THE EFFECTS OF RESISTANCE TRAINING ON EMOTION REGULATION AND HEMODYNAMIC PARAMETERS IN RESPONSE TO A STRESSFUL TASK

by

Danielle Adora Sterner

A thesis submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Master of Science in
Applied Exercise Physiology

Charlotte

2022

Approved by:

____
Dr. David Bellar

____
Dr. Susan Arthur

____
Dr. Michael J. McDermott

ABSTRACT

DANIELLE STERNER. The Effects of Resistance Training On Emotion Regulation And Hemodynamic Parameters In Response To A Stressful Task
(Under The Direction of DR. DAVID BELLAR)

Physical exercise is associated with improvements in mental health, potentially through enhanced emotion regulation (ER). However, the mechanisms that account for these relations remain unclear and no studies have examined the effect of resistance training on ER. **PURPOSE:** The purpose of the investigation is to determine the effects of resistance and flexibility training on ER and hemodynamic parameters in response to a stressful task. **METHODS:** The study consisted of a two-group pretest, posttest design with random assignment to group. Subjects (mean age = 19, male = 19%, female = 87%) were randomly assigned to the treatment group (resistance training, n = 12) or control group (stretching, n = 11) for a 10-week training intervention. Maximum strength and flexibility assessments were performed at baseline, at the midpoint of the training, and after the intervention. Subjects completed an emotionally challenging task, the Paced Auditory Serial Addition Test (PASAT-C), prior to and after the training intervention. A noninvasive finger cuff blood pressure system (NIBP) was used to monitor hemodynamic responses during the PASAT-C. Pre and post-PASAT-C affect and ER were assessed via the Positive and Negative Affect Scale (PANAS) and State-Based Difficulties in Emotion Regulation Scale (S-DERS). Data were analyzed via repeated measures ANOVA for group (resistance, flexibility), day (initial, final lab visit), and time (pre-, post-PASAT). **RESULTS:** The strength training group increased significantly in 1 RM maximums across the lifts performed (F=6.88, $p<0.01$ baseline: 223±96kg, midpoint: 345±105kg, final: 376±119kg. The flexibility group trended towards increased flexibility across all measures (F=2.47, $p=0.10$ baseline: 162.4±25.2cm, midpoint: 177.3±22.5cm, final: 184.3±23.3cm). Analysis of positive affect scores revealed a significant main effect of time

($F=13.43$, $p<0.01$), but no significant effects of group or interactions. Analysis of negative affect revealed significant effects of group ($F= 5.53$, $p= 0.02$) and time ($F= 6.37$, $p=0.02$), but no significant interaction effects. Analysis of S-DERS data revealed significant effects of time for Nonacceptance ($F= 10.86$, $p<0.01$), Modulate ($F= 8.50$, $p<0.01$), Awareness ($F= 5.85$, $p=0.02$) and Clarity ($F= 8.2$, $p<0.01$). All post-PASAT-C DERS values were higher than at Pre. Similarly, significant main effects of time were found for both heart rate ($F= 17.71$, $p<0.01$) and systolic blood pressure ($F= 50.08$, $p<0.01$) which were greater post-PASAT-C. **CONCLUSION:** Although the PASAT-C produced significant increases in hemodynamic and difficulties with ER, neither resistance nor flexibility training affected responses across time points. **PRACTICAL APPLICATIONS:** Practitioners should be aware that programming resistance and flexibility exercises can convey health or performance-related benefits but may not affect emotion regulation or physiological responses to stressors. Practitioners interested in programming training to influence emotion regulation or physiological responses to stressors are encouraged to use aerobic exercise, which has demonstrated efficacy in these areas.

ACKNOWLEDGEMENTS

I would first like to thank my advisor, Dr. David Bellar, who made this entire research study possible. His knowledge, guidance, and advice carried me through all the stages of completing my thesis; from aiding in coming up with a research topic, procedures, study design, data analysis, and through all the stages of writing this document. Thank you for challenging me and pushing me to learn and grow to become a better researcher over the last 2 years. I would also like to thank my committee members, Dr. Susan Arthur and Dr. Michael J McDermott, for their expertise and knowledge helping to elevate my study. Thank you all for making my first research study run as smooth as possible.

The completion of this study would not have been accomplished without the help of my research assistants. Thank you, Adam, Alexis, Kathy, Paige, and Carrigan for the countless hours you all put into carrying out the research procedures with diligence and enthusiasm. Finally, I'd like to thank my family, friends, colleagues, and faculty for their support and encouragement during the challenges and celebrations throughout completing the study. Everyone's continuous support and understanding has made this experience one to remember.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACTH	adrenocorticotropic hormone
AT	aerobic training
EM	emotion regulation
BB	barbell
BPM	beats per minute
CNS	central nervous system
DAPRE	daily adjustable progressive resistive exercise
DBP	diastolic blood pressure
DB	dumbbell
FT	flexibility training
HR	heart rate
HRV	heart rate variability
HPA	hypothalamic-pituitary-adrenal
IGF-1	insulin like growth factor 1
MDD	major depressive disorder
NIBP	noninvasive blood pressure
PANAS	positive and negative affect scale
PAR-Q	physical activity readiness questionnaire
PASAT-C	modified computerized paced auditory serial addition test
PNS	peripheral nervous system
PSS	perceived stress scale
RM	repetition maximum

RT	resistance training
S-DERS	state-based difficulties in emotion regulation scale
SBP	systolic blood pressure
SEES	subjective exercise experience scale
TSST	trier social stress test

CHAPTER 1: INTRODUCTION

Expressing emotion is a common response to stress. The ability to manage emotion responses is influenced by cognitive and environmental factors. Mental illness is very common and there are ways to help prevent, ease, and solve stress. One in five adults living in the United States live with a mental illness (Substance Abuse and Mental Health Services Administration, 2020). Inability to properly regulate emotion responses (ER) to stressful situations can result in a negative impact on one's well-being and relationships. For example, pathophysiological complications of disease can stem from stress. Stress can exacerbate autoimmune, cardiovascular, and respiratory diseases (Schneiderman et al., 2005). Those who live or work in a constantly stressful environment have a higher chance of developing stress related disorders (Yaribeygi et al., 2017). Psychosocial therapy, medication, and exercise are common forms of treatment in regulating emotional responses (Schneiderman et al., 2005). Exercise should be utilized as a preventative measure for buffering and negating the side effects of being stressed. It is known that exercise as positive effects on mood and can be utilized as a treatment for mental health. Determinants of mental health include the ability to manage emotions, thoughts, behaviors, and interactions with others when faced with stress. Depression and anxiety disorders are the most common mental illnesses, which raises the question for effective treatment and prevention options (Zschucke et al., 2013). Patients with depression often have characteristics of anxiety disorders, and those with anxiety disorders commonly have depression (Tiller, 2012). A large amount of research completed to date has looked at the effects of aerobic training on mood and lacks knowledge regarding the effects of resistance training. The benefits of resistance exercise as a form of treatment for emotional regulation is an area of research that needs more exploration.

1.1 PURPOSE AND HYPOTHESIS

There are arguments on which type of exercise has the greatest effect on mood. Aerobic training (AT) paired with resistance training (RT) is known to have positive effects on mood; however, there is a gap in knowledge to conclude the effects of only resistance training on mood. Muscular strength increases independence and overall quality of life and decreases morbidity and premature mortality (Warburton et al., 2001). Emotion regulation strategies are utilized to monitor, evaluate, and subconsciously produce thoughts and behaviors that are intended to change emotional states (Parkinson & Totterdell, 1996). The purpose of the study is to determine the effects of resistance training on emotion regulation and hemodynamic parameters in response to a stressful task.

It is hypothesized that the resistance training will have an effect on emotion regulation under the stressful task. Multiple factors contribute to the body's response to stress, such as hormones, neurotransmitters, nervous system activation, and hypothalamic-pituitary-adrenal (HPA) axis activity (Yaribeygi et al., 2017). A majority of mood-regulating strategies utilize maintaining or increasing the positive mood states and eliminating or decreasing negative emotions (Solanki & Lane, 2010). The second hypothesis of the study is that the resistance training will have an effect on the hemodynamic parameters under the stressful task. Resistance training at a low to high-intensity can decrease blood pressure and cardiac output (Rezk et al., 2006). Positive adaptations in heart rate and blood pressure can be produced through resistance training (De Sá et al., 2020).

CHAPTER 2: REVIEW OF LITERATURE

This literature review will include in depth details about the benefits of exercise on mental health, ER, and hemodynamic responses to exercise and stress. Concepts covering the benefits of exercise on mental health include the effects of exercise on mood and mental illness, the acute versus chronic adaptations of RT on mental health, the effects of exercise on the nervous system, the nervous systems function during exercise, and the differences between RT and AT on ER and the nervous system function. Stress response, the activity of the HPA axis, and autonomic response in regards to ER when presented with stress will be expanded on. Finally, the role of hemodynamic responses, such as heart rate, blood pressure, stroke volume, and cardiac output, during exercise, stress, and ER will be considered.

2.1 BENEFITS OF EXERCISE ON MENTAL HEALTH

2.1.1 Effects of Exercise on Mood and Mental Illness

In most cases, exercise can be a treatment utilized to reduce stress levels due to its mood-altering effects. People with severe mental health conditions die prematurely, as much as two decades early, due to preventable conditions. In the United States, roughly 51.3 million adults 18 or older in 2019 live with a mental illness, which is one in every five adults. Young adults aged 18-25 years old had the highest prevalence of mental illness compared to age groups 26 and older. When comparing genders, females have a higher prevalence of mental illness than males (as cited in Substance Abuse and Mental Health Services Administration, 2020) and nearly 50% of adolescents aged 13-18 have a mental disorder (Merikangas et al., 2010). In 2019, 13.1 million adults have a severe mental illness, and only 8.6 million (65.5%) received mental health treatment in the past year.

A mental health treatment can include inpatient or outpatient treatment/counseling or prescription medication for problems with emotions, nerves, or mental health (Substance Abuse and Mental Health Services Administration, 2020). In addition to muscle-strengthening activities two or more days per week, the U.S. Department of Health and Human Services physical activity guidelines recommends that adults perform at least 150 minutes per week of moderate physical activity or 75 minutes per week of vigorous physical activity for health benefits (Physical Activity Guidelines for Americans, 2008). In the United States from 2010-2015, only 22.9% of adults aged 18-64 met both aerobic and strength guidelines, and only 32.4% of the population met at least one of the guidelines (National Health Statistics Reports, 2018). The lowest states in the US averaging below the national average include Mississippi, Kentucky, and South Carolina, which are below 14.8% for meeting both aerobic and resistance training guidelines. New Hampshire, Vermont, and Massachusetts are above the national average for aerobic and resistance training guidelines, averaging 29.5%. Regarding sex differences, roughly 18.7% of women meet the guidelines compared to 28.8% of men aged 18-64 years old (National Health Statistics Reports, 2018). It is important to note that females have a higher prevalence of mental illness compared to men and are also less active than men. These statistics prove that mental illnesses are common and can be influenced by the lack of physical activity that populations of all ages are missing.

A stressor can be defined as an environmental or cognitive event that causes stress. Stress can be in a negative or positive state (Yaribeygi et al., 2017). Both of these generate arousal but only when the perception of the stressor is negative will it generate anxiety. Therefore, negative stress comprises cognitive and somatic anxiety whereas positive stress compromises positive mental energy and physiological arousal (National Strength & Conditioning Association et al. [NSCA], 2015). Even though research consistently declares a relationship between exercise and mental illnesses, multiple hypotheses can explain the benefits of exercise. These hypotheses include the thermogenic, endorphin, monoamine, distraction, and self-efficacy (Craft & Perna, 2004). The thermogenic hypothesis suggests that exercise promotes an increase in core temperature, which increases specific brain regions. DeVries (1981) claims that an increase in brain stem temperature can result in a reduction of muscular tension and an overall feeling of relaxation. Endorphins are hormones that promote a positive feeling, and the endorphin hypothesis proposes that the release of endorphins following exercise creates a positive effect. The controversy remains whether plasma or peripheral endorphins are responsible for activity in the brain (Craft & Perna, 2004). The monoamine hypothesis states that exercise increases the availability of brain neurotransmitters, such as serotonin, dopamine, and norepinephrine. These neurotransmitters are diminished with depression and lead to increased feelings of fatigue and stress (Craft & Perna, 2004).

For example, in patients with major depressive disorder (MDD), neurotransmitters are found to be depleted and directly relate to the patient experiencing symptoms. The synthesis of serotonin is downregulated due to the dysfunction of the central nervous system (CNS) and neurotransmitter receptors availability (Hasler, 2010). It is also important to note that cortisol is another hormone associated with stress. Hyperactivity of the HPA axis produces an excess amount of cortisol, which causes a dysfunction of neurogenesis (Verduijn et al., 2015). Excess amounts of cortisol within the body can lead to emotional and physical signs of stress, which can negatively affect the progression of mental illnesses, such as MDD (Hasler, 2010). Exercise allows for an increased regulation of the HPA-axis, which results in a decrease in released levels of cortisol (Lopresti et al., 2013). The distraction hypothesis suggests that the activity of physical exercise serves as the distraction mechanism and suppresses worries or thoughts (Leith, 2010). The utilization of activities as a distraction and a means of coping with depression has been shown to have more positive influence on depression than more introspective activities, such as journaling or keeping track of one's mood (Morrow & Nolen-Hoeksema, 1990). Finally, the self-efficacy hypothesis states that exercise provides a focused activity that enhances a sense of accomplishment and increase in self-efficacy. People can have more control by playing an active role in their own treatment, which can lead to improved self-esteem (Craft & Perna, 2004). One study found that a positive state of well-being and personal accomplishment was found to correlate strongly related to exercise (Bretland & Thorsteinsson, 2015). Exercise whether acute or chronic will elicit multiple adaptations within different systems.

2.1.2 Acute versus Chronic Adaptations of Resistance Training on Mental Health

Exercise training has many effects on the autonomic nervous system, cardiovascular system, and renal-adrenal system. Some benefits of exercise can include a decreased sympathetic tone, increase in vagal tone, decrease resting heart rate, decrease blood pressure, decrease insulin resistance, increase blood and plasma volume, and increase renal-adrenal function (Fu & Levine, 2013). Specifically, RT and AT exercise promote the activation of different cell signaling pathways (Powers & Howley, 2017). Some cardiovascular responses improved by resistance exercise include blood pressure, stroke volume, heart rate, and cardiac output (National Strength & Conditioning Association [NSCA] et al., 2015). After longitudinal long-term training, acute changes are present within concentrations of basal and blood hormone levels due to resistance exercise training (Deschenes & Kraemer, 2002).

Acute exercise appears to improve mood by activating specific cortical areas by stimulating the release of neurotransmitters and trophic factors that contribute to adherence to a regular exercise program. Chronic physical exercise induces neurogenesis and angiogenesis, which are important for improving behavioral and cognitive function in addition to improving the general health of patients with mental disorders (Matta Mello Portugal et al., 2013). There is evidence that physical exercise promotes changes in the human brain due to increases in metabolism, oxygenation, and blood flow (Matta Mello Portugal et al., 2013). The activation of the HPA axis also changes in congruence with the type, duration and intensity of physical exercise that an individual performs. When stimulated, the hypothalamus releases corticotropin-releasing hormone (Matta Mello Portugal et al., 2013). Cortisol is a marker of HPA activity and increases during acute exercise. Cortisol plays a key role in promoting the regulation of the bioenergetics system, and providing an increase of blood glucose through gluconeogenesis (Fuqua and Rogol, 2013). There are more neuroprotective effects from chronic exercise in comparison to acute physical exercise (Matta Mello Portugal et al., 2013). The longitudinal changes in endocrine functions are caused by an increase in exercise stress being tolerated by the body in response to incremental external loading. This hypothesis states that any chronic adaptations in acute hormonal response patterns potentially augments the ability to better tolerate and sustain prolonged higher intensity exercise (National Strength & Conditioning Association [NSCA] et al., 2015).

One study found that short term RT has been shown to decrease resting heart rate by 5% to 12%. However, when studied longitudinally, mixed responses are reported with either no change of resting heart rate or reductions of 4% to 13% (Fleck, 2003). A majority of research preformed has been regarding stress response and ER on aerobic exercise. One study found that aerobic and anaerobic exercise were found to be similarly effective as cognitive and behavioral therapy, and more effective than most other anxiety reducing activities (Wipfli et al., 2008). There is a gap in research concluding the chronic effects on HPA levels from resistance training. In humans, there are chronic and acute adaptations from intense exercise training that results in a reduced response of the HPA axis to the same absolute workload (Luger et al., 1987). A majority of studies that documented HPA axis baseline functions have been inconsistent, meaning the explanation to why this occurs is unclear (Wittert et al., 1996). It is uncertain why there is reduced adrenal responsiveness to adrenocorticotropic hormone (ACTH) in response to chronic exercise, but not other states of ACTH excess (Wittert et al., 1996). Exercise whether acute or chronic has a multitude of effects on the nervous system.

2.1.3. Effects of Exercise on the Nervous System

The nervous system is considered the integrative center for receiving and sending information in the body. Exercise directly affects the nervous system by upregulating many different hormone levels; one key hormone that is released from physical activity are growth hormones. These anabolic hormones are synthesized from somatroph cells from the anterior pituitary gland and secretion rates are regulated by the hypothalamus (Ayuk, 2006). Carbohydrate, protein, and lipid metabolism are modulated from growth hormones and are responsible for longitudinal growth (Le Roith et al., 2001). Some regulatory factors include insulin like growth factor 1 (IGF-1), growth hormone releasing hormone, and growth hormone releasing peptide (Ayuk, 2006). Changes in insulin and glucose secretion will result in counter regulatory responses, modifications in growth hormone, and IGF-1 function on maintaining carbohydrate homeostasis (Clemmons, 2004). IGF-1 is also a key indicator of neuronal functions in the CNS for synaptic plasticity and density, neurotransmission, neurogenesis and neuron differentiation (Aleman & Torres-Alemán, 2009). Growth hormone’s role is to promote neuroplasticity, enhance learning, protect neurons, and help maintain brain functions (Cotman & Engesser-Cesar, 2002).

Neuroplasticity is an ongoing process that is affected by changes in behavior and modifies existing neural networks through structural and functional adaptations of synapses in response to changes in behavior. Exercise-induced structural and functional changes in the brain have been reported in both human and animal studies (Lin et al., 2018). There are thousands of synaptic connections between neurons throughout the human body. Maintaining cognition and brain activity coordination is greatly affected by the synaptic connections. Synaptic protein levels need to be maintained for neural health and are greatly impacted by exercise (Cotman & Engesser-Cesar, 2002). Exercise causes an increase of trophic factors that enhance neuroplasticity, and cognitive and behavioral function (Lin et al., 2018). Different neural adaptations will result from resistance versus aerobic exercise training due to different types of stimulation of the neuromuscular system (O'Connor et al., 2010). Indirect mechanisms of resistance exercise will improve the central nervous system by improving vascular health which helps to maintain brain function.

The risk of developing a chronic health disease can be negated through physical activity. Even the smallest progressions in physical activity will increase physical fitness and greatly reduce the risk of premature death from preventable diseases (Warburton, 2006). For example, one meta-analysis looked at the effects of physical exercise on the function of the CNS and found there is a dysfunction in pathologies of metabolism in response to stress. This results in an upregulation of HPA axis activity which in turn increases the chances of mental illnesses to occur (Morgan et al., 2015). Metabolic syndrome, heart disease, obesity, and diabetes can be prevented from aerobic training (O'Connor et al., 2010). One study concluded that increasing energy expenditure by 1000 calories through physical activity per week, is associated with a mortality benefit of about 20% (Warburton, 2006).

There has been accumulating evidence that indicates exercise can improve learning and memory as well as attenuate neurodegeneration, including Alzheimer's disease (Lin et al., 2018).

Another study concluded that both aerobic and resistance training have been shown to be beneficial for controlling diabetes; however, resistance training may have greater benefits for glycemic control than aerobic training may have (Dunstan et al., 2004). It is important to note that regarding physical activity in older populations, musculoskeletal health is important to maintain functional independence. Majority activities of daily living do not require a high cardiac output but depend more on muscular skeletal components (Warburton et al., 2001). Exercise has multiple different effects on nervous system adaptations. The function of the central and peripheral nervous system (PNS) controls parasympathetic and sympathetic responses during exercise.

2.1.4. Nervous System Function During Exercise

During exercise, sensory feedback from the periphery results in alteration in the CNS that can have profound effects on subsequent motor activity and psychological function (Anish 2005). Volitional movements and reflexes are two different types of movements produced through the nervous system. Volitional movement is the result of an intended cognitive process, while a reflexive movement is involuntary and starts with a given stimulus (input) that elicits a set motor actions (output) (Schwartz, 2016). Neurotransmitters dictate and create the communication between neurons in different brain regions and neuronal pathways (Taylor et al., 2016). A motor unit is the connection between the CNS and muscle. Motor units are the functional portion of the neuromuscular system involved in motor output (Taylor et al., 2016).

The sympathetic nervous system controls cardiovascular responses during exercise and postural changes (Christensen & Galbo, 1983). Hemodynamics are controlled by the nervous system during exercise. Signals come from the central command center, the brain and the periphery which include baroreflexes, arterial chemoreflexes, and exercise pressor reflexes. The parasympathetic and sympathetic nervous system regulate heart rate variability (Uy et al., 2013).

The parasympathetic system decreases heart rate to help conserve energy under resting conditions (McCorry, 2007). Sympathetic activation from the CNS from exercise causes an increase in heart rate, venous return, and cardiac output to keep up with exercise demands. Baroreflexes control sympathetic nervous system activation, which are reset during exercise (Nobrega et al., 2014). In healthy individuals, sympathetic activity to the cardiovascular system overcomes parasympathetic tone (Nobrega et al., 2014).

2.1.5 Differences between Resistance Training and Aerobic Training on Emotional Regulation and Nervous System Function

According to the National Health Statistics Report, only 22.9% of adults aged 18 to 64 met both guidelines for aerobic and resistance training, 32.4% met one guideline, and 44.7% did not meet either guideline (National Health Statistics Reports, 2018). One study found that there is an adaptation and resistance to oxidative stress via free radical production in response to chronic exercise. Exercise over time becomes a protective mechanism and generates antioxidant enzymes which can decrease overall stress and damage to the nervous system (Lopresti et al., 2013). Along with the effects of different types of exercise, the duration of exercise over time can also have different effects on ER. A meta-analysis by Vilarino (2021) looked at the effects of resistance training on mental health in patients with fibromyalgia which is a chronic disease that includes skeletal muscle pain. The presence of mental disorders is common among patients with fibromyalgia. Seven studies met the inclusion criteria and completed 4 to 8 weeks of resistance training, 2 to 3 times per week. The study concluded that resistance training improved the mental health of patients with fibromyalgia and reduced depression and anxiety symptoms. The studies also found that resistance training produces an effect similar to aerobic exercise and produces better results than flexibility training (FT) for mental health (Vilarino et al., 2021).

