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The Effects of Social Support on Perceived Mood and Perceived Muscle Tension

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The effects of social support on perceived mood and perceived muscle tension following a moderate stressor

by

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This thesis was prepared under the direction of the candidate's thesis committee chair, Elizabeth Blickensderfer, Ph.D., Department of Human Factors and Systems, and has been approved by the members of the thesis committee. This thesis was submitted to the Department of Human Factors and Systems and has been accepted in partial fulfillment of the requirements for the degree of Master of Science in Human Factors and Systems.

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Abstract

The researcher examined the effects of social support on stress reactivity following a moderate psychological stressor. The first independent variable (IV), social support, had two levels: alone (A) and pairs (P). The participants in the pairs level took part in the study with a friend. Participants in the alone level took part in the study by themselves. The second IV, period, had two levels: pre-stressor (Pre) and post-stressor (Post). Stress was induced with a mental arithmetic serial subtraction task and was measured by perceived mood state with the Perception of Mood States (POMS) and perceived muscle tension with the Nordic Musculoskeletal Questionnaire (NMQ). The results showed a main effect of social support on perceived mood both pre and post stressor and a main effect of period on perceived mood. Due to study limitations, it not possible to determine the extent to which social support buffers participants from stress reactivity; however, incorporating social support into stress management and musculoskeletal disorder (MSD) prevention programs can enhance their efficacy.

Introduction

For decades, researchers have studied the effects of stress on human health and performance (Hawkley, Bernston, Engeland, & Marucha, 2005). Many such studies measure the effects of psychosocial issues, such as social support (Schnall, 2008), loneliness (Cacioppo & Hawkley, 2003), and psychological work demands (Conway, 1999), on stress effects. Other studies focus on the negative effects of elevated stress levels, either acutely (Kamarck, Manuck, & Jennings, 1990) or over long periods of time (Hawkley, Bernston, Engeland, & Marucha, 2005). Within the existing body of literature concerning current stress research, it appears that understanding what factors effect stress reactivity and ameliorate the negative effects of stress, such as strain, is of paramount importance. One model that attempts to predict strain due to psychosocial work hazards is the demand-control imbalance model (Karasek, 1990). It predicts stress-related strain will occur when job demands are high and workers have little control over their work (Bridger, 2003). It is suggested that social support acts as a buffer to mitigate the negative effects of the demand-control imbalance. This model can be expanded from the workplace to draw the conclusion that when life demands are high and an individual has little control over their life, stress-related strain results. It can then be concluded that social support can act as a buffer to lessen stress-related strain resulting from a demand-control imbalance in an individual's life in general.

Research shows that stress-related strain can often lead to chronic pain and musculoskeletal disorders (MSDs) (Bridger, 2003). MSDs have many negative effects on individuals and society. Some are easy to measure, such as the cost of treatment and lost workdays due to pain. Others are more difficult to measure, such as the emotional distress

an individual with chronic low back pain (LBP) suffers when they can no longer pick up their child. Studies show that there is a correlation between stress and MSDs, but the exact relationship is still a vague area within the greater field of stress research. While some researchers search specifically for the answers to *why* stress and MSDs are related, other researchers study how to buffer individuals from and ameliorate the negative effects of stress and how to prevent the onset of or treat stress-related strain, such as MSDs. Such studies explore the potential buffering effects of social support to reduce stress-related strain (Small, et al., 2006). Results of these studies suggest incorporating social support into intervention programs, such as stress management and MSD prevention, to increase their efficacy. The results also suggest incorporating the development of strong social ties through the physical layout and workflow design of workplaces to help reduce stress levels of employees (Bridger, 2003). In short, research shows that people who work with friends and who develop friendships at work have lower stress levels and less instances of stress-related strain, such as MSDs.

This study's purpose was to examine the possible buffering effects of social support to mitigate stress, as measured by perceived mood state and perceived muscle tension, associated with moderate psychological stressors. Results of this study could suggest that by making social support available to individuals during moderately stressful events could lead to lessened rates of muscle tension and subsequent development of chronic pain and or MSDs.

The following literature review begins with an overview of stress research. A definition of stress, stressors, stress reactivity, and strain and a discussion of the effects of stress follow. Then descriptions of stress theories, especially social support, are given.

Finally, various types of stress measurements, especially perceived mood states and perceived muscle tension, are explained.

Literature Review

Brief History of Stress Research

During the nineteenth century, the French physiologist Claude Bernard developed the concept of homeostasis (Greenberg, 2009). Homeostasis is the state in which all the body's systems work in unison to keep the body's internal environment balanced and stable. Bernard developed this concept by observing similarities between steam engines and biological organisms – they both convert stored energy through a combustion process to move some part or generate motion. He hypothesized that there exists an internal environment that causes the process biological organisms use to store energy and convert it into movement. He believed that the internal environment's main purpose was to keep the organism at homeostasis despite fluctuation in the external environment via various chemical and physical responses. Bernard's concept of homeostasis led later researchers to discover more about the body's physical and chemical reactions to changes in the external environment to allow the body to remain in a balanced and stable state.

In the early twentieth century, a physiologist at Harvard Medical School named Walter Cannon first noted that respiration rate, blood pressure, heart rate, and serum cholesterol levels elevate as a reaction to stress (Greenberg, 2009). He called this reaction to stress the "fight-or-flight response." An endocrinologist named Hans Seyle studied the fight-or-flight response and identified three phases of stress reaction, which he termed the "general adaptation syndrome," and defined stress as the body's nonspecific response to

any demand placed upon it. Good demands to which the human must adapt were termed "eustress," and bad demands to which the human must adapt were termed "distress." Interestingly, humans have the same physiological reaction to eustress and distress.

With the ground-breaking work of researchers such as Seyle and Cannon, the field of stress research flourished (Greenberg, 2009). One such researcher, A.T.W. Simeons, posed the argument that the human brain did not develop to properly respond to common stressors in modern life. Humans respond to symbolic stressors (psychological stressors such as threats to self-esteem or depression) inappropriately with the fight-or-flight response, and humans can neither fight nor flee from these symbolic stressors. The subsequent unused stress products have detrimental effects on the body and can lead to psychosomatic disease.

Other researchers have studied the relationship between stress and processes of the body to more clearly understand which diseases are tied to stress and therefore how to prevent these diseases from occurring (Greenberg, 2009). Additional research on the effects of stress on the body include: the effects of stress on headaches, ulcerative colitis, cancer, and digestion. Researchers have studied various ways to successfully treat people with stress related illnesses (Benson & Cassey, 2008). One such researcher was Herbert Benson, a cardiologist at Harvard Medical School, who became interested in stress research when he began a meditation practice. Benson developed a relaxation technique called the "relaxation response" based on his meditation practice and effectively treated patients with high blood pressure.

Another researcher named Dr. Edmund Jacobson developed a relaxation technique called progressive relaxation, often termed neuromuscular relaxation

(Greenberg, 2009). It allows for muscle relaxation and eliminates unnecessary muscle tension by systematically contracting and releasing muscle groups. Dr. Jacobson created this technique after he noticed that his bedridden patients had tense muscles despite appearing physically relaxed. He termed this muscle tension "bracing" and concluded that was a result of nerve impulses sent to the muscles in response to stress.

Additionally, researchers have explored stress as a result of stressors from life situations and changes (Greenberg, 2009). Studies by Holmes and Rahe show that significant life changes can greatly increase the chance of illness. Lazarus, DeLongis and colleagues have found evidence that, as opposed to major life changes, daily hassles can be more detrimental to health. Most importantly, stress researchers have found that, although a small amount of stress can be good for human health, too much can encourage the onset of illness.

Defining Stress

These and other stress researchers have developed various definitions of stress. For the purposes of this study, stress was defined as the results of an imbalance between demands placed upon a person and their perceived resources or coping abilities (Lazarus, 1987). A person experiencing this imbalance can respond physiologically and or psychologically to a perceived stressor, leading to stress reactivity and possibly strain. (Greenberg, 2009). (These terms are also defined in Figure 1 below.)

Stressors are things that cause the involuntary physiological response, such as a loud noise, a fight with a loved one, an illness, or an approaching deadline (Greenberg, 2009). Stress reactivity, sometimes called the stress response, is the involuntary physiological response caused by the stressor. When a person comes into contact with a

stressor, a signal in the brain sends a chemical messenger to the glands to send out stress hormones, such as cortisol and adrenaline (Cacioppo & Hawkley, 2003). The sympathetic nervous system (SNS), or "fight or flight response," turns on. Senses are heightened, heart rate and blood pressure increase, breathing rates rise, muscles tighten or brace, digestion and cellular growth and repair slow, neural excitability increases, the amount of saliva in the mouth decreases, sodium retention increases, perspiration increases, respiratory rate changes, serum glucose rises, hydrochloric acid levels in the stomach rise, and brain waves change. This prepares humans for survival in life-and-death situations, and can, to a certain extent, increase performance in things like sporting events or work presentations (Benson & Cassey, 2008).

Strain is the psychological, physical, and or behavioral outcomes of stress reactivity (Greenberg, 2009). Examples of strain are depression, chronic pain or MSDs, and insomnia. Interestingly, research suggests that individuals with quality social support are both less likely to develop any of these examples of strain and that they have more resources available to recover from strain (Cacioppo & Hawkley, 2003). Strain is covered more fully in the following section regarding the effects of stress.

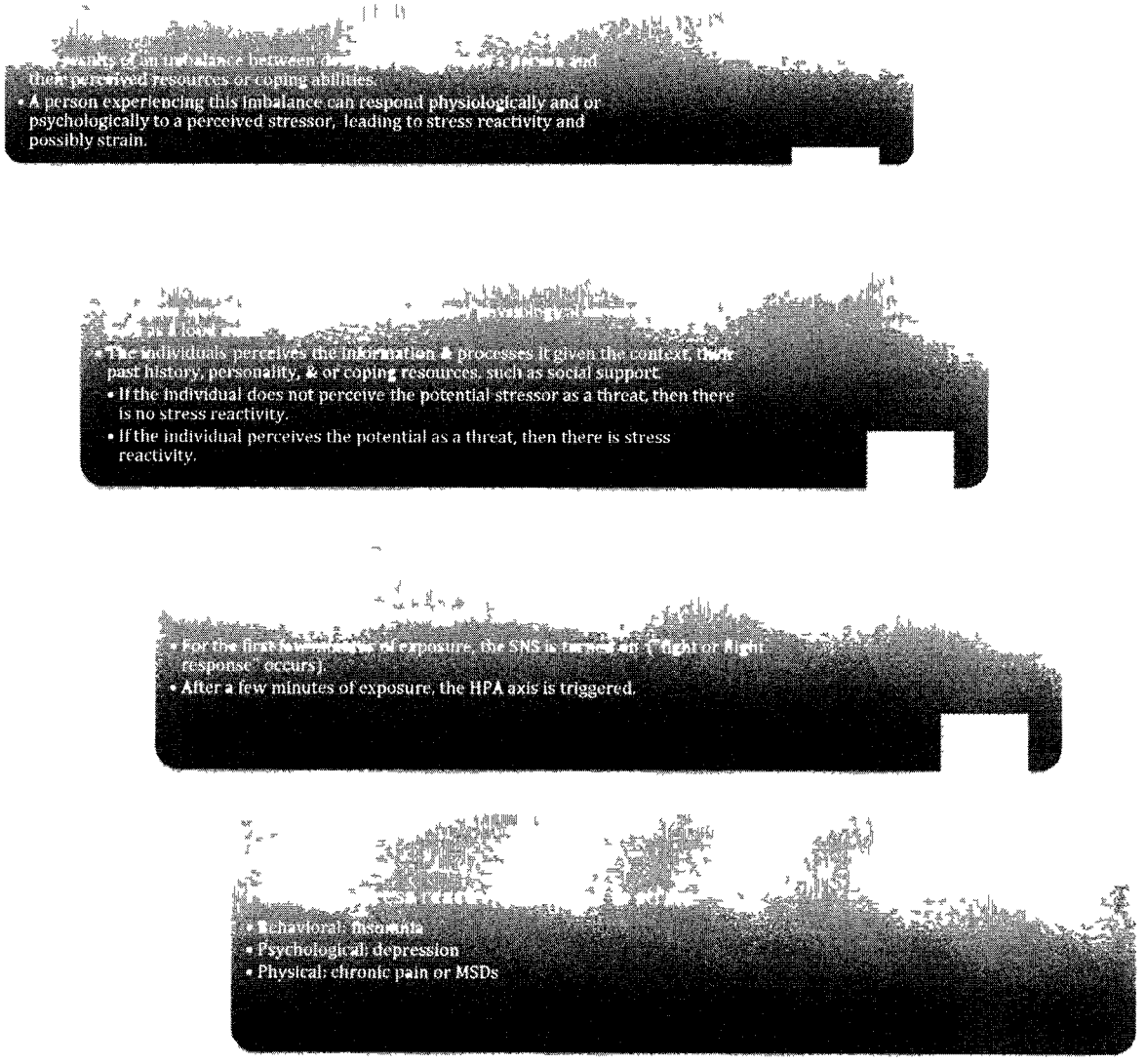

Figure 1 Defining Stress, Stressors, Stress Reactivity, and Strain

The Effects of Stress

If and individual perceives an event as a stressor and exposure to that stressor lasts beyond a few minutes, a physiological process that prepares the body for more pervasive activation of bodily functions will occur (Kottler & Chen, 2008) This physiological process is called the hypothalamus-pituitary-adrenal (HPA) axis and is described in the following paragraphs and in Figure 2 below.

