| 1. Refreshed | 0 | 1 | 2 | 3 | 4 |
| 2. Calm | 0 | 1 | 2 | 3 | 4 |
| 3. Fatigued | 0 | 1 | 2 | 3 | 4 |
| 4. Enthusiastic | 0 | 1 | 2 | 3 | 4 |
| 5. Relaxed | 0 | 1 | 2 | 3 | 4 |
| 6. Energetic | 0 | 1 | 2 | 3 | 4 |
| 7. Happy | 0 | 1 | 2 | 3 | 4 |
| 8. Tired | 0 | 1 | 2 | 3 | 4 |
| 9. Revived | 0 | 1 | 2 | 3 | 4 |
| 10. Peaceful | 0 | 1 | 2 | 3 | 4 |
| 11. Worn-out | 0 | 1 | 2 | 3 | 4 |
| 12. Upbeat | 0 | 1 | 2 | 3 | 4 |

NEO-Five Factor Inventory

Read each statement carefully. For each statement circle the response that best represents your opinion. Circle only one answer for each statement.

Note that the responses are numbered in rows. Make sure your answer is by the correct number on the attached answer sheet.

SD D N A SA

Circle **SD** if you *strongly disagree* or the statement is definitely false.

Circle **D** if you *disagree* or the statement is mostly false.

Circle **N** if you are *neutral* on the statement, if you cannot decide, or if the statement is about equally true and false.

Circle **A** if you *agree* or the statement is mostly true.

Circle **SA** if you *strongly agree* or the statement is definitely true.

1. I am not a worrier.
2. I like to have a lot of people around me.
3. I don't like to waste my time daydreaming.
4. I try to be courteous to everyone I meet.
5. I keep my belongings neat and clean.

6. I often feel inferior to others.
7. I laugh easily.
8. Once I find the right way to do something, I stick to it.
9. I often get into arguments with my family and co-workers.
10. I'm pretty good about pacing myself so as to get things done on time.

11. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.
12. I don't consider myself especially "light-hearted."
13. I am intrigued by the patterns I find in art and nature.
14. Some people think I'm selfish and egotistical.
15. I am not a very methodical person.

16. I rarely feel lonely or blue.
17. I really enjoy talking to people.
18. I believe letting students hear controversial speakers can only confuse and mislead them.
19. I would rather cooperate with others than compete with them.
20. I try to perform all the tasks assigned to me conscientiously.

21. I often feel tense and jittery.
22. I like to be where the action is.
23. Poetry has little or not effect on me.
24. I tend to be cynical and skeptical of others' intentions.
25. I have a clear set of goals and work toward them in an orderly fashion.

26. Sometimes I feel completely worthless.
27. I usually prefer to do things alone.
28. I often try new and foreign foods.
29. I believe that most people will take advantage of you if you let them.
30. I waste a lot of time before settling down to work.

31. I rarely feel fearful or anxious.
32. I often feel as if I'm bursting with energy.
33. I seldom notice the moods or feelings that different environments produce.
34. Most people I know like me.
35. I work hard to accomplish my goals.

36. I often get angry at the way people treat me.
37. I am a cheerful, high-spirited person.
38. I believe we should look to our religious authorities for decisions on moral issues.
39. Some people think of me as cold and calculating.
40. When I make a commitment, I can always be counted on to follow through.

41. Too often, when things go wrong, I get discouraged and feel like giving up.
42. I am not a cheerful person.
43. Sometimes when I am reading poetry or looking at art, I feel a chill or wave of excitement.
44. I'm hard-headed and tough-minded in my attitudes.
45. Sometimes I'm not as dependable or reliable as I should be.

46. I am seldom sad or depressed.
47. My life is fast-paced.
48. I have little interest in speculating on the nature of the universe or the human condition.
49. I generally try to be thoughtful and considerate.
50. I am a productive person who always gets the job done.

51. I often feel helpless and want someone else to solve my problems.
52. I am a very active person.
53. I have a lot of intellectual curiosity.
54. If I don't like people, I let them know it.
55. I never seem to be able to get organized.

56. At times I have been so ashamed I just wanted to hide.
57. I would rather go my own way than be a leader of others.
58. I often enjoy playing with theories or abstract ideas.
59. If necessary, I am willing to manipulate people to get what I want.
60. I strive for excellence in everything I do.

Perceived Exertion Scale

While exercising we want you to rate your perception of exertion, i.e., how heavy and strenuous the exercise feels to you. The perception of exertion depends mainly on the strain and fatigue in your muscles and on your feeling of breathlessness or aches in the chest.