In order to maximize the benefits of RT, adherence to progressive overload, specificity, and variation are mandatory to elicit any changes. The key quality to an individualized RT program is the manipulation of program variables. The program variables include intensity, volume, exercise selection, the order of the exercises, rest intervals between sets, velocity of contraction, and frequency. Altering one or more of these variables can significantly affect the acute responses and physiologic adaptations to resistance training (Kraemer et al., 2002). Regarding the intensity of exercise in order to enhance mood, it is important to exercise at low to moderate resistance intensity in order to elicit any chances (Strickland & Smith, 2014). For example, resistance exercise at 45% of 1 repetition maximum (RM) decreased anxiety levels for up to 120 minutes post-exercise, however the same effects were not observed at 30% or 60% of 1RM (O'Connor et al., 1993). Another study to support these findings found that an intensity of 50% of 1 RM produced a decreased level of anxiety; however, the same results were not found at 80% of 1 RM (Focht & Koltyn, 1999). One study found that high intensity exercise was superior to moderate intensity exercise in increasing positive well-being (Bretland & Thorsteinsson, 2015). A meta-analysis consisting of 16 studies compared the effects of utilizing RT as an alternative treatment for anxiety symptoms and concluded that resistance training had a positive effect on subjects and reduced anxiety levels (Gordon et al., 2017). Both genders can greatly benefit from resistance training regarding their mental health; however, gender differences may also play a role in the effects of resistance exercise. Research conducted by Focht (2002) demonstrated that college aged female students experienced great decreases in anxiety when completing resistance training at 75% 1RM.

Research shows that exercise has mood-enhancing effects, particularly if individuals initially had felt stressed and irritated prior to exercise (Acevedo & Ekkekakis, 2006). In conjunction with this, one study found that both exercise and aerobic fitness moderates the stress-illness relationship. Limited health center visits and increased health was reported in active and fit individuals when stress was introduced (Brown, 1991). Resistance exercise has been shown to elevate the concentrations of growth hormone through 30 minutes post-exercise (Kraemer & Ratamess, 2005). One study concluded that decreased symptoms of depression, improved cognitive ability, and increased self-esteem are a few mental health benefits from resistance exercise training (Westcott, 2012). When comparing strength and aerobic exercise programs, total exercise duration is the only variable that is used when comparing programs and not intensity. More volume is being produced during aerobic exercise training when compared to a resistance training program that has more rest periods. Therefore, it is reasonable to conclude that the effects on mental health from resistance exercise training is misjudged in comparison to the effects of aerobic training (O'Connor et al., 2010). According to a meta-analysis conducted on different exercise program variables, aerobic exercise consisting of walking, cycling in group or individual settings that is performed 3-4 times per week for 30-40 minutes at a low or moderate intensity, is beneficial in the treatment of depression (Stanton & Reaburn, 2014). The development of mental illnesses caused by stress results in affecting nearly every system in the body. Exercise also challenges the cardiovascular, musculoskeletal and nervous systems and can negate the negative effects on these systems caused by stress (Anish, 2005). The development of mental illnesses caused by stress results in affecting nearly every system in the body.

2.2 EMOTIONAL REGULATION

2.2.1 Stress Response

Mood, behavior, well-being, and overall health are influenced by stressors (Schneiderman et al., 2005). Hormones, neurotransmitters, and peptides from the nervous, cardiovascular, endocrine, and immune systems are some of the many factors that contribute to the body's response to stress (Yaribeygi et al., 2017). Acute stressors threaten homeostasis, which must be met with adaptive responses. However, the acute stressor can become maladaptive if there is a continuous stimulus (Schneiderman et al., 2005). Mental health disorders such as depression, anxiety, and stress are often treated with psychotherapy and medication. In contrast, individuals often prefer an alternative for treatment with exercise (Mikkelsen et al., 2017). For example, significantly lower rates of anxiety and depression were associated with regular exercise in a cross-sectional study with 269 adults (Khanzada et al., 2015).

Anxiety is one of the most common mental health disorders that affects the ability to sleep, concentrate, and perform daily tasks (Mikkelsen et al., 2017). Anxiety is often divided into two categories, state or trait anxiety. State anxiety is the temporary psychological and physiological to situational stress while trait anxiety is having a level of anxiety is a personal characteristic (Endler & Kocovski, 2001). Young healthy individuals are more adaptive to acute stress responses and typically do not lead to a health burden. However, if stressors are persistent and strong individuals who are biologically vulnerable because of age, genetic or trait anxiety, or constitutional factors, stressors can lead to disease (Schneiderman et al., 2005). Trait anxiety and the stressful situation affect the level of state anxiety (Endler & Kocovski, 2001).

Evaluating stress can take place in a lab or environmental setting using a multitude of different tests. For example, the Trier Social Stress Test (TSST) requires subjects to make an interview-style presentation, followed by a mental arithmetic test, in front of a panel that does not provide encouragement or feedback (Allen et al., 2017). A public speaking test is another example of evaluating stress. This can be done many different ways but the theme is that subjects are to perform a speech and are then evaluated by peers and self (Daly et al., 1989). The Perceived Stress Scale (PSS) is very commonly used for measuring the perception of stress. It measures the degree to which situations in the subject's life are perceived as stressful or not (Cohen et al., 1983). The Subjective Exercise Experience Scale (SEES) is another test that measures psychological response to the stimulus of exercise. The SEES is a measure of global psychological responses to the stimulus properties of exercise (MeAuley & Courneya, 1994).

The Modified Computerized Paced Auditory Serial Addition Test (PASAT-C) is another test used to evaluate stress and is what will be utilized in this study. The Paced Auditory Serial Addition Test or PASAT-C was originally developed to assess the cognitive function in those with traumatic brain injuries (Gronwall, 1977). Research has shown that the PASAT-C can detect impairments in cognitive processing (Tombaugh, 2006). In a laboratory environment the PASAT-C is utilized to produce psychological stress. The test allows for a comprehensive examination of psychological, behavioral, and cognitive responses without sacrificing the experimental control and precision (Lejuez et al., 2003). The PASAT-C is recognized as a measure of different functional domains, primarily attention, because it requires the successful completion of a variety of cognitive functions affected by different stress hormones (Gronwall, 1977). Stress hormones are produced by the HPA axis and controlled by the sympathetic nervous system (Schneiderman et al., 2005).

2.2.2 The Hypothalamic-Pituitary-Adrenal Axis

The hypothalamic-pituitary-adrenal axis or HPA axis plays an important role for emotional regulation. Homeostasis of cognitive function is affected by an internal or external stimulus regulated by HPA axis activation (Stranahan et al., 2008). Differences in the HPA axis functioning is related to emotional regulation (Gilbert et al., 2016). The amygdala, prefrontal cortex, and hippocampus are threat-recognition centers within the human body. Signals are sent to the hypothalamus from these organs resulting in an increased synthesis of corticotropin-releasing factor. Next, the pituitary gland stimulates the production of adrenocorticotrophin hormone. Finally, the adrenal gland releases cortisol from ACTH signaling to, which initiates a negative feedback system. It should also be noted that cortisol reduces activation of levels within the HPA axis (Stranahan et al., 2008). During the "fight-or-flight" response and during exercise, the sympathetic nervous system response stimulates all organs and tissues in the body. The adrenal medulla is stimulated to release epinephrine and norepinephrine into the blood which causes an increase in blood pressure and heart rate (McCorry, 2007).

Problem solving skills have beneficial effects on emotional regulation by being able to better change or disregard stressors (Aldao et al., 2010). Major depressive disorder is linked to disruptions in HPA axis functioning (Gilbert et al., 2016). Additional cognitive effort is needed for problem-solving in depressed or anxious individuals resulting in a brief spike in cortisol levels while engaging in problem solving (Aldao et al., 2010). Reoccurring acute or chronic exposure to a specific stress will result in an HPA axis adaptation to become less responsive to the similar stress in the future (Wittert et al., 1996). Basal HPA function adapts with exposure to high intensity training, which promotes an increase in pituitary ACTH secretion, and a decrease in adrenal cortisol response (Wittert et al.,1996). An absence of problem-solving skills is connected with anxiety and depression (Aldao et al., 2010). Conversely, there is an autonomic response of problem-solving skills in individuals that are not affected by a mental illness (Gilbert et al., 2016). Not being able to handle stressors can result in maladaptation in emotional regulation (Aldao et al., 2010). This concludes that those dealing with stress, anxiety or depression report stress at a higher level (Gilbert et al., 2016). Exercise provides the opportunity to utilize problem solving skills to respond to possible stressful situations.

2.2.3Autonomic Response

The autonomic nervous system is responsible for maintaining homeostasis of every organ and system within the body and performs without conscious voluntary control (McCorry, 2007). Autonomic reflexes transmit sensory information to homeostatic control centers such as the brainstem and hypothalamus (McCorry, 2007). The feed-forward mechanism of the CNS produces neural impulses from the motor cortex that initiates the autonomic nervous system within the brainstem. This leads to a withdrawal of parasympathetic activation and an increase in sympathetic activation (Nobrega et al., 2014). The autonomic nervous system is divided into two systems, the sympathetic nervous system and parasympathetic nervous system (McCorry, 2007). The autonomic nervous system controls muscle contraction and relaxation, myocardial activity activation, and glandular secretion rates which are controlled by the release of acetylcholine, norepinephrine, and epinephrine. These neurotransmitters will stimulate activity in some tissues and inhibit activity in others (McCorry, 2007). When the ceCNS has increased activation, there is a greater increase in blood pressure, heart rate, and pulmonary ventilation (Nobrega et al., 2014).

An acute stressor, such as a life-threatening situation or while a chronic stressor is an everyday task. The sympathetic nervous system is utilized to react and redirect blood flow for these different situations. The manipulation of subjective, behavioral, or physiological factors of an emotional response can be defined as emotional regulation (Musser et al., 2011). Individuals utilize emotional regulation when initially faced with a stress and when anticipating a stressful event (Nasso et al., 2019). Suppression is a type of emotional regulation that involves being conscious of inhibiting expressive behaviors during emotional arousal (Gross & Levenson, 1993). One study found that during an emotionally challenging situation, arousal increased from the synergistic activity to the sympathetic and parasympathetic system (Stifter et al., 2010).

Regarding exercise and the role of the autonomic system, cardiovascular, respiratory, and hormonal responses must change in order to meet the working demands of skeletal muscle. Inputs from motor cortex, arterial and skeletal muscle receptors are upregulated during physical exercise from autonomic regulation (Nobrega et al., 2014). Autonomic control during exercise initially increases heart rate due to parasympathetic withdrawal and activation of sympathetic activity (White & Raven, 2014). Once exercise ends, there is a reduction in central command activity from stimuli in muscle metabolism and mechanoreceptors (Buchheit et al., 2007). Sympathetic nerve activity decreases and parasympathetic tone increases which results in a reduction in heart rate, stroke volume, cardiac output, myocardial contractility, and mean arterial pressure (Crisafulli et al., 2003). Changes in tissues and organs during strenuous physical activity are induced by the sympathetic nervous system and changes induced by the parasympathetic system are utilized when the body is resting (McCorry, 2007).

2.3 HEMODYNAMIC RESPONSE DURING EXERCISE, STRESS, AND EMOTIONAL CHALLENGES

2.3.1 Heart Rate

Changes in external stimuli are accompanied by different subjective emotional states that cause changes in heart rate (Uy et al., 2013). Increases in heart rate, from rest to exercise rate, rely on the balance between activation of the sympathetic and parasympathetic systems (White & Raven, 2014). During exercise, adequate oxygen needs to be delivered to working muscles by increasing heart rate. Regulating blood pressure is important in order to maintain perfusion to vital organs without excessive pressure variations (Nobrega et al., 2014).

2.3.2 Blood Pressure

RT produces a positive adaptation in heart rate and blood pressure (De Sá et al., 2020). Comparing isometric and dynamic exercise, oxygen uptake from the rise in blood pressure is higher in isometric compared to dynamic exercise (Christensen & Galbo, 1983). A chronic decrease in blood pressure and cardiac output can be produced from resistance training at a low to high intensity (Rezk et al., 2006).

2.3.3 Stroke Volume

Stroke volume can be defined as the volume of blood pumped out of the left ventricle during each contraction (Abudiab et al., 2013). In order to meet metabolic demands of working muscles during exercise, cardiovascular demands must greatly increase (Michael et al., 2017). During exercise, the heart pumps more forcefully which increases stroke volume in order to beat faster and stronger to increase cardiac output and maintain work demands (Abudiab et al., 2013).

2.3.4 Cardiac Output

Cardiac output is controlled by heart rate and stroke volume. An increase in cardiac output is due to an increase in both heart rate and stroke volume (Nobrega et al., 2014). Greater sympathetic activity during exercise increases heart rate, therefore increases cardiac output. Vagal tone withdrawal causes the initial increase in heart rate (Christensen & Galbo, 1983). Oxygen demands for the body changes depending on the activity. The regulation of cardiac output is influenced by the autonomic nervous system, cardiovascular, respiratory, and endocrine systems (Arya et al., 2019).

CHAPTER 3: METHODS

3.1 PARTICIPANTS

The study will consist of 18 to 31year-old female and male college students. A sample size of 23 subjects was selected after a review of relevant literature. 12 subjects were in the treatment group and 11 subjects were in the control. Subjects from the University of North Carolina at Charlotte were be recruited for the study via email. The inclusion criteria are subjects with a sedentary lifestyle and less than a year of resistance training experience. Exclusion criteria includes any 'yes' answers on the Physical Activity Readiness Questionnaire (ParQ+), any existing musculoskeletal injuries, and subjects cannot be pregnant. Subjects cannot participate in organized aerobic, flexibility, or resistance training outside of the study.

3.2 PROCEDURES

The study consisted of a two-group pre-test, posttest design with random assignment to group. Subjects, half male and half female, were randomly assigned to the treatment group (resistance training) or control group (stretching). Subjects were electronically be sent the physical activity readiness questionnaire (PAR-Q) form that they are responsible for filling out, as well as a list of exclusion criteria and inclusion criteria.

Subjects came to the Laboratory within 008 in Belk Gym at the University of North Carolina at Charlotte every visit and will be supervised the entire time. The first visit is baseline data collection. Subjects will fill out an informed consent form, State-Based Difficulties in Emotion Regulation Scale (S-DERS), and Positive and Negative Affect Scale (PANAS) assessments. Next, subjects were hooked up to the noninvasive blood pressure monitoring system

(NIBP) which collects hemodynamic data; once the system is working properly, subjects took the Paced Auditory Serial Addition Test (PASAT-C). After the PASAT-C, the NIBP system is removed and the subjects will again complete the S-DERS and PANAS assessments.

Next, the resistance training group was familiarized with their resistance training movements and test their 5 RM on each exercise. The first 4 weeks, the resistance training group completed the warm-up, resistance training session and cool-down twice a week. After 4 weeks, subjects completed a 5-RM on the same exercises and their individualized prescriptions were reprogrammed. Subjects continued the resistance training program for another 4 weeks, continuing to come in twice a week. The flexibility group was familiarized with their stretching program movements, and complete flexibility assessments. The stretching group also came in twice a week for 4 weeks and complete their stretching program. After 4 weeks, the stretching group retested the flexibility assessments and complete another 4 weeks of training.

After the conclusion of 8 weeks of training, the last visit included both groups completing the S-DERS and PANAS assessments. Subjects again were hooked up to the noninvasive blood pressure monitoring system and completed the PASAT-C. The NIBP system was then be taken off and the S-DERS and PANAS were completed again. Finally, the resistance training group completed the 5-RM tests, and the stretching group completed the flexibility assessments. See figure #. 1

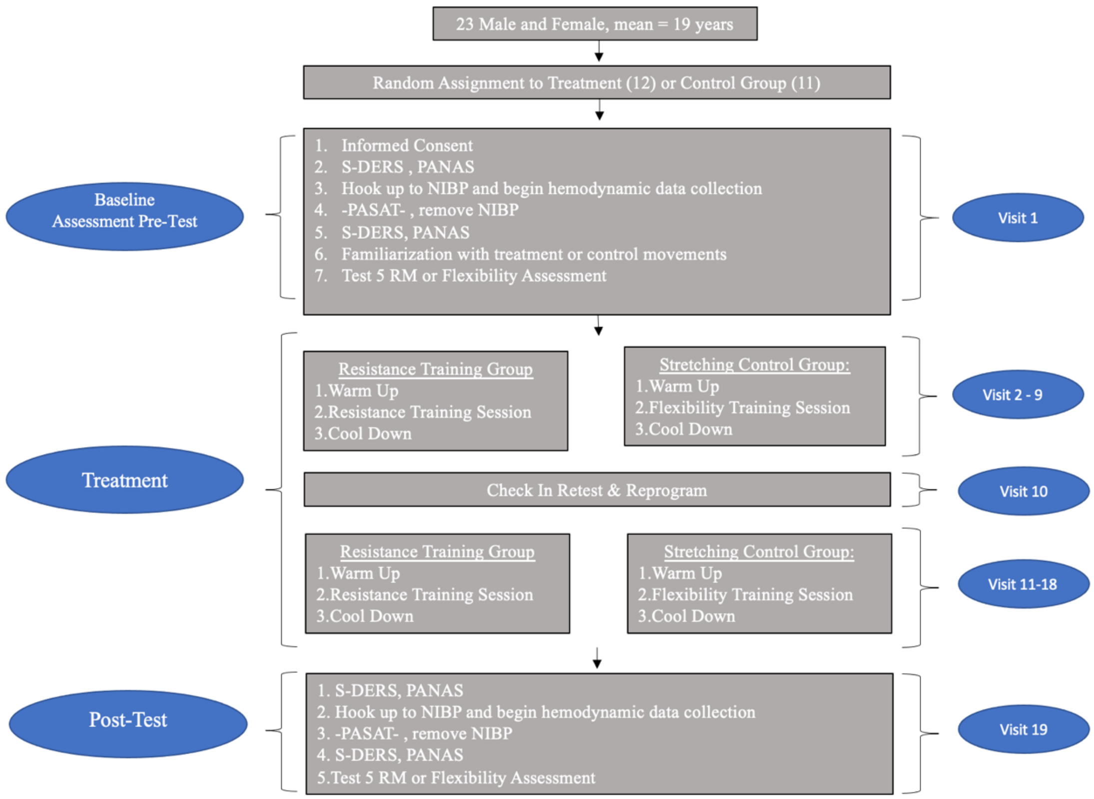


Figure 1. *Study Design and Methodology*

3.2.1 Warm Up and Cool Down

Warm Up		
Exercise	Sets	Reps
Dead Bugs	1	10
Heel to Toe Walk	1	10 yards
Fire Hydrants	1	10 each
Squat and Rotation	1	10
Inch Worms	1	10
Lunge with Elbow	1	10

Cool Down
Exercise
walk for 3 minutes

Table 1. *Warm Up and Cool Down*

The goal of the general warm up is to increase heart rate, blood flow, and muscle temperature to prepare the body for their prescribed training program (Fradkin et al., 2010). The warmup consisted of 6 different dynamic exercises that target muscle groups that were worked during the training program. Both treatment and control groups completed the same warm up. At the end of the resistance and flexibility training group sessions, a cool down took place. The cool down for both the treatment and control group was 3 minutes of walking. The goal of a cool down is to decrease the risk for musculoskeletal injury and allow for heart rate to return to resting levels. Physical risks include discomfort, pain, or musculoskeletal injury.

3.2.2 Resistance Training

The RT program was 8 weeks long with two sessions per week. It consisted of 5 dumbbell (DB) and machine-based exercises. A warm up was performed prior to the session and a cool down followed after. Subjects performed a 5 RM on all 5 exercises before and after the 8-week program and in the middle after 4 weeks of training. Each exercise had 4 sets and utilized the daily adjustable progressive resistive exercise system on the 4th set. Subjects were instructed to perform as many repetitions as possible on the last set. This allowed for more daily adjustments for increasing strength increases based on how many repetitions are completed. Intensity, repetitions, and rest between sets varied every couple of weeks to create variety and maintain subject interest. Physical risks include discomfort, pain, or musculoskeletal injury.

Visit: ___________						
Resistance Program						
Exercise	Intensity	Sets	Reps	Rest	Wt	DAPRE
Lat Pull Down	75%	3	10	1 min		
DB Chest Press	75%	3	10	1 min		
Row	75%	3	10	1 min		
Smith Back Squat	75%	3	10	1 min		
DB Calf Raise	75%	3	10	1 min		

Visit: ___________						
Resistance Program						
Exercise	Intensity	Sets	Reps	Rest	Wt	DAPRE
Lat Pull Down	80%	3	8	1 min		
DB Chest Press	80%	3	8	1 min		
Row	80%	3	8	1 min		
Smith Back Squat	80%	3	8	1 min		
DB Calf Raise	80%	3	8	1 min		

Visit: ___________						
Resistance Program						
Exercise	Intensity	Sets	Reps	Rest	Wt	DAPRE
Lat Pull Down	85%	3	6	1.5 min		
DB Chest Press	85%	3	6	1.5 min		
Row	85%	3	6	1.5 min		
Smith Back Squat	85%	3	6	1.5 min		
DB Calf Raise	85%	3	6	1.5 min		

Table 2. *Resistance Training Program*

3.2.3 DAPRE Protocol

The daily adjustable progressive resistive exercise system (DAPRE) allows for more frequent manipulation of intensity and volume and will be utilized with every training session during the study. On the fourth set, the subject performs as many repetitions as possible until failure. The number of reps completed will adjust the weight for the next exercise session. Weight adjustment will be based on the DAPRE protocol (Knight, 1985). Physical risks include discomfort, pain, or musculoskeletal injury.

Number of Repetitions Performed During Set 3	Adjusted Resistance for Set 4	Resistance for Next Exercise Session
0 – 2	- 5 to 10 lbs.	- 5 to 10 lbs.
3 – 4	- 0 to 5 lbs.	Same Resistance
5 – 6	Same Resistance	+ 5 to 10 lbs.
7 – 10	+ 5 to 10 lbs.	+ 5 to 15 lbs.
11	+ 10 to 15 lbs.	+ 10 to 20 lbs.

Table 3. *DAPRE Protocol: Resistance Adjustments for Daily Adjustable Progressive Resistance Exercise*

3.2.4 5 Repetition Maximum

To evaluate baseline strength and RT progression, a 5 RM test was utilized. Subjects were supervised by a Certified Strength and Conditioning Specialist (CSCS) and will be spotted at all times. Subjects were instructed to warm up with a light weight resistance that easily allows for 8 - 10 repetitions followed by a 1-minute rest period. Next, an estimated warm up resistance weight that allows for 6-8 repetitions by adding 10 - 20 pounds for upper body exercise and 30 - 40 pounds for lower body exercise followed by a 2 - 4-minute rest period. For the first test set, increase the load by 10 - 20 pounds for upper body exercise and 30 - 40 pounds for lower body exercise and perform 5 reps. If successful, add 5 - 10 pounds and perform 5 reps again followed by a 2 - 4-minute rest period. Repeat previous steps until failure to complete 5 reps. Completion of 5 RM is voluntary and subjects will not be forced to complete tasks. Physical risks include discomfort, pain, or musculoskeletal injury.

