

May 2018

# Examining the Effect of Perseverative Thinking on Physiological Activation in Response to Stress

Kathleen Kelly  
k.kelly@siu.edu

Follow this and additional works at: [http://opensiuc.lib.siu.edu/uhp\\_theses](http://opensiuc.lib.siu.edu/uhp_theses)

---

## Recommended Citation

Kelly, Kathleen, "Examining the Effect of Perseverative Thinking on Physiological Activation in Response to Stress" (2018). *Honors Theses*. 448.  
[http://opensiuc.lib.siu.edu/uhp\\_theses/448](http://opensiuc.lib.siu.edu/uhp_theses/448)

This Dissertation/Thesis is brought to you for free and open access by the University Honors Program at OpenSIUC. It has been accepted for inclusion in Honors Theses by an authorized administrator of OpenSIUC. For more information, please contact [opensiuc@lib.siu.edu](mailto:opensiuc@lib.siu.edu).

Examining the Effect of Perseverative Thinking on Physiological Activation in Response to  
Stress

Kathleen M. Kelly

Faculty Advisor: Sarah Kertz, PhD

5/9/2018

## Abstract

The current study had two aims: (1) measure changes in heart rate variability from the time of learning about a stressor task to completion of the task and (2) measuring the change in heart rate during and after the stressor task. Thirty participants were recruited from a midwestern university campus as well as surrounding communities. The study utilized a laboratory based stressor to examine the influence of perseverative thinking on stress recovery over a 24-hour period. Participants were involved in the study for a continuous 48 hours that included three lab visits. Participants' activities and heart rates were measured through texted questionnaires and Fitbits between visits. Participants who scored high on measures of anxiety were expected to exhibit longer latency of stress recovery (i.e., return to baseline) after the stressor task. Results indicated a non-significant relationship between trait anxiety and latency of stress recovery; however, significant results were found for the indirect effects of perseverative thinking on the direct relationship.

*Key Terms: cognition, heart rate, perseverative perseverative thinking, latency of stress, recovery*

## TABLE OF CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
ABSTRACT.....	2
CHAPTER 1 .....	8
- Introduction.....	8
CHAPTER 2 .....	11
- Literature Review.....	11
- Factors that influence Stress and Experienced Levels.....	11
- Stress Induced Research .....	13
- Social Evaluation .....	15
- Continuous Stress and Cardiovascular Responses with Resulted Therapies.....	17
- Purpose of Current Study.....	18
- Hypotheses.....	19
CHAPTER 3 .....	20
- Method .....	20
- Participants.....	20
- Materials .....	21
- Measures .....	21
- Procedure .....	24
CHAPTER 4 .....	26

- Results.....26
- Preliminary Data Analyses .....26
- Preliminary Results.....26
- Primary Analyses .....27
  
- CHAPTER 5 .....28
  
- Discussion.....28
- Implications.....29
- Relations to Previous Studies.....30
- Limitations .....32
- Future Directions .....33
- Conclusions.....33
  
- References.....36

APPENDICES

I. Materials

A. Email and Verbal Phone Script

B. Screener Supplements

C. Consent Form

D. Debriefing Statement

II. Measures

A. Demographics

B. State Trait Anxiety Inventory

C. Perseverative Thinking Questionnaire

D. Attention Control Scale

E. Positive and Negative Affect Schedule

F. State Ruminating Negative Thinking Item

G. State Stress Item

H. PAWS Stress Questionnaire

I. Social Phobia Inventory

III Advertising Appendix

<u>TABLE</u>	<u>PAGE</u>
Table 1: Correlations Between Study Variables .....	44
Table 2: Non-Transformed Normality Data.....	45
Table 3: Mediation Results: Total, Direct, Indirect Effects .....	46

## LIST OF TABLES

<u>FIGURE</u>	<u>PAGE</u>
<i>Figure 1: Study Recruitment Procedure</i> .....	41
<i>Figure 2: Study Procedure</i> .....	42
<i>Figure 3: Mediation Model</i> .....	43

LIST OF FIGURES



## CHAPTER 1

### INTRODUCTION

Anxiety and its symptoms have been studied indirectly since the time of Charles Darwin (1872) as he researched the evolutionary and adaptive significance of the fight or flight response in animals (Barlow, 2002). Signs of the fight or flight response are foreign to no one: increased heart rate, hurried breath, and light headedness; however, these physiological sensations are just as necessary for any species' survival as the skills that have evolved to reproduce and scavenge (Dhabhar, 2009). Søren Kierkegaard explained the origins of anxiety emerging from the idea of “nonexistence” in his “The Concept of Dread” (1844). Using this prospective as a lens to investigate anxiety, it becomes easy to understand that without anxiety species lose the urgency to develop skills of survival within the demands of the environment (Lee, Jeong, Yim, & Jeon, 2016). In recent history, however, a need to understand the physical responses and their connection with cognition has become overwhelming as the depth of anxiety has extended to include a range of disorders that often include very potent psychophysiological reactions such as specific phobias and panic disorder (Angst, 1998; Ottaviani, Medea, Lonigro, Tarvainen, & Couyoumdjian, 2015).