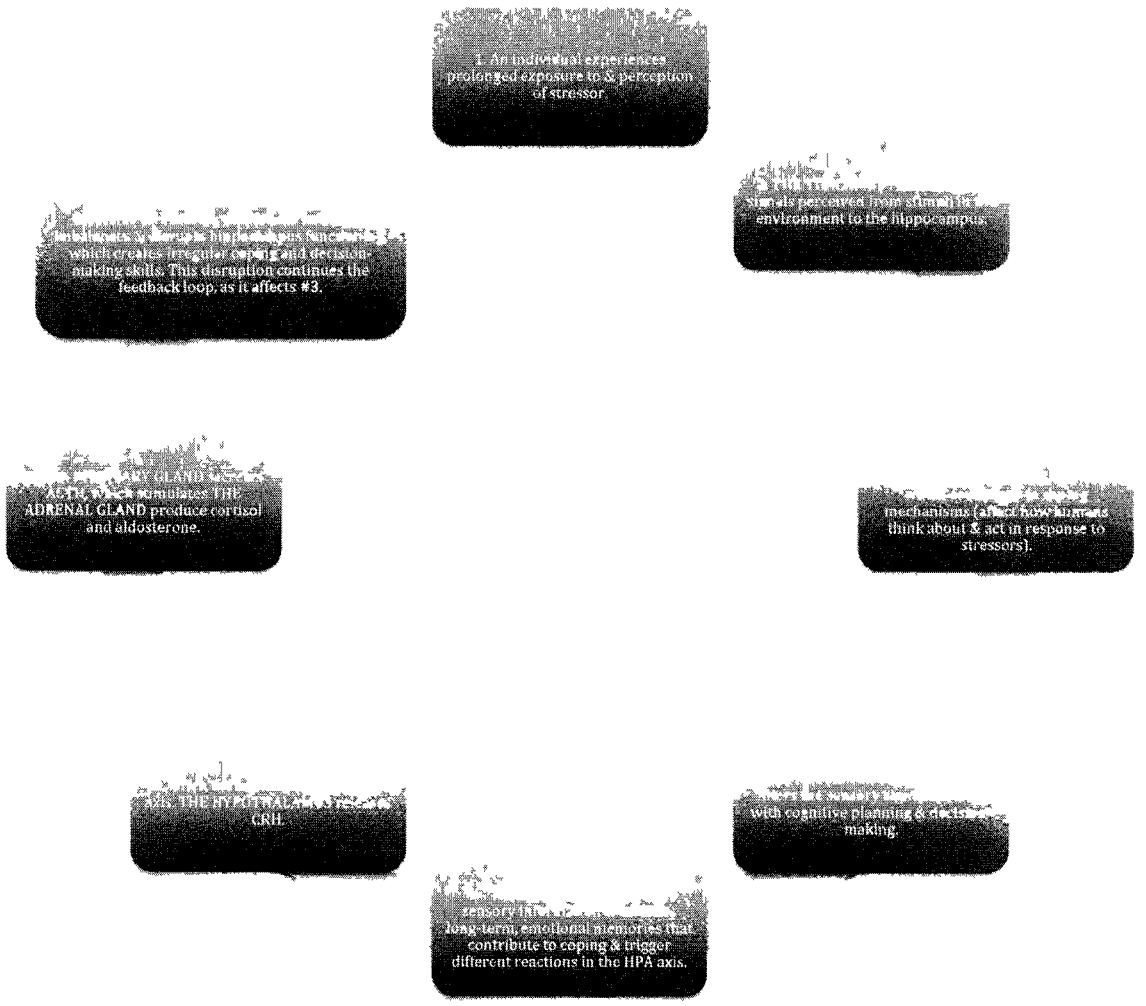

Figure 2 The HPA Axis

A "neuroendocrine" relationship between the brain and kidneys plays an instrumental role in how humans experience, think about, and act in response to emotional and physical stressors (Lazarus, 1987). Within the brain, the thalamus relays sensory signals perceived from stimuli in the environment to the hippocampus. The hippocampus holds a vast amount of past experiences referred to as episodic memories. Short-term memories and new information are partnered with past experiences stored in long-term memory, which contribute to coping mechanisms. This allows past experiences to affect how humans think about and act in response to stressors. Next, the pre-frontal

cortex and the amygdala filter the sensory signals. The pre-frontal cortex helps with cognitive planning and decision-making. The amygdala not only filters but also elaborates upon the sensory signals. The amygdala contains long-term, emotional memories that also contribute to coping, which are attached to the new sensory signals to add deeper meaning. For example, if someone was run over by a blue car, the memory of being run over and the feelings of pain and helplessness associated with that experience could be stimulated when the person sees a blue car at present. Emotional meaning is now attached to the new information. The emotional signals from the amygdala trigger different reactions in the hypothalamic-pituitary-adrenal (HPA) axis, which is central to how the body reacts to stress.

The HPA axis is a looping process (Lazarus, 1987). When a person is exposed to a stressor and the signal reaches the HPA axis, the hypothalamus releases a hormone called corticotrophin releasing hormone (CRH) (Kottler & Chen, 2008). This stimulates the pituitary gland, which secretes the adrenocorticotropic hormone (ACTH). ACTH stimulates the adrenal glands to produce cortisol and aldosterone. Cortisol is related to the sensation of stress. Once released, it should send a signal back to the hypothalamus to reduce the amount of CRH released. Under normal circumstances, the brain regulates the HPA axis and keeps levels of each hormone stable. Under chronically stressful circumstances, excessive levels of cortisol create hormonal imbalances. Cortisol also attaches to and disrupts hippocampus functioning, which creates irregular coping and decision-making skills (Lazarus, 1987).

The HPA axis function implies that perception of circumstances, rather than the circumstances themselves, affects whether or not an individual considers those

circumstances stressful (Lazarus, 1987). This suggests that two individuals, given different contexts, past histories, personalities, and or coping resources, could react very differently to the same circumstance. One of those individuals could perceive the circumstance as a stressor, the HPA axis could be triggered, and any number of negative effects of stress could ensue. Many studies, the present study included, attempt to discover how a change in context or available coping resources can help individuals perceive a potential stressor as less threatening and therefore lessen the negative effects of stress (Cacioppo & Hawkley, 2003). One such manipulation is presenting participants with social support as a coping resource. Results of these studies suggest that participants with access to quality social support, either during an acute, laboratory-induced stressor (Kamarck, Manuck, & Jennings, 1990) or during long term, difficult life events, such as a serious illness (Uchino, Cacioppo, & Kiecolt-Glaser), show fewer negative effects of stress than those participants without quality social support.

As stated previously, strain is the psychological, physical, and or behavioral outcomes of stress reactivity. Unfortunately, stress reactivity in the human mind and body is the same whether the stressor is life-threatening or minor and detrimental strains can occur in either case (Greenberg, 2009). If left uncontrolled or unchecked, stress can take a serious toll on physical and mental health. A brief list of mental and physical health problems linked to stress includes: allergies, anger, anxiety, arthritis, muscle tension, chronic pain, musculoskeletal disorders, constant worry, depression, grinding teeth, heart problems, hypertension, infertility, insomnia, memory loss and muscle tension (Benson & Cassey, 2008). Unhealthy behavioral reactions to stress include: substance abuse or overuse, electronic addictions, over or under eating and subsequent significant weight

gain or loss, withdrawal from relationships, and decrease in school or work performance, and over or under sleeping.

Researchers have discovered that the relationship between stress and health is nonlinear (Greenberg, 2009). It can be illustrated with a U-shaped curve which shows that a great deal of health problems occur with high levels of stress or with not enough stress. For optimal health, humans need a moderate level of stress. An example of this is a work hardening program that prepares workers for particular, demanding, physical tasks required for their occupation (Bridger, 2003). Workers, who have gone through properly designed work hardening programs, are able to prepare their bodies for the demands of their jobs both in strength and in technique. A worker, who has not gone through a work hardening program, may be too weak or not have proper technique and thus has greater risk of injury. When too much stress is present, any number of negative health effects can occur regardless of work hardening programs. One such negative health effect of particular interest for this study is the concept of bracing or stress-induced muscle tension. Research shows that tense muscles are more prone to strain or sprain and that bracing over time can lead to chronic pain and MSDs. Also of particular interest to this study, many researchers suggest that in the presence of social support participants show a decrease in tension, negative mood states, and injury rates (Lavallee & Flint, 1996). The results of these studies imply that work places and individuals interested in preventing MSDs should incorporate stress reduction techniques into their interventions.

In addition to physiological stress reactions, there are also noted behavioral stress reactions. One example is the impact of stress on performance, which have a nonlinear relationship (Benson & Cassey, 2008). As shown in Figure 3, if little stress is present,

human performance is low. As stress levels initially increase, so does performance, and humans enter a range of their best potential performance. As stress levels continue to increase, human performance drops.

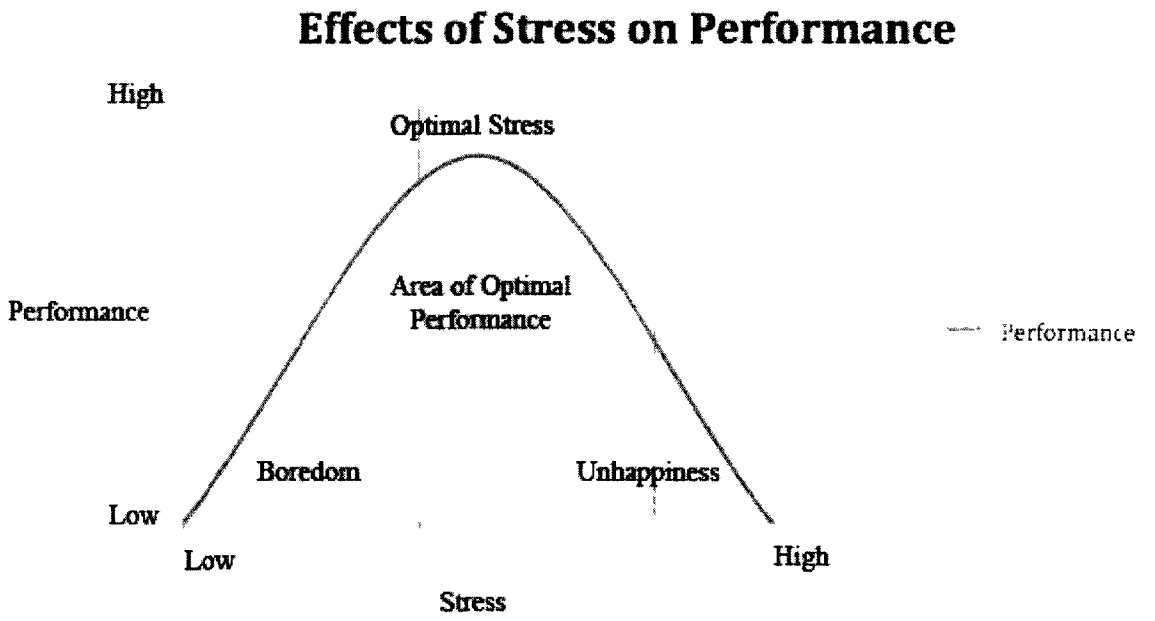

Figure 3 Effects of Stress on Performance

In regards to cognitive performance, stress affects numerous cognitive processes, such as perception, attention, memory, decision-making, problem-solving, and response execution (Bridger, 2003). When the human brain is exposed to too much stress, symptoms like forgetfulness, lack of concentration, impaired judgment, poor decision-making, inability to be productive, shortened attention span, and disorganized thoughts can result. Referring once again to the demand-control imbalance model (Karasek, 1990), it appears that when individuals are placed in high-demand situations with little control over their actions or environment, stress ensues and performance drops. The suggestion that social support acts as a buffer to mitigate the negative effects of the demand-control imbalance (Bridger, 2003) points to the concept that the presence of or access to social support can aid an individual in moderating the amount of stress exposure and reactivity

and thus keep their performance an optimal level.

Stress Theories

Stress researchers highlight various causes of stress and the effects of stress on human performance and overall health (Greenberg, 2009). There are a number of these causal theories within stress research, and this section is not meant to be an exhaustive account of each of these theories. This section is rather a brief description of commonly cited theories and more detailed accounts of one theory that directly pertain to this study. An overview of the theories is depicted in Figure 4.

One theory that deals with the effects of stress on humans is the "Life Events Theory" developed by Holmes and Rahe (Greenberg, 2009). It is based on the rationale that certain events or situations require more resources than are available for adaptation or success. The more of these stressful life situations an individual is exposed to, the greater that individual's stress levels. DeLongis and colleagues support the general Life Events Theory but state more specifically that daily, routine stressful life events, which they call hassles, increase stress levels more so than larger, less frequent stressful life events. Another theory regarding the causes of stress is the "Hardiness Theory." Researchers adhering to this theory state that an individual's attitudes toward stressful life events effects stress levels, not the events themselves. One such researcher, Kobasa, suggests that people perceiving a stressful event as a challenge rather than a threat will have lower stress levels.