3.2.5 Flexibility Training

The control group or flexibility training (FT) consisted of 2 sessions per week for 8 weeks. A warm up will start the session followed by a cool down after. FT will include 7 different movements that target different muscle groups. Each movement will have 3 sets and seconds held in each stretch and rest time will vary every couple of weeks to increase intensity and create variety for subjects. Subjects will be evaluated by a flexibility assessment before the training program begins, after 4 weeks, and after 8 weeks. Physical risks include discomfort, pain, or musculoskeletal injury.

Visit: ____________

Stretching Program			
Exercise	Sets	Reps	Rest
Side Bend with Straight Arms: both sides	3	15 sec	1 min
Cross Arm in Front of Chest: both sides	3	15 sec	1 min
Spinal Twist: both sides	3	15 sec	1 min
Side Quadricep Stretch: both sides	3	15 sec	1 min
Modified Hurdler Stretch	3	15 sec	1 min
Butterfly	3	15 sec	1 min
Calf Wall Stretch: both sides	3	15 sec	1 min

Visit: ____________

Stretching Program			
Exercise	Sets	Reps	Rest
Side Bend with Straight Arms: both sides	3	20 sec	1 min
Cross Arm in Front of Chest: both sides	3	20 sec	1 min
Spinal Twist: both sides	3	20 sec	1 min
Side Quadricep Stretch: both sides	3	20 sec	1 min
Modified Hurdler Stretch	3	20 sec	1 min
Butterfly	3	20 sec	1 min
Calf Wall Stretch: both sides	3	20 sec	1 min

Visit: ____________

Stretching Program			
Exercise	Sets	Reps	Rest
Side Bend with Straight Arms: both sides	3	25 sec	1 min
Cross Arm in Front of Chest: both sides	3	25 sec	1 min
Spinal Twist: both sides	3	25 sec	1 min
Side Quadricep Stretch: both sides	3	25 sec	1 min
Modified Hurdler Stretch	3	25 sec	1 min
Butterfly	3	25 sec	1 min
Calf Wall Stretch: both sides	3	25 sec	1 min

Table 4. *Flexibility Training Program*

3.2.6 Flexibility Assessments

The flexibility assessment were utilized to evaluate progression of the flexibility training group. Three quantitative flexibility assessments were utilized that target different muscle groups that are being used during the stretching program. A shoulder mobility test will test upper limb mobility, prone trunk lift will test trunk mobility, and straight leg raise will test lower limb mobility. Physical risks include discomfort, pain, or musculoskeletal injury.

3.2.7 Shoulder Mobility

For shoulder mobility, the subject while standing would reach one arm overhead, elbow pointed to the sky, palm reaches as far down the back as possible. The other arm reaches under behind the back, elbow pointed to the ground, reaching as far up as possible. The goal is to have the fingertips reach behind the back. A ruler will be placed behind the subject's back, and the distance between the two middle fingers were recorded.

3.2.8 Prone Trunk Lift

During the prone trunk lift, the subject lies face down on the ground. Hands are placed under the subject's hips. Researcher holds a yard stick perpendicular to the ground near the subject's head. Subject lifts the upper torso as far off the ground as possible while the researcher measures from the bottom of the chin.

3.2.9 Straight Leg Raise

The straight leg raise test includes the subject lying supine, a researcher would hold a yard stick perpendicular at the subject's hip. Subject would lift one leg as high as they can while keeping the other leg flat on the ground and both legs straight. A goniometer will be used to measure the angle of how high the subject can lift their leg.

3.2.10 PASAT-C

The Modified Computerized Paced Auditory Serial Addition Test (PASAT-C) is designed for measuring distress tolerance (Lejuez, 2003). Single digits are presented every 3 seconds and the subject must add each new digit to the one immediately prior. The total score is on-screen the entire time. Each time the patient provides an incorrect answer or omits an answer, a loud sound is played. There are 3 different blocks to the PASAT-C, each block duration gets shorter as the test continues. The possibility for psychological risks during the PASAT-C can produce negative affective states such as anxiety, depression, and altered behavior.

3.3 DESCRIPTON OF MEASUREMENTS

3.3.1 NIBP Nano System

The noninvasive blood pressure nano system (NIBP) collected finger pressure, mean arterial pressure, cardiac output and heart rate. Subjects wore a wrist unit and wrap blood pressure finger cuffs around 2nd and 3rd fingers. Cuffs switch back and forth for measuring blood pressure to avoid cutting off circulation to one finger. A height correction unit will be attached near the sternum and the other end will attach to one of the blood pressure cuffs. This compensates for differences in height differences between the heart and finger cuffs. Once the NIBP system is on, blood pressure finger cuffs will automatically inflate and deflate and data is automatically collected.

3.3.2 S-DERS

The State-Based Difficulties in Emotion Regulation Scale consists of 20 statements that evaluate how the subject's emotions are within the moment they are taking the survey. Subjects answer each question with a 1 - 5; ranging from not at all, somewhat, moderately, very much, and completely. This questionnaire is utilized to measure emotional regulation in present time (Lavender et al., 2016). The possibility for psychological risks during the S-DERS can produce negative affective states such as anxiety, depression, and altered behavior.

3.3.3 PANAS

Positive and Negative Affect Scale is another questionnaire used to evaluate how the subject is feeling in the present moment. PANAS contains 20 words that the subjects use a scale to each word to describe how they are feeling when they are taking the questionnaire. The scale ranks from 1 meaning not at all to 5 meaning extremely (Watson et al., 1988). The possibility for psychological risks during the PANAS can produce negative affective states such as anxiety, depression, and altered behavior.

3.4 STATISTICAL ANALYSIS PLAN

Data was analyzed for normal distribution using Shapiro Wilks tests. Analysis of training programs were undertaken using repeated measures Anova examining changes in 5RM performance or flexibility assessments across time within the group. Repeated measures Anova was used to assess changes in difficulty in emotion regulation across time between groups. Repeated measures Anova was also be used to assess changes in hemodynamic and psychological responses to the PASAT test across time between groups. Tukey's HSD was used for the post hoc test. All assumptions of Anova (normality of residuals, sphericity) were assessed and if needed corrections applied. JMP 15.0 Pro was used for all data analysis.

CHAPTER 4: RESULTS

4.1 RESISTANCE AND FLEXIBILITY ASSESSMENTS

4.1.1 Cable Lat Pull Down

Analysis by Oneway Anova by visit number (1,10,19) revealed a significant effect for cable latissimus pull down (F Ratio= 4.68, p= 0.0163). A Tukey-Kramer HSD revealed a significant effect between time points 1 and 19 (p= 0.0187) See data Table 5.

4.1.2 Cable Row

Analysis by Oneway Anova by visit number (1,10,19) revealed a significant effect for cable row (F Ratio= 3.54, p= 0.0403). A Tukey-Kramer HSD revealed a significant effect between time points 1 and 19 (p= 0.0372) See data Table 5.

4.1.3 DB Chest Press

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for DB chest press (F Ratio= 3.14, p= 0.0563). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (p= 0.0786) See data Table 5.

4.1.4 Smith Machine Back Squat

Analysis by Oneway Anova by visit number (1,10,19) revealed a significant effect for smith machine back squat (F Ratio= 16.09, p= <.0001). A Tukey-Kramer HSD revealed a significant effect between time points 1 and 10 (p= 0.0007) and a significant effect between points 1 and 19 (p= <.0001) See data Table 5.

4.1.5 Calf Raise

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for calf raise (F Ratio= 2.88, p= 0.07). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (p= 0.0881) See data Table 5.

4.1.6 Left Shoulder Mobility

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for left shoulder mobility (F Ratio= 0.05, *p*= 0.9492). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (*p*= 0.9994) See data Table 5.

4.1.7 Right Shoulder Mobility

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for right shoulder mobility (F Ratio= 0.21, *p*= 0.8079). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (*p*= 0.8216) See data Table 5.

4.1.8 Prone Trunk Lift

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for prone trunk lift (F Ratio= 2.79, *p*= 0.0769). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (*p*= 0.0692) See data Table 5.

4.1.9 Left Leg Lift

Analysis by Oneway Anova by visit number (1,10,19) did not reveal a significant effect for left leg lift (F Ratio= 0.79, *p*= 0.4594. A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (*p*= 0.4342) See data Table 5.

4.1.10 Right Leg Lift

Analysis by Oneway Anova by visit number (1,10,19) revealed a significant effect for right leg lift (F Ratio= 3.71, *p*=0.0365). A Tukey-Kramer HSD did not reveal a significant effect between time points 1 and 19 (*p*= 0.0593) See data Table 5.

4.1.11 Resistance and Flexibility Results Summary

The strength training group increased significantly in 1 RM maximums across the lifts performed (F=6.88, *p*< 0.01 baseline: 223±96kg, midpoint: 345±105kg, final: 376±119kg. The flexibility group trended towards increased flexibility across all measures (F=2.47, *p*=0.10 baseline: 162.4±25.2cm, midpoint: 177.3±22.5cm, final: 184.3±23.3cm).

Table 5.

Resistance and Flexibility Assessments Results

Variable	Group	Time	Unit	M	SD
Cable Lat Pull Down	Resistance	Visit 1	lbs	99.17	33.36
		Visit 10	lbs	137.5	40.7
		Visit 19	lbs	146.25	45.34
Cable Row	Resistance	Visit 1	lbs	71.67	37.98
		Visit 10	lbs	103.75	40.12
		Visit 19	lbs	116.67	49
DB Chest Press	Resistance	Visit 1	lbs	94.58	39.05
		Visit 10	lbs	134.58	48.45
		Visit 19	lbs	137.5	52.11
Smith Machine Back Squat	Resistance	Visit 1	lbs	103.33	64.08
		Visit 10	lbs	222.08	70.7
		Visit 19	lbs	260.0	76.5
Calf Raise	Resistance	Visit 1	lbs	121.25	56.05
		Visit 10	lbs	162.08	48.59
		Visit 19	lbs	167.08	48.92
Left Shoulder Mobility	Flexibility	Visit 1	cm	0.29	4.68
		Visit 10	cm	0.82	3.84
		Visit 19	cm	0.35	3.99
Right Shoulder Mobility	Flexibility	Visit 1	cm	3.71	4.16
		Visit 10	cm	4.5	3
		Visit 19	cm	4.6	3.02
Prone Trunk Lift	Flexibility	Visit 1	in	11.88	1.8
		Visit 10	in	12.54	2.63
		Visit 19	in	14.35	3.03
Left Leg Lift	Flexibility	Visit 1	degrees	73.92	11.45
		Visit 10	degrees	76.18	14.37
		Visit 19	degrees	80.9	13.34
Right Leg Lift	Flexibility	Visit 1	degrees	72.58	12.78
		Visit 10	degrees	83.27	9.13
		Visit 19	degrees	84.1	11.45

4.2 PSYCHOLOGICAL SURVEYS

4.2.1 PANAS Negative

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.60, p=0.443), did not reveal a significant effect for visit (F= 3.02, p=0.089), and revealed a significant main effect for time (F= 13.43, p=0.0007). The interaction effect for group*visit number* time was found to be non-significant (F= 0.40, p= 0.526). See data Table 6.

4.2.2 PANAS Positive

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) revealed a significant main effect for group (F= 5.53, p= 0.0235), did not reveal a significant effect for visit (F= 0.06, p= 0.794), and did not reveal a significant effect for time (F= 6.37, p=0.0155). The interaction effect for group*visit number* time was found to be non-significant (F= 0.04, p= 0.838). See data Table 6.

4.2.3 S-DERS: Nonacceptance

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.99, p=0.323), did not reveal a significant effect for visit (F= 2.61, p=0.114), and revealed a significant main effect for time (F= 10.86, p=0.002). The interaction effect for group*visit number* time was found to be non-significant (F= 0.12, p=0.603). See data Table 6.

4.2.4 S-DERS: Modulate

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 1.32, p=0.258), did not reveal a significant main effect for visit (F= 1.26, p=0.267), and revealed a significant main effect for time (F= 8.50, *p*=0.0057). The interaction effect for group*visit number* time was found to be non-significant (F= 2.73, *p*=0.106). See data Table 6.

4.2.5 S-DERS Awareness

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.14, *p*=0.713), did not reveal a significant main effect for visit (F= 0.85, *p*=0.36), and revealed a significant main effect for time (F= 5.85, *p*=0.02). The interaction effect for group*visit number* time was found to be non-significant (F= 1.31, *p*= 0.259). See data Table 6.

4.2.6 S-DERS Clarity

Analysis by repeated measures Anova Group (A, B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 1.09, *p*=0.300), did not reveal a significant main effect for visit (F= 1.68, *p*=0.202), and revealed a significant main effect for time (F= 8.2, *p*=0.006). The interaction effect for group*visit number* time was found to be non-significant (F= 2.27, *p*=0.139). See data Table 6.

4.2.7 Psychological Survey Results Summary

Analysis of positive affect scores revealed a significant main effect of time (F=13.43, *p*< 0.01), but no significant effects of group or interactions. Analysis of negative affect revealed significant effects of group (F= 5.53, *p*= 0.02) and time (F= 6.37, *p*=0.02), but no significant interaction effects. Analysis of S-DERS data revealed significant effects of time for Nonacceptance (F= 10.86, *p*< 0.01), Modulate (F= 8.50, *p*< 0.01), Awareness (F= 5.85, *p*=0.02) and Clarity (F= 8.2, *p*< 0.01).

Table 6

Psychological Surveys Results

Variable	Group	Time	M	SD
PANAS Negative	Resistance	Visit 1: Pre	15.58	5.14
		Visit 1: Post	18.92	7.57
		Visit 19: Pre	13.42	3.5
		Visit 19: Post	14.75	4.31
	Flexibility	Visit 1: Pre	16	4.73
		Visit 1: Post	19.18	5.49
		Visit 19: Pre	14.36	4.63
		Visit 19: Post	17.45	6.42
PANAS Positive	Resistance	Visit 1: Pre	31.58	7.65
		Visit 1: Post	28.33	9.9
		Visit 19: Pre	13.42	3.50
		Visit 19: Post	14.75	4.31
	Flexibility	Visit 1: Pre	27.64	6.1
		Visit 1: Post	22.82	7.22
		Visit 19: Pre	25.36	9.31
		Visit 19: Post	23.73	7.9
S-DERS: Nonacceptance	Resistance	Visit 1: Pre	10	5.12
		Visit 1: Post	11	5.27
		Visit 19: Pre	8.08	1.62
		Visit 19: Post	8.17	2.33
	Flexibility	Visit 1: Pre	10.09	6.27
		Visit 1: Post	13.09	7.3
		Visit 19: Pre	8.27	2.41
		Visit 19: Post	11.09	5.39
S-DERS: Modulate	Resistance	Visit 1: Pre	9	3.91
		Visit 1: Post	10.5	4.95
		Visit 19: Pre	8.17	1.11
		Visit 19: Post	8.25	1.22
	Flexibility	Visit 1: Pre	10	5.39
		Visit 1: Post	10.91	4.11
		Visit 19: Pre	8.72	1.9
		Visit 19: Post	10.82	3.6
S-DERS: Awareness	Resistance	Visit 1: Pre	12.42	3.55
		Visit 1: Post	13.58	4.01
		Visit 19: Pre	11.92	6.2
		Visit 19: Post	11.83	5.75
	Flexibility	Visit 1: Pre	12	2.93
		Visit 1: Post	13.18	4.35
		Visit 19: Pre	10.36	4.25
		Visit 19: Post	12.27	5.1
S-DERS: Clarity	Resistance	Visit 1: Pre	3	1.35
		Visit 1: Post	3.75	2.05
		Visit 19: Pre	2.5	0.67
		Visit 19: Post	2.83	1.11
	Flexibility	Visit 1: Pre	3.54	1.92
		Visit 1: Post	3.72	1.62
		Visit 19: Pre	2.81	1.25
		Visit 19: Post	3.72	1.9

4.3 HEMODYNAMIC PARAMETERS

4.3.1 Heart Rate Mean

Analysis by repeated measures Anova Group (A,B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.17, *p*=0.68), did not reveal a significant main effect for visit (F= 1.00, *p*=0.322), and revealed a significant main effect for time (F= 17.71, *p*=0.0001). The interaction effect for group*visit number* time was found to be non-significant (F= 1.51, *p*= 0.226). See data Table 7.

4.3.2 Systolic Blood Pressure Mean

Analysis by repeated measures Anova Group (A,B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.12, *p*=0.73), did not reveal a significant main effect for visit (F= 3.67, *p*=.062), and revealed a significant main effect for time (F= 50.08, *p*=0.0001). The interaction effect for group*visit number* time was found to be non-significant (F= 0.002, *p*=0.91). See data Table 7.

4.3.3 Diastolic Blood Pressure Mean

Analysis by repeated measures Anova Group (A,B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.005, *p*=0.943), did not reveal a significant main effect for visit (F= 0.02, *p*=0.876), and revealed a significant main effect for time (F= 67.54, *p*=0.0001). The interaction effect for group*visit number* time was found to be non-significant (F= 0.17, *p*=0.679). See data Table 7.

4.3.4 Root Mean Squared Standard Deviation

Analysis by repeated measures Anova Group (A,B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 1.09, *p*=0.301), did not reveal a significant main effect for visit (F= 1.75, *p*=0.193), and did not reveal a significant main effect for time (F= 0.87, *p*=0.356). The interaction effect for group*visit number* time was found to be non-significant (F= 0.87, *p*=0.356). See data Table 7.

4.3.5 Average RR Interval

Analysis by repeated measures Anova Group (A,B) by visit number (1,19) by time (pre, during PASAT) did not reveal a significant main effect for group (F= 0.87, *p*=0.354), did not reveal a significant main effect for visit (F= 0.48, *p*=0.493), and did not reveal a significant main effect for time (F= 0.00, *p*=1.00). The interaction effect for group*visit number* time was found to be non-significant (F= 0.00, *p*=1.00). See data Table 7.

4.3.6 Hemodynamic Parameter Results Summary

All post-PASAT-C DERS values were higher than at Pre. Similarly, significant main effects of time were found for both heart rate (F= 17.71, $p < 0.01$) and systolic blood pressure (F= 50.08, $p < 0.01$) which were greater post-PASAT-C.

Table 7

Hemodynamic Parameters Results

Variable	Group	Time	Unit	M	SD
Heart Rate Mean	Resistance	Visit 1: Pre	bpm	84.19	10.63
		Visit 1: During	bpm	87.1	9.86
		Visit 19: Pre	bpm	79.12	12.4
		Visit 19: During	bpm	80.68	12.22
	Flexibility	Visit 1: Pre	bpm	82.89	9.67
		Visit 1: During	bpm	84.99	10.69
		Visit 19: Pre	bpm	81.9	4.83
		Visit 19: During	bpm	85.97	5.96
Systolic Blood Pressure Mean	Resistance	Visit 1: Pre	mmHg	104.8	23.28
		Visit 1: During	mmHg	117.27	19.9
		Visit 19: Pre	mmHg	93.02	9.29
		Visit 19: During	mmHg	103.85	11.76
	Flexibility	Visit 1: Pre	mmHg	100.21	21.33
		Visit 1: During	mmHg	112.12	23.39
		Visit 19: Pre	mmHg	93.53	14.73
		Visit 19: During	mmHg	105.02	16.59
Diastolic Blood Pressure Mean	Resistance	Visit 1: Pre	mmHg	55.44	12.88
		Visit 1: During	mmHg	64.89	11.19
		Visit 19: Pre	mmHg	56.22	10.63
		Visit 19: During	mmHg	62.27	12.15
	Flexibility	Visit 1: Pre	mmHg	54.64	12.59
		Visit 1: During	mmHg	61.73	14.95
		Visit 19: Pre	mmHg	57.66	10.67
		Visit 19: During	mmHg	63.28	11.8
Root Mean Squared Standard Deviation	Resistance	Visit 1: Pre		54.81	19.61
		Visit 1: During		54.81	19.61
		Visit 19: Pre		66.97	19.96
		Visit 19: During		68.36	20.32
	Flexibility	Visit 1: Pre		55.21	22.28
		Visit 1: During		55.21	22.28
		Visit 19: Pre		56.31	9.44
		Visit 19: During		56.31	9.44
Average R R Interval	Resistance	Visit 1: Pre	ms	685.97	81.96
		Visit 1: During	ms	685.97	81.96
		Visit 19: Pre	ms	731.95	100.47
		Visit 19: During	ms	732.37	105.37
	Flexibility	Visit 1: Pre	ms	693.15	79.35
		Visit 1: During	ms	693.15	79.35
		Visit 19: Pre	ms	680.06	43.52
		Visit 19: During	ms	680.06	43.52

CHAPTER 5: DISCUSSION

5.1 EFFECTS OF PROGRAMMED RESISTANCE TRAINING

Initial strength gains for untrained individuals, respond favorably to a multitude of training stimuli (Mangine et al., 2015), a combination of neurological activation and skeletal muscle adaptation (Moritani, 1993), and increased muscle coordination (Hanson et al., 2009). Satellite cells are activated in the very early stages of training; their proliferation and later fusion with existing fibers are intimately involved in the hypertrophic response (Folland & Williams, 2007). In the first 6-8 weeks of training before noticeable changes in muscle size, it is suggested that there is an increased activation of neural drive, resulting in increased strength. Surface EMG recordings support an increased neural activation of approximately 10% as a result of training (Moritani & deVries,1979, P. Komi, 1986). Enhanced neurological activation can be due to increased motor-unit recruitment and firing frequency that can be improved through resistance training (Folland & Williams, 2007). Although there is little data on resistance training, data suggests that resistance training of moderate intensity (around 70% of 1 RM) can reduce cardiovascular parameters (Fagard, 2006). A one-year progressive resistance training study done by Morganti, found roughly a 70% increase in strength but observed that approximately 45% of the greatest gains were seen in the first 3 months (Morganti et al., 1995). Rapid improvement in the ability to perform the training exercise resulted from learning the correct sequence of muscle contractions as a motor pattern in the central nervous system, typically referred to as a central pattern generator (Jones et al., 1989). A cross-over training effect has been observed in several studies where training one limb has resulted in strength increases in the contralateral untrained limb (Jones et al., 1989). Central adaptation affecting both limbs, cross-over strength increases ranging from 10 to 30% have been demonstrated (Darcus & Salter,1955; Komi et al., 1978; Moritani & deVries,1979). In the current

10-week study, significant strength increases were observed from visit 1 to visit 19. Cable lat pull down had a 47% increase, cable row had a 63% increase, DB chest press had a 45% increase, smith machine back squat had a 152% increase, and weighted calf raises had a 38% increase. In conclusion, the current study findings are similar to the literature.