As stated earlier, the physical responses to stress have been long noted. For nearly a century, research has supported the theory that prolonged physiological activation in the response of stress is linked with negative health outcomes (Pieper & Brosschot, 2005). Hans Selye (1936) noted the physical defense system that follows stress until it is resolved. According to Selye, without resolution the animal will experience ‘exhaustion’. Reaching the stage of

exhaustion due to the prolongation of stress exposure leads to risk of a physical state that can lead to diseases such as coronary disease (Linden, Earle, Gerin, & Chistenfeld, 1997). These negative outcomes include lowered immune system, decreased general health, increased cardiovascular risks, and inflated risk for developing diabetes (Chemaeva et al., 2015).

Prolonged physiological activation in response to stress is linked with negative health outcomes, such as cardiovascular disease (Pieper & Brosschot, 2005); however, the influence of psychological factors on this relationship has been understudied. More recently, researchers have investigated perseverative cognitions, such as worry and rumination, and reported that such cognitions exacerbate stress responses and contribute to the worsening of health outcomes, such as coronary artery disease, stroke, and hypertension (Pieper & Brosschot, 2005).

More specifically, prolonged physiological activation after a stressor cannot be fully explained by biological processes, and one explanation for sustained activation is psychophysiological preparation. Psychophysiological preparation is a state of readiness that becomes heightened with perseverative cognition. However, critical aspects of psychophysiological preparation, such as the duration of the stress response and time to recover post stressor have yet to be fully examined (Mata, Rodriguez-Ruiz, Ruiz-Padial, Turpin, & Vila, 2009). Findings to date support this model by suggesting that perseverative thinking interacts with naturally occurring stressors to produce negative physiological effects on heart rate, heart rate variability, and increased cortisol level (Pieper & Brosschot, 2005).

Prior studies are limited by a lack of control of the intensity and duration of the stressor (Brosschot, Gerin, & Thayer, 2006; Pieper, Brosschot, Leeden, & Thayer, 2007). Therefore, the current study utilized a laboratory based, controlled stressor to examine the influence of perseverative thinking on activation of stress and recovery over 24 hours. Recent theories focus

on the specific link between perseverative negative patterns of thought, also known as worry and ruminative thoughts, and the perseverance of these physical consequences that often result in disease (Pieper & Brosschot, 2005). Perseverative thought has most notably been studied in regard to the maintenance of psychopathology, particularly anxiety and depression (Ehring & Watkins, 2008). Unfortunately, much of the research to date has failed to consider the association of perseverative negative thinking with the relationship between the prolonged effects of stress and the development of disease (Pieper & Brosschot, 2005).

To address the gap, Brosschot et al. (2006) developed the perseverative cognition hypothesis, which proposes that perseverative thinking interacts with stress. This interaction contributes to various negative health outcomes observed through a number of proposed responses, such as (1) amplifying the physiological response to stress in the short-term, (2) delaying recovery from stress, and/or (3) repeatedly reactivating the stress response after the stressor has passed in the long-term. Continuous reactivation of the stress response lengthens the damaging physiological effects of stress, which may result in stress-related cardiovascular diseases, such as coronary artery disease, stroke, and hypertension. As more evidence is collected, the relation between perseverative cognition and multiple health related risk factors, including elevated stress, poor diet, high systolic and diastolic blood pressure (BP), low heart rate variability, and high cortisol levels is supported (e.g., Brosschot et al., 2006; Verkuil et al., 2010; Ottaviana et al, 2015).

Pieper, Brosschot, Van der Leeden, and Thayer (2010) also investigated prolonged stress by specifically testing the extended effect of worry on physiological arousal in response to stress caused naturally from occurring events in the daily lives of participants. Worry and apprehension were related to an increase in heart rate for as long as 2 hours following moderate stress induced

in the lab for participants who experienced greater levels of anxiety. A limitation of Pieper and colleagues' (2010) study is the lack of experimental control for the duration and intensity of the stressor. Since the study relied on stress experience outside of the lab, the intensity of responses cannot be compared as duration and intensity of the stress experienced was too varied based on the experiences of the participants.

The current study tested the perseverative thinking hypothesis in a controlled, laboratory setting. To add to the literature, the current study tested the immediate and prolonged effect of trait anxiety on heart rate and self-reported stress in response to a stress induction task known as the Tier Social Stress Task (Birkett, 2011).