Continuing with the concept of perception and stress, Lazarus and Folkman (1987) developed the transactional theory and researched emotions and coping. They explained that exposure to stressors is an inevitable part of life, but how an individual

perceives the stressor and copes with stress can make the outcome positive or negative. Transactional theory states that cognitive appraisal and coping are the main constructs of stress. Cognitive appraisal describes how humans interact with and perceive their environment and how they continually assess the demands, resources, and restraints placed on them. Coping is often defined as how an individual thinks about and acts to resolve stress. Transactional theory states that coping is the process of using either a problem-focused or emotions-focused response to a threat and that individual personality greatly affects how people cope. Personality can shape various reactions to a stressor, such as a confrontational, self-blaming, escaping and avoiding, or angry reaction. This theory offers explanations as to why a poor fit between available resources and the environment can stress some individuals more than others, and it supports the idea that coping mechanisms are skills and mindsets that can be learned and changed. One commonly mentioned coping resource is social support, which will be discussed in more detail at the end of this section.

In relation to psychosocial stress theories and health, the demand-control imbalance model suggests that strain, or negative effects of stress, arise when job demands are high and employees have little control over their type of work and work environment (Karasek, 1990). It is suggested that social support acts as a buffer to mitigate the negative effects of the demand-control imbalance (Bridger, 2003). This model can be expanded from the workplace to draw the conclusion that when life demands are high and an individual has little control over their life, stress-related strain results. It can then be concluded that social support can act as a buffer to lessen stress-

related strain resulting from a demand-control imbalance in an individual's life in general.

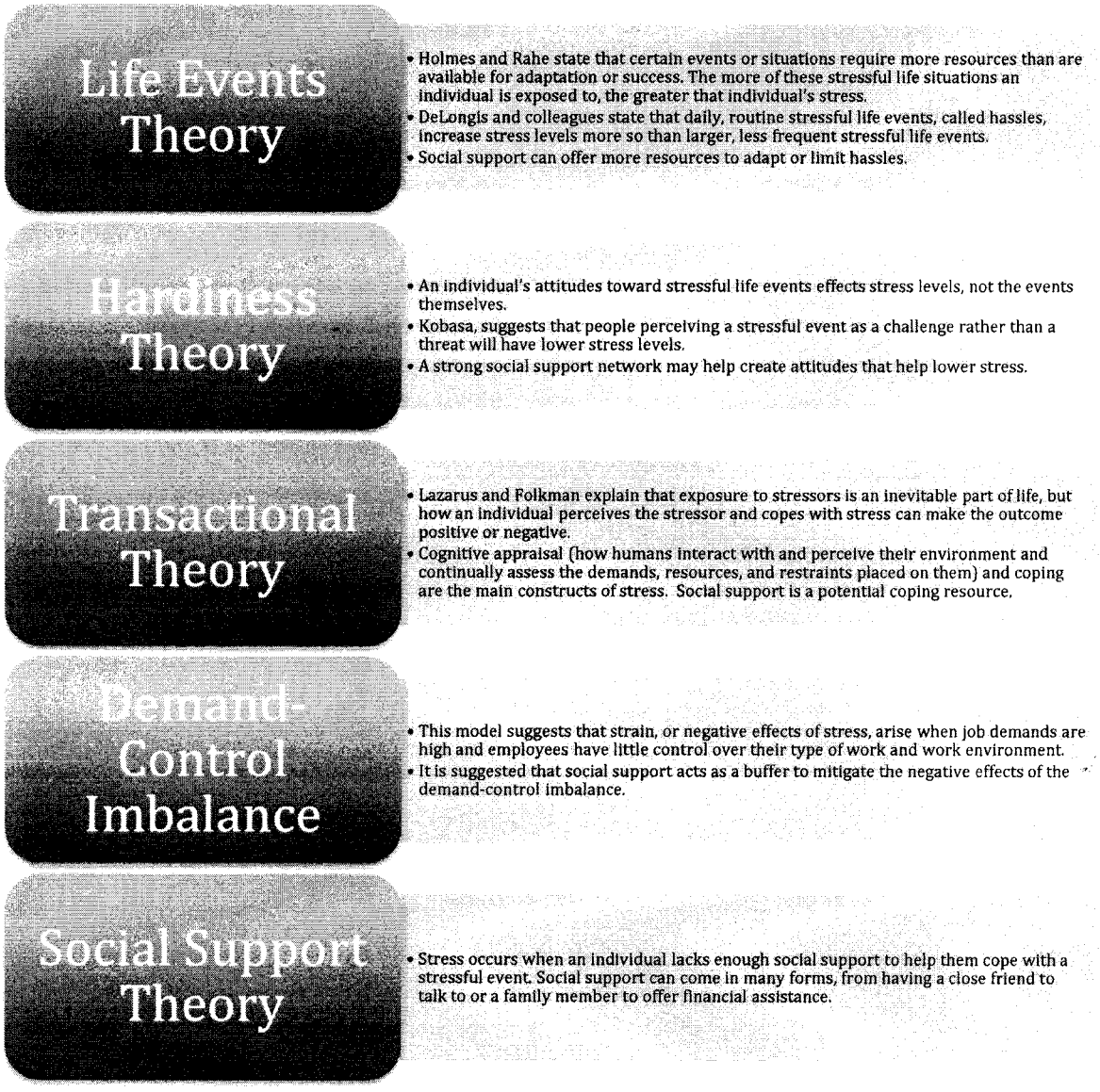

Figure 4. Stress Theories

The "Social Support Theory" is the final theory mentioned in this study (Greenberg, 2009). Researchers adhering to this theory suggest that stress occurs when an individual lacks enough social support to help them cope with a stressful event. Social support can come in many forms, from having a close friend to talk to or a family

member to offer financial assistance. As the present study looks directly at the effects of social support on stress levels, an in-depth discussion of the topic follows.

Social support.

The Social Support Theory states that social support can protect individuals from increased stress levels and resulting illness or disease (Greenberg, 2009). Social support can be defined as acceptance, belonging, being loved, being needed, having people to whom one feels close, and having people to confide in and share stressors, difficulties, and joys. It can come in four main forms: tangible support, emotional support, or informational support, and appraisal support. Two hypotheses exist that attempt to explain how social support helps manage stress. The first is the "Direct Effect Theory." This theory suggests that social support is a way of preventing stressors from happening at all. For example, if an individual receives support in the form of career advice and that advice prevented job loss, a potential stressor was avoided. The second theory is called "The Buffering Theory" (Cohen, Doyle, Turner, Alper, & Skoner, 2003) and states that social support reduces physical reactivity to stress, moderates how stressors are evaluated, promotes health, and is protective against stress-related illnesses (Schnall, 2008). Research supports the buffering hypothesis by showing that the presence of social support, even the presence of another person, lessens the stress response when an individual is exposed to a stressor (Harber, Schneider, Everard, & Fisher, 2005).

In regards to the effects of social support on serious illness, studies show that medically treated patients with coronary artery disease, who have low levels of economic and social resources, are at higher-risk of negative health outcomes than patients with similar conditions and higher levels of social and economic resources (Williams, et al.,

1992). Other similar studies show that social support can act as a moderator on depressive symptoms in cardiac patients, and in fact access to social support resources was most effective as a moderator in patients that were the most vulnerable or lacked other coping resources (Barefoot, et al., 2000). These findings suggest the design and implementation of psychosocial resources in health intervention strategies and illness treatment plans.

Perceived social support is strongly associated with lower resting BP, lower basal levels of stress hormones, and higher immune system functioning (Uchino, Cacioppo, & Kiecolt-Glaser). One particular study showed that socially isolated young adults rated daily stressors as more intense than their less socially isolated peers (Cacioppo & Hawkley, 2003). The socially isolated young adults showed greater vascular resistance (a mechanism of BP control and a hypertension risk factor). Their physiological functions were poorer and slower in both maintenance and repair, including sleep efficacy and wound healing.

A non-evaluative and non-directive source of social support amplifies the stress response reduction (Harber, Schneider, Everard, & Fisher, 2005). Additionally, a higher quality and longer-standing relationship between the individual exposed to stress and their companion can more greatly reduce the stress response (Schnall, 2008). For example, a pet's presence reduces cardiovascular reactivity while performing a stressful task (Allen, Blascovich, Tomaka, & Kelsey, 1991), and a supportive friend's presence can help lower the cardiac stress reaction when carrying out difficult mental arithmetic tasks (Kamarck, Manuck, & Jennings, 1990).

The perception of stressors and challenging situations is moderated by social support (Schnall, 2008). People often magnify the negative aspects of stressors and challenges. For example, disturbing objects can seem closer than non-disturbing objects (Matthews & Mackintosh, 2004). Social support can lessen this magnification of stressors and challenges. Two examples from research show that people perceive babies' cries as communicating less distress (Harber, Jussim, Kennedy, Freyberg, & Baum, 2008) and physical pain as less intense with the presence of social support (Brown, Sheffield, Leary, & Robinson, 2003). As stated above, the quality and length of the relationship between the individual exposed by the stressor or challenge and the companion greatly increases social support's moderation effect.

Social support assessments have been used extensively in research in order to measure aspects like the length and quality of friendships (The Regents of the University of California, n.d.). While a variety of instruments exist to assess social support, one best measure does not exist. Researchers believe this is because many different measures and strategies have yielded scores that correlate similarly to various health outcomes. One example of a brief social support assessment would be a yes/no questionnaire used to discover whether or not major types of support, such as emotional support, are available. An example of a more extensive assessment would be a survey that asks about emotional, instrumental, and informational support and quality of support from specific social relationships, such as types of support available from children, friends, and or general support available from "others." To choose an appropriate type of assessment, researchers should consider factors like time available to administer the surveys and if there are questions about the types of relationships important to the study.

Two major limitations for measures of social support are the lack of established, standard measures and the variability of support over time and the difficulty in measuring these variations and their effects on social support and health outcomes (The Regents of the University of California, n.d.). These limitations make cross study comparisons and conclusions based on these a challenge; therefore, little evidence exists to link social support to major physical health outcomes, although strong theoretical backing that such effects exist. Researchers within this area suggest that a more commonly used set of measures would be a positive advance and enable future comparative studies.

In review, the lack of social support, it is theorized, can cause stress levels to rise and increase the severity of negative reactions to stress. The presence of social support as a coping resource can, in turn, help lower stress levels, ameliorate the potential negative effects of stress, and act as an effective psychosocial stress management technique. Also, a number of different social support measures are used in research, but there is no consensus which measure, if any, is most valid. Researchers have found consistent findings across different measures of social support, suggesting that the construct is strong despite the variety of available assessments and is useful in stress and health studies. The social support theory is also summarized in Figure 5 below.

Figure 5 Social Support Theory

In order to test if, in fact, any coping resource can help individuals manage stress or recover from negative effects of stress, researchers must be able to measure stress and its effects. In the following sections, various ways to measure stress and stress reactivity will be discussed.

Measuring Stress

Because stress reactivity and strain manifest in a number of ways, numerous stress measurements exist. The types of measurements depend upon the researcher's academic field and what specific element of stress the researcher is studying. Psychophysiologists often focus on stress reactivity and measure physiological responses such as heart rate variability, blood pressure, the skin's electrical conductance with a galvanometer (also called electrodermal response or galvanic skin response), cortisol levels in saliva, and electromyography (EMG) to monitor muscle tension (Subramanya & Telles, 2009). Cognitive psychologists have developed standard, widely used laboratory tasks to study the effects of stress on cognitive processes such as perception, attention, memory, decision-making, problem-solving, and response execution. For example, there are "attention" tasks or "memory" tasks where attention or memory is revealed while other processes are eliminated or controlled. Clinical psychologists often rely on perceived or self-reported stress scales for psychological, physiological, and behavioral symptoms. For the purposes of this study, the researcher focuses on perceived mood states and perceived muscle tension and discomfort as stress measures. Detailed discussions of these measures follow.

Perception of mood and the POMS.

Within psychology, subjective evaluations are a traditional mode of assessing the role of stress in disease risk (The Regents of the University of California, n.d.). They emphasize the individuals' assessment of their own abilities to cope with specific experiences or events and their affective response to that assessment. Numerous reliable, valid, and respected subjective evaluations of stress exist within psychology, yet perceived stress measures have yet to be developed and tested fully. To measure perceived stress, researchers often use the Perceived Stress Scale, which measures the degree to which an individual will appraise their life situations as stressful rather than their amount of stress in response to a specific stressor (Cohen, Kamarck, & Mermelstein, 1983). It is believed that appraisal of events as threatening leads to the negative affective response that connects behavioral and biological responses. These responses are thought cause vulnerability to illness.

For the purposes of this study, the researcher looks to understand how stress and stressors can affect acute psychological and emotional states. Within the realm of stress research, adjective checklists are commonly used to measure mood (The Regents of the University of California, n.d.). In these procedures, participants are presented with a number of adjectives that describe various moods. They then indicate whether the adjective and respective mood reflects their own present emotional state. Many different adjective checklists exist within psychological research, each including a unique response scale, set of adjectives, and instruction set. Some examples of mood scales used in research are: the 36 adjective Nowlis Mood Adjective Checklist, the 132 adjective

Multiple Affect Adjective Checklist, and the 20 adjective Positive Affect-Negative Affect Schedule.