5.2 FLEXIBILITY EFFECTS FROM PROGRAMED STRETCHING

Range of motion can be limited by muscle tension. Stretching applies tension to structures such as joint capsules, fascia and muscle. By lengthening these structures more range of motion will occur (Page, 2012). Long term stretching would cause a permanent shift in the optimum length of muscle (Woods et al., 2007). There was a slight increase among all flexibility assessments (left shoulder mobility, right shoulder mobility, prone trunk lift, left leg lift, right leg lift); however, none were significant. It is important to note that the flexibility group served as the comparison group for the study. A different mode of exercise, “flexibility” with the same time of exposure was essential for comparison with the resistance training group. A meta-analysis between 8 different stretching protocols completed by Woods (2007), all utilized different static stretches held for 30 seconds and reported an increase in flexibility (Woods et al., 2007).

In the present study non-significant increases were: left shoulder mobility had a 20% increase, right shoulder mobility had a 24% increase, prone trunk lift had a 21% increase, left leg lift had a 9% increase, and right leg lift had a 16% increase. Each stretch was held from 15 to 25 seconds throughout the 10 weeks, when compared to other studies that found increases in flexibility stretches were roughly held for 30 seconds. A study conducted by Bandy (1997) demonstrated that although stretching for 30 and 60 seconds one or three times per day for 5 days per week for 6 weeks was more effective for increasing muscle flexibility (as determined by increased knee extension ROM) than no stretching, there was no difference between stretching one or three times per day using either a 30 or 60 second duration of stretching. Therefore, a 30-second duration is an effective amount of time (Bandy et al., 1997). Non-significant increases were present in the flexibility assessment were most likely due to holding the stretches for less than 30 seconds.

5.3 EFFECTS OF PASAT-C ON EMOTION REGULATION AND HEMODYNAMIC PARAMETERS

The PASAT-C is a highly effective test for producing emotion regulation and hemodynamics changes. According to a meta-analysis conducted by Kim (2018) looked at 37 publications that met the inclusion criteria of human participants, heart rate variability (HRV) as an objective psychological stress measure, and measured HRV reactivity; the current neurobiological evidence suggests that HRV is impacted by stress and supports its use for the objective assessment of psychological health and stress (Kim et al., 2018). Research has shown that the PASAT-C can detect impairments in cognitive processing (Tombaugh, 2006). The PASAT-C was developed to for measuring distress tolerance (Gronwall, 1977). This task allows for the comprehensive examination of behavioral, motor, cognitive, self-report, and psychological response modes without sacrificing experimental precision and control (Lujuez et al., 2003). The PASAT-C is an effective tool to cause distress because it requires the successful completion of a variety of cognitive functions, primarily those related to attention which can be disturbed with stress (Tombaugh, 2006). In the present study, an increase was observed across all psychological surveys (PANAS-Negative, S-DERS: Nonacceptance, S-DERS: Modulate, S-DERS: Awareness, S-DERS: Awareness) pre and post PASAT-C in both groups regardless of time period. An increase pre to post PASAT-C was observed for both groups for heart rate mean and systolic and diastolic blood pressure. Behavioral evidence supports that emotion regulation may impact the association between stressful experiences and psychopathology (Young et al., 2019). There were no other similar studies to our protocols and exact measures but the following studies use a similar stress test to compare data with. In one study, participants completed a social stress task (a mock job interview), completed distress ratings before and after the task, and completed self-report measures of cognitive reappraisal (using the ERQ) and depressive symptoms. Among those reporting higher levels of depressive symptoms, greater self-reported tendency to use cognitive reappraisal was associated with faster 'emotional recovery' (Shapero et al., 2018). Another study utilizing the TSST test as the stress inducer and found impacts on psychological and hemodynamic responses. Heart rates ($p<0.001$) and saliva cortisol levels ($p<0.001$) were significantly elevated in response to the TSST. Perceived stress ($p < 0.001$), anxiety ($p < 0.001$) and emotional insecurity ($p < 0.001$) ratings were significantly increased during and after the TSST as compared to baseline values (Hellhammer & Schubert, 2012).

5.4 EXERCISE AND EMOTION REGULATION

Physical exercise is associated with improvements in mental health (Slee et al., 2007), potentially through enhanced emotion regulation (Bernstein & McNally, 2018). However, the mechanisms that account for these relations remain unclear (Paluska & Schwenk, 2000) and no studies have examined the effect of resistance training on emotional regulation. Research shows that resistance training has mood-enhancing effects, particularly if individuals initially felt stressed and irritated prior to exercise (Acevedo & Ekkekakis, 2006). The present study provides a new insight into the relationship between chronic resistance training and emotion regulation. Resistance training is an important component of rehabilitation due to its ability to increase muscular strength and enhance functional ability (Kristensen & Burgess, 2013). With resistance training gaining popularity, the foundation for research on the physiological and psychological benefits are growing (Cavarretta et al., 2018). Designing an appropriate resistance training program is challenging (National Strength & Conditioning Association [NSCA] et al., 2015; Schoenfeld et al., 2016;

Zatsiorsky & Kramer, 2006). Additionally, many long-term studies have noted improvements in the psychological aspects of health, such as depression, anxiety, self-esteem, cognition, and stress in relation to resistance training (Doyne et al., 1987; Katula et al., 2008; Lachman et al., 2006; O'Connor et al., 2010). Aerobic and resistance training programs of similar duration, offer substantial psychological and physiological benefits (Norris et al., 1990). A meta-analysis done by Cavarretta (2018), looked at 32 studies that investigated the effect of resistance training on affect, anxiety, and mood in healthy populations. Of these studies, 57.1% (8 out of 14) demonstrated some improvement in effect, 37.5% (6 out of 16) some improvement in anxiety, and 50% (2 out of 4) some statistically significant medium improvement in mood. Aerobic exercise is linked with affective pleasure-displeasure responses that reinforce adherence to future exercise participation. Research in resistance training has yet to confirm the same effects, however it is important to consider making resistance exercise more psychologically rewarding to produce the same outcome (Cavarretta et al., 2018). For example, aerobic training more effectively modifies cardiovascular risk factors, whereas resistance training more effectively maintains basal metabolic rate, muscle mass, and physical function (Egan & Zierath, 2013). Both aerobic and resistance training are beneficial for health and should be encouraged.

A study conducted by Bernstein & McNally, looked that the effects of aerobic training on emotion regulation and found that aerobic training can improve emotional health by strengthening emotion regulation. Anxiety, depression, and emotion regulation were evaluated using psychological surveys (DASS, DERS). However, the link that explains the association between aerobic exercise and emotional well-being is poorly understood (Bernstein & McNally, 2016). Everyone becomes upset at times, some individuals can recover quickly by shifting their attention away from this distress, others cannot (Cassell, 1998). Practitioners should be aware that according to the results of the current study, programming resistance and flexibility exercises can convey health or performance-related benefits but do not affect an individual's emotion regulation or physiological responses to stressors. Practitioners interested in programming training to influence emotion regulation or physiological responses to stressors are encouraged to use aerobic exercise, which has demonstrated efficacy in these areas. Although the physical health advantages of aerobic exercise likely contribute to emotional well-being, the psychological impact of physical activity is not entirely explained by these changes (Bernstein & McNally, 2016). Future research is needed to evaluate other combinations of volume, intensity, and exercise selection in relation to the specific effects on emotion regulation.

5.5 RESISTANCE TRAINING VS AEROBIC TRAINING EFFECTS ON HEMODYNAMIC PARAMETERS

Physical exercise is one of the most effective methods to improve cardiovascular health (Patel et al., 2017). The regulation of cardiac output is influenced by the autonomic nervous system, cardiovascular, respiratory, and endocrine systems (Arya et al., 2019). A 6-week long study done by Norris, consisting of 40-minute sessions 3 times a week, compared the effects of aerobic and weight training on HR and BP. Both aerobic and weight training groups lowered their HR and BP. The weight training group had a 5% reduction in HR and a 9% reduction in BP. The aerobic group had more significant effects with a 13% reduction in HR and a 3% reduction in BP (Norris et al., 1990). Since aerobic exercise creates more acute metabolic demands of working muscle compared to anaerobic exercise, cardiovascular demands must greatly increase (Michael et al., 2017). Similar to aerobic exercise, resistance training may exert a potentially beneficial influence on the CV system.

RT produces a positive adaptation in heart rate and blood pressure (De Sá et al., 2020). No significant differences were observed when comparing hemodynamic responses between the resistance and flexibility group pre and during the PASAT-C. Acute circulatory responses to resistance training can decrease resting heart rate levels, possibly due to increase activation of the parasympathetic system resulting in release of acetylcholine increasing vasodilation. (McCartney, 1999). Systolic and diastolic blood pressure remained roughly the same at pre and at post PASAT-C visit 1 and 19 among both groups (though pre-BP was lower than post consistently). A meta-analysis including 9 difference resistance training programs with a mean duration of 14 weeks completed by Fagard (2006), found that there was roughly a 3 mmHg decrease in post resistance intervention (Fagard, 2006). Root mean squared standard deviation and average R R interval, to measures of HRV, also remained roughly the same pre and post PASAT-C visit 1 and 19 among both groups. Future research should look at different resistance intensity, column, and exercise selection and its effects on hemodynamic parameters different from the current study.

5.6 LIMITATIONS

The generalizability of the results is limited by the subjects being in their late teens and early twenties. Academic stressors of attending college may have affected stress levels by taking the psychological surveys and the PASAT-C. Outside of this study, participants were instructed not to participate in any physical activity. The study population could limit generalizability. Post intervention data results utilizing the PASAT-C could have been affected by outside stressors such as tests and final projects due at the end of the semester. Post PASAT-C could have also been impacted by familiarity with the tool the second time taking the test. It is important to note that poor mathematical skills can affect the subject’s response to the PASAT-C. Psychological surveys, Difficulties in Emotion Regulation Scale (DERS) and Depression, Anxiety, Stress Scale (DASS-

21) were planned on being used however due to error in administration, they were not able to be analyzed. The DERS was supposed to be administered at the beginning at each training session however due to printing issues causing there to be missing questions on the surveys, the entire survey was not administered properly until half way through the study. The DASS-21 also had missing questions due to printing issues, therefore data was only collected post intervention and not pre. Data that was collected from the two surveys were analyzed and extrapolated and found that even if the two surveys were administered properly, there would not be a significant effect.

CHAPTER 6: CONCLUSION

The ability to manage emotional responses is influenced by cognitive and environmental factors. Mental illness is very common and there are ways to help prevent, ease, and solve stress. The purpose of the investigation was to determine the effects of resistance training on emotional regulation and hemodynamic parameters in response to a stressful task. The psychological surveys scores, before and after the PASAT-C, were not significantly lower post intervention compared to baseline testing. Additionally, the hemodynamic parameters before and after the PASAT-C were not significantly lower post intervention compared to baseline testing. There were significant increases in strength with the resistance training group seen in 3 exercises (cable lat pull down, cable row, and smith machine back squat) and nonsignificant strength increases among 2 exercises (dumbbell chest press and calf raise). There were significant increases in flexibility with the stretching training group seen in 1 assessment (right leg lift) and nonsignificant flexibility increases among 4 assessments (left shoulder mobility, right shoulder mobility, prone trunk lift, and left leg lift). Resistance training did not have a significant effect on emotional regulation nor hemodynamic parameters. The PASAT-C is a valid test to measure distress tolerance as it produces negative affective states. In summary, strength and conditioning coaches, personal trainers, and researchers should be aware that resistance training of moderate intensity does not elicit an effect on emotion regulation and hemodynamic parameters. The mechanisms to evaluate that resistance training affects emotional regulation in regards to stress remains poorly understood and requires future exploration. This study is the first to examine the effects of chronic resistance training intervention on state and trait stress, anxiety, and depression. Future researchers should expand on the current study by finding more accurate assessments and manipulating intensity, volume, exercise selection to evaluate emotional regulation pre and post exercise intervention.

REFERENCES

Abudiab, M. M., Redfield, M. M., Melenovsky, V., Olson, T. P., Kass, D. A., Johnson, B. D., & Borlaug, B. A. (2013). Cardiac output response to exercise in relation to metabolic demand in heart failure with preserved ejection fraction. *European Journal of Heart Failure*, *15*(7), 776–785. https://doi.org/10.1093/eurjhf/hft026

Acevedo, E. O., & Ekkekakis, P. (2006). *Psychobiology of Physical Activity* (First ed.). Human Kinetics.

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

Aleman, A., & Torres-Alemán, I. (2009). Circulating insulin-like growth factor I and cognitive function: Neuromodulation throughout the lifespan. *Progress in Neurobiology*, *89*(3), 256–265. https://doi.org/10.1016/j.pneurobio.2009.07.008

Allen, A. P., Kennedy, P. J., Dockray, S., Cryan, J. F., Dinan, T. G., & Clarke, G. (2017). The Trier Social Stress Test: Principles and practice. *Neurobiology of Stress*, *6*, 113–126. https://doi.org/10.1016/j.ynstr.2016.11.001

Anish, E. J. (2005). Exercise and Its Effects on the Central Nervous System. *Current Sports Medicine Reports*, *4*(1), 18–23. https://doi.org/10.1097/01.csmr.0000306066.14026.77

Arya, V., Kobe, J., Mishra, N., Al-Moustadi, W., Nates, W., & Kumar, B. (2019). Cardiac output monitoring: Technology and choice. *Annals of Cardiac Anaesthesia*, *22*(1), 6. https://doi.org/10.4103/aca.aca_41_18

Ayuk, J. (2006). Growth hormone and its disorders. *Postgraduate Medical Journal*, *82*(963), 24–30. https://doi.org/10.1136/pgmj.2005.036087

Bandy, W. D., Irion, J. M., & Briggler, M. (1997). The Effect of Time and Frequency of Static Stretching on Flexibility of the Hamstring Muscles. *Physical Therapy*, *77*(10), 1090–1096. https://doi.org/10.1093/ptj/77.10.1090

Bernstein, E. E., & McNally, R. J. (2016). Acute aerobic exercise helps overcome emotion regulation deficits. *Cognition and Emotion*, *31*(4), 834–843. https://doi.org/10.1080/02699931.2016.1168284

Bernstein, E. E., & McNally, R. J. (2018). Exploring behavioral pattern separation and risk for emotional disorders. *Journal of Anxiety Disorders*, *59*, 27–33. https://doi.org/10.1016/j.janxdis.2018.08.006

Bretland, R. J., & Thorsteinsson, E. B. (2015). Reducing workplace burnout: the relative benefits of cardiovascular and resistance exercise. *PeerJ*, *3*, e891. https://doi.org/10.7717/peerj.891

Brown, J. D. (1991). Staying fit and staying well: Physical fitness as a moderator of life stress. *Journal of Personality and Social Psychology*, *60*(4), 555–561. https://doi.org/10.1037/0022-3514.60.4.555

Buchheit, M., Laursen, P. B., & Ahmaidi, S. (2007). Parasympathetic reactivation after repeated sprint exercise. *American Journal of Physiology-Heart and Circulatory Physiology*, *293*(1), H133–H141. https://doi.org/10.1152/ajpheart.00062.2007

Cassell, E. J. (1998). The Nature of Suffering and the Goals of Medicine. *Loss, Grief & Care*, *8*(1–2), 129–142. https://doi.org/10.1300/j132v08n01_18

Cavarretta, D. J., Hall, E. E., & Bixby, W. R. (2018). The acute effects of resistance exercise on affect, anxiety, and mood – practical implications for designing resistance training programs. *International Review of Sport and Exercise Psychology*, *12*(1), 295–324. https://doi.org/10.1080/1750984x.2018.1474941

Christensen, N. J., & Galbo, H. (1983). Sympathetic Nervous Activity During Exercise. *Annual Review of Physiology*, *45*(1), 139–153. https://doi.org/10.1146/annurev.ph.45.030183.001035

Clemmons, D. R. (2004). The relative roles of growth hormone and IGF-1 in controlling insulin sensitivity. *Journal of Clinical Investigation*, *113*(1), 25–27. https://doi.org/10.1172/jci20660

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A Global Measure of Perceived Stress. *Journal of Health and Social Behavior*, *24*(4), 385. https://doi.org/10.2307/2136404

Cotman, C. W., & Engesser-Cesar, C. (2002). Exercise Enhances and Protects Brain Function. *Exercise and Sport Sciences Reviews*, *30*(2), 75–79. https://doi.org/10.1097/00003677-200204000-00006

Craft, L. L., & Perna, F. M. (2004). The Benefits of Exercise for the Clinically Depressed. *The Primary Care Companion to The Journal of Clinical Psychiatry*, *06*(03), 104–111. https://doi.org/10.4088/pcc.v06n0301

Crisafulli, A., Orrù, V., Melis, F., Tocco, F., & Concu, A. (2003). Hemodynamics during active and passive recovery from a single bout of supramaximal exercise. *European Journal of Applied Physiology*, *89*(2), 209–216. https://doi.org/10.1007/s00421-003-0796-4

Daly, J. A., Vangelisti, A. L., & Lawrence, S. G. (1989). Self-focused attention and public speaking anxiety. *Personality and Individual Differences*, *10*(8), 903–913. https://doi.org/10.1016/0191-8869(89)90025-1

Darcus, H. D., & Salter, N. (1955). The effect of repeated muscular exertion on muscle strength. *The Journal of Physiology*, *129*(2), 325–336. https://doi.org/10.1113/jphysiol.1955.sp005357

de Sá, C. A., Catani, D., Cardoso, A. M., da Silva-Grigoletto, M. E., Battiston, F. G., & Corralo, V. S. (2020). Resistance training affects the hemodynamic parameters of hypertensive and normotensive women differently, and regardless of performance improvement. *Journal of Exercise Science & Fitness*, *18*(3), 122–128. https://doi.org/10.1016/j.jesf.2020.03.003

Deschenes, M. R., & Kraemer, W. J. (2002). Performance and Physiologic Adaptations to Resistance Training. *American Journal of Physical Medicine & Rehabilitation*, *81*(Supplement), S3–S16. https://doi.org/10.1097/00002060-200211001-00003

deVries, H. A. (1981). Tranquilizer Effect of Exercise: A Critical Review. *The Physician and Sportsmedicine*, *9*(11), 46–55. https://doi.org/10.1080/00913847.1981.11711206

Doyne, E. J., Ossip-Klein, D. J., Bowman, E. D., Osborn, K. M., McDougall-Wilson, I. B., & Neimeyer, R. A. (1987). Running versus weight lifting in the treatment of depression. *Journal of Consulting and Clinical Psychology*, *55*(5), 748–754. https://doi.org/10.1037/0022-006x.55.5.748

Dunstan, D. W., Daly, R. M., Owen, N., Jolley, D., Vulikh, E., Shaw, J., & Zimmet, P. (2004). Home-Based Resistance Training Is Not Sufficient to Maintain Improved Glycemic Control Following Supervised Training in Older Individuals With Type 2 Diabetes. *Diabetes Care*, *28*(1), 3–9. https://doi.org/10.2337/diacare.28.1.3

Egan, B., & Zierath, J. (2013). Exercise Metabolism and the Molecular Regulation of Skeletal Muscle Adaptation. *Cell Metabolism*, *17*(2), 162–184. https://doi.org/10.1016/j.cmet.2012.12.012

Endler, N. S., & Kocovski, N. L. (2001). State and trait anxiety revisited. *Journal of Anxiety Disorders*, *15*(3), 231–245. https://doi.org/10.1016/s0887-6185(01)00060-3

Fagard, R. (2006). Exercise Is Good For Your Blood Pressure: Effects of Endurance Training and Resistance Training. *Clinical and Experimental Pharmacology and Physiology*, *33*(9), 853–856. https://doi.org/10.1111/j.1440-1681.2006.04453.x

Focht, B. C. (2002). Pre-exercise anxiety and the anxiolytic responses to acute bouts of self-selected and prescribed intensity resistance exercise. *The Journal of Sports Medicine and Physical Fitness*, *42*(2), 217–223.

Focht, B. C., & Koltyn, K. F. (1999). Influence of resistance exercise of different intensities on state anxiety and blood pressure. *Medicine & Science in Sports & Exercise*, *31*(3), 456–463. https://doi.org/10.1097/00005768-199903000-00016

Folland, J. P., & Williams, A. G. (2007). The Adaptations to Strength Training. *Sports Medicine*, *37*(2), 145–168. https://doi.org/10.2165/00007256-200737020-00004

Fradkin, A. J., Zazryn, T. R., & Smoliga, J. M. (2010). Effects of Warming-up on Physical Performance: A Systematic Review With Meta-analysis. *Journal of Strength and Conditioning Research*, *24*(1), 140–148. https://doi.org/10.1519/jsc.0b013e3181c643a0

Fu, Q., & Levine, B. D. (2013). Exercise and the autonomic nervous system. *Autonomic Nervous System*, 147–160. https://doi.org/10.1016/b978-0-444-53491-0.00013-4

Fuqua, J. S., & Rogol, A. D. (2013). Neuroendocrine alterations in the exercising human: Implications for energy homeostasis. *Metabolism*, *62*(7), 911–921. https://doi.org/10.1016/j.metabol.2013.01.016

Gilbert, K., Mineka, S., Zinbarg, R. E., Craske, M. G., & Adam, E. K. (2016). Emotion Regulation Regulates More Than Emotion. *Clinical Psychological Science*, *5*(1), 37–51. https://doi.org/10.1177/2167702616654437

Gordon, B. R., McDowell, C. P., Lyons, M., & Herring, M. P. (2017). The Effects of Resistance Exercise Training on Anxiety: A Meta-Analysis and Meta-Regression Analysis of Randomized Controlled Trials. *Sports Medicine*, *47*(12), 2521–2532. https://doi.org/10.1007/s40279-017-0769-0

Gronwall, D. M. A. (1977). Paced Auditory Serial-Addition Task: A Measure of Recovery from Concussion. *Perceptual and Motor Skills*, *44*(2), 367–373. https://doi.org/10.2466/pms.1977.44.2.367

Gross, J. J., & Levenson, R. W. (1993). Emotional suppression: Physiology, self-report, and expressive behavior. *Journal of Personality and Social Psychology*, *64*(6), 970–986. https://doi.org/10.1037/0022-3514.64.6.970

Hanson, E. D., Srivatsan, S. R., Agrawal, S., Menon, K. S., Delmonico, M. J., Wang, M. Q., & Hurley, B. F. (2009). Effects of Strength Training on Physical Function: Influence of Power, Strength, and Body Composition. *Journal of Strength and Conditioning Research*, *23*(9), 2627–2637. https://doi.org/10.1519/jsc.0b013e3181b2297b

Hasler, G. (2010). Pathophysiology of Depression: Do we have any solid Evidence of Interest to Clinicians? *World Psychiatry*, *9*(3), 155–161. https://doi.org/10.1002/j.2051-5545.2010.tb00298.x

Hellhammer, J., & Schubert, M. (2012). The physiological response to Trier Social Stress Test relates to subjective measures of stress during but not before or after the test. *Psychoneuroendocrinology*, *37*(1), 119–124. https://doi.org/10.1016/j.psyneuen.2011.05.012

Jones, D. A., Rutherford, O. M., & Parker, D. F. (1989). Physiological Changes in Skeletal Muscle as a Result of Strength Training. *Quarterly Journal of Experimental Physiology*, *74*(3), 233–256. https://doi.org/10.1113/expphysiol.1989.sp003268

Katula, J. A., Rejeski, W. J., & Marsh, A. P. (2008). Enhancing quality of life in older adults: A comparison of muscular strength and power training. *Health and Quality of Life Outcomes*, *6*(1), 45. https://doi.org/10.1186/1477-7525-6-45

Khanzada, F. J., Soomro, N., & Khan, S. Z. (2015). Association of Physical Exercise on Anxiety and Depression Amongst Adults. *Journal of the College of Physicians and Surgeons--Pakistan*, 546–548.