## CHAPTER 2

### LITERATURE REVIEW

#### **Factors that Influence Stress and Experienced Levels**

Cardiovascular disease is the greatest cause of mortality in western countries; interestingly and key to the current research, anxiety and depression are often comorbid with cardiovascular disease (Tan & Morgan, 2015; Olive, Telford, Byrne, Abhayarantna, & Telford, 2016; Hamer, 2012; Austin, Kushnick, Knutson, McGlynn, & Patterson, 2015). Cardiovascular disease has been linked with many lifestyle habits such as greater body mass index (BMI), less exercise, and is more often reported for males and older adults with high cholesterol and increased systolic blood pressure (the pressure in the heart cavities during a contraction; Martin et al., 2013; Linden et al., 1997; Cole, Blackstone, Pashkow, Sander, & Lauer, 2017; Harada et al., 2016). Interestingly, individuals with increased cardiovascular stress responses have

increased risk of cardiovascular disease due to elevated hypertension and cortisol levels (Bibbey, Carroll, Ginty, & Phillips, 2015; Wawryzniak, 2016; Gantt, Dadds, Burns, Glaser, & Moore, 2017; Chida & Steptoe, 2010).

Dragomir and colleagues (2014) investigated the relations between cardiovascular responses and psychological stress during a three-year longitudinal study of the “stress reactivity hypothesis model.” This model assumed that those who experienced heightened physical reactivity in response to stress have biological traits influencing the responses. Traits are persistent over time without conscious, continuous intervention, which led Dragomir et al. (2014) to examine the stability of automatic, unremitting increased physical responses over time (Bertsch, Hagemann, Maumann, Schachinger, & Schulze, 2012). Delayed cardiovascular recovery from stress was consistent throughout the three-year duration of the study. Such findings lead to the question: what factors cause the persistence of stress?

Kirsch and Lehman (2015) investigated factors such as gender, lifestyles, and coping strategies and their effects on cardiovascular disease; moreover, their research, which was based on the transaction model of stress, concluded that the factors had different effects. The transactional model of stress supports the assumption that individuals and their environment are interdependent and have a bidirectional relationship (Zimmer-Gembeck, 2016). Protective factors were noted for men. Due to the influence of estrogen, women who were pre-menopausal as well as women using estrogen-replacement therapies experienced lower autonomic activity than men of the same age (Kajantie & Phillips, 2006; Martin et al., 2013). Besides estrogen, another gender difference was the amount of stress reported and the type of coping mechanism used. For instance, women more often reported higher rates of stress than their counterparts; furthermore, woman coped with mechanisms such as emotion-focused coping, which differed

from the avoidant approach used by men. Interestingly, systolic blood pressure was lower in men who used avoidant coping along and were physically active; however, in women systolic blood pressure remained the same while using avoidant coping no matter the amount of exercise (Cole et al., 2017; Hamer, 2012). The greatest predictor of cardiovascular disease and risk factors were amount and use of social supports, which are linked to lower blood pressure, lower cortisol levels, increased oxytocin, and greater immune functioning (Hamer, 2012). Kirsch and Lehman (2015) reported that women utilize more social supports. Ultimately, results from research conducted on stress reactions may not generalize across genders, which is why creating a uniform stress task to be used across participants has been included in recent studies.

### **Stress Induced Research**

Physical responses to stress have largely been studied using stress-induced techniques (Brindle, Ginty, Phillips, & Carrol, 2014). One barrier researchers face when studying stress and its effects is controlling the duration and intensity of the stress experienced across participants. To address this, the field has created a variety of stress tasks that participants undergo in a laboratory setting. An example of this type of task is the Tier Social Stress Test (TSST; Birkett, 2011) which was used in the current study. The Tier Social Stress Task consists of two tasks. First, participants are given ten minutes to formulate a speech that will be videotaped. Next, participants are given five minutes to conduct the speech. Lastly, participants are asked to verbally report answers to the math task of sequentially subtracting thirteen from one thousand and twenty-two aloud.

Yusuke and Usua (2017) examined the relation between heart rate variability and slower recovery after using a variation of the TSST. The researchers used a series of Stroop Tests for a set duration to induce cardiovascular stress responses (Chida & Steptoe, 2010; Austin et al.,

2015). They compared heart rate variability at two points during the procedure: 1) rest time, and 2) after 15 minutes of recovery. They hypothesized that “slow recovery”, low frequency band heart rate would decrease during the task and continue for a duration of two hours post testing. Only “very low frequency” heart rate delayed recovery following the task, which led to the assumption that the aspect of heart rate variability that decreases recovery time is the “very low frequency” band; moreover, the decreased variability due to the reduced vagal activity creates a risk factor for mortality (Cole et al., 2017; Harada et al., 2016; Vella & Friedman, 2009).