For this particular study, the researcher will use the Profile of Mood States (POMS). Douglas M. McNair, Maurice Lorr, and Leo F. Droppleman developed the POMS through the 1950s, 1960s, and early 1970s first at the Outpatient Psychotherapy Research Laboratory at the Veterans Administration in Washington, DC and subsequently at Boston University (McNair, 1971). The original scale takes three to seven minutes to complete. It contains an adjective checklist with 65 self-reported items and uses a 5-point Likert Scale where 0 corresponds to "not at all" and 4 corresponds to "extremely." The POMS is broken into are six subscales or *factors* of mood: tension, depression, anger, vigorousness, fatigue, and confusion. There are an equal number of questions per factor, and the questions are asked in a random order in regard to factor. For calculating raw scores, scores for each individual factor are summed; then the cumulative scores for tension, depression, anger, fatigue, and confusion are summed; and finally, the cumulative score for vigorousness is subtracted from the summation of all other factor totals. Calculations for the POMS's internal consistency show a 0.63 to 0.96 Cronbach alpha rating. Subscales and the total score correlation in POMS and POMS-SF was calculated as 0.84.

For the present study, the researcher required a rapid method to assess and monitor fluctuating, active, acute mood states for participants at two time intervals within the study. The POMS provides such an assessment and has been an ideal tool to measure and monitor participant mood state change in clinical, medical, and addiction counseling centers. This sensitivity to change in mood states also makes the POMS a good tool for

clinical drug trials because it allows for accurate measurement of effects of drugs on mood state.

Bracing or muscle tension and the NMQ.

One of the first stress researchers to notice the connection between muscle tension and stress was Dr. Edmund Jacobson (Greenberg, 2009). He noticed that bedridden patients had pronounced muscle tension, called "bracing," despite appearing at rest and lacking physical stressors. He hypothesized that their muscle tension was a function of nerve impulses sent to the muscles and that the tension interfered with the patients' recoveries. Individuals often unnecessarily contract muscles, such as elevating the scapulae (raising the shoulders) while typing or driving, and the muscle readies itself for some action that is seldom taken.

Bracing frequently occurs in response to symbolic stressors, such as a threat to one's self-esteem, as discussed in the introduction, and chronic over tension can lead to a variety of psychosomatic, psychiatric, and musculoskeletal disorders (Greenberg, 2009). Studies have shown that mental stressors can contribute to prolonged muscle tension, even in the absence of physical demands, and that lack of mental rest is an important risk factor in the development of muscle pain (Lundberg, et al., 200). Interestingly, many studies have shown that perceived, self-reported muscle tension, pain, and or discomfort does not correlate strongly with objective measurements of muscle tension, such as EMG readings when the stress is psychosocial (Vasseljen & Westgaard, 1996). Researchers hypothesize that the feeling of muscular tension and or discomfort when exposed to psychosocial or mental stressors is a physiological activation response that may or may not include the activation of muscle fibers, implying that pain provoked by psychosocial

and mental stressors may not be mediated through increased muscle fiber firing. Regardless of the muscle fiber activation, adverse effects, such as MSDs, can result from perceived tension and discomfort, making it an important and valid area of study within the fields of stress and MSD research.

Many perceived muscle tension, discomfort, and pain questionnaires are used frequently in research. Some examples are the commonly used pain scale, where a participant rates their pain from 1 – 10, and the lesser known but frequently used Oswestry Disability Pain Index (ODI), which assesses chronic low back pain (Bridger, 2003). For the purposes of this study, the researcher will use the Nordic Musculoskeletal Questionnaire (NMQ) because it is a rapid, reliable, non-invasive tool to assess perceived muscle pain, tension, and or discomfort. The research can use the NMQ to identify at various time intervals potential changes in muscle tension or "bracing," which, as discussed previously, can increase due to stress and decrease due to relaxation.

The (NMQ) was the result of a project funded by The Nordic Council of Ministers to develop, test, and standardize a method to compare pain and discomfort in various parts of the body for use in epidemiological studies (Crawford, 2010). It has been used extensively in research and applied to a wide range of occupations to analyze musculoskeletal disorders. It is important to note that only a medical examination can diagnose disease; therefore, the NMQ does not establish a clinical diagnosis but rather is used for epidemiological purposes.

The NMQ It is comprised of two sections (Crawford, 2010). Section One is a general questionnaire containing 40 forced-choice questions that identify areas of the body with pain or discomfort. Participants indicate whether they have had pain or

discomfort in the respective area in the last twelve months and last seven days to identify pain symptoms, or feelings of pain. Often, a pain scale is included to find the intensity of the pain symptoms. Participants also indicate if the pain has prevented normal activity in the last seven days to identify pain disability. It includes a body map to indicate nine symptom sites to help the participant locate the following areas: neck, shoulders, upper back, elbows, low back, wrist/hands, hips/thighs, knees, and ankles/feet. Section Two includes an additional 25 forced-choice questions relating to the neck, the shoulders, and lower back. They cover accidents affecting each area, functional impact at home and work, duration of the problem, assessment by a health professional, and musculoskeletal problems in the last 7 days.

Many studies have concluded that the NMQ is a valid, reliable, repeatable, non-invasive, and useful tool to monitor and measure self-reported muscle pain, tension, and discomfort (Crawford, 2010). A test–retest method showed the number of different answers ranged from 0 to 23%. Validity testing comparing the NMQ and patient clinical history showed a range of 0 to 20% disagreement, which the researchers concluded was an acceptable range and deemed the NMQ a valid screening tool. Despite the strength of the NMQ, a number of improvements within the questionnaire have been made, including changing wording, layout and administrative use. A study after the changes compared self-reported pain in the last 7 days and clinical examination. Specificity ranged from 71 and 88% and sensitivity between 66 and 92%. In another study, patients with a range of upper limb disorders completed an NMQ on two occasions one week apart. Reported pain symptoms were highly repeatable and sensitivity scores were 0.90 for cervical

spondylosis, 1.00 for shoulder capsulitis, 0.90 for lateral epicondylitis, 1.00 for carpal tunnel syndrome, and 0.78 for Raynaud's Syndrome.

To reiterate, for the purposes of this study, the researcher chose the NMQ because it is a rapid, reliable, non-invasive tool to assess perceived muscle pain, tension, and or discomfort. The researcher used the NMQ to identify at various time intervals potential changes in muscle tension or "bracing," which, as discussed previously, can increase due to stress and decrease due to relaxation.

Summary of Literature Review

Stress research has grown in importance in the past decades, especially in the areas of the effects of stress on health and performance (Kottler & Chen, 2008). Although researchers may disagree somewhat on the definition of stress, it is generally defined as the results of an imbalance between demands placed upon a person and their perceived resources or coping abilities (Lazarus, 1987). A person experiencing this imbalance can respond physiologically and or psychologically to a perceived stressor, leading to stress reactivity and possibly strain. (Greenberg, 2009). A popular area of research is how stress effects health, and studies have shown that there is an optimal level of stress that encourages an optimal level of health, but too little or too much stress can cause a number of negative health outcomes. A negative health outcome of particular interest is perceived muscle tension that can lead to chronic pain and or MSDs. Various theories exist that address the origins of stress, including the Life Events Theory, the Hardiness Theory, the Transactional Theory, and the Social Support Theory (Chan, Han, & Cheung, 2008). Social Support refers to acceptance, belonging, having people to whom one feels close, having people to confide in and share stressors, difficulties, and joys. It can come

in four main forms: tangible support, emotional support, or informational support, and appraisal support. Because stress can be induced in a variety of ways, it can also be managed in a variety of ways. Psychosocial buffers, such as social support, can help individuals control both stress reactivity and the negative effects and strain that can occur as a result of prolonged stress exposure.

With this study, the researcher focused on the relationship between social support and two elements of stress reactivity: perceived mood states and muscle tension. The researcher aimed to add to the body of knowledge within the area of stress research in three ways. One, this study would help in the development of social support measurements and assessments. Two, the researcher would examine the role social support plays in buffering stress effects after a moderate stressors, and results may suggest that a solution as simple as allowing friendships to develop at workplaces could help reduce the number of employees with stress-related strain, such as MSDs. Third, understanding more about stress buffers may help lead researchers to more deeply understand the underlying causes of stress. Ultimately, researchers in this field aim to understand the causes of stress and eliminate any negative effects that stem from it. In the meantime, stress researchers aim help those suffering from the negative effects of stress feel better.

Hypothesis and Problem Questions

With this study. the researcher proposed to look at the effects of social support on participant perceived mood state and perceived muscle tension. The researcher asked: does social support help lessen the negative effects of stress, namely perceived mood state and perceived muscle tension, following moderate psychological stressors? The

study was a 2x2, mixed (within and between-subjects) design. The two levels of the first independent variable (IV), social support, were alone (A) and pairs (P). The two levels of the second IV, period, were pre-stressor (Pre) and post-stressor (Post). The study predicted:

1. A main effect of social support will exist. Participants in the pairs group will report a more positive mood state and less muscle tension and discomfort than participants in the alone group.
2. A main effect of period will exist. During the pre-stressor period, participants will report a more positive mood state and less muscle tension and discomfort than participants during the post-stressor period.
3. An interaction between period and social support will occur, meaning social support will lessen the effects of the stressor, and participants in the alone, post-stressor group will show the highest negative mood states and muscle tension than all other groups.
4. A positive correlation between length and quality of friendship and perceived positive mood state will exist. Participants in the pairs group with the highest quality friendships will report more positive mood states during both pre and post-stressor periods than participants in the pairs group with the lowest quality of friendships.
5. A negative correlation between length and quality of friendship and perceived muscle tension will occur. Participants in the pairs group with the highest quality friendships will report the lowest perceived muscle tension and discomfort during both pre and post-stressor periods.

6. A correlation for perceived mood will occur. Participants with the most positive perceived mood states pre-stressor will report the most positive perceived mood post-stressor, regardless of condition.
7. A correlation for muscle tension and discomfort will occur. Participants with the lowest reported levels of muscle tension and discomfort pre-stressor will report the lower reported levels of muscle tension and discomfort post-stressor, regardless of condition.

Methods

Participants

A total of 22 male participants ages 18-25 took part in the study (N=22) with eleven participants of interest (n=11) in each level of the social support IV. In addition, there were 11 male participants in the pairs group that were not participants of interest (POIs). Each set of eleven participants were measured twice for the period IV, once pre-stressor and once post-stressor. Participants were instructed to not ingest heart-rate altering substances the day of participation and to not alter their eating, sleep, or caffeine intake habits 48 hours before participation. Refer to Table 1 for more information regarding sample sizes per level of IV and POIs.

Table 1

Sample Sizes per Level of IV and Participants of Interest

		Period
		Pre-Stressor & Post-Stressor
Social Support	Alone (A)	*n*=11
	Pairs (P)	*n*=11
	Friend (not POI)	*n*=11
	Total POI	*N=22*

The researcher recruited participants in and around Embry-Riddle Aeronautical University in Daytona Beach, Florida by posting fliers and sending emails briefly describing the types of participants needed, the general area of study, when and where the study was to be conducted, and how to contact the researcher. To fulfill the pairs condition of the social support IV, participants were asked to volunteer with a male friend, who also met the participant criteria and passed the participant screening. The researcher screened for and excluded from the study people with existing, diagnosed mental health disorders, such as anxiety and depression; existing, diagnosed or self-reported musculoskeletal disorders or chronic pain; and existing, diagnosed health conditions that could put them at risk during stress induction, such as hypertension and high blood pressure. After the screening, the researcher randomly assigned 22 applicants, or eleven pairs of friends, to the pairs group and eleven individual applicants to the alone group.

From the demographics survey, the researcher found that the average participant age was 21.32 (*SD* = 2.03). Reported participant ethnicity showed 68.2% of participants were white, 4.5% were African American, 9.1% were Latino, 13.6% were Asian, and 4.5% reported other. For the academic enrollment information, 9.1% of participants were

not enrolled in school, 9.1% were first year undergraduate students, 22.7% were second year undergraduates, 18.2% were third year undergraduates, 18.2% were fourth year or higher undergraduates, and 22.7% were graduate students. All enrolled students were full-time. Participants worked on average 10.14 (SD = 12.64) hours per week and took part in extracurricular activities on average 9.22 (SD = 6.65) hours per week. Responding on a scale from zero to ten, zero being no stress or not applicable and ten being high stress, participants reported on average their course load stress was 5.18 (SD = 2.19), work related stress was 2.23 (SD = 2.45), stress over the last 24 hours was 2.5 (SD = 2.44), and stress over the last 48 hours was 5.2 (SD = 2.67). Participants also reported that, on average, they only very slightly altered any eating, sleeping, or caffeine intake the day before the study (M = 2.50, SD = 2.58). According to responses from the pre-stressor NMQ, the participants had high musculoskeletal health with few occurrences of disability due to musculoskeletal pain within the past 12 months and low levels of reported pain symptoms within the past 12 and seven months. For frequencies of pain symptoms and disabilities over time, please refer to Table 2.