Kim, H. G., Cheon, E. J., Bai, D. S., Lee, Y. H., & Koo, B. H. (2018). Stress and Heart Rate Variability: A Meta-Analysis and Review of the Literature. *Psychiatry Investigation*, *15*(3), 235–245. https://doi.org/10.30773/pi.2017.08.17

Knight, K. L. (1985). Quadriceps strengthening with the DAPRE technique: case studies with neurological implications. *Medicine & Science in Sports & Exercise*, *17*(6), 646–650. https://doi.org/10.1249/00005768-198512000-00004

Komi, P. (1986). Training of Muscle Strength and Power: Interaction of Neuromotoric, Hypertrophic, and Mechanical Factors. *International Journal of Sports Medicine*, *07*(S 1), S10–S15. https://doi.org/10.1055/s-2008-1025796

Komi, P. V., Viitasalo, J. T., Rauramaa, R., & Vihko, V. (1978). Effect of isometric strength training on mechanical, electrical, and metabolic aspects of muscle function. *European Journal of Applied Physiology and Occupational Physiology*, *40*(1), 45–55. https://doi.org/10.1007/bf00420988

Kraemer, W. J., & Ratamess, N. A. (2005). Hormonal Responses and Adaptations to Resistance Exercise and Training. *Sports Medicine*, *35*(4), 339–361. https://doi.org/10.2165/00007256-200535040-00004

Kraemer, W. J., Ratamess, N. A., & French, D. N. (2002). Resistance Training for Health and Performance. *Current Sports Medicine Reports*, *1*(3), 165–171. https://doi.org/10.1249/00149619-200206000-00007

Kristensen, J., & Burgess, S. (2013). A comparison of two 3-week resistance training programmes commonly used in short-term military rehabilitation. *Journal of the Royal Army Medical Corps*, *159*(1), 35–39. https://doi.org/10.1136/jramc-2013-000008

Lachman, M. E., Neupert, S. D., Bertrand, R., & Jette, A. M. (2006). The Effects of Strength Training on Memory in Older Adults. *Journal of Aging and Physical Activity*, *14*(1), 59–73. https://doi.org/10.1123/japa.14.1.59

Lavender, J. M., Tull, M. T., DiLillo, D., Messman-Moore, T., & Gratz, K. L. (2016). Development and Validation of a State-Based Measure of Emotion Dysregulation. *Assessment*, *24*(2), 197–209. https://doi.org/10.1177/1073191115601218

le Roith, D., Bondy, C., Yakar, S., Liu, J. L., & Butler, A. (2001). The Somatomedin Hypothesis: 2001. *Endocrine Reviews*, *22*(1), 53–74. https://doi.org/10.1210/edrv.22.1.0419

Leith, L. M. (2010). *Foundations of Exercise and Mental Health*. Fitness Information Technology.

Lejuez, C. W., Kahler, C. W., & Brown, R. A. (2003). A modified computer version of the Paced Auditory Serial Addition Task (PASAT) as a laboratory-based stressor. *The Behavior Therapist*, 290–293.

Lin, T. W., Tsai, S. F., & Kuo, Y. M. (2018). Physical Exercise Enhances Neuroplasticity and Delays Alzheimer's Disease. *Brain Plasticity*, *4*(1), 95–110. https://doi.org/10.3233/bpl-180073

Lopresti, A. L., Hood, S. D., & Drummond, P. D. (2013). A review of lifestyle factors that contribute to important pathways associated with major depression: Diet, sleep and exercise. *Journal of Affective Disorders*, *148*(1), 12–27. https://doi.org/10.1016/j.jad.2013.01.014

Lujuez, C. W., Kahler, C. W., & Brown, R. A. (2003). A modified computer version of the Paced Auditory Serial Addition Task (PASAT) as a laboratory-based stressor. *The Behavior Therapist*, *26*, 290–293.

Mangine, G. T., Hoffman, J. R., Gonzalez, A. M., Townsend, J. R., Wells, A. J., Jajtner, A. R., Beyer, K. S., Boone, C. H., Miramonti, A. A., Wang, R., LaMonica, M. B., Fukuda, D. H., Ratamess, N. A., & Stout, J. R. (2015). The effect of training volume and intensity on improvements in muscular strength and size in resistance-trained men. *Physiological Reports*, *3*(8), e12472. https://doi.org/10.14814/phy2.12472

Matta Mello Portugal, E., Cevada, T., Sobral Monteiro-Junior, R., Teixeira Guimarães, T., da Cruz Rubini, E., Lattari, E., Blois, C., & Camaz Deslandes, A. (2013). Neuroscience of Exercise: From Neurobiology Mechanisms to Mental Health. *Neuropsychobiology*, *68*(1), 1–14. https://doi.org/10.1159/000350946

McCartney, N. (1999). Acute responses to resistance training and safety. *Medicine & Science in Sports & Exercise*, *31*(1), 31–37. https://doi.org/10.1097/00005768-199901000-00007

McCorry, L. K. (2007). Physiology of the Autonomic Nervous System. *American Journal of Pharmaceutical Education*, *71*(4), 78. https://doi.org/10.5688/aj710478

MeAuley, E., & Courneya, K. S. (1994). The Subjective Exercise Experiences Scale (SEES): Development and Preliminary Validation. *Journal of Sport and Exercise Psychology*, *16*(2), 163–177. https://doi.org/10.1123/jsep.16.2.163

Merikangas, K. R., He, J. P., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., Benjet, C., Georgiades, K., & Swendsen, J. (2010). Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*(10), 980–989. https://doi.org/10.1016/j.jaac.2010.05.017

Michael, S., Graham, K. S., & Davis, G. M. (2017). Cardiac Autonomic Responses during Exercise and Post-exercise Recovery Using Heart Rate Variability and Systolic Time Intervals—A Review. *Frontiers in Physiology*, *8*. https://doi.org/10.3389/fphys.2017.00301

Mikkelsen, K., Stojanovska, L., Polenakovic, M., Bosevski, M., & Apostolopoulos, V. (2017). Exercise and mental health. *Maturitas*, *106*, 48–56. https://doi.org/10.1016/j.maturitas.2017.09.003

Morgan, J. A., Corrigan, F., & Baune, B. T. (2015). Effects of physical exercise on central nervous system functions: a review of brain region specific adaptations. *Journal of Molecular Psychiatry*, *3*(1), 1–13. https://doi.org/10.1186/s40303-015-0010-8

Morganti, C. M., Nelson, M. E., Fiatarone, M. A., Dallal, G. E., Economos, C. D., Crawford, B. M., & Evans, W. J. (1995). Strength improvements with 1 yr of progressive rsistance training in older women. *Medicine & Science in Sports & Exercise*, *27*(6), 906???912. https://doi.org/10.1249/00005768-199506000-00017

Moritani, T. (1993). Neuromuscular adaptations during the acquisition of muscle strength, power and motor tasks. *Journal of Biomechanics*, *26*, 95–107. https://doi.org/10.1016/0021-9290(93)90082-p

Moritani, T., & deVries, H. A. (1979). Neural factors versus hypertrophy in the time course of muscle strength gain. *American Journal of Physical Medicine*, *58*, 115–130.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology*, *58*(3), 519–527. https://doi.org/10.1037/0022-3514.58.3.519

Musser, E. D., Backs, R. W., Schmitt, C. F., Ablow, J. C., Measelle, J. R., & Nigg, J. T. (2011). Emotion Regulation via the Autonomic Nervous System in Children with Attention-Deficit/Hyperactivity Disorder (ADHD). *Journal of Abnormal Child Psychology*, *39*(6), 841–852. https://doi.org/10.1007/s10802-011-9499-1

Nasso, S., Vanderhasselt, M. A., Demeyer, I., & de Raedt, R. (2019). Autonomic regulation in response to stress: The influence of anticipatory emotion regulation strategies and trait rumination. *Emotion*, *19*(3), 443–454. https://doi.org/10.1037/emo0000448

National Health Statistics Reports. (2018). *State Variation in Meeting the 2008 Federal Guidelines for Both Aerobic and Muscle-strengthening Activities Through Leisure-time Physical Activity Among Adults Aged 18–64: United States, 2010–2015* (No. 112). U.S.

Department Of Health And Human Services Centers for Disease Control and Prevention National Center for Health Statistics. https://www.cdc.gov/nchs/data/nhsr/nhsr112.pdf

Nobrega, A. C. L., O'Leary, D., Silva, B. M., Marongiu, E., Piepoli, M. F., & Crisafulli, A. (2014). Neural Regulation of Cardiovascular Response to Exercise: Role of Central Command and Peripheral Afferents. *BioMed Research International*, *2014*, 1–20. https://doi.org/10.1155/2014/478965

Norris, R., Carroll, D., & Cochrane, R. (1990). The effects of aerobic and anaerobic training on fitness, blood pressure, and psychological stress and well-being. *Journal of Psychosomatic Research*, *34*(4), 367–375. https://doi.org/10.1016/0022-3999(90)90060-h

NSCA -National Strength & Conditioning Association, Haff, G. G., & Triplett, T. N. (2015). *Essentials of Strength Training and Conditioning* (4th ed.). Human Kinetics.

O'Connor, P. J., Bryant, C. X., Veltri, J. P., & Gebhardt, S. M. (1993). State anxiety and ambulatory blood pressure following resistance exercise in females. *Medicine & Science in Sports & Exercise*, *11*(4), 516–521. https://doi.org/10.1249/00005768-199304000-00015

O'Connor, P. J., Herring, M. P., & Caravalho, A. (2010). Mental Health Benefits of Strength Training in Adults. *American Journal of Lifestyle Medicine*, *4*(5), 377–396. https://doi.org/10.1177/1559827610368771

Page, P. (2012). Current concepts in muscle stretching for exercise and rehabilitation. *International Journal of Sports Physical Therapy*, *7*(1), 109–119.

Paluska, S. A., & Schwenk, T. L. (2000). Physical Activity and Mental Health. *Sports Medicine*, *29*(3), 167–180. https://doi.org/10.2165/00007256-200029030-00003

Parkinson, B., & Totterdell, P. (1996). *Changing Moods: Psychology of Mood and Mood Regulation*. Longman.

Patel, H., Alkhawam, H., Madanieh, R., Shah, N., Kosmas, C. E., & Vittorio, T. J. (2017). Aerobic vs anaerobic exercise training effects on the cardiovascular system. *World Journal of Cardiology*, *9*(2), 134. https://doi.org/10.4330/wjc.v9.i2.134

Physical Activity Guidelines for Americans. (2008). U.S. Department of Health and Human Services. http://www.health.gov/PAGuidelines/

Powers, S., & Howley, E. (2017). *Exercise Physiology: Theory and Application to Fitness and Performance* (10th ed.). McGraw-Hill Education.

Rezk, C. C., Marrache, R. C. B., Tinucci, T., Mion, D., & Forjaz, C. L. M. (2006). Post-resistance exercise hypotension, hemodynamics, and heart rate variability: influence of exercise intensity. *European Journal of Applied Physiology*, *98*(1), 105–112. https://doi.org/10.1007/s00421-006-0257-y

Schneiderman, N., Ironson, G., & Siegel, S. D. (2005). Stress and Health: Psychological, Behavioral, and Biological Determinants. *Annual Review of Clinical Psychology*, *1*(1), 607–628. https://doi.org/10.1146/annurev.clinpsy.1.102803.144141

Schoenfeld, B. J., Ogborn, D., & Krieger, J. W. (2016). Dose-response relationship between weekly resistance training volume and increases in muscle mass: A systematic review and meta-analysis. *Journal of Sports Sciences*, *35*(11), 1073–1082. https://doi.org/10.1080/02640414.2016.1210197

Schwartz, A. (2016). Movement: How the Brain Communicates with the World. *Cell*, *164*(6), 1122–1135. https://doi.org/10.1016/j.cell.2016.02.038

Shapero, B. G., Stange, J. P., McArthur, B. A., Abramson, L. Y., & Alloy, L. B. (2018). Cognitive reappraisal attenuates the association between depressive symptoms and emotional response to stress during adolescence. *Cognition and Emotion*, *33*(3), 524–535. https://doi.org/10.1080/02699931.2018.1462148

Slee, N., Arensman, E., Garnefski, N., & Spinhoven, P. (2007). Cognitive-Behavioral Therapy for Deliberate Self-Harm. *Crisis*, *28*(4), 175–182. https://doi.org/10.1027/0227-5910.28.4.175

Solanki, D., & Lane, A. M. (2010). Relationships between Exercise as a Mood Regulation Strategy and Trait Emotional Intelligence. *Asian Journal of Sports Medicine*, *1*(4). https://doi.org/10.5812/asjsm.34831

Stanton, R., & Reaburn, P. (2014). Exercise and the treatment of depression: A review of the exercise program variables. *Journal of Science and Medicine in Sport*, *17*(2), 177–182. https://doi.org/10.1016/j.jsams.2013.03.010

Stifter, C. A., Dollar, J. M., & Cipriano, E. A. (2010). Temperament and emotion regulation: the role of autonomic nervous system reactivity. *Developmental Psychobiology*, *53*(3), 266–279. https://doi.org/10.1002/dev.20519

Stranahan, A. M., Lee, K., & Mattson, M. P. (2008). Central Mechanisms of HPA Axis Regulation by Voluntary Exercise. *NeuroMolecular Medicine*, *10*(2), 118–127. https://doi.org/10.1007/s12017-008-8027-0

Strickland, J. C., & Smith, M. A. (2014). The anxiolytic effects of resistance exercise. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00753

Substance Abuse and Mental Health Services Administration. (2020). *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on*

Drug Use and Health. https://www.samhsa.gov/data/sites/default/files/reports/rpt29393/2019NSDUHFFRPDFWHTML/2019NSDUHFFR1PDFW090120.pdf.

Taylor, J. L., Amann, M., Duchateau, J., Meeusen, R., & Rice, C. L. (2016). Neural Contributions to Muscle Fatigue. *Medicine & Science in Sports & Exercise*, *48*(11), 2294–2306. https://doi.org/10.1249/mss.0000000000000923

Tiller, J. W. G. (2012). Depression and anxiety. *The Medical Journal of Australia*, *1*(4), 28–31. https://doi.org/10.5694/mjao12.10628

Tombaugh, T. (2006). A comprehensive review of the Paced Auditory Serial Addition Test (PASAT). *Archives of Clinical Neuropsychology*, *21*(1), 53–76. https://doi.org/10.1016/j.acn.2005.07.006

Uy, C. C., Jeffrey, I. A., Wilson, M., Aluru, V., Madan, A., Lu, Y., & Raghavan, P. (2013). Autonomic Mechanisms of Emotional Reactivity and Regulation. *Psychology*, *04*(08), 669–675. https://doi.org/10.4236/psych.2013.48095

Verduijn, J., Milaneschi, Y., Schoevers, R. A., van Hemert, A. M., Beekman, A. T. F., & Penninx, B. W. J. H. (2015). Pathophysiology of major depressive disorder: mechanisms involved in etiology are not associated with clinical progression. *Translational Psychiatry*, *5*(9), e649. https://doi.org/10.1038/tp.2015.137

Vilarino, G. T., Andreato, L. V., de Souza, L. C., Branco, J. H. L., & Andrade, A. (2021). Effects of resistance training on the mental health of patients with fibromyalgia: a systematic review. *Clinical Rheumatology*. https://doi.org/10.1007/s10067-021-05738-z

Warburton, D. E. (2006). Health benefits of physical activity: the evidence. *Canadian Medical Association Journal*, *174*(6), 801–809. https://doi.org/10.1503/cmaj.051351

Warburton, D. E., Gledhill, N., & Quinney, A. (2001). Musculoskeletal Fitness and Health. *Canadian Journal of Applied Physiology*, *26*(2), 217–237. https://doi.org/10.1139/h01-013

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Westcott, W. L. (2012). Resistance Training is Medicine. *Current Sports Medicine Reports*, *11*(4), 209–216. https://doi.org/10.1249/jsr.0b013e31825dabb8

White, D. W., & Raven, P. B. (2014). Autonomic neural control of heart rate during dynamic exercise: revisited. *The Journal of Physiology*, *592*(12), 2491–2500. https://doi.org/10.1113/jphysiol.2014.271858

Wittert, G. A., Livesey, J. H., Espiner, E. A., & Donald, R. A. (1996). Adaptation of the hypothalamopituitary adrenal axis to chronic exercise stress in humans. *Medicine &amp Science in Sports &amp Exercise*, *28*(8), 1015–1019. https://doi.org/10.1097/00005768-199608000-00011

Woods, K., Bishop, P., & Jones, E. (2007). Warm-Up and Stretching in the Prevention of Muscular Injury. *Sports Medicine*, *37*(12), 1089–1099. https://doi.org/10.2165/00007256-200737120-00006

Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI Journal*, *16*, 1057–1072. https://doi.org/10.17179/excli2017-480

Young, K., Sandman, C., & Craske, M. (2019). Positive and Negative Emotion Regulation in Adolescence: Links to Anxiety and Depression. *Brain Sciences*, *9*(4), 76. https://doi.org/10.3390/brainsci9040076

Zatsiorsky, V. M., & Kramer, W. J. (2006). *Science and practice of strength training Champaign, IL: Human Kinetics* (2nd ed. ed.). Champaign, IL: Human Kinetics.

APPENDIX A: IRB DOCUMENTS

CHARLOTTE
RESEARCH AND ECONOMIC DEVELOPMENT

To:	Danielle Sterner University of North Carolina at Charlotte
From:	IRB
Date of Approval:	16-Dec-2021
Expiration or Admin Check-In Date:	12-Sep-2024
RE:	Notice of Amendment Approval
Submission Type:	Amendment
Expedited Category:	4~7
Study #:	IRB-22-0054
Study Title:	The Effects of Resistance Training On Emotional Regulation And Hemodynamic Parameters In Response To A Stressful Task

This submission has been approved by the IRB. It has been determined that the risk involved in this amendment is no more than minimal. Unless otherwise noted, regulatory and other findings made previously for this study continue to be applicable.

Important Information:

1. The University requires face coverings (masks) in all indoor spaces on campus, regardless of vaccination status.
2. The updates to safety mandates apply to North Carolina only. Researchers conducting HSR activities in locations outside of North Carolina must continue to adhere to local and state requirements where the research is being conducted.
3. Face coverings (masks) are still required in healthcare settings, public transportation, and daycares as well as many North Carolina schools. Researchers conducting HSR activities in these settings must continue to adhere to face coving requirements.
4. In addition, some North Carolina counties have additional requirements that researchers must follow.
5. Organizations, institutions, agencies, businesses, etc. may have further site-specific requirements such as continuing to have a mask requirement, or limiting access, and/or physical distancing. Researchers must adhere to all requirements mandated by the study site.

Your approved consent forms (if applicable) and other documents are available online at Submission Page.

Investigator's Responsibilities:

1. Amendments must be submitted for review and approval before implementing the amendment. This includes changes to study procedures, study materials, personnel, etc.
2. Data security procedures must follow procedures as approved in the protocol and in accordance with OneIT Guidelines for Data Handling.
3. Promptly notify the IRB (uncc-irb@uncc.edu) of any adverse events or unanticipated risks to participants or others.
4. Complete the Closure eform via Niner Research once the study is complete.
5. Be aware that this study is included in the Office of Research Protections and Integrity (ORPI) Post-Approval Monitoring program and may be selected for post-review monitoring at some point in the future.

Please be aware that approval may still be required from other relevant authorities or "gatekeepers" (e.g., school principals, facility directors, custodians of records).

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule) and 21 CFR 50 & 56 (FDA), where applicable.

Template updated July 2020

UNC CHARLOTTE

Department of Kinesiology
9201 University City Boulevard, Charlotte, NC 28223-0001

Consent to Participate in a Research Study

Title of the Project:
The Effects of Resistance Training On Emotional Regulation And Hemodynamic Parameters In Response To A Stressful Task.

Principal Investigator: Danielle Sterner, BS, CSCS
Thesis Chair: David Bellar, PhD, CSCS

You are invited to participate in a research study. Participation in this research study is voluntary. The information provided is to help you decide whether or not to participate. If you have any questions, please ask.

Important Information You Need to Know

- The purpose of the investigation is to determine the effects of resistance training on emotional regulation and hemodynamic parameters in response to a stressful task.
- We are asking male and female students at UNC Charlotte who have less than 1 year experience in resistance training.
- This study will require you to come to the Lab 008 in Belk Gym twice a week for less than an hour to complete the study over the span of 10 weeks for roughly 14 hours of your time.
- If you are pregnant or believe you may be pregnant you cannot participate in this study.
- If you have an existing skeletal muscle injury you cannot participate in this study.
- You should not volunteer for this study if you are pregnant or have an existing skeletal muscle injury.
- Please read this form and ask any questions you may have before you decide whether to participate in this research study.

Why are we doing this study?

The purpose of the investigation is to determine the effects of resistance training on emotional regulation and hemodynamic parameters in response to a stressful task.

Why are you being asked to be in this research study?

You are being asked to be in this study because you responded to our advertisement and fit the criteria for the study.

Subjects will come to the Laboratory within 008 in Belk Gym at the University of North Carolina at Charlotte every visit and will be supervised the entire time by a certified strength and conditioning coach. After written consent is obtained and the subject signs the exclusion statement, data collection will begin. The first visit will be the baseline data collection. The psychological instruments that were selected to be utilized during this study were chosen in discussion with Dr. Mcdermott who is a clinical psychologist. Subjects will fill out Difficulties in Emotion Regulation Scale (DERS), Depression, Anxiety, Stress Scale (DASS-21), State-Based

Difficulties in Emotion Regulation Scale (S-DERS), and Positive and Negative Affect Scale (PANAS) assessments. Next, subjects will be hooked up to the noninvasive blood pressure monitoring system (NIBP) which will start collecting hemodynamic data; once the system is working properly, subjects will take the Paced Auditory Serial Addition Test (PASAT-C). After the PASAT-C, the NIBP system is removed and the subjects will again complete the S-DERS and PANAS assessments.

Next, the resistance training group will be familiarized with their resistance training movements, and test their 5-repetition maximum (5-RM) on each exercise. The first 4 weeks, the resistance training group will complete the DERS assessment, warm-up, complete the resistance training session and cool-down twice a week. After 4 weeks, subjects will complete a 5-RM on the same exercises and their individualized prescriptions will be reprogrammed. Subjects will continue the resistance training program for another 4 weeks, continuing to come in twice a week. The flexibility group will be familiarized with their stretching program movements, and complete flexibility assessments. The stretching group will also come in twice a week for 4 weeks and complete their stretching program. After 4 weeks, the stretching group will retest the flexibility assessments and complete another 4 weeks of training.