Look at this rating scale; we want you to use this scale from 6 to 20, where 6 means “no exertion at all” and 20 means “maximal exertion.”

9 corresponds to “very light” exercise. For a normal, healthy person it is like walking slowly at his or her own pace for some minutes.

13 on the scale is “somewhat hard” exercise. but it still feels OK to continue.

17 “very hard” is very strenuous. A healthy person can still go on, but he or she really has to push him or herself. It feels very heavy, and the person is very tired.

19 on the scale is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experienced.

Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Don’t underestimate it, but don’t overestimate it either. It’s your own feeling of effort and exertion that’s important, not how it compares to other people’s. What other people think is not important either. Look at the scale and the expressions and then give a number.

| | |
|----|--------------------|
| 6 | No exertion at all |
| 7 | |
| 8 | Extremely light |
| 9 | Very light |
| 10 | |
| 11 | Light |
| 12 | |
| 13 | Somewhat hard |
| 14 | |
| 15 | Hard (heavy) |
| 16 | |
| 17 | Very hard |
| 18 | |
| 19 | Extremely hard |
| 20 | Maximal exertion |

Participant Information
(For Experimenter Use)

BP _____/_____

HR Baseline _____

HR warmup _____

HR 5 minutes _____

HR 10 minutes _____

HR 15 minutes _____

Exertion Rating _____

HR 20 minutes _____

HR average _____

HR cooldown _____

Exertion Rating _____

Appendix B

Table 1. Descriptive Statistics – Pilot Study

| | Sedentary n = 35 | | Moderate n = 114 | | High Activity n = 64 | |
|-------|---------------------|-------|---------------------|-------|-------------------------|-------|
| | M | SD | M | SD | M | SD |
| PACES | 81.83 ^a | 16.72 | 94.32 ^b | 17.91 | 113.52 ^c | 17.91 |
| EES | 18.44 ^a | 5.44 | 24.69 ^b | 5.26 | 30.69 ^c | 4.48 |

^a Sedentary/moderate, $p < .0005$

^b Moderate/active, $p < .0005$

^c Sedentary/active, $p < .0005$

Table 2. Descriptive Statistics – Gender – Pilot Study

| | Males n = 96 | | Females n = 118 | |
|-------|-----------------|-------|--------------------|-------|
| | M | SD | M | SD |
| PACES | 102.15 * | 16.74 | 94.72 | 20.62 |
| EES | 27.08 ** | 5.84 | 24.08 | 6.75 |
| IPAQ | 2.29 *** | .61 | 2.02 | .69 |

* p = .005, ** p = .001, *** p = .003

Table 3. Correlations – Pilot Study

| | PACES | EES | IPAQ |
|-------|--------|--------|------|
| PACES | -- | | |
| EES | .775 * | -- | |
| IPAQ | .573 * | .631 * | -- |

* $p < .0005$

Table 4. Hypothesis 2 – Enjoyment and Activity

| | Sedentary n = 11 | | Moderate n = 20 | | Highly Active n = 22 | |
|-------|---------------------|-------|--------------------|-------|-------------------------|-------|
| | M | SD | M | SD | M | SD |
| EES | 17.73 ^a | 6.00 | 23.75 ^b | 4.08 | 31.00 ^b | 4.15 |
| PACES | 77.27 ^c | 14.65 | 96.90 ^d | 11.97 | 107.73 ^c | 10.82 |

^a Sedentary/moderate, $p = .003$

^b Sedentary/active, and moderate/active, $p < .0005$

^c Sedentary/moderate, sedentary/active, $p < .0005$

^d Moderate/active, $p = .015$

Table 5. Hypothesis 4 - Personality and Activity

| | Sedentary n = 11 | | Highly Active n = 22 | |
|-------------------|---------------------|-------|-------------------------|------|
| | M | SD | M | SD |
| Neuroticism | * 37.18 | 8.91 | 29.27 | 7.11 |
| Extroversion | ** 41.18 | 6.78 | 46.32 | 4.46 |
| Openness | 38.73 | 6.08 | 36.95 | 6.43 |
| Agreeableness | 47.55 | 6.47 | 44.05 | 5.31 |
| Conscientiousness | 43.36 | 10.75 | 45.77 | 5.56 |

* $p = .044$, ** $p = .024$

Table 6. Hypothesis 9 – Mood and Exercise

| | Pre Bike Ride | | Post Bike Ride | |
|---------------------|---------------|------|----------------|------|
| | M | SD | M | SD |
| Positive Engagement | 7.45 | 2.19 | 7.80 | 2.43 |
| Revitalization | * 6.43 | 2.49 | 7.49 | 2.40 |
| Tranquility | 8.63 | 2.47 | 8.31 | 2.16 |
| Physical Exhaustion | ** 4.37 | 2.98 | 3.39 | 2.59 |