In contrast to studying the effects of stress on heart rate variability, Chemaeya et al. (2015), induced stress in their participants to examine the links of acute autonomic stress reactivity and atherosclerosis (i.e., degree of arterial elasticity). Atherosclerosis is associated with high blood cholesterol, inflammation, and hypertension (Hamer, 2012; Ottaviani, 2015). Atherosclerosis is common in people who smoke, are obese, or have diabetes; furthermore, the phenomenon leads to damage to the endothelium of veins. Once damage has occurred, the clotting process thickens the walls, which in turn reduces elasticity. It was hypothesized that more elasticity of the endothelium leads to better cardiovascular health. A variation of the TSST was paired with startle responses to create acute stress. Those with more elastic blood vessels experienced greater heart rate response to the stress task as well as had better cardiovascular health. These findings support the idea that elevated cardiac reactivity is an “adaptive reaction” to stress even for those who are healthy.

Research that utilizes stress provoking tasks often does not address the question of recovery due to the immediate retraction of the stressor (Linden et al., 1997). This is not surprising when the economic and time burden of conducting a study in this area is considered (Brosschot et al., 2005). The current study aimed to address this issue by extending the stress

task over a course of twenty-four hours after the initial task to measure the state of recovery. The emphasis on social evaluation within the Tier Social Stress Task has historically created induced stress intense enough to study over such an extended period.

### **Social Evaluation**

Higher levels of stress can be created when inducing stress in participants through social evaluation paired with self-awareness (Smith, Birmingham, & Bert, 2012). The inflated response to social pressure is due to the dysregulation of the Sympathetic-Adrenal-Medullar (SAM) system and Hypothalamic, Pituitary, Adrenal (HPA) axis (Bibbey, Carroll, Ginty, & Phillips, 2015; Smith, Birmingham, & Bert, 2012; Morrow & Nolen-Hoeksema, 1990; Boylan, Jennings, & Matthews, 2016; Chida & Steptoe, 2010; Panaite, Salomon, Jin, & Rottenberg, 2015; Linden et al., 1997; Olive et al., 2016). Brosschot et al. (2006) proposed the relation between worrying, rumination and prolonged stress sensitivity as the prolonged activation perseverative cognition hypothesis. Smith, Birmingham, and Bert (2012) examined how social stress in daily life was associated with ambulatory blood pressure. Increased reports of social evaluation were linked to higher systolic and diastolic blood pressure, as well as social evaluation, which in turn become risks for cardiovascular disease (Brosschot et al., 2014). Morrow and Nolen-Hoeksema (1990) investigated depressive affect and its association with self-awareness. They concluded that increased self-awareness contributes to greater depressed moods in individual. Interestingly, more hostile participants experienced increased cardiovascular responses when exposed to self-awareness evaluations (Morrow & Nolen-Hoeksema, 1990; Linden et al., 1997; Villa & Friedman, 2009). An elevated cardiovascular response is associated with cardiovascular disease such as coronary heart disease, which is directly related to the current project investigating specifically the length of time increased cardiovascular responses (a risk factor for



cardiovascular disease) exist in those with higher anxiety. If interventions can be developed to shorten the increased responses, cardiovascular disease risks may be lowered as well.

What remains unclear is the intensity of a social evaluation threat that must be used to create a controlled, equal response across participants; however, Bibbey et al. (2015) found no such specific answer exists due to individual differences in biological thresholds of tolerable levels of central nervous system responses. Bibbey et al. (2015) specifically examined individuals with Type D personality (distressed, inhibited emotions, and inflated levels of negative affect). Individuals with Type D personalities have increased mortality rates, particularly related to cardiovascular disease (Cao et al., 2016). Bibby et al. (2015) used a variation of the TSST, creating a range of levels of social inhibition across participants; however, emotional inhibition was linked to increased cardiovascular activity and cortisol levels. Specifically, the nature of the math portion of the TSST highlighted the relation between high social inhibition, raised blood pressure and cortisol reactivity due to the lack of reinforcement and emphasis on punishment by requiring participants to start the math portion over again with any mistake. However, heart rate and blood pressure did not differ between those with and without Type D personality throughout the duration of the task (Kelly-Hughes, Wetherell, & Smith, 2014). Those with Type D personalities demonstrated higher heart rate and cortisol levels in the socially invasive task than those without Type D personality; however, no difference was observed across groups when the tasks were not performed in the presence of a research confederate (non-social). This is important because it highlights the variety of stress responses that exist and their differing effects on physical reactions. Ultimately