Table 2

Musculoskeletal Health – Frequencies of Pain Symptoms and Disabilities Over Time

	Disability		Symptom							
	12 Mo.		12 Mo.		7 Mo.		Pre-Stressor		Post-Stressor	
Body Part	No	Yes	No	Yes	No	Yes	*M*	*SD*	*M*	*SD*
Neck	21	1	11	11	11	11	0.59	0.80	1.00	1.02
Shoulders	20	2	12	10	12	10	0.50	0.67	0.77	0.81
Elbows	20	2	18	4	19	3	0.14	0.48	0.09	0.29
Wrists/Hands	22	0	18	4	19	3	0.14	0.48	0.36	0.65
Upper Back	20	2	16	6	15	7	0.50	0.86	0.73	0.83
Lower Back	21	1	15	7	15	7	0.45	0.67	0.73	1.03
Hips/Thighs	22	0	19	3	18	4	0.41	0.96	0.27	0.55
Knees	19	3	12	10	13	9	0.36	0.66	0.18	0.50
Ankles/Feet	19	3	13	9	13	9	0.18	0.50	0.18	0.50
						Total	3.18	3.4	4.32	3.33

Independent Variable 1 – Social Support

To understand the effects of social support on perceived mood states and muscle tension, the researcher separated the participants into two groups, alone (A) and pairs (P). The alone group did not receive social support during the study and went through the entire experiment by themselves. There were a total of eleven (n= 11) participants in the alone group. The participants of interest in the pairs group received social support during the study by going through the experiment with their recruited friend. There were eleven POIs (n= 11) in the pairs group, and eleven friends or non-POIs (n= 11).

Independent Variable 2 – Period

To understand the change in participant perceived mood state and muscle tension over time (or period), researchers measured all participants (N=22) twice, pre-stressor (Pre) and post-stressor (Post). Between the Pre and Post periods, participants were exposed to a mental arithmetic stressor for six minutes. The difference between the Pre,

or baseline, measurement and the Post measurement would show the effect of the stressor on participant perceived mood and muscle tension.

Dependent Variables

The researcher measured participant stress levels by perceived mood states with the POMS and perceived muscle tension with the NMQ. The measures were taken both pre and post-stressor. Those taken at the beginning of the study before the stressor (Pre) were considered the baseline measures. The pre-stressor measures were administered as NMQ first and POMS second, while post-stressor measures were administered as POMS first and NMQ second in order to capture mood immediately before and after the stressor.

Profile of mood states (POMS).

The researcher measured stress reactivity via perceived mood state change with the Profile of Mood States (POMS) (McNair, 1971) before and after the stressor without alteration. (Please see the section regarding measuring stress in the literature review for a full description of the POMS.) To review, the POMS is an adjective checklist, which presents participants with a number of adjectives describing various moods. Participants then indicate whether the adjective and respective mood reflects their own present emotional state. For example, the participant is advised to describe how they feel "right now" by circling one of the numbers listed after each word listed. A scale of 0 – 4 is given, 0 meaning they do not feel this way at all and 4 meaning they feel this way in an extreme manner. Some adjectives listed on the checklist are; friendly, tense, angry, worn out, and un-happy. If a participant felt extremely friendly at the time of filling out the questionnaire, they would circle 4. A copy of the POMS for this study can be found in Appendix F.

Nordic musculoskeletal questionnaire (NMQ).

The researcher used the NMQ to measure stress reactivity via perceived change in muscle tension (Crawford, 2010). (Please see the section regarding measuring stress in the literature review for a full description of the NMQ.) The baseline, or Pre, NMQ included frequency, duration, history, and intensity of current state of muscle tension and discomfort symptoms and possible disabilities. The second, or Post, NMQ will only include intensity of current state of muscle tension and discomfort. A copy of the Pre NMQ can be found in Appendix G and the Post NMQ in Appendix H.

Induced Stress – Mental Arithmetic

Often in stress research, stress must be induced in participants within a laboratory setting (Greenberg, 2009). The stress induced can be physical or mental, and for the purpose of this study, the focus will be placed on mental stress. Nonsocial mental stressors include both active and passive stressors. Active stressors involve the participant in difficult tasks, and passive stressors must simply be endured by the participant.

In this study, the researcher used a mental arithmetic task of serial subtraction, which is a nonsocial, active stressor (Kamarck, Manuck, & Jennings, 1990). It is a widely used and accepted manner of inducing stress in controlled studies, takes only a brief time to administer, and allows for comparison of participant stress levels despite individual differences. Because it is a nonsocial and moderate stressor, it should have permitted the researcher to observe an effect from social support or lack thereof.

Participants were asked to perform serial subtraction by 17s aloud from a four-digit number and told that they were rated on speed and accuracy. After two minutes a new four-digit number was given and participants were told to increase their response

speed. Participants went through this process three times with three different four-digit numbers, making the task last six minutes total. If participants made a mistake in their subtraction, they were instructed to start the serial subtraction over from the given four-digit number. A complete description of the mental arithmetic task used in this study can be found in Appendix I.

Additional Materials

In addition to the questionnaires and surveys listed above, the researcher used a variety of other forms during the study. These are described in detail in the following sections.

Potential participant screening form.

The researcher screened potential participants before accepting them to take part in the study. This form included questions to help the researcher exclude applicants, who were smokers, were taking any mood altering medication or medication that could cause symptoms of anxiety, had any psychological or mood related disorders, had heart problems or high blood pressure, and had musculoskeletal disorders or chronic pain. The Potential Participant Screening Form can be found in Appendix B.

Informed consent.

The researcher used an informed consent form based on the American Psychological Association's standards, procedures, and protocols. A copy of the informed consent form for this study can be found in Appendix C.

Demographics survey.

The researcher administered a demographics survey to collect general information regarding the participants at the beginning of the study. The survey collected specific

information that could have had an effect on measurement outcomes. Examples of the questions include: participant age, year in school (if student), occupation, caffeine consumption, hours of sleep the night before, and exposure to stress or stressors within an hour of the study (such as taking an exam). A copy of the demographics survey for this study can be found in Appendix D.

Length and quality of friendship.

Past social support studies have found that the length and quality of friendship between partners can influence social support's buffering effect (Schnall, 2008), but one, best measure for this phenomenon does not exist (The Regents of the University of California, n.d.). Due to a lack of a commonly used survey on length and quality of friendship within social support research, for this study, the researcher measured the quality and length of friendship with their partner (where applicable) with a survey that includes questions from a prior, similar social support study (Schnall, 2008). Some of these questions were: how long have you known your friend, how frequently do you and your friend interact, rate how you feel about your quality of friendship (1 = poor quality to 5 = high quality), and rate whether you would go to your friend for help (1 = not at all to 5 = absolutely). The researcher calculated a composite score of participant responses to the seven questions, which were worth five points each, making a total possible score of 35 representing the highest quality friendship and 5 being the lowest quality friendship. A copy of the Length and Quality of Friendship form for this study can be found in Appendix E. To test the reliability of the Length and Quality of Friendship Questionnaire, the researcher ran a Cronbach's Alpha. Results of the Cronbach's Alpha show a low internal consistency, $\alpha = 0.542$. This relatively low reliability score is due to the low

number of participants filling out the questionnaire, (n = 11), and small number of questions asked.

Research evaluation.

The researcher measured participant reaction and attitude to the research with a research evaluation survey administered at the end of the study. The research evaluation included questions such as: did they feel comfortable in the laboratory, did they feel comfortable with the researcher, did they feel uncomfortable during the mental arithmetic task, did they feel that the presence of a friend helped buffer their stress reactivity (for participants in the Pairs group), and did they feel having a partner would have helped buffer their stress reactivity (for participants in the Alone group). A copy of the research evaluation is available in Appendix J.

Procedure

The procedure the researcher followed is described here and shown in Figure 6. To begin, the researcher advertised for participants using emails and fliers circulated throughout the Embry-Riddle Aeronautical University campus in Daytona Beach, Florida. For a copy of this flier and email, please refer to Appendix A. Second, the researcher screened applicants and excluded any that were smokers, taking any mood altering medication or medication that could cause symptoms of anxiety, had any psychological or mood related disorders, had heart problems or high blood pressure, and had musculoskeletal disorders or chronic pain. Third, the researcher randomly assigned applicants, who passed the screening, to levels of the social support IV, contacted them via phone or email, and scheduled a time to run the participant and or the pair of participants. The researcher also advised that the participants not consume heart rate

altering medication or alter sleep, eating or caffeine intake habits the day of or the day before participation.

During the data collection phase, participants in the alone group went through the following steps alone. In the pairs group, both participants were treated the same in all parts of the study except the mental math serial subtraction, although only the POI's data was analyzed. Initially, participants entered the first habituation phase, which lasted five minutes, and met the researcher. The researcher then covered the informed consent form with all participants. Participants had to sign the waiver to continue taking part in the study. All participants signed the waiver. The second habituation phase, which lasted five minutes, followed and included filling out the demographics survey and length and quality of friendship survey (pairs only). After habituation, Measures 1 (Baseline) was administered, lasting roughly 10 minutes, and included the Pre POMS, and Pre NMQ. The stressor, mental math serial subtraction, followed the baseline measurements and lasted roughly 10 minutes. For the pairs group, the researcher chose which participant became the POI by flipping a coin. The researcher then instructed the POI on how to carry out the mental math serial subtraction task. The researcher then gave the friend, or non-POI, a dummy task. The friend sat in a chair on the other side of the room from the participant of interest and wrote down all their responses on a sheet of paper. They were not allowed to help their partner with their responses. The friend was informed that their notes were be used for scoring purposes. The actual serial subtraction tasks lasted roughly six minutes, and the participant of interest serially subtracted 17 from a given four-digit number. After two minutes, they were given a new four-digit number. After an additional two minutes, they were given a third four-digit number. After the stressor, Measures 2

were taken, which lasted roughly 5 minutes and included the Post POMS, Post NMQ, and research evaluation. To close the study, researchers took the final five minutes to debrief and release the participants. Complete participation in the study lasted roughly 40 minutes.

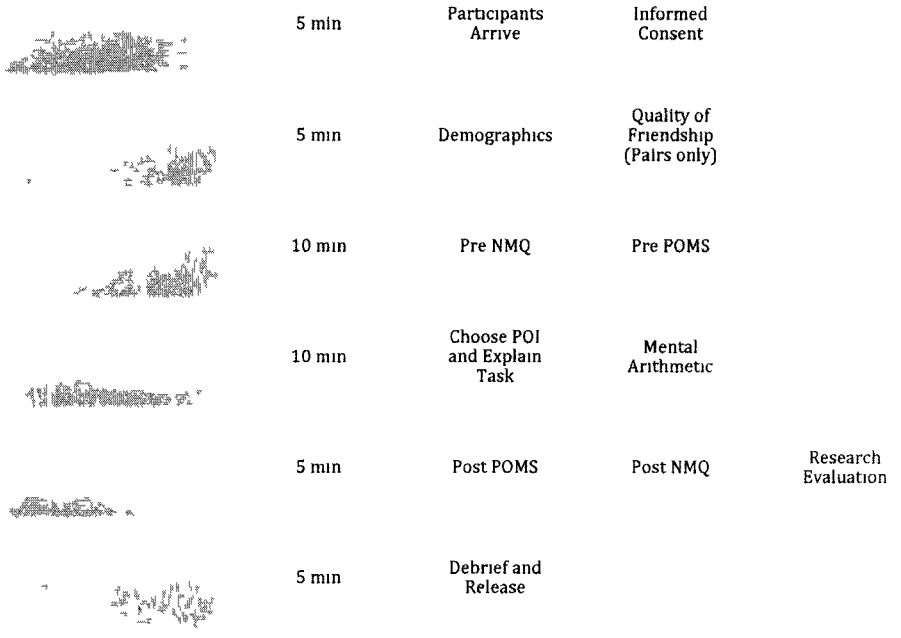

Figure 6 Procedure

Results

To review, the researcher studied the effects of social support on stress reactivity following a moderate psychological stressor by measuring perceived mood state with the POMS and perceived muscle tension with the NMQ pre and post-stressor. For descriptive statistics, please see Tables 3. To analyze data, the researcher entered collected data into SPSS and conducted several statistical analyses, which are listed below.

1. A mixed, between and within subjects, MANOVA was run to find the following:

a. A main effect of social support comparing perceived mood state and perceived muscle tension between participants in the pairs versus alone groups.
b. A main effect of period comparing perceived mood state and perceived muscle tension between participants pre versus post-stressor.
c. An interaction between social support and period on perceived mood state and perceived muscle tension.

2. Change scores were calculated for perceived mood state and perceived muscle tension. The researcher then ran a one-way between subjects MANOVA to analyze the effects of social support on the change in perceived mood state and the change in perceived muscle tension.
3. The researcher ran a Spearman's rank correlation coefficient to find a correlation between the following:
    a. Perceived mood pre and post-stressor.
    b. Perceived muscle tension pre and post-stressor.
    c. Length and quality of friendship and perceived mood state.
    d. Length and quality of friendship and perceived muscle tension.