After the conclusion of 8 weeks of training, the last visit will include both groups completing the DERS, DASS-21, S-DERS, and PANAS assessments. Subjects will again be hooked up to the noninvasive blood pressure monitoring system and complete the PASAT-C. The NIBP system will then be taken off and the S-DERS and PANAS will be completed again. Lastly, the resistance training group will complete the 5-RM tests and the stretching group will complete the flexibility assessments

<u>What benefits might I experience?</u>

You will learn a great deal of information about different exercises that you can incorporate in your future exercise programs. You will obtain increases in musculoskeletal strength if placed in the resistance training group and improvement in flexibility. Machine equipment will be regularly inspected to ensure safety.

<u>What risks might I experience?</u>

The possibility for psychological risks during the PASAT-s, DASS-21, DERS, S-DERS, and PANAS can produce negative affective states such as anxiety, depression, and altered behavior. These tests are not used to clinically diagnose subjects. You may experience discomfort in fingers with cuffs on during the noninvasive blood pressure system. Physical risks from participation in this study include discomfort, pain, or musculoskeletal injury during the warm up, resistance training or flexibility training, and cool down. Physical risk of equipment failure causing injury.

How will my information be protected?

You are asked to provide your email address and phone number as part of this study so that we can communicate with you about scheduling your lab visits for participation in the study. Once all of your information and visits have been scheduled you will be identified by a subject ID number. All electronic data will be stored within a secure drop box and physical papers will be locked within a cabinet in the researcher's office.

How will my information be used after the study is over?

After this study is complete, study data may be shared with other researchers for use in other studies without asking for your consent again or as may be needed as part of publishing our results. Your information will be combined with information from other people taking part in the study, you will not be identified in any published or presented materials.

What are my rights if I take part in this study?

It is up to you to decide to be in this research study. Participating in this study is voluntary. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

Who can answer my questions about this study and my rights as a participant?

For questions about this research, you may contact Danielle Sterner, BS dsterner@uncc.edu or faculty advisor, Dr. David Bellar, dbellar@uncc.edu

Conflict of Interest

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Office of Research Protections and Integrity at 704-687-1871 or uncc-irb@uncc.edu.

Resources Available

Thank you for participating in our study, we wanted to provide you with some helpful information as a follow up to your results.

- Resting blood pressure (BP) is less than or equal to 120/80, systolic blood pressure (SBP) /diastolic blood pressure (DBP). Prehypertension is defined by SBP 120-139 or DBP 80-89. Stage 1 hypertension is a SBP of 140-159 or DBP of 90-99. Stage 2 hypertension is a SBP of ≥160 or DBP of ≥100.If you are concerned by these results we advise you to speak to your primary physician or if you are a UNCC student to visit the University of North Carolina at Charlotte Student Health Center to discuss this result. An appointment at the Student Health Center can be scheduled in person or by calling 704-687-7400.

- If you are not a UNCC student, speak to your physician or check out https://www.mecknc.gov/HealthDepartment/Documents/FreeLowCostClinics.pdf for additional resources. For more information regarding nutrition tips please visit https://dashdiet.org/ for additional resources.

- Physical activity is recommended to maintain a healthy lifestyle. The American College of Sport Medicine (ACSM) recommends healthy adults aged 18-65 years old should participate in moderate intensity physical activity for a minimum of 30 minutes, 5 days a week or vigorous intensity physical activity for 20 minutes, 3 days per week. Please visit https://www.heart.org/en/healthy-living/fitness/fitness-basics/aha-recs-for-physical-activit y-in-adults for more information.

- The depression, anxiety and stress survey that you completed is not used to diagnose mental health conditions, however if you are concerned about your responses or the way you felt while completing the survey we suggest that you consider talking to someone about this. If you are a UNC Charlotte Student you can contact the Center for Counseling and Psychological Services at 704-687-0311. If you are not a student, we would suggest that you contact a licensed counselor to speak with about your concerns. OpenPath is a resource that provides affordable options in the Charlotte area both online and in person counseling. The website for OpenPath is: https://openpathcollective.org/city/charlotte/

Consent to Participate

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. You will receive a copy of this document for your records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

____

Name (PRINT)

____

Signature Date

____

Name & Signature of person obtaining consent Date

Thank you for participating in our study, we wanted to provide you with some helpful information as a follow up to your results.

- Resting blood pressure (BP) is less than or equal to 120/80, systolic blood pressure (SBP) /diastolic blood pressure (DBP). Prehypertension is defined by SBP 120-139 or DBP 80-89. Stage 1 hypertension is a SBP of 140-159 or DBP of 90-99. Stage 2 hypertension is a SBP of ≥160 or DBP of ≥100.If you are concerned by these results we advise you to speak to your primary physician or if you are a UNCC student to visit the University of North Carolina at Charlotte Student Health Center to discuss this result. An appointment at the Student Health Center can be scheduled in person or by calling 704-687-7400.

- If you are not a UNCC student, speak to your physician or check out https://www.mecknc.gov/HealthDepartment/Documents/FreeLowCostClinics.pdf for additional resources. For more information regarding nutrition tips please visit https://dashdiet.org/ for additional resources.

- Physical activity is recommended to maintain a healthy lifestyle. The American College of Sport Medicine (ACSM) recommends healthy adults aged 18-65 years old should participate in moderate intensity physical activity for a minimum of 30 minutes, 5 days a week or vigorous intensity physical activity for 20 minutes, 3 days per week. Please visit https://www.heart.org/en/healthy-living/fitness/fitness-basics/aha-recs-for-physical-activity-in-adults for more information.

- The depression, anxiety and stress survey that you completed is not used to diagnose mental health conditions, however if you are concerned about your responses or the way you felt while completing the survey we suggest that you consider talking to someone about this. If you are a UNC Charlotte Student you can contact the Center for Counseling and Psychological Services at 704-687-0311. If you are not a student, we would suggest that you contact a licensed counselor to speak with about your concerns. OpenPath is a resource that provides affordable options in the Charlotte area both online and in person counseling. The website for OpenPath is: https://openpathcollective.org/city/charlotte/

2020 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	**YES**	**NO**
1) Has your doctor ever said that you have a heart condition ☐ **OR** high blood pressure ☐?	☐	☐
2) Do you feel pain in your chest at rest, during your daily activities of living, **OR** when you do physical activity?	☐	☐
3) Do you lose balance because of dizziness **OR** have you lost consciousness in the last 12 months? Please answer **NO** if your dizziness was associated with over-breathing (including during vigorous exercise).	☐	☐
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? **PLEASE LIST CONDITION(S) HERE:** ______	☐	☐
5) Are you currently taking prescribed medications for a chronic medical condition? **PLEASE LIST CONDITION(S) AND MEDICATIONS HERE:** ______	☐	☐
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer **NO** if you had a problem in the past, but it **does not limit your current ability** to be physically active. **PLEASE LIST CONDITION(S) HERE:** ______	☐	☐
7) Has your doctor ever said that you should only do medically supervised physical activity?	☐	☐

If you answered NO to all of the questions above, you are cleared for physical activity.
Please sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

- Start becoming much more physically active – start slowly and build up gradually.
- Follow Global Physical Activity Guidelines for your age (https://apps.who.int/iris/handle/10665/44399).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

PARTICIPANT DECLARATION
If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for its records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME ______________________ DATE ______________

SIGNATURE ______________________ WITNESS ______________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ______________________

If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ at www.eparmedx.com before becoming more physically active.
- Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.

2020 PAR-Q+

FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1.	**Do you have Arthritis, Osteoporosis, or Back Problems?**	
	If the above condition(s) is/are present, answer questions 1a-1c If **NO** ☐ go to question 2	
1a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
1b.	Do you have joint problems causing pain, a recent fracture or fracture caused by osteoporosis or cancer, displaced vertebra (e.g., spondylolisthesis), and/or spondylolysis/pars defect (a crack in the bony ring on the back of the spinal column)?	YES ☐ NO ☐
1c.	Have you had steroid injections or taken steroid tablets regularly for more than 3 months?	YES ☐ NO ☐
2.	**Do you currently have Cancer of any kind?**	
	If the above condition(s) is/are present, answer questions 2a-2b If **NO** ☐ go to question 3	
2a.	Does your cancer diagnosis include any of the following types: lung/bronchogenic, multiple myeloma (cancer of plasma cells), head, and/or neck?	YES ☐ NO ☐
2b.	Are you currently receiving cancer therapy (such as chemotheraphy or radiotherapy)?	YES ☐ NO ☐
3.	**Do you have a Heart or Cardiovascular Condition? This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm**	
	If the above condition(s) is/are present, answer questions 3a-3d If **NO** ☐ go to question 4	
3a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
3b.	Do you have an irregular heart beat that requires medical management? (e.g., atrial fibrillation, premature ventricular contraction)	YES ☐ NO ☐
3c.	Do you have chronic heart failure?	YES ☐ NO ☐
3d.	Do you have diagnosed coronary artery (cardiovascular) disease and have not participated in regular physical activity in the last 2 months?	YES ☐ NO ☐
4.	**Do you currently have High Blood Pressure?**	
	If the above condition(s) is/are present, answer questions 4a-4b If **NO** ☐ go to question 5	
4a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
4b.	Do you have a resting blood pressure equal to or greater than 160/90 mmHg with or without medication? (Answer **YES** if you do not know your resting blood pressure)	YES ☐ NO ☐
5.	**Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre-Diabetes**	
	If the above condition(s) is/are present, answer questions 5a-5e If **NO** ☐ go to question 6	
5a.	Do you often have difficulty controlling your blood sugar levels with foods, medications, or other physician-prescribed therapies?	YES ☐ NO ☐
5b.	Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living? Signs of hypoglycemia may include shakiness, nervousness, unusual irritability, abnormal sweating, dizziness or light-headedness, mental confusion, difficulty speaking, weakness, or sleepiness.	YES ☐ NO ☐
5c.	Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, **OR** the sensation in your toes and feet?	YES ☐ NO ☐
5d.	Do you have other metabolic conditions (such as current pregnancy-related diabetes, chronic kidney disease, or liver problems)?	YES ☐ NO ☐
5e.	Are you planning to engage in what for you is unusually high (or vigorous) intensity exercise in the near future?	YES ☐ NO ☐

2020 PAR-Q+

6.	**Do you have any Mental Health Problems or Learning Difficulties?** This includes Alzheimer's, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome If the above condition(s) is/are present, answer questions 6a-6b — If **NO** ☐ go to question 7	
6a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
6b.	Do you have Down Syndrome **AND** back problems affecting nerves or muscles?	YES ☐ NO ☐
7.	**Do you have a Respiratory Disease?** This includes Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary High Blood Pressure If the above condition(s) is/are present, answer questions 7a-7d — If **NO** ☐ go to question 8	
7a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
7b.	Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?	YES ☐ NO ☐
7c.	If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 2 days/week), or have you used your rescue medication more than twice in the last week?	YES ☐ NO ☐
7d.	Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?	YES ☐ NO ☐
8.	**Do you have a Spinal Cord Injury?** This includes Tetraplegia and Paraplegia If the above condition(s) is/are present, answer questions 8a-8c — If **NO** ☐ go to question 9	
8a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
8b.	Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?	YES ☐ NO ☐
8c.	Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?	YES ☐ NO ☐
9.	**Have you had a Stroke?** This includes Transient Ischemic Attack (TIA) or Cerebrovascular Event If the above condition(s) is/are present, answer questions 9a-9c — If **NO** ☐ go to question 10	
9a.	Do you have difficulty controlling your condition with medications or other physician-prescribed therapies? (Answer **NO** if you are not currently taking medications or other treatments)	YES ☐ NO ☐
9b.	Do you have any impairment in walking or mobility?	YES ☐ NO ☐
9c.	Have you experienced a stroke or impairment in nerves or muscles in the past 6 months?	YES ☐ NO ☐
10.	**Do you have any other medical condition not listed above or do you have two or more medical conditions?** If you have other medical conditions, answer questions 10a-10c — If **NO** ☐ read the Page 4 recommendations	
10a.	Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months **OR** have you had a diagnosed concussion within the last 12 months?	YES ☐ NO ☐
10b.	Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?	YES ☐ NO ☐
10c.	Do you currently live with two or more medical conditions?	YES ☐ NO ☐

PLEASE LIST YOUR MEDICAL CONDITION(S) AND ANY RELATED MEDICATIONS HERE: ______________________

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.

2020 PAR-Q+

If you answered NO to all of the FOLLOW-UP questions (pgs. 2-3) about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually - 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- If you are over the age of 45 yr and **NOT** accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you answered **YES** to **one or more of the follow-up questions** about your medical condition:
You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommendations program - the **ePARmed-X+ at www.eparmedx.com** and/or visit a qualified exercise professional to work through the ePARmed-X+ and for further information.

Delay becoming more active if:

- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-X+ **at www.eparmedx.com** before becoming more physically active.
- Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The authors, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-X+. If in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME ____________________ DATE ____________________

SIGNATURE ____________________ WITNESS ____________________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ____________________

For more information, please contact
www.eparmedx.com
Email: eparmedx@gmail.com

Citation for PAR-Q+
Warburton DER, Jamnik VK, Bredin SSD, and Gledhill N on behalf of the PAR-Q+ Collaboration. The Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and Electronic Physical Activity Readiness Medical Examination (ePARmed-X+). Health & Fitness Journal of Canada 4(2):3-23, 2011.

The PAR-Q+ was created using the evidence-based AGREE process (1) by the PAR-Q+ Collaboration chaired by Dr. Darren E. R. Warburton with Dr. Norman Gledhill, Dr. Veronica Jamnik, and Dr. Donald C. McKenzie (2). Production of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the BC Ministry of Health Services.

Key References
1. Jamnik VK, Warburton DER, Makarski J, McKenzie DC, Shephard RJ, Stone J, and Gledhill N. Enhancing the effectiveness of clearance for physical activity participation; background and overall process. APNM 36(S1):S3-S13, 2011.
2. Warburton DER, Gledhill N, Jamnik VK, Bredin SSD, McKenzie DC, Stone J, Charlesworth S, and Shephard RJ. Evidence-based risk assessment and recommendations for physical activity clearance; Consensus Document. APNM 36(S1):S266-s298, 2011.
3. Chisholm DM, Collis ML, Kulak LL, Davenport W, and Gruber N. Physical activity readiness. British Columbia Medical Journal. 1975;17:375-378.
4. Thomas S, Reading J, and Shephard RJ. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Canadian Journal of Sport Science 1992;17:4 338-345.

Template updated July 2020

UNC CHARLOTTE
Department of Kinesiology
9201 University City Boulevard, Charlotte, NC 28223-0001

Title of the Project: The Effects of Resistance Training On Emotional Regulation And Hemodynamic Parameters In Response To A Stressful Task.

Principal Investigator: Danielle Sterner, BS, CSCS
Thesis Chair: David Bellar, PhD

By signing this form I attest that I am not pregnant and I do not have any current skeletal muscle injuries and I am willing to continue with the procedures in this research study.

____
Name (PRINT)

____
Signature Date

____
Name & Signature of person obtaining consent Date

UNC CHARLOTTE

University of North Carolina At Charlotte
Department of KinesiologyRESEARCH STUDY ANNOUNCEMENT

Attention:

We are researchers in the UNC Charlotte Department of Kinesiology, and are conducting a study to test if resistance training affects your emotional regulation when presented with stress.

If you are at least 18 years old, have a sedentary lifestyle, and less than a year of resistance training experience you are eligible to participate in this study. You are not eligible to participate in this study if you are pregnant or have an implanted medical device (such as a pacemaker).

Participation in this study requires 19 visits to the Laboratory within 008 in Belk Gym at the University of North Carolina at Charlotte. Prior to your first visit, you will be emailed a PAR-Q form to complete and send back as well as a list of exclusion criteria and inclusion criteria to see if you are eligible to participate in the study. You will then be randomly assigned to a resistance training group or a flexibility training group. The first visit will be the baseline data collection as well as filling out surveys about your stress, anxiety, depression, collecting your blood pressure and heart rate using a finger cuff noninvasive blood pressure monitoring system, completing the PASAT-C stress test and performing either a 5 repetition maximum or flexibility assessment.

Next, you will come to room 008 in Belk Gym twice a week for 4 weeks and complete your resistance or flexibility training under supervision of research staff. Sessions will take no longer than 45 minutes. You will also complete a survey prior to every session about your stress levels.After 4 weeks of training you will be retested either your 5 repetition maximum if you are in the resistance training group or the flexibility assessment if you are in the flexibility group. Next, 4 more weeks of training will be completed, training twice a week for less than 45 minute. After the 8 weeks of training have been concluded you will take all of the baseline tests again including filling out surveys about your stress, anxiety, depression, collecting your blood pressure and heart rate using a finger cuff noninvasive blood pressure monitoring system, completing the PASAT-C stress test and performing either a 5 repetition maximum or flexibility assessment.

Your time commitment should not be more than 45 minutes, twice a week for 8 weeks to complete the study. All information we collect will be kept confidential.

If interested please contact:

dsterner@uncc.edu

(717) 969 - 5135

Hello,

My name is Danielle Sterner and I am a second year masters student in the Kinesiology department and I need eligible participants to volunteer to participate in my study.

We are researchers in the UNC Charlotte Department of Kinesiology, and are conducting a study to test if resistance training affects your emotional regulation when presented with stress.

If you are at least 18 years old, have a sedentary lifestyle, and less than a year of resistance training experience you are eligible to participate in this study. You are not eligible to participate in this study if you currently have a skeletal muscle injury or are pregnant.

Participation in this study requires roughly 14 hours of your time over the span of 10 weeks at Belk Gymnasium in Laboratory 008 at the University of North Carolina at Charlotte. Prior to your first visit, you will be emailed the informed consent to review. Along with the PARQ+ form that you will to complete and send back as well as a list of exclusion criteria and inclusion criteria to see if you are eligible to participate in the study. You will then be randomly assigned to a resistance training group or a flexibility training group. The first visit will be the baseline data collection as well as filling out surveys about your stress, anxiety, depression, collecting your blood pressure and heart rate using a finger cuff noninvasive blood pressure monitoring system, completing the PASAT-C stress test and performing either a 5 repetition maximum or flexibility assessment.

Next, you will come to room 008 in Belk Gym twice a week for 4 weeks and complete your resistance or flexibility training under supervision of research staff. Sessions will take no longer than 45 minutes. You will also complete a survey prior to every session about your stress levels. After 4 weeks of training you will be retested either your 5 repetition maximum if you are in the resistance training group or the flexibility assessment if you are in the flexibility group. Next, 4 more weeks of training will be completed, training twice a week for less than 45 minute. After the 8 weeks of training have been concluded you will take all of the baseline tests again including filling out surveys about your stress, anxiety, depression, collecting your blood pressure and heart rate using a finger cuff noninvasive blood pressure monitoring system, completing the PASAT-C stress test and performing either a 5 repetition maximum or flexibility assessment.

Your time commitment should not be more than 45 minutes, twice a week for 10 weeks to complete the study. All information we collect will be kept confidential.

If you have questions or wish to take part in the study please email Danielle Sterner. dsterner@uncc.edu

Thanks!

APPENDIX B: DATA COLLECTION PROCEDURES

S-DERS

Please read each statement and indicate how much it applies to **<u>YOUR EMOTIONS RIGHT NOW</u>**.

1	2	3	4	5
Not at all	Somewhat	Moderately	Very much	Completely

______ 1) I feel guilty for feeling this way.

______ 2) I am paying attention to how I feel.

______ 3) I feel out of control.

______ 4) I am embarrassed for feeling this way.

______ 5) I am feeling very bad about myself.

______ 6) I am acknowledging my emotions.

______ 7) I have no idea how I am feeling.

______ 8) I feel ashamed with myself for feeling this way.

______ 9) I am having difficulty doing the things I need to do right now.

______ 10) I believe that I will continue feeling this way for a long time.

______ 11) I care about what I am feeling.

______ 12) I am angry with myself for feeling this way.

______ 13) I am having difficulty controlling my behaviors.

______ 14) I am confused about how I feel.

______ 15) I believe that I am going to end up feeling very depressed.

______ 16) I am taking time to figure out what I am really feeling.

______ 17) My emotions feel out of control.

______ 18) I am irritated with myself for feeling this way.

______ 19) I believe that my feelings are valid and important.

______ 20) I feel like I'm a weak person for feeling this way.

______ 21) My emotions feel overwhelming.

Participant Number ____________

PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent **<u>you feel this way right now, at the present moment</u>**. Use the following scale to record your answers.

1	2	3	4	5
Very slightly or not at all	**a little**	**Moderately**	**quite a bit**	**extremely**

_____interested

_____distressed

_____excited

_____upset

_____strong

_____guilty

_____scared

_____hostile

_____enthusiastic

_____proud

_____irritable

_____alert

_____ashamed

_____inspired

_____nervous

_____determined

_____attentive

_____jittery

_____active

_____afraid

5 Rep Max Protocol

1. Instruct athlete to warm up with a light weight resistance that easily allows for 8-10 repetitions
2. 1 minute rest period
3. Estimate warm up resistance weight that allows for 6-8 repetitions by adding
   a. 10 - 20 pounds or 5% - 10% for upper body exercise
   b. 30 - 40 pounds or 10% - 20% for lower body exercise
4. 2 - 4 minute rest period
5. Make a load increase and perform 5 reps:
   a. 10 - 20 pounds or 5% - 10% for upper body exercise
   b. 30 - 40 pounds or 10% - 20% for lower body exercise
6. 2 - 4 minute rest period
7. If successful, add 5 - 10 pounds and perform 5 reps again.
8. 2 - 4 minute rest period
9. Repeat steps 7 & 8 until failure to complete 5 reps

Flexibility Assessments

Upper Limb
Shoulder Mobility

1. While standing one arm reaches overhead, elbow pointed to the sky, palm reaches as far down the back as possible. The other arm reaches under behind the back, elbow pointed to the ground, reaching as far up as possible. The goal is to have the fingertips reach behind the back. Switch sides.
2. A ruler will be placed behind the subject's back, and the distance between the two middle fingers will be recorded.

Trunk
Prone Trunk Lift

1. Subject lies face down on the ground. Hands are placed under the subject's hips. Researcher holds a yard stick perpendicular to the ground near the subject's head. Subject lifts upper torso as far off the ground as possible while researcher measures
2. A ruler will be placed from the ground up and the researcher will record from the bottom of the chin.