* $p = .008$, ** $p = .023$

Appendix C

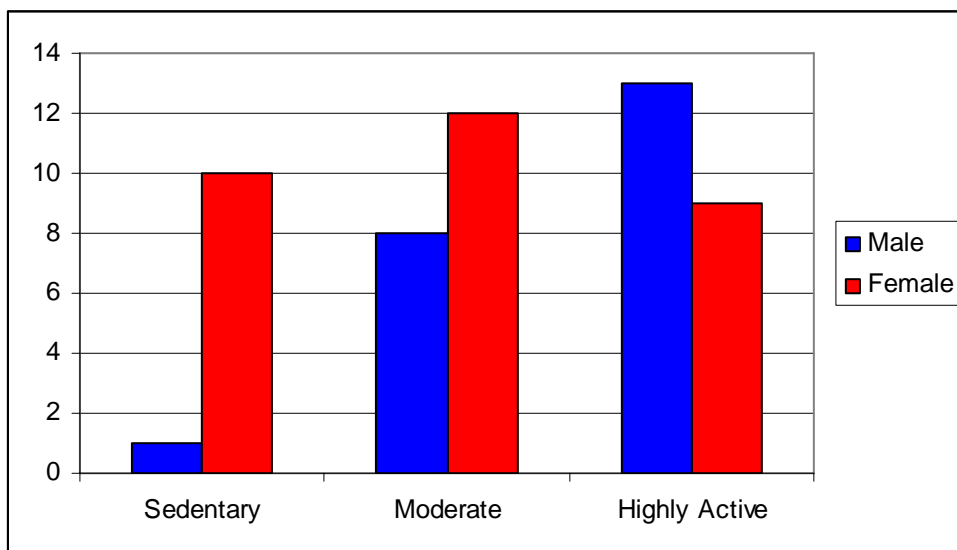
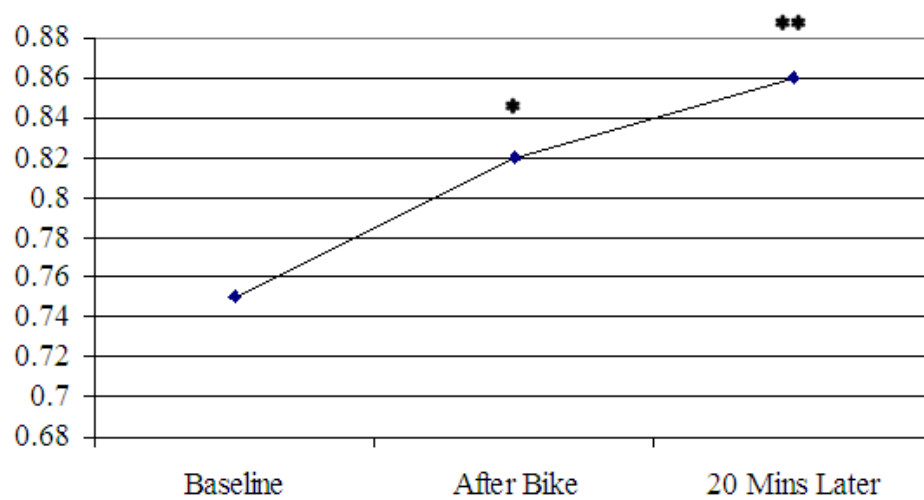
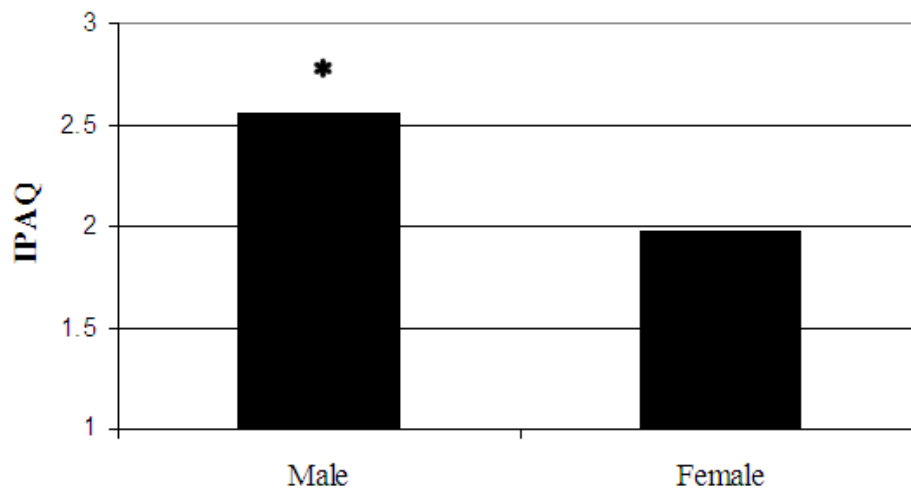