Table 3

Descriptive Statistics

DV	Social Support	Mean	Standard Deviation	*N*
Mood Pre-Stressor	Alone	10.82	12.08	11
	Pairs	-0.46	6.74	11
	Total	5.18	11.16	22
Mood Post-Stressor	Alone	31.00	17.50	11
	Pairs	16.64	13.79	11
	Total	23.82	17.04	22
Mood Total (Pre + Post)	Alone	20.909	17.944	11
	Pairs	8.091	13.753	11
Muscle Tension Pre-Stressor	Alone	3.36	3.44	11
	Pairs	3.00	3.52	11
	Total	3.18	3.40	22
Muscle Tension Post-Stressor	Alone	4.82	3.43	11
	Pairs	3.82	3.31	11
	Total	4.32	3.33	22
Muscle Tension Total (Pre + Post)	Alone	4.091	3.435	11
	Pairs	3.409	3.362	11

In regards to the first hypothesis, the results of the mixed MANOVA showed a significant main effect of social support, Hotelling's Trace= 0.450, $F(1, 20) = 4.273$, $p = 0.029$, $\eta^2 = 0.31$. The effect size measure, partial eta-squared, suggested that roughly 31% of variance was due to the effect of the IV, social support. Results of the univariate tests showed a significant effect of social support on mood, $F(1, 20) = 8.628$, $p = 0.008$, $\eta^2 = 0.301$, but did not show a significant effect on muscle tension, $F(1, 20) = 0.280$, $p = 0.603$, $\eta^2 = 0.014$. The effect size measure, partial eta-squared, suggested that roughly 30.1% of variance in mood and 1.4% of variance in muscle tension was due to the effect of the IV, social support. For means and standard deviations, please see Table 3. These results will be discussed in detail in the discussion, and for more information regarding these results, please see Table 4.

Table 4

Results Hypothesis One – Main Effect of Social Support

Source	Hotelling's Trace	F	p	η^2	Observed Power
Multivariate	0.450	4.273	0.029	0.310	0.674
Mood	-	8.628	0.008	0.301	0.798
Muscle Tension	-	0.280	0.603	0.014	0.080

In regards to the second hypothesis, the mixed MANOVA showed a significant main effect of period, Hotelling's Trace= 1.423, $F(1, 20) = 13.514, p \leq 0.001$, $\eta^2 = 0.587$. Results of the univariate tests showed a significant effect of period on mood using Greenhouse Geiser estimates, $F(1, 20) = 28.434, p \leq 0.001$, $\eta^2 = 0.587$. As can be seen in Table 3, participants had more positive mood states before the stressor than after. The effect size measure, partial eta-squared, suggested that roughly 58.7% of variance was due to the effect of the IV, period. Results of the univariate tests did not show a significant effect of period on muscle tension $F(1, 20) = 2.727, p = 0.114$, $\eta^2 = 0.120$. The effect size measure, partial eta-squared, suggested that roughly 12% of variance in mood was due to the effect of the IV, period. Because the p value and observed power were relatively low and there was a specific *a priori* hypothesis regarding the effects of period on muscle tension and the directionality of this effect, the researcher ran a one-tailed, paired-sample T-test. The results of the one-tailed, paired samples T-test showed there was not a significant effect of period on muscle tension, $t(21) = -1.683, p = 0.0535$, bu the low p value warrants further investigation. For means and standard deviations, please see Table 3. These results will be discussed in detail in the discussion, and for more information regarding these results, please see Table 5.

Table 5

Results for Hypothesis Two – Main Effect of Period

Source	Hotelling's Trace	F	p	η^2	Observed Power
Multivariate	1.423	13.514	0.000	0.587	0.993
Mood Pre vs. Post	-	28.434	0.000	0.587	0.999
Muscle Tension Pre vs. Post	-	2.727	0.114	0.120	0.349
Source		t	p		
Muscle Tension Pre vs. Post		-1.683	0.0535		

In regards to the third hypothesis, results of the mixed MANOVA showed no significant interaction between social support and period, Wilk's Lambda = 0.985, $F(1, 20) = 0.146, p = 0.865, \eta^2 = 0.015$. The effect size measure, partial eta-squared. suggested that roughly 1.5% of variance was due to the effect of the IVs, social support and period. The researcher noted the difference between means in mood and muscle tension pre-stressor between the alone and pairs groups. To understand more fully these differences between means, the research ran two T-tests to compare: 1) alone group mood pre-stressor versus pairs group mood pre-stressor, and 2) alone group muscle tension pre-stressor versus pairs group muscle tension pre-stressor. Results of the first T-test show that alone group mood pre-stressor was significantly more positive than pairs group mood pre-stressor, $t(20) = 2.702, p = 0.016$. Results of the Levene's Test showed that equal variances can be assumed, $p = 0.033$. Results of the second T-test show that the alone group muscle tension pre-stressor was not significantly different than pairs group muscle tension pre-stressor, $t(20) = 0.245, p = 0.809$. Results of the Levene's Test showed that equal variances cannot be assumed, $p = 0.659$. These results will be discussed in detail in the discussion, and for more information, please see Table 6.

Table 6

Results for Hypothesis Three - an Interaction Between Social Support and Period

Source	Wilk's Lambda	F	p	η^2	Observed Power
Social Support*Period	0.985	0.146	0.865	0.015	0.069

Source	t	p
Mood Pre-Stressor Alone vs. Pairs	2.702	0.016
Muscle Tension Pre-Stressor Alone vs. Pairs	0.245	0.809

In regards to the fourth hypothesis, the researcher calculated change or delta scores for perceived mood state and perceived muscle tension by subtracting pre-stressor scores from post-stressor scores. For a descriptive statistics summary of the change scores, please see Table 7.

Table 7

Descriptive Statistics for Change Scores

		M	SD	N
Change POMS	Alone	20.182	19.605	11
	Pairs	17.091	12.373	11
	Total	18.636	16.076	22
Change Muscle Tension	Alone	1.455	2.876	11
	Pairs	0.818	3.545	11
	Total	1.136	3.167	22

The researcher then ran a one-way between subjects MANOVA to analyze the effects of social support on the change in perceived mood state and the change in perceived muscle tension. Results did not show a significant effect of social support on change scores, Hotelling's Trace = 0.015, $F(1, 20) = 0.146, p = 0.865$, $\eta^2 = 0.015$. The effect size measure, partial eta-squared, suggests that roughly 1.5% of variance is due to

the effect of the IV, social support. These results will be discussed in detail in the discussion, and for more information, please see Table 8.

Table 8

Results for Hypothesis Four - Effects of Social Support on Change in Perceived Mood State and Change in Perceived Muscle Tension

Source	Hotelling's Trace	F	p	η^2	Observed Power
Multivariate	0.015	0.146	0.865	0.015	0.069

The researcher ran correlation analyses for the remaining hypotheses. The results of these analyses have been presented in a correlation matrix in Table 9.

Table 9

Correlation Matrix Reporting Spearman's Rho

	1.	2.	3.	4.	5.	6.
1. Mood Pre-Stressor	-	0.515*	0.336	-0.018	0.238	0.098
2. Mood Post-Stressor		-	0.483*	0.395	0.044	0.429*
3. Muscle Tension Pre-Stressor			-	0.538**	-0.232	0.327
4. Muscle Tension Post-Stressor				-	0.109	0.174
5. Length & Quality of Friendship					-	-0.480
6. Discomfort Mental Math						-

* $p \leq 0.05$, ** $p \leq 0.01$

Note: N = 22 for all calculations except Length & Quality of Friendship, where n = 11.

In regards to the fifth hypothesis, the researcher ran a Spearman's rank correlation coefficient, also called Spearman's rho, which is the appropriate correlation calculation when the data is not normally distributed. Results showed that mood is significantly positively correlated, $\rho = 0.515, p = 0.014$, pre and post-stressor. This suggested that participants in a more positive mood state pre-stressor remained in a more positive mood state post-stressor as compared to participants in a more negative mood state pre and post-stressor. These results will be discussed in detail in the discussion.

In regards to the sixth hypothesis, the results showed that perceived muscle tension is significantly positively correlated pre and post-stressor according to Spearman's rho, $\rho = 0.538, p = 0.010$. This suggested that participants with low muscle tension pre-stressor continued to have low muscle tension post-stressor as compared to participants with high muscle tension pre and post-stressor. These results will be discussed in detail in the discussion.

In regards to the seventh hypothesis, the results showed that there was not a significant correlation between the length and quality of friendship and mood pre-stressor, $\rho = 0.238, p = 0.480$, or post-stressor, $\rho = 0.019, p = 0.937$. This suggested that length and quality of friendship was not related to participant mood state in either period. These results will be discussed in detail in the discussion.

In regards to the eighth hypothesis, the results showed there was not a significant correlation between the length and quality of friendship and perceived muscle tension pre-stressor, $\rho = -0.232, p = 0.492$, or post-stressor, $\rho = 0.079, p = 0.749$. This suggested that length and quality of friendship was not related to muscle tension in either period. These results will be discussed in detail in the discussion.

Responses to the Length and Quality of Friendship Questionnaire are described in Table 10 below. Responses indicate that all participants had only known their friends for roughly one to four years, and yet the quality of these friendships were reported as high. It is important to remember that participants were recruited from a university and were between the ages of 18 – 25. Because participants and their recruited friends attended university together, this created a situation where participants would only have known each other for one to four years yet have developed a quality friendship in that time.

Table 10

Responses to Length and Quality of Friendship Questionnaire

Question	Response Frequency				
How long have you known your friend?	<1 Year	1–2 Yrs	3–4 Yrs	4–5 Yrs	5+Yrs
	45.5%	9.1%	45.5%		
How often do you interact with your friend?	1-2 Days /Wk	3-4 Days /Wk	4-5 Days / Wk	5–6 Days /Wk	Every Day
	18.2%	36.4%		18.2%	27.3%
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Fun				63.6%	36.4%
Reliability			9.1%	45.5%	45.5%
Listen/Give Advice			18.2%	45.5%	36.4%
Perceived High Quality				36.4%	63.6%

In regards to the composite scores and descriptive statistics for this questionnaire, please see Table 11. The results concerning the Length and Quality of Friendship Questionnaire will be discussed in detail in the discussion.

Table 11

Length & Quality of Friendship Cumulative Scores & Descriptive Statistics

n	Minimum	Maximum	Range	Mean	Standard Deviation
11	22.00	33.00	11.00	27.55	2.89

Concerning the research evaluation, the researcher found the following results as shown in Table 12:

Table 12

Research Evaluation Responses

	Response Frequency				
Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Comfort with Location	4.5%			40.9%	54.5%
Comfort with Researcher	4.5%		4.5%	27.3%	63.6%
Presence of a Friend Brings Comfort	18.2%	27.3%	31.8%	9.1%	13.6%
Mental Math Was Unreasonable	27.3%	40.9%	27.3%	4.5%	
Discomfort During Mental Math		18.2%	13.6%	45.5%	22.7%

The researcher also ran a Spearman's rank correlation coefficient to measure the degree of relatedness between perceived mood post-stressor and participant's response to question number five above regarding feeling uncomfortable during the mental math phase. Results showed that there was a significant correlation between perceived mood post-stressor and participant's self-reported discomfort during the mental math phase, $\rho = 0.429$, $p = 0.046$. This correlation acted as a manipulation check and suggested that participants reported similar reactions to the stressor (mental math) in two different measures. These results will be discussed in detail in the discussion.

Discussion

Due to study limitations, the extent to which social support can act as a buffer during a moderate psychological stressor (Greenberg, 2009) cannot be shown; however, results of the study do suggest a more pronounced positive mood state with participants in the pairs group throughout the study. Conclusions regarding the extent to which stress acts as a buffer cannot be drawn from this study for four main reasons: a flaw in the design of the study prevented the researcher from capturing true baseline measures and revealing a

potential interaction, the NMQ lacked the sensitivity needed to reveal a change in participant muscle tension, great variability within participants made it challenging to discern the treatment effect statistically, and a low number of participants reduced power. These difficulties and limitations, as well as the results of the study, will be described in detail below.

In regards to the first hypothesis, the results showed that participants in the pairs group were in more positive moods than participants in the alone group regardless of whether their mood was considered before or after the stressor. Many of the participants in the pairs groups interacted with their friends for quite a few minutes directly before taking part in the study, and all participants in the pairs group were present in the lab with their friend during the pre-stressor phases, potentially allowing the social support to begin affecting participants before the stressor began. This makes it difficult to interpret results to discern if social support acted as a buffer to the stress induced by mental math.

This challenge appears to be a design issue rather than a threat to the validity of the central thesis. A suggested re-design for a future version of this study would be to schedule the participant of interest in the pairs group to arrive ten to fifteen minutes earlier than their friend. During this time, they would fill out the initial surveys and be instructed on the mental math task. The friend would only be introduced into the experiment right before the stressor was carried out. The researcher predicts that this would create a situation where mood would be more similar between the pair and alone groups before the stressor, as the pairs group would not be exposed to the potentially buffering effects of social support until the stressor phase of the study.

An additional issue is the standard deviation for mood in both the alone and pairs groups is very high. This indicated a great amount of variation amongst participants, which again made it difficult to discern if the variation between groups after the stressor resulted from the manipulation or individual variation. For future studies, it is suggested that the habituation phase should be extended and perhaps include some type of activity or exposure that could regulate all participants' moods before taking baseline measurements.

Researchers did not find an effect of social support on perceived muscle tension pre or post-stressor. These results do not definitively suggest that a moderate psychological stressor does not induce muscle tension; rather, a number of other factors could have affected the efficacy of the measure to capture a change of state in participants. First, the NMQ may not have been a sensitive enough measure for the particular age group and health status of participants, who were young and healthy and who may not react quite as strongly to stress in terms of muscle tension as compared to an older or less healthy group of participants. Second, the participants were not recruited based on body awareness abilities, but using this measure with a population with high body awareness, such as athletes, may be sensitive enough to detect subtle changes in their muscle tension. The NMQ was originally developed for epidemiological and clinical purposes, and the researcher did not find literature to suggest modifications or changes to apply the NMQ in this type of experiment (Crawford, 2010). Results of the T-test comparing muscle tension in the pre-stressor period versus the post-stressor period suggest that the NMQ may be a useful, practical, non-invasive, self-reported measure for acute changes in muscle tension, but more research to properly modify the NMQ for use in experimental

settings is needed. Additionally, the stressor, mental math serial subtraction, only lasted six minutes and is a moderate stressor (Kamarck, Manuck, & Jennings, 1990). It may not have been strong enough or lasted long enough to create neuromuscular reactivity.