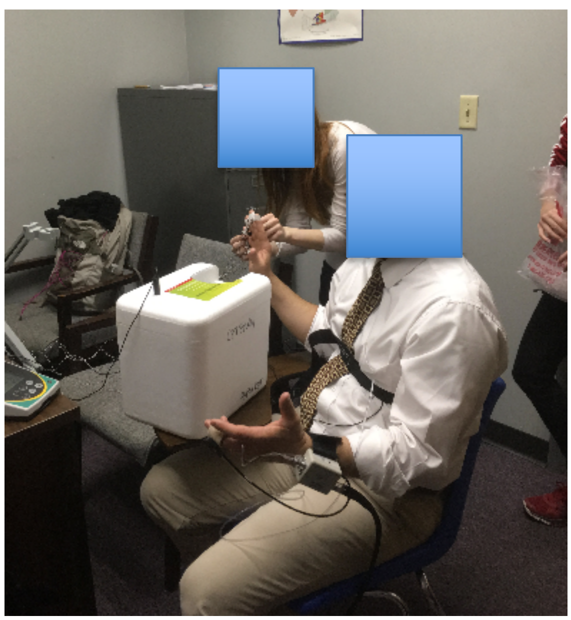
Lower Limb
Straight Leg Raise

1. While lying supine, keep legs straight. A researcher will hold a yard stick perpendicular at the subject's hip. Subject will lift one leg as high as they can while keeping the other leg flat on the ground and both legs straight. Switch legs.
2. A goniometer will be used to measure the angle of how high the subject can lift their leg.

NIBP Procedure

Human Non-Invasive Blood Pressure

1. Attach the main wrist unit instrument to subjects wrist
2. Wrap blood pressure finger cuffs around 2nd and 3rd fingers (cuffs switch back and forth for measuring blood pressure to avoid cutting off circulation to one finger)
3. Put the height correction unit near the sternum and attach the other end to one of the blood pressure cuffs. This compensates for differences in height differences between the heart and finger cuffs.
4. Turn on the NIBP system, blood pressure finger cuffs will automatically inflate and deflate.
5. Data is automatically collected and produces live data of finger pressure, mean arterial pressure, and heart rate.



PASAT Procedure

Background Information

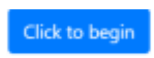
The Modified Computerized Paced Auditory Serial Addition Test (PASAT-C) is designed for measuring distress tolerance.

Single digits are presented every 3 seconds and the patient must add each new digit to the one immediately prior. Shorter inter-stimulus intervals, e.g., 2 seconds or less have also been used with the PASAT.

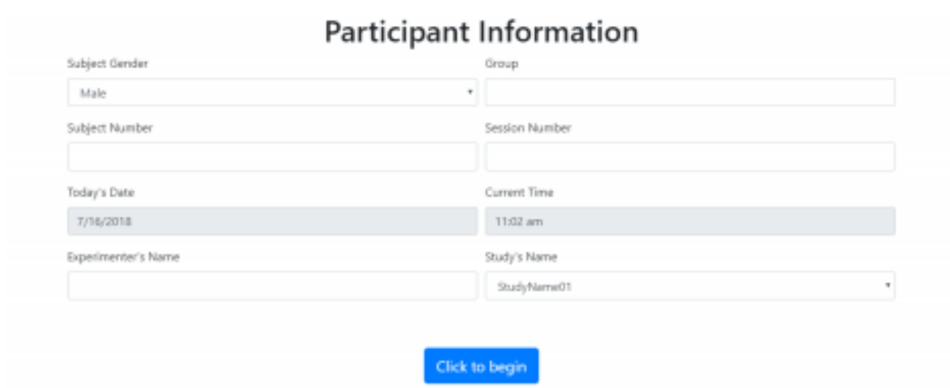
The total score is onscreen the entire time.
Each time the patient provides an incorrect answer or omits an answer, a loud sound is played.

1. This application has three (3) different "rounds" of PASAT tasks. Each "round" is referred to as a **Block** (**Block 1, Block 2, and Block 3)** in the application**.**
2. Each **Block** has its own time properties which can be configured by the experimenter.
   - **Digit Presentation Interval**: Time (in seconds) that a single digit is displayed on the screen before disappearing.
   - **Block Duration**: Time (in minutes) for which a **Block** will be executed. This is the duration of a PASAT task.
   - **Break Time**: Time (in seconds) for a pause after a **Block**.

Participant Information Form

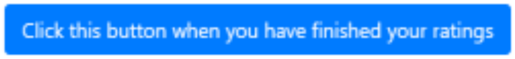
4. Fill out the **Participant Information** form and click 

button to go to the next page.

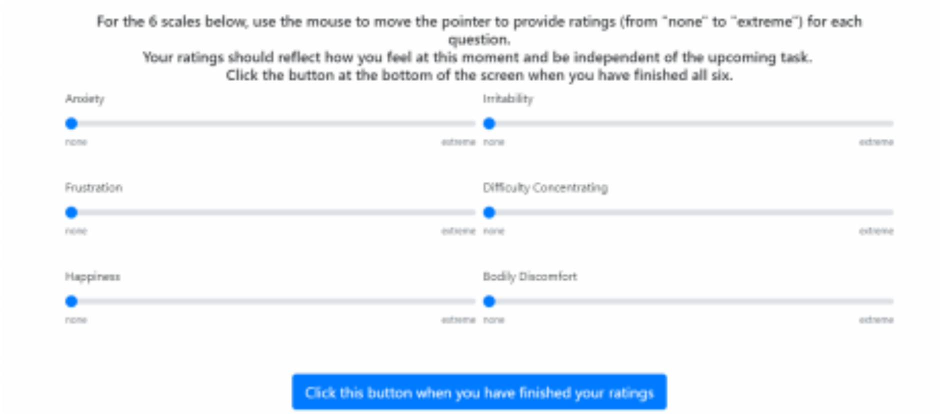


Six Scales Form 1

5. Complete the **6 scales** form and click the



button to go to the next page.



Block 1

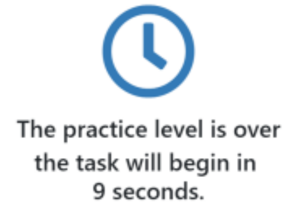
6. Click the

button to start the PASAT **Block 1**.

7. While **Block 1** is running, click the red number buttons to submit the answer.

Break 1

8. Wait for **Break 1** to finish to proceed to the next task.



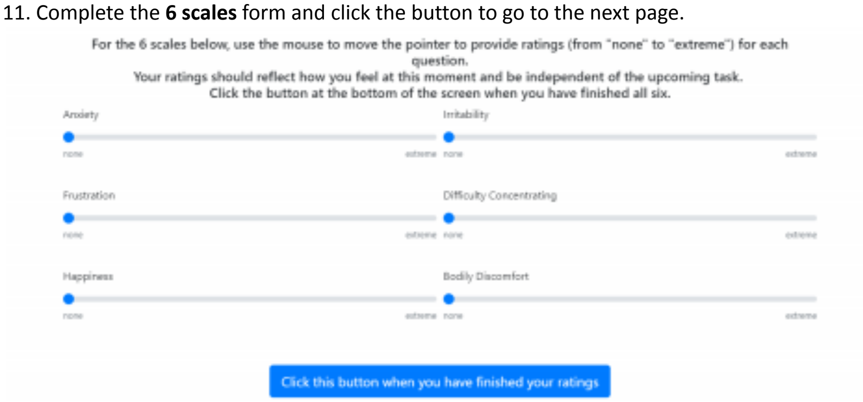
Block 2

9. PASAT **Bock 2** will automatically start.

10. While **Block 2** is running, click the red number buttons to submit the answer.

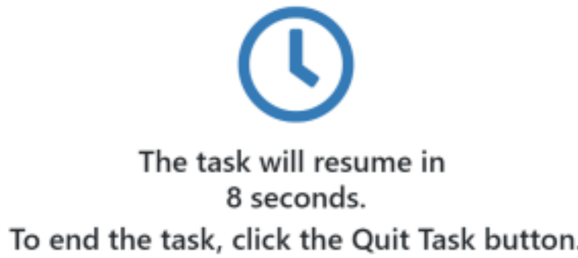
Six Scales Form 2

11. Complete the **6 scales** form and click the button to go to the next page.



Break 2

12. Wait for **Break 2** to finish to proceed to the next task.



Block 3

13. PASAT **Bock 3** will automatically start.

14. While **Block 3** is running, click the red number buttons to submit the answer.

15. Note that you can quit **Block 3** at any time by clicking the button.

Submit Answers

16. Answers will be automatically submitted after completing/quitting **Block 3**. A message should appear confirming the answer submission.

APPENDIX C: DATA ANALYSIS

Cable Lat Pull Down
Fit Group
Oneway Analysis of Cable Lat Pull Down By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.22094
Adj Rsquare	0.173724
Root Mean Square Error	40.10324
Mean of Response	127.6389
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	15051.389	7525.69	4.6794	0.0163*
Error	33	53072.917	1608.27		
C. Total	35	68124.306			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	99.167	11.577	75.61	122.72
10	12	137.500	11.577	113.95	161.05
19	12	146.250	11.577	122.70	169.80

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.45379	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-40.174	-31.424	6.910
10	-31.424	-40.174	-1.840
1	6.910	-1.840	-40.174

Positive values show pairs of means that are significantly different.

Connecting Letters Report

Level			Mean
19	A		146.25000
10	A	B	137.50000
1		B	99.16667

Levels not connected by same letter are significantly different.

Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	47.08333	16.37208	6.9096	87.25706	0.0187*	
10	1	38.33333	16.37208	-1.8404	78.50706	0.0639	
19	10	8.75000	16.37208	-31.4237	48.92372	0.8550	

Cable Row
Oneway Analysis of Cable Row By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.176807
Adj Rsquare	0.126917
Root Mean Square Error	42.63644
Mean of Response	97.36111
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	12884.722	6442.36	3.5439	0.0403*
Error	33	59989.583	1817.87		
C. Total	35	72874.306			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	71.667	12.308	46.626	96.71
10	12	103.750	12.308	78.709	128.79
19	12	116.667	12.308	91.626	141.71

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.45379	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-42.711	-29.795	2.289
10	-29.795	-42.711	-10.628
1	2.289	-10.628	-42.711

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level			Mean
19	A		116.66667
10	A	B	103.75000
1		B	71.66667

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	45.00000	17.40625	2.2886	87.71137	0.0372*	
10	1	32.08333	17.40625	-10.6280	74.79471	0.1715	
19	10	12.91667	17.40625	-29.7947	55.62804	0.7405	

DB Chest Press
Oneway Analysis of DB Chest Press By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.159975
Adj Rsquare	0.109064

Root Mean Square Error	46.86241
Mean of Response	122.2222
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	13801.389	6900.69	3.1423	0.0563
Error	33	72470.833	2196.09		
C. Total	35	86272.222			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	94.583	13.528	67.06	122.11
10	12	134.583	13.528	107.06	162.11
19	12	137.500	13.528	109.98	165.02

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.45379	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-46.945	-44.028	-4.028
10	-44.028	-46.945	-6.945
1	-4.028	-6.945	-46.945

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
19	A	137.50000
10	A	134.58333
1	A	94.58333

Levels not connected by same letter are significantly different.

Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	42.91667	19.13150	-4.0281	89.86144	0.0786	
10	1	40.00000	19.13150	-6.9448	86.94477	0.1073	
19	10	2.91667	19.13150	-44.0281	49.86144	0.9873	

Smith Machine Back Squat

Oneway Analysis of Smith Machine Back Squat By Visit Number

Oneway Anova

Summary of Fit

Rsquare	0.49368
Adj Rsquare	0.462994
Root Mean Square Error	70.59049
Mean of Response	195.1389
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	160334.72	80167.4	16.0881	<.0001*
Error	33	164439.58	4983.0		
C. Total	35	324774.31			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	103.333	20.378	61.87	144.79
10	12	222.083	20.378	180.62	263.54
19	12	260.000	20.378	218.54	301.46

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1	12	103.33333	64.07855	18.497884	62.619765	144.0469

10	12	222.08333	70.693266	20.407388	177.16697	266.99969
19	12	260	76.455572	22.070823	211.42245	308.57755

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.45379	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-70.715	-32.798	85.952
10	-32.798	-70.715	48.035
1	85.952	48.035	-70.715

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level			Mean
19	A		260.00000
10	A		222.08333
1		B	103.33333

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	156.6667	28.81845	85.9521	227.3812	<.0001*	
10	1	118.7500	28.81845	48.0354	189.4646	0.0007*	
19	10	37.9167	28.81845	-32.7979	108.6312	0.3967	

Calf Raise
Oneway Analysis of Calf Raise By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.148712
Adj Rsquare	0.097119
Root Mean Square Error	51.30186
Mean of Response	150.1389
Observations (or Sum Wgts)	36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	15172.22	7586.11	2.8824	0.0702
Error	33	86852.08	2631.88		
C. Total	35	102024.31			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	121.250	14.810	91.12	151.38
10	12	162.083	14.810	131.95	192.21
19	12	167.083	14.810	136.95	197.21

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for each pair using Student's t
Confidence Quantile

t	Alpha
2.03452	0.05

LSD Threshold Matrix
Abs(Dif)-LSD

	19	10	1
19	-42.611	-37.611	3.223
10	-37.611	-42.611	-1.777
1	3.223	-1.777	-42.611

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level			Mean
19	A		167.08333

10	A	B	162.08333
1		B	121.25000

Levels not connected by same letter are significantly different.

Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	45.83333	20.94390	3.2227	88.44402	0.0358*	
10	1	40.83333	20.94390	-1.7773	83.44402	0.0598	
19	10	5.00000	20.94390	-37.6107	47.61068	0.8128	

Left Shoulder Mobility
Oneway Analysis of Left Shoulder Mobility By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.003473
Adj Rsquare	-0.06296
Root Mean Square Error	4.208684
Mean of Response	0.484848
Observations (or Sum Wgts)	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	1.85189	0.9259	0.0523	0.9492
Error	30	531.39053	17.7130		
C. Total	32	533.24242			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	0.291667	1.2149	-2.190	2.7729
10	11	0.818182	1.2690	-1.773	3.4098
19	10	0.350000	1.3309	-2.368	3.0681

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

Confidence Quantile

q*	Alpha
2.46534	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	10	19	1
10	-4.4243	-4.0653	-3.8046
19	-4.0653	-4.6402	-4.3843
1	-3.8046	-4.3843	-4.2359

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
10	A	0.81818182
19	A	0.35000000
1	A	0.29166667

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
10	1	0.5265152	1.756804	-3.80460	4.857628	0.9518	
10	19	0.4681818	1.838906	-4.06534	5.001705	0.9649	
19	1	0.0583333	1.802051	-4.38433	4.500995	0.9994	

Right Shoulder Mobility
Oneway Analysis of Right Shoulder Mobility By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.014118
Adj Rsquare	-0.05161
Root Mean Square Error	3.475421
Mean of Response	4.227273
Observations (or Sum Wgts)	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	5.18902	2.5945	0.2148	0.8079
Error	30	362.35644	12.0785		
C. Total	32	367.54545			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	3.70833	1.0033	1.6594	5.7573
10	11	4.45455	1.0479	2.3145	6.5946
19	10	4.60000	1.0990	2.3555	6.8445

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.46534	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-3.8318	-3.5982	-2.7770
10	-3.5982	-3.6534	-2.8303
1	-2.7770	-2.8303	-3.4979

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
19	A	4.6000000
10	A	4.4545455
1	A	3.7083333

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	0.8916667	1.488086	-2.77697	4.560300	0.8216	
10	1	0.7462121	1.450722	-2.83031	4.322731	0.8650	
19	10	0.1454545	1.518521	-3.59821	3.889119	0.9950	

Prone Trunk Lift
Oneway Analysis of Prone Trunk Lift By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.15716
Adj Rsquare	0.100971
Root Mean Square Error	2.498765
Mean of Response	12.84848
Observations (or Sum Wgts)	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	34.92765	17.4638	2.7970	0.0769
Error	30	187.31477	6.2438		
C. Total	32	222.24242			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	11.8750	0.72133	10.402	13.348
10	11	12.5455	0.75341	11.007	14.084
19	10	14.3500	0.79018	12.736	15.964

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.46534	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-2.7550	-0.8871	-0.1627
10	-0.8871	-2.6268	-1.9010
1	-0.1627	-1.9010	-2.5149

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
19	A	14.350000
10	A	12.545455
1	A	11.875000

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	2.475000	1.069907	-0.16268	5.112682	0.0692	
19	10	1.804545	1.091789	-0.88708	4.496173	0.2398	
10	1	0.670455	1.043043	-1.90100	3.241908	0.7978	

Left Leg Lift
Oneway Analysis of Left Leg Lift By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.050536
Adj Rsquare	-0.01276
Root Mean Square Error	13.05304
Mean of Response	76.78788
Observations (or Sum Wgts)	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	272.0621	136.031	0.7984	0.4594
Error	30	5111.4530	170.382		

C. Total	32	5383.5152			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	73.9167	3.7681	66.221	81.612
10	11	76.1818	3.9356	68.144	84.219
19	10	80.9000	4.1277	72.470	89.330

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.46534	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-14.391	-9.342	-6.795
10	-9.342	-13.722	-11.168
1	-6.795	-11.168	-13.137

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
19	A	80.900000
10	A	76.181818
1	A	73.916667

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	6.983333	5.588976	-6.7954	20.76204	0.4342	
19	10	4.718182	5.703282	-9.3423	18.77869	0.6893	

10	1	2.26515 2	5.44864 5	- 11.1676	15.6979 0	0.9094	

Right Leg Lift
Oneway Analysis of Right Leg Lift By Visit Number
Oneway Anova
Summary of Fit

Rsquare	0.198088
Adj Rsquare	0.144627
Root Mean Square Error	11.27238
Mean of Response	79.63636
Observations (or Sum Wgts)	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Visit Number	2	941.6379	470.819	3.7053	0.0365*
Error	30	3811.9985	127.067		
C. Total	32	4753.6364			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	12	72.5833	3.2541	65.938	79.229
10	11	83.2727	3.3988	76.332	90.214
19	10	84.1000	3.5646	76.820	91.380

Std Error uses a pooled estimate of error variance

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Confidence Quantile

q*	Alpha
2.46534	0.05

HSD Threshold Matrix
Abs(Dif)-HSD

	19	10	1
19	-12.428	-11.315	-0.382
10	-11.315	-11.850	-0.911

1	-0.382	-0.911	-11.345

Positive values show pairs of means that are significantly different.
Connecting Letters Report

Level		Mean
19	A	84.100000
10	A	83.272727
1	A	72.583333

Levels not connected by same letter are significantly different.
Ordered Differences Report

Level	- Level	Difference	Std Err Dif	Lower CL	Upper CL	p-Value	
19	1	11.51667	4.826546	-0.3824	23.41573	0.0593	
10	1	10.68939	4.705358	-0.9109	22.28969	0.0755	
19	10	0.82727	4.925259	-11.3151	12.96969	0.9846	

PANAS Negative
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre PANAS: Negative	Post PANAS: Negative
Intercept	14.8409091	17.5757576
Group[A]	-0.3409091	-0.7424242
Visit Number[1]	0.95075758	1.47348485
Group[A]*Visit Number[1]	0.13257576	0.60984848

Least Squares Means
Overall Means

Pre PANAS: Negative	Post PANAS: Negative
14.826087	17.5434783

Group

	Pre PANAS: Negative	Post PANAS: Negative
A	14.5	16.8333333
B	15.1818182	18.3181818

Visit Number

	Pre PANAS: Negative	Post PANAS: Negative
1	15.7916667	19.0492424
19	13.8901515	16.1022727

Group*Visit Number

	Pre PANAS: Negative	Post PANAS: Negative
A,1	15.5833333	18.9166667
A,19	13.4166667	14.75
B,1	16	19.1818182
B,19	14.3636364	17.4545455

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.095041	1.3306	3	42	0.2772

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	12.852439	539.8024	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.014354	0.6029	1	42	0.4418

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0718788	3.0189	1	42	0.0896

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0067414	0.2831	1	42	0.5975

Within Subjects
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0292838	0.4100	3	42	0.7467
Univar unadj Epsilon=	1	0.4100	3	42	0.7467
Univar G-G Epsilon=	1	0.4100	3	42	0.7467
Univar H-F Epsilon=	1	0.4100	3	42	0.7467

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.3197771	13.4306	1	42	0.0007*
Univar unadj Epsilon=	1	13.4306	1	42	0.0007*
Univar G-G Epsilon=	1	13.4306	1	42	0.0007*
Univar H-F Epsilon=	1	13.4306	1	42	0.0007*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0068926	0.2895	1	42	0.5934
Univar unadj Epsilon=	1	0.2895	1	42	0.5934
Univar G-G Epsilon=	1	0.2895	1	42	0.5934
Univar H-F Epsilon=	1	0.2895	1	42	0.5934

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0116824	0.4907	1	42	0.4875
Univar unadj Epsilon=	1	0.4907	1	42	0.4875

Univar G-G Epsilon=	1	0.4907	1	42	0.4875
Univar H-F Epsilon=	1	0.4907	1	42	0.4875

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.009739	0.4090	1	42	0.5259
Univar unadj Epsilon=	1	0.4090	1	42	0.5259
Univar G-G Epsilon=	1	0.4090	1	42	0.5259
Univar H-F Epsilon=	1	0.4090	1	42	0.5259

PANAS Positive
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[x] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre PANAS: Positive	Post PANAS: Positive
Intercept	29.0625	26.8030303
Group[A]	2.5625	3.53030303
Visit Number[1]	0.54734848	-1.2272727
Group[A]*Visit Number[1]	-0.5890152	-0.7727273

Least Squares Means
Overall Means

Pre PANAS: Positive	Post PANAS: Positive
29.173913	26.9565217

Group

	Pre PANAS: Positive	Post PANAS: Positive

A	31.625	30.3333333
B	26.5	23.2727273

Visit Number

	Pre PANAS: Positive	Post PANAS: Positive
1	29.6098485	25.5757576
19	28.5151515	28.030303

Group*Visit Number

	Pre PANAS: Positive	Post PANAS: Positive
A,1	31.5833333	28.3333333
A,19	31.6666667	32.3333333
B,1	27.6363636	22.8181818
B,19	25.3636364	23.7272727

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1401225	1.9617	3	42	0.1344

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	11.064597	464.7131	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1316079	5.5275	1	42	0.0235*

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.001639	0.0688	1	42	0.7943

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0065741	0.2761	1	42	0.6020

Within Subjects

All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1234404	1.7282	3	42	0.1758
Univar unadj Epsilon=	1	1.7282	3	42	0.1758
Univar G-G Epsilon=	1	1.7282	3	42	0.1758
Univar H-F Epsilon=	1	1.7282	3	42	0.1758

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1517026	6.3715	1	42	0.0155*
Univar unadj Epsilon=	1	6.3715	1	42	0.0155*
Univar G-G Epsilon=	1	6.3715	1	42	0.0155*
Univar H-F Epsilon=	1	6.3715	1	42	0.0155*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0278326	1.1690	1	42	0.2858
Univar unadj Epsilon=	1	1.1690	1	42	0.2858
Univar G-G Epsilon=	1	1.1690	1	42	0.2858
Univar H-F Epsilon=	1	1.1690	1	42	0.2858

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0935818	3.9304	1	42	0.0540
Univar unadj Epsilon=	1	3.9304	1	42	0.0540
Univar G-G Epsilon=	1	3.9304	1	42	0.0540
Univar H-F Epsilon=	1	3.9304	1	42	0.0540

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0010029	0.0421	1	42	0.8384
Univar unadj Epsilon=	1	0.0421	1	42	0.8384
Univar G-G Epsilon=	1	0.0421	1	42	0.8384
Univar H-F Epsilon=	1	0.0421	1	42	0.8384

S-DERS: Nonacceptance
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre S-DERS: Nonacceptance	Post S-DERS: Nonacceptance
Intercept	9.11174242	10.8371212
Group[A]	-0.0700758	-1.2537879
Visit Number[1]	0.93371212	1.20833333
Group[A]*Visit Number[1]	0.02462121	0.20833333

Least Squares Means
Overall Means

Pre S-DERS: Nonacceptance	Post S-DERS: Nonacceptance
9.10869565	10.7826087

Group

	Pre S-DERS: Nonacceptance	Post S-DERS: Nonacceptance
A	9.04166667	9.58333333
B	9.18181818	12.0909091

Visit Number

	Pre S-DERS: Nonacceptance	Post S-DERS: Nonacceptance
1	10.0454545	12.0454545
19	8.1780303	9.62878788

Group*Visit Number

	Pre S-DERS: Nonacceptance	Post S-DERS: Nonacceptance
A,1	10	11
A,19	8.08333333	8.16666667
B,1	10.0909091	13.0909091
B,19	8.27272727	11.0909091

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0874149	1.2238	3	42	0.3129

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	5.3954798	226.6102	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0237619	0.9980	1	42	0.3235

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0622087	2.6128	1	42	0.1135

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0007358	0.0309	1	42	0.8613

Within Subjects
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F

F Test	0.1315964	1.8423	3	42	0.1542
Univar unadj Epsilon=	1	1.8423	3	42	0.1542
Univar G-G Epsilon=	1	1.8423	3	42	0.1542
Univar H-F Epsilon=	1	1.8423	3	42	0.1542

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.2585928	10.8609	1	42	0.0020*
Univar unadj Epsilon=	1	10.8609	1	42	0.0020*
Univar G-G Epsilon=	1	10.8609	1	42	0.0020*
Univar H-F Epsilon=	1	10.8609	1	42	0.0020*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1217138	5.1120	1	42	0.0290*
Univar unadj Epsilon=	1	5.1120	1	42	0.0290*
Univar G-G Epsilon=	1	5.1120	1	42	0.0290*
Univar H-F Epsilon=	1	5.1120	1	42	0.0290*

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0065511	0.2751	1	42	0.6027
Univar unadj Epsilon=	1	0.2751	1	42	0.6027
Univar G-G Epsilon=	1	0.2751	1	42	0.6027
Univar H-F Epsilon=	1	0.2751	1	42	0.6027

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0029317	0.1231	1	42	0.7274

Univar unadj Epsilon=	1	0.1231	1	42	0.7274
Univar G-G Epsilon=	1	0.1231	1	42	0.7274
Univar H-F Epsilon=	1	0.1231	1	42	0.7274

S-DERS: Modulate
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre S-DERS: Modulate	Post S-DERS: Modulate
Intercept	8.97348485	10.1193182
Group[A]	-0.3901515	-0.7443182
Visit Number[1]	0.52651515	0.58522727
Group[A]*Visit Number[1]	-0.1098485	0.53977273

Least Squares Means
Overall Means

Pre S-DERS: Modulate	Post S-DERS: Modulate
8.95652174	10.0869565

Group

	Pre S-DERS: Modulate	Post S-DERS: Modulate
A	8.58333333	9.375
B	9.36363636	10.8636364

Visit Number

	Pre S-DERS: Modulate	Post S-DERS: Modulate
1	9.5	10.7045455
19	8.4469697	9.53409091

Group*Visit Number

	Pre S-DERS: Modulate	Post S-DERS: Modulate
A,1	9	10.5
A,19	8.16666667	8.25
B,1	10	10.9090909
B,19	8.72727273	10.8181818

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0670148	0.9382	3	42	0.4308

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	8.8763969	372.8087	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0313389	1.3162	1	42	0.2578

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0300958	1.2640	1	42	0.2673

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0045007	0.1890	1	42	0.6660

Within Subjects
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.085588	1.1982	3	42	0.3221
Univar unadj Epsilon=	1	1.1982	3	42	0.3221
Univar G-G Epsilon=	1	1.1982	3	42	0.3221
Univar H-F Epsilon=	1	1.1982	3	42	0.3221

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.2024647	8.5035	1	42	0.0057*
Univar unadj Epsilon=	1	8.5035	1	42	0.0057*
Univar G-G Epsilon=	1	8.5035	1	42	0.0057*
Univar H-F Epsilon=	1	8.5035	1	42	0.0057*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0193429	0.8124	1	42	0.3726
Univar unadj Epsilon=	1	0.8124	1	42	0.3726
Univar G-G Epsilon=	1	0.8124	1	42	0.3726
Univar H-F Epsilon=	1	0.8124	1	42	0.3726

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0005316	0.0223	1	42	0.8819
Univar unadj Epsilon=	1	0.0223	1	42	0.8819
Univar G-G Epsilon=	1	0.0223	1	42	0.8819
Univar H-F Epsilon=	1	0.0223	1	42	0.8819

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0650769	2.7332	1	42	0.1057
Univar unadj Epsilon=	1	2.7332	1	42	0.1057
Univar G-G Epsilon=	1	2.7332	1	42	0.1057
Univar H-F Epsilon=	1	2.7332	1	42	0.1057

S-DERS: Awareness
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre S-DERS: Awareness	Post S-DERS: Awareness
Intercept	11.6742424	12.717803
Group[A]	0.49242424	-0.0094697
Visit Number[1]	0.53409091	0.66477273
Group[A]*Visit Number[1]	-0.2840909	0.21022727

Least Squares Means
Overall Means

Pre S-DERS: Awareness	Post S-DERS: Awareness
11.6956522	12.7173913

Group

	Pre S-DERS: Awareness	Post S-DERS: Awareness
A	12.1666667	12.7083333
B	11.1818182	12.7272727

Visit Number

	Pre S-DERS: Awareness	Post S-DERS: Awareness
1	12.2083333	13.3825758
19	11.1401515	12.0530303

Group*Visit Number

	Pre S-DERS: Awareness	Post S-DERS: Awareness
A,1	12.4166667	13.5833333
A,19	11.9166667	11.8333333
B,1	12	13.1818182
B,19	10.3636364	12.2727273

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0234015	0.3276	3	42	0.8054

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	8.3323282	349.9578	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0032665	0.1372	1	42	0.7129

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0201284	0.8454	1	42	0.3631

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0000764	0.0032	1	42	0.9551

Within Subjects
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0664092	0.9297	3	42	0.4348
Univar unadj Epsilon=	1	0.9297	3	42	0.4348
Univar G-G Epsilon=	1	0.9297	3	42	0.4348
Univar H-F Epsilon=	1	0.9297	3	42	0.4348

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1392263	5.8475	1	42	0.0200*
Univar unadj Epsilon=	1	5.8475	1	42	0.0200*

Univar G-G Epsilon=	1	5.8475	1	42	0.0200*
Univar H-F Epsilon=	1	5.8475	1	42	0.0200*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.032204	1.3526	1	42	0.2514
Univar unadj Epsilon=	1	1.3526	1	42	0.2514
Univar G-G Epsilon=	1	1.3526	1	42	0.2514
Univar H-F Epsilon=	1	1.3526	1	42	0.2514

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0021833	0.0917	1	42	0.7635
Univar unadj Epsilon=	1	0.0917	1	42	0.7635
Univar G-G Epsilon=	1	0.0917	1	42	0.7635
Univar H-F Epsilon=	1	0.0917	1	42	0.7635

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0312391	1.3120	1	42	0.2585
Univar unadj Epsilon=	1	1.3120	1	42	0.2585
Univar G-G Epsilon=	1	1.3120	1	42	0.2585
Univar H-F Epsilon=	1	1.3120	1	42	0.2585

SDERS: Clarity
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	46
DFE	42

Parameter Estimates

	Pre S-DERS: Clarity	Post S-DERS: Clarity
Intercept	2.96590909	3.5094697
Group[A]	-0.2159091	-0.217803
Visit Number[1]	0.30681818	0.22916667
Group[A]*Visit Number[1]	-0.0568182	0.22916667

Least Squares Means
Overall Means

Pre S-DERS: Clarity	Post S-DERS: Clarity
2.95652174	3.5

Group

	Pre S-DERS: Clarity	Post S-DERS: Clarity
A	2.75	3.29166667
B	3.18181818	3.72727273

Visit Number

	Pre S-DERS: Clarity	Post S-DERS: Clarity
1	3.27272727	3.73863636
19	2.65909091	3.28030303

Group*Visit Number

	Pre S-DERS: Clarity	Post S-DERS: Clarity
A,1	3	3.75
A,19	2.5	2.83333333
B,1	3.54545455	3.72727273
B,19	2.81818182	3.72727273

Between Subjects
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0715144	1.0012	3	42	0.4017

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	5.8368949	245.1496	1	42	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0261851	1.0998	1	42	0.3003

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0399905	1.6796	1	42	0.2021

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0041349	0.1737	1	42	0.6790

Within Subjects
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0568788	0.7963	3	42	0.5029
Univar unadj Epsilon=	1	0.7963	3	42	0.5029
Univar G-G Epsilon=	1	0.7963	3	42	0.5029
Univar H-F Epsilon=	1	0.7963	3	42	0.5029

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1952918	8.2023	1	42	0.0065*
Univar unadj Epsilon=	1	8.2023	1	42	0.0065*
Univar G-G Epsilon=	1	8.2023	1	42	0.0065*
Univar H-F Epsilon=	1	8.2023	1	42	0.0065*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	2.3709e-6	0.0001	1	42	0.9921
Univar unadj Epsilon=	1	0.0001	1	42	0.9921
Univar G-G Epsilon=	1	0.0001	1	42	0.9921
Univar H-F Epsilon=	1	0.0001	1	42	0.9921

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0039855	0.1674	1	42	0.6845
Univar unadj Epsilon=	1	0.1674	1	42	0.6845
Univar G-G Epsilon=	1	0.1674	1	42	0.6845
Univar H-F Epsilon=	1	0.1674	1	42	0.6845

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0540598	2.2705	1	42	0.1393
Univar unadj Epsilon=	1	2.2705	1	42	0.1393
Univar G-G Epsilon=	1	2.2705	1	42	0.1393
Univar H-F Epsilon=	1	2.2705	1	42	0.1393

Heart Rate Mean
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	45
DFE	41

Parameter Estimates

	Pre Heart Rate Mean	During Heart Rate Mean
Intercept	81.9831396	84.6831515
Group[A]	-0.4111104	-0.7931621
Visit Number[1]	1.55481231	1.36143788
Group[A]*Visit Number[1]	1.06101686	1.85020606

Least Squares Means
Overall Means

Pre Heart Rate Mean	During Heart Rate Mean
82.0321333	84.7368956

Group

	Pre Heart Rate Mean	During Heart Rate Mean
A	81.5720292	83.8899894
B	82.39425	85.4763136

Visit Number

	Pre Heart Rate Mean	During Heart Rate Mean
1	83.5379519	86.0445894
19	80.4283273	83.3217136

Group*Visit Number

	Pre Heart Rate Mean	During Heart Rate Mean
A,1	84.1878583	87.1016333
A,19	78.9562	80.6783455
B,1	82.8880455	84.9875455
B,19	81.9004545	85.9650818

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.053457	0.7306	3	41	0.5397

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	80.21712	3288.9019	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0041881	0.1717	1	41	0.6808

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0245596	1.0069	1	41	0.3215

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.024475	1.0035	1	41	0.3223

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0468341	0.6401	3	41	0.5936
Univar unadj Epsilon=	1	0.6401	3	41	0.5936
Univar G-G Epsilon=	1	0.6401	3	41	0.5936
Univar H-F Epsilon=	1	0.6401	3	41	0.5936

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.4319762	17.7110	1	41	0.0001*
Univar unadj Epsilon=	1	17.7110	1	41	0.0001*
Univar G-G Epsilon=	1	17.7110	1	41	0.0001*
Univar H-F Epsilon=	1	17.7110	1	41	0.0001*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0086491	0.3546	1	41	0.5548

Univar unadj Epsilon=	1	0.3546	1	41	0.5548
Univar G-G Epsilon=	1	0.3546	1	41	0.5548
Univar H-F Epsilon=	1	0.3546	1	41	0.5548

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0022158	0.0908	1	41	0.7646
Univar unadj Epsilon=	1	0.0908	1	41	0.7646
Univar G-G Epsilon=	1	0.0908	1	41	0.7646
Univar H-F Epsilon=	1	0.0908	1	41	0.7646

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0369055	1.5131	1	41	0.2257
Univar unadj Epsilon=	1	1.5131	1	41	0.2257
Univar G-G Epsilon=	1	1.5131	1	41	0.2257
Univar H-F Epsilon=	1	1.5131	1	41	0.2257

Systolic Mean
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	45
DFE	41

Parameter Estimates

	Pre Systolic Mean	During Systolic mean
Intercept	97.672129	109.567249

Group[A]	0.80626534	0.99544867
Visit Number[1]	4.83209716	5.1310214
Group[A]*Visit Number[1]	1.49273352	1.58083958

Least Squares Means
Overall Means

Pre Systolic Mean	During Systolic mean
97.8305978	109.738522

Group

	Pre Systolic Mean	During Systolic mean
A	98.4783943	110.562697
B	96.8658636	108.5718

Visit Number

	Pre Systolic Mean	During Systolic mean
1	102.504226	114.69827
19	92.8400318	104.436227

Group*Visit Number

	Pre Systolic Mean	During Systolic mean
A,1	104.803225	117.274558
A,19	92.1535636	103.850836
B,1	100.205227	112.121982
B,19	93.5265	105.021618

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.1032761	1.4114	3	41	0.2532

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	38.766851	1589.4409	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0029301	0.1201	1	41	0.7307

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0895997	3.6736	1	41	0.0623

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0085271	0.3496	1	41	0.5576

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0011857	0.0162	3	41	0.9971

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	1.2213668	50.0760	1	41	<.0001*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0003089	0.0127	1	41	0.9109

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0007713	0.0316	1	41	0.8597

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.000067	0.0027	1	41	0.9585

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F

F Test	0.1032761	1.4114	3	41	0.2532

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	38.766851	1589.4409	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0029301	0.1201	1	41	0.7307

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0895997	3.6736	1	41	0.0623

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0085271	0.3496	1	41	0.5576

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0011857	0.0162	3	41	0.9971
Univar unadj Epsilon=	1	0.0162	3	41	0.9971
Univar G-G Epsilon=	1	0.0162	3	41	0.9971
Univar H-F Epsilon=	1	0.0162	3	41	0.9971

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	1.2213668	50.0760	1	41	<.0001*
Univar unadj Epsilon=	1	50.0760	1	41	<.0001*
Univar G-G Epsilon=	1	50.0760	1	41	<.0001*
Univar H-F Epsilon=	1	50.0760	1	41	<.0001*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0003089	0.0127	1	41	0.9109
Univar unadj Epsilon=	1	0.0127	1	41	0.9109
Univar G-G Epsilon=	1	0.0127	1	41	0.9109
Univar H-F Epsilon=	1	0.0127	1	41	0.9109

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0007713	0.0316	1	41	0.8597
Univar unadj Epsilon=	1	0.0316	1	41	0.8597
Univar G-G Epsilon=	1	0.0316	1	41	0.8597
Univar H-F Epsilon=	1	0.0316	1	41	0.8597

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.000067	0.0027	1	41	0.9585
Univar unadj Epsilon=	1	0.0027	1	41	0.9585
Univar G-G Epsilon=	1	0.0027	1	41	0.9585
Univar H-F Epsilon=	1	0.0027	1	41	0.9585

Diastolic Mean
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	45
DFE	41

Parameter Estimates

	Pre Diastolic Mean	During Diastolic Mean
Intercept	55.8664752	63.0413856
Group[A]	-0.2837975	0.53915833
Visit Number[1]	-0.8241339	0.26780379
Group[A]*Visit Number[1]	0.68124792	1.04408561

Least Squares Means
Overall Means

Pre Diastolic Mean	During Diastolic Mean
55.8569933	63.08252

Group

	Pre Diastolic Mean	During Diastolic Mean
A	55.5826777	63.5805439
B	56.1502727	62.5022273

Visit Number

	Pre Diastolic Mean	During Diastolic Mean
1	55.0423413	63.3091894
19	56.6906091	62.7735818

Group*Visit Number

	Pre Diastolic Mean	During Diastolic Mean
A,1	55.4397917	64.8924333
A,19	55.7255636	62.2686545
B,1	54.6448909	61.7259455
B,19	57.6556545	63.2785091

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0064761	0.0885	3	41	0.9660

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	27.531803	1128.8039	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.000127	0.0052	1	41	0.9428

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0006027	0.0247	1	41	0.8759

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0057964	0.2377	1	41	0.6285

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0663133	0.9063	3	41	0.4464
Univar unadj Epsilon=	1	0.9063	3	41	0.4464
Univar G-G Epsilon=	1	0.9063	3	41	0.4464
Univar H-F Epsilon=	1	0.9063	3	41	0.4464

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	1.6472269	67.5363	1	41	<.0001*
Univar unadj Epsilon=	1	67.5363	1	41	<.0001*
Univar G-G Epsilon=	1	67.5363	1	41	<.0001*
Univar H-F Epsilon=	1	67.5363	1	41	<.0001*

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F

F Test	0.0216707	0.8885	1	41	0.3514
Univar unadj Epsilon=	1	0.8885	1	41	0.3514
Univar G-G Epsilon=	1	0.8885	1	41	0.3514
Univar H-F Epsilon=	1	0.8885	1	41	0.3514

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0381519	1.5642	1	41	0.2181
Univar unadj Epsilon=	1	1.5642	1	41	0.2181
Univar G-G Epsilon=	1	1.5642	1	41	0.2181
Univar H-F Epsilon=	1	1.5642	1	41	0.2181

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0042126	0.1727	1	41	0.6799
Univar unadj Epsilon=	1	0.1727	1	41	0.6799
Univar G-G Epsilon=	1	0.1727	1	41	0.6799
Univar H-F Epsilon=	1	0.1727	1	41	0.6799

RMS SD
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	45
DFE	41

Parameter Estimates

	Pre RMS SD	During RMS SD

Intercept	58.6494129	58.6702462
Group[A]	2.89350379	2.91433712
Visit Number[1]	-3.6833144	-3.6624811
Group[A]*Visit Number[1]	-3.1337689	-3.1129356

Least Squares Means
Overall Means

Pre RMS SD	During RMS SD
58.5622222	58.5844444

Group

	Pre RMS SD	During RMS SD
A	61.5429167	61.5845833
B	55.7559091	55.7559091

Visit Number

	Pre RMS SD	During RMS SD
1	54.9660985	55.0077652
19	62.3327273	62.3327273

Group*Visit Number

	Pre RMS SD	During RMS SD
A,1	54.7258333	54.8091667
A,19	68.36	68.36
B,1	55.2063636	55.2063636
B,19	56.3054545	56.3054545

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0991457	1.3550	3	41	0.2700

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	10.88294	446.2005	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0266707	1.0935	1	41	0.3018

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.042666	1.7493	1	41	0.1933

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0308537	1.2650	1	41	0.2672

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0666667	0.9111	3	41	0.4440
Univar unadj Epsilon=	1	0.9111	3	41	0.4440
Univar G-G Epsilon=	1	0.9111	3	41	0.4440
Univar H-F Epsilon=	1	0.9111	3	41	0.4440

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0212766	0.8723	1	41	0.3558
Univar unadj Epsilon=	1	0.8723	1	41	0.3558
Univar G-G Epsilon=	1	0.8723	1	41	0.3558
Univar H-F Epsilon=	1	0.8723	1	41	0.3558

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0212766	0.8723	1	41	0.3558
Univar unadj Epsilon=	1	0.8723	1	41	0.3558

Univar G-G Epsilon=	1	0.8723	1	41	0.3558
Univar H-F Epsilon=	1	0.8723	1	41	0.3558

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0212766	0.8723	1	41	0.3558
Univar unadj Epsilon=	1	0.8723	1	41	0.3558
Univar G-G Epsilon=	1	0.8723	1	41	0.3558
Univar H-F Epsilon=	1	0.8723	1	41	0.3558

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0212766	0.8723	1	41	0.3558
Univar unadj Epsilon=	1	0.8723	1	41	0.3558
Univar G-G Epsilon=	1	0.8723	1	41	0.3558
Univar H-F Epsilon=	1	0.8723	1	41	0.3558

Average RR
Manova Fit
Response Specification
To construct the linear combinations across responses,

[ ] Univariate Tests Also
[ ] Test Each Column Separately Also

N	45
DFE	41

Parameter Estimates

	Pre Average RR	During Average RR
Intercept	697.889394	697.889394
Group[A]	11.280303	11.280303
Visit Number[1]	-8.3287879	-8.3287879

Group[A]*Visit Number[1]	-14.874242	-14.874242

Least Squares Means
Overall Means

Pre Average RR	During Average RR
697.624444	697.624444

Group

	Pre Average RR	During Average RR
A	709.169697	709.169697
B	686.609091	686.609091

Visit Number

	Pre Average RR	During Average RR
1	689.560606	689.560606
19	706.218182	706.218182

Group*Visit Number

	Pre Average RR	During Average RR
A,1	685.966667	685.966667
A,19	732.372727	732.372727
B,1	693.154545	693.154545
B,19	680.063636	680.063636

Between Subjects
Sum
All Between

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0694284	0.9489	3	41	0.4260

Intercept

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	82.026699	3363.0946	1	41	<.0001*

Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0214301	0.8786	1	41	0.3541

Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0116828	0.4790	1	41	0.4928

Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0.0372608	1.5277	1	41	0.2235

Within Subjects
Contrast
All Within Interactions

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0	0.0000	3	41	1.0000
Univar unadj Epsilon=	1	.	3	41	.
Univar G-G Epsilon=	.	.	.	.	.
Univar H-F Epsilon=	.	.	.	.	.

Time

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0	0.0000	1	41	1.0000
Univar unadj Epsilon=	1	.	1	41	.
Univar G-G Epsilon=	.	.	.	.	.
Univar H-F Epsilon=	.	.	.	.	.

Time*Group

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0	0.0000	1	41	1.0000
Univar unadj Epsilon=	1	.	1	41	.
Univar G-G Epsilon=	.	.	.	.	.
Univar H-F Epsilon=	.	.	.	.	.

Time*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0	0.0000	1	41	1.0000
Univar unadj Epsilon=	1	.	1	41	.
Univar G-G Epsilon=	.	.	.	.	.
Univar H-F Epsilon=	.	.	.	.	.

Time*Group*Visit Number

Test	Value	Exact F	NumDF	DenDF	Prob>F
F Test	0	0.0000	1	41	1.0000
Univar unadj Epsilon=	1	.	1	41	.
Univar G-G Epsilon=	.	.	.	.	.
Univar H-F Epsilon=	.	.	.	.	.