Figure 1. Demographics



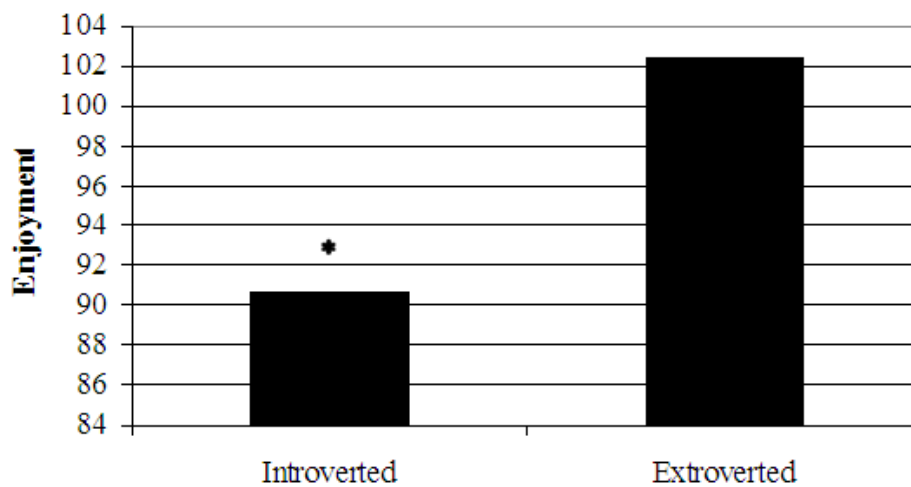
* $p < .0005$, ** $p = .002$

Figure 2. Cortisol Levels and Exercise



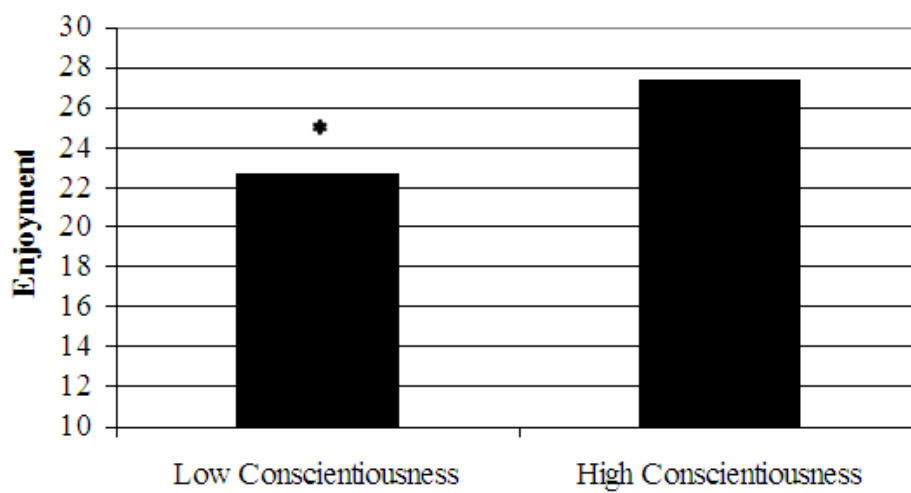
* $p = .006$

Figure 3. Hypothesis 2 – Gender and Activity



* $p = .009$

Figure 4. Hypothesis 4 – Extroversion and Enjoyment (PACES)



* $p = .013$

Figure 5. Hypothesis 5 – Conscientiousness and Enjoyment (EES)

Vita

Pamela Mary Schweighart was born in Manchester, CT on March 16, 1982 although she grew up in Richmond, VA. She graduated from Mills E. Godwin High School in 2000. She then went to Roanoke College in Salem, VA where she received BS degrees in Psychology and Computer Science with a minor in Mathematics in 2004. She was also inducted into Phi Beta Kappa at Roanoke College.

Pamela is currently pursuing her doctorate in Experimental Psychology at the University of Tennessee, Knoxville, TN. She married in 2008 and publications can also be found under her maiden name, Armata.