In regards to the second hypothesis, results indicated an effect of period on perceived mood. This suggests that the stressor did work to induce stress reactivity in participants, as all participants showed a decrease in positive and increase in negative mood state post-stressor. An effect of period on perceived muscle tension was not found due to the issues raised previously about the lack of sensitivity and appropriateness of the NMQ for measuring muscle-tension with the particular population being studied.

In regards to the third hypothesis, the researchers did not find an interaction between social support and period on perceived mood or perceived muscle tension. This suggests that participants in the pairs group did not receive a greater buffer against stress reactivity due to the presence of a friend post-stressor versus participants in the alone group. In regards to the fourth hypothesis, the researcher did not find a significant effect of social support on change in perceived mood or change in perceived muscle tension. The lack of significant interaction and significant difference between change scores may stem from the issues raised above regarding the flaw in the study design. Because participants in the pairs group were exposed to the social support condition before baseline measures were captured, their pre-stressor mood states already reflected the effects of the condition. The researcher predicts that if participant mood states were captured before exposure to social support, both alone and pairs would show statistically similar states, and a significant interaction and difference in change scores would be found. Despite the lack of a true baseline, there is a trend in the mean difference scores that suggests negative mood

increased more for participants in the alone group than the pairs group post-stressor. The mean difference between alone and pairs pre-stressor was 10.36, while the mean difference between alone and pairs post-stressor was 14.36. If two other limitations of the study previously mentioned, relatively low power and high within groups variability, were corrected, this change in mean difference may have been detected statistically with a significant interaction and difference in change scores even without controlling for exposure to social support in the pairs group pre-stressor.

In regards to the fifth and sixth hypotheses, the researcher found a positive relationship between perceived mood pre and post-stressor, as well as perceived muscle tension pre and post-stressor. The results suggest that participants in a more positive mood state pre-stressor will end in a more positive mood state post-stressor as compared to those beginning in a bad mood. They also suggest that participants with low muscle tension pre-stressor will end with low muscle tension post-stressor as compared to those beginning with high muscle tension.

In regards to the seventh and eight hypotheses, the researcher found no relationship between the length and quality of friendship and mood or muscle tension pre-stressor or post-stressor. These results suggest that the length and quality of friendship in the pairs group does not influence participant mood before or after the stressor or perceived muscle tension before or after the stressor. These results should not definitively define the impact that length and quality of friendship could have in terms of acting as a buffer against stress reactivity, but rather an indicator that there was little variation in the length and quality of the friendships amongst participants in the pairs group. The mean score for length and quality of friendship was 27.55 out of a possible 35 points with a standard

deviation of 2.89, showing statistically that there was not ample variation in length and quality of friendship to discern if that could affect stress reactivity in participants. For future studies, one possible addition would be to vary the length and quality of friendship amongst groups, or even possibly creating a group where participants are paired with a "friend" that they have just met for purposes of the study. In these examples, the true effects of length and quality of friendship on stress reactivity during a moderate psychological stressor could be uncovered. What the means and standard deviations do show, however, is that all participants had similar relationships with their friends, or, to state another way, were exposed to equivalent social support conditions.

As mentioned previously, the reliability analysis of the Length and Quality of Friendship Questionnaire showed a low internal consistency, but this low internal consistency stems from the fact that there were relatively few questions on the questionnaire and very low power, with only 11 participants of interest in the pairs group responding, making the results of the reliability analysis imprecise. Suggestions for future studies or questionnaires of this sort should include more participants and more questions concerning length and quality of friendship to improve the reliability analysis results.

Concerning the research evaluation, the researcher ran a correlation analysis to measure the degree of relatedness between perceived mood post-stressor and participant's response regarding feeling uncomfortable during the mental math phase. Results show that there is a significant relationship between perceived negative mood post-stressor and participant's reported discomfort during the mental math phase. This suggests that participants were consistent across two self-reported measures that analyzed their perceived mood state about and directly following the stressor.

To summarize the limitations of the study, there existed a design flaw resulting in pre-stressor differences in mood across conditions, an insensitive measure for muscle tension, high standard deviations, a small sample size, and too few questions on some of the surveys. In regards to the design flaw, participants in the pairs group were in a significantly better mood than those in the alone group, which could suggest that participants in the pairs group were able to benefit from the buffering effects of social support before the study even began. Future studies of this type should capture baseline measures for participants of interest before being exposed to social support to prevent this from occurring. In regards to the measure, the NMQ was potentially insensitive and could not detect subtle differences in perceived muscle tension for participants. For future studies, this measure may be sensitive enough and appropriate for more body-aware populations, such as athletes, or older and or less healthy populations than those taking part in the present study. In regards to pre-stressor differences in mood, the standard deviation for the POMS was high, suggesting that the participants varied greatly individually. Acute mood states are highly variable and individual in general, and to control for this in future studies, allowing for a lengthier habituation phase and making all pre-stressor conditions exactly the same for all participants may reduce this variability. In regards to sample size, future studies should run more than 11 participants ($n = 11$) per condition for more powerful and accurate statistical analyses. Finally, in regards to internal consistency, all questionnaires should have enough questions listed to run an accurate reliability analysis.

Despite these limitations and their affects on the statistical analyses, results do show that participants with social support were in a better mood throughout the study as

compared to participants without social support. Additionally, all participants were in a significantly worse mood post-stressor, suggesting that the stressor was successful in inducing stress. Significant correlations between mood and muscle tension pre and post-stressor were found, and a manipulation check shows a significant correlation between self-reported discomfort during mental math and mood state post stressor.

Conclusions

Understanding the effects of stress on human health and performance continues to be an important area of study (Hawkley, Bernston, Engeland, Marucha, & al, 2005). Often, researchers look at the effects of psychosocial issues, such as social support (Schnall, 2008), on stress reactivity and the negative effects of elevated stress levels, either acutely (Kamarck, Manuck, & Jennings, 1990) or over long periods of time (Hawkley, Bernston, Engeland, Marucha, & al, 2005). Models, such as the demand-control imbalance model, attempt to predict how psychosocial hazards may lead to stress-related strain (Karasek, 1990). This model states that that when life demands are high and an individual has little control over their life, stress-related strain results, and that social support can act as a buffer to lessen stress-related strain resulting from a demand-control imbalance.

Research shows that stress-related strain can often lead to chronic pain and musculoskeletal disorders (MSDs) (Bridger, 2003). Studies show that there is a correlation between stress and MSDs, but the exact relationship is still a vague area within the greater field of stress research. Because of the links between social support and stress reactivity and strain reduction, studies have explored the potential buffering effects of social support to reduce stress-related strain (Small, et al., 2006). Results of the current

study are inconclusive in this area due to the lack of sensitivity in the measure used to capture muscle tension. Past studies suggest incorporating social support into stress management and MSD prevention programs to increase their efficacy the development of strong social ties through the physical layout and workflow design of workplaces to help reduce stress levels of employees (Bridger, 2003). To reiterate, past research shows that people, who work with friends and who develop friendships at work, have lower stress levels and less instances of stress-related strain, such as MSDs. Conclusions about the link between the buffering effects of social support and stress-related muscle tension that could potentially develop into MSDs or chronic pain cannot be draw from the present study's results due to a lack of sensitivity in the muscle tension measure.

This study's purpose was to analyze the possible buffering effects of social support to mitigate stress reactivity, as measured by perceived mood state and perceived muscle tension, following a moderate psychological stressors. Due study limitations, the extent to which social support can act as a buffer during a moderate psychological stressor cannot be shown. For future studies similar to the present one, the researcher suggests capturing baseline measures for all participants of interest before exposure to social support; extending and standardizing the habituation phase to regulate participants' states before capturing a baseline; using a more sensitive measure than the NMQ, testing a more body aware population (e.g. athletes), testing a more sensitive population (e.g. elderly or chronic pain sufferers), modifying the NMQ to measure acute changes in muscle tension in experimental studies, or increasing the length and or intensity of the stressor to induce neuromuscular reactivity; increasing the sample size; and to include

enough questions and participant responses on surveys to conduct accurate reliability analyses when needed.

Results of this study suggest that the presence of a friend before, during, and after a stressful situation does allow an individual to remain in a more positive mood state. Stress management programs would benefit from including social support in their design, and workplaces and other organizations could reduce overall stress reactivity for members of the group if they allow members to develop friendships and a social support network.

In regards to adding to the overall body of stress and social support research, this study only offers a small amount of helpful information. The most meaningful bit of information regarding stress and social support from this study is that both are very difficult to isolate, capture, and study in a laboratory experiment aiming for high internal validity. Stress, social support, perceived mood, and perceived muscle tension are all highly unique to the individual in terms of how one perceives, interprets, applies meaning to, and communicates their experience. This vast amount of individual variability makes understanding the relationship between these four factors difficult to explain statistically; yet, the more opportunities researchers have to study these phenomena, the closer they will come to creating more accurate measures and experimental designs to uncover the true causes of stress and understand the mechanisms behind buffers to stress reactivity. In the meantime, results of this study suggest that having a friend close at hand before, during, and after stressful events can be help individuals remain in more positive mood states than if they experienced the stressful event alone.

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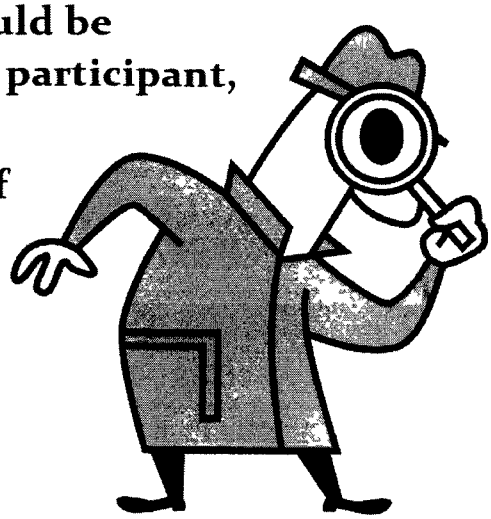
Appendix A – Participant Recruitment Flyers

Research Participants Needed!

Males 18-24 Years of Age...

- Want to win $100? (Odds are 1 out of 30 – you'll probably win!)
- Interested in finding out how smart you are?
- Interested in finding out how calm and collected you can be under pressure?
- Do you have a friend, who would be interested in being a research participant, too?
- If you answered "yes" to any of these questions, please contact Ashley Karr at hfresearch2011@gmail.com or call 404.754.2057.



Appendix B – Potential Participant Screening Form

1. Participant Screening Form

* 1. Participant ID.

* 2. What is your gender?

○ Male ○ Female

* 3. What is your age?

* 4. Do you use tobacco products (i.e. cigarettes, chewing tobacco, etc.) more than once a week most weeks of the year?

○ Yes ○ No

* 5. Have you recently experienced any trauma or a traumatic event?

○ Yes ○ No

* 6. Currently, do you have psychological or mood related disorders, such as depression or anxiety?

○ Yes ○ No

* 7. Do you have any heart conditions or high blood pressure?

○ Yes ○ No

* 8. Do you take any medication that can alter any of the following: heart rate, blood pressure, reactivity to stress, mood, or psychological state?

○ Yes ○ No

* 9. Do you suffer from chronic pain or any musculoskeletal disorders?

○ Yes ○ No

* 10. Are you currently injured?

○ Yes ○ No

Appendix C – Informed Consent

1. INFORMED CONSENT

INFORMED CONSENT TO BE A RESEARCH SUBJECT

RESEARCH PROJECT
Understanding reactivity to mental tasks

PURPOSE OF THE STUDY
The purpose of the proposed research is to explore the effects of psychosocial factors on reactivity resulting from mental tasks.

Ashley Karr, a graduate student in Human Factors and Systems at Embry-Riddle Aeronautical University, will conduct this study. You were selected to participate based upon your response to recruitment flyers and or emails, a participant screening form, and health status.

PROCEDURES
Your participation in this research will involve one meeting with the researcher for approximately 20 minutes. During this time you will complete surveys and carry out a simple arithmetic task. The research session will be completed at Embry-Riddle Aeronautical University.

RISKS
Time commitment for participants will be approximately 20 minutes, and this will be a sacrifice of time that will require schedule adaptation from daily routines. Any fears regarding the confidentiality of information will be respected and diligent efforts will be undertaken to maintain confidentiality as explained below. The only foreseeable risk will be a temporary increase in stress levels. However, the cumulative amount of time you will experience an increased stress levels is minimal, and the overall impact on your physical and mental health should be negligible.

BENEFITS
Participants in the research will be provided with access to an executive summary of the research findings following the completion of the thesis research. Participants completing the study will also be entered into a raffle to win $100 gift card.

CONFIDENTIALITY
Your identity, and those of individuals you identify, will remain confidential and will not be revealed in published or unpublished results of this study. For the purposes of the study, in order to protect your privacy, the researchers will use an ID code rather than your name. All recorded data will be transcribed using these codes, and a separate key will be created which links and identifies you and your type of participation in this study. This key will be kept in a separate secure location from the actual data. Only the principal investigator will have access to this key and the original data. The researcher will be under nondisclosure obligations. Any illustrations or diagrams will use code names or be reported in aggregate form in order to preserve the confidentiality of your identity and information. Every effort will be made to ensure confidentiality for you.

WITHDRAWAL
Participation in this research is voluntary. You may, at your discretion, refuse to answer any questions or refuse to participate in any portion of the study. In addition, you may choose to withdraw from this study at any time without any penalty by verbally stating your intentions to the researcher.

CONCERNS
If you have any concerns or questions at any time during this study, you may reach the principal investigator, Ashley Karr, at (404) 754-2057. You may also call Dr. Elizabeth Blickensderfer at (386) 323-8066 or Dr. Albert Boquet, Chair of the Institutional Review Board, Embry-Riddle Aeronautical University, Daytona Beach, Florida 32114, phone, (386) 226-7035, to discuss concerns that cannot be directly discussed with the principal investigator or your rights as a participant in research projects.

* 1. Participant Name (Printed)

* 2. Participant Signature

Sign

Date

Appendix D – Demographic Survey

1. Demographics

* 1. Participant ID

* 2. Age

* 3. Ethnicity

- ◯ White / Caucasian
- ◯ African American
- ◯ Latino / Hispanic
- ◯ Asian
- ◯ Middle Eastern
- ◯ Multiracial
- ◯ Other / No Comment

* 4. Marital Status

- ◯ Single
- ◯ In a committed relationship
- ◯ Married
- ◯ Separated
- ◯ Divorced
- ◯ Widowed

* 5. Highest Level of Education COMPLETED

- ◯ GED
- ◯ High School
- ◯ Associate's Degree
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate Degree

* 6. CURRENT level of education

- ◯ Not a Student
- ◯ Undergraduate (1st Year)
- ◯ Undergraduate (2nd Year)
- ◯ Undergraduate (3rd Year)
- ◯ Undergraduate (4th+ Year)
- ◯ Graduate Student (Master's or PhD)

* 7. Are you CURRENTLY enrolled?

- ◯ Yes
- ◯ No

* 8. Type of student

- ◯ Part time
- ◯ Full time
- ◯ Not Applicable

* 9. Type of Degree Currently PURSUING

- ◯ GED
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate Degree
- ◯ Not Applicable

* 10. How stressful is your course load?
(1= Not at All Stressful; 5 = Somewhat Stressful; 10 = Extremely Stressful)

◯ N/A ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

* 11. Number of hours worked per week on average. Enter "0" if not employed.
Example: Enter "15.5" if you work 15.5 hours per week on average.

[ ]

* 12. On a scale of 1-10, how stressful is your job?
(1= Not at All Stressful; 5 = Somewhat Stressful; 10 = Extremely Stressful)

◯ N/A ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5 ◯ 6 ◯ 7 ◯ 8 ◯ 9 ◯ 10

* 13. Number of hours on average spent in extracurricular activities (i.e. student groups, clubs, regularly organized activities). Enter "0" if not involved in any such activities. Example: Enter "15.5" if you spend on average a cumulative of 15.5 hours per week in extracurricular activities.

* 14. Rate the questions below on a scale of 1 to 10

	Not At All	2	3	4	Somewhat	6	7	8	9	Extremely
Did you alter your caffeine intake over the last 48 hours?	○	○	○	○	○	○	○	○	○	○
Did you alter your sleep patterns over the last 48 hours?	○	○	○	○	○	○	○	○	○	○
Did you alter your eating habits over the last 48 hours?	○	○	○	○	○	○	○	○	○	○
How stressful was your last hour before coming here?	○	○	○	○	○	○	○	○	○	○
How stressful was your last 48 hours?	○	○	○	○	○	○	○	○	○	○

Appendix E – Length & Quality of Friendship

1. Quality of Friendship

* 1. Participant ID

* 2. How long have you known your friend?

Less Than 1 Year | 1 - 2 Years | 3 - 4 Years | 4 - 5 Years | More Than 5 Years

* 3. How often do you and your friend communicate (electronically and or face-to-face)?

Every Few Weeks | 1 - 2 Times / Week | 3 - 4 Times / Week | 5 - 6 Times / Week | Everyday

* 4. How often do you and your friend spend time together?

Every Few Weeks | 1 - 2 Times / Week | 3 - 4 Times / Week | 5 - 6 Times / Week | Every Day

* 5. When my friend and I hang out, I have fun.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 6. I can rely on my friend when I need help.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 7. I know my friend will listen to me and offer good advice when I need someone to talk to.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 8. I consider this friendship of very high quality.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

Appendix F – Profile of Mood States (POMS)

1. POMS

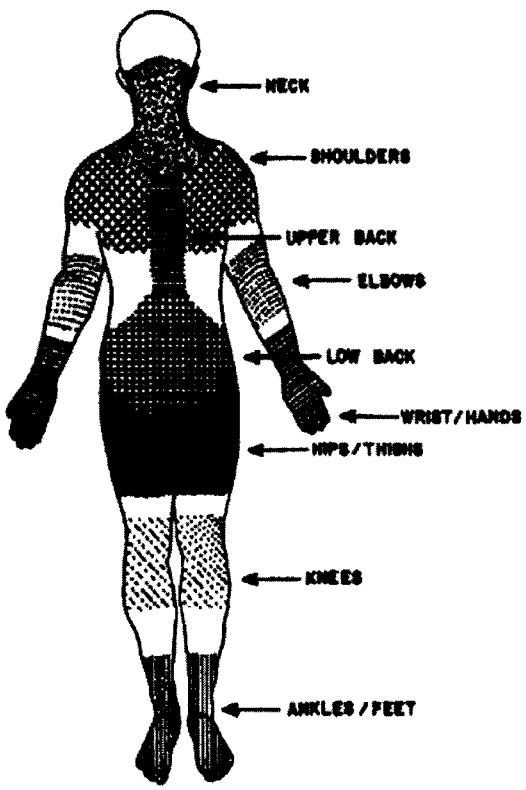
1. Participant ID

2. Below is a list of words that describe feelings that people have. Please read each word carefully. Then circle the number that best describes how you feel RIGHT NOW

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

Appendix G – Pre Nordic Musculoskeletal Questionnaire (NMQ)

Instructions: Answer the questions to the best of your ability and as honestly as possible In the muscle tension & discomfort scales listed below, 0 is no tension or discomfort and 4 is extreme tension or discomfort. Refer to the picture below to identify areas of the body.



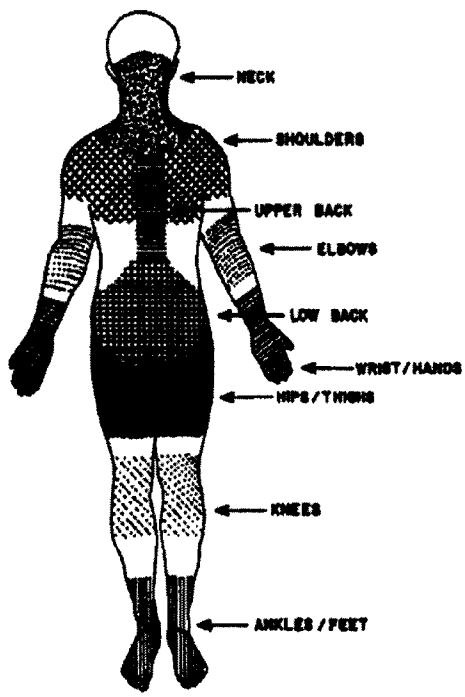
Have you had muscle tension or discomfort in the last 12 months?	**Have you had muscle tension or discomfort in the last 7 months?**	**Has the tension or discomfort prevented you from carrying out normal activities in the past 12 months?**	**Right now, how much tension and or discomfort do you feel?**
1. Neck: qNo qYes	2. Neck: qNo qYes	3. Neck: qNo qYes	4. Neck: None Moderate Extreme 0 1 2 3 4

5. Shoulders: qNo qYes *Right* qYes *Left* qYes *Both*	6. Shoulders: qNo qYes *Right* qYes *Left* qYes *Both*	7. Shoulders (both/either): qNo qYes	8. Shoulders (both/either): None Moderate Extreme 0 1 2 3 4
9. Elbows: qNo qYes *Right* qYes *Left* qYes *Both*	10. Elbows: qNo qYes *Right* qYes *Left* qYes *Both*	11. Elbows (both/either): qNo qYes	12. Elbows (both/elbows) None Moderate Extreme 0 1 2 3 4
13. Wrist/Hands: qNo qYes *Right* qYes *Left* qYes *Both*	14. Wrist/Hands: qNo qYes *Right* qYes *Left* qYes *Both*	15. Wrist/Hands (both/either): qNo qYes	16. Wrist/Hands (both/either): None Moderate Extreme 0 1 2 3 4
17. Upper Back: qNo qYes	18. Upper Back: qNo qYes	19. Upper Back: qNo qYes	20. Upper Back: None Moderate Extreme 0 1 2 3 4
21. Lower Back: qNo qYes	22. Lower Back: qNo qYes	23. Lower Back: qNo qYes	24. Lower Back: None Moderate Extreme 0 1 2 3 4
25. Hip/Thigh Area: qNo qYes *Right* qYes *Left* qYes *Both*	26. Hip/Thigh Area: qNo qYes *Right* qYes *Left* qYes *Both*	27. Hip/Thigh Area (both/either): qNo qYes	28. Hip/Thigh Area (both/either): None Moderate Extreme 0 1 2 3 4
29. Knees: qNo qYes *Right* qYes *Left*	30. Knees: qNo qYes *Right* qYes *Left*	31. Knees (both/either): qNo qYes	32. Knees (both/either): None Moderate Extreme 0 1 2 3 4

qYes *Both*	qYes *Both*		
33. Ankles/Feet: qNo qYes *Right* qYes *Left* qYes *Both*	34. Ankles/Feet: qNo qYes *Right* qYes *Left* qYes *Both*	35. Ankles/Feet (both/either): qNo qYes	36. Ankles/Feet (both/either): None Moderate Extreme 0 1 2 3 4

Appendix H – Post Nordic Musculoskeletal Questionnaire (NMQ)

Instructions: Answer the questions to the best of your ability and as honestly as possible In the muscle tension & discomfort scales listed below, 0 is no tension or discomfort and 4 is extreme tension or discomfort. Refer to the picture below to identify areas of the body.



1. How much tension and or discomfort do you feel in the neck RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

2. How much tension and or discomfort do you feel in the shoulders (bother/either) RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

3. How much tension and or discomfort do you feel in the elbows RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

4. How much tension and or discomfort do you feel in the wrists/hands RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

5. How much tension and or discomfort do you feel in the upper back RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

6. How much tension and or discomfort do you feel in the lower back RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

7. How much tension and or discomfort do you feel in the hips/thighs area RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

8. How much tension and or discomfort do you feel in the knees RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

9. How much tension and or discomfort do you feel in the feet/ankles RIGHT NOW?

None		Moderate		Extreme
0	1	2	3	4

Appendix I – Mental Arithmetic Stressor

This is a serial subtraction exercise. I will give you a four-digit number, such as 1111. When I start the timer, you must subtract 17 from that number and continue subtracting 17 from each answer given. For example, you would say, "1111, 1094, 1077, 1060, 1043, etc." You will be scored and evaluated on your speed and accuracy. If you make an error, you will be told to stop and begin again from the given four-digit number. For example, if you said, "1111, 1094, 1077, 1060, 1053," you would be told to stop, and you would have to begin again from 1111. After two minutes, you will be given a new four-digit number to begin your serial subtraction by 17. You must increase your speed and accuracy. After another two minutes, a third and final four-digit number will be given. You must again increase your speed and accuracy. After a total of six minutes have passed, the exercise will be over. (**For pairs only:** Your partner is not allowed to help you do the serial subtraction. They have been provided with a notepad and pencil. They must write down everything that you say. We will use their sheet to aid in scoring and evaluating your performance.) Do you have any questions? Do you understand what is expected of you? Then let's begin.

Number	**Speed**	**Accuracy**	**Number**	**Speed**	**Accuracy**	**Number**	**Speed**	**Accuracy**
8547			**3572**			**5621**		
8530			3555			5604		
8513			3538			5587		
8496			3521			5570		
8479			3504			5553		
8462			3487			5536		
8445			3470			5519		
8428			3453			5502		
8411			3436			5485		
8394			3419			5468		
8377			3402			5451		
8360			3385			5434		
8343			3368			5417		
8326			3351			5400		
8309			3334			5383		
8292			3317			5366		
8275			3300			5349		
8258			3283			5332		
8241			3266			5315		
8224			3249			5298		
8207			3232			5281		
8190			3215			5264		

Appendix J – Research Evaluation

1. Research Evaluation

* 1. Participant ID

* 2. I felt comfortable with the researcher when I first arrived, filled out paperwork, and after the mental math phase. (This does not include the mental math phase.)

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 3. In general, I felt comfortable with the location of the study.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 4. I felt uncomfortable during the mental math phase.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 5. I think that what was required of research participants during the mental math phase was unreasonable.

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree

* 6. Having a close friend go through the study with me, especially the mental math phase, would make me more comfortable than if I had gone through the study alone

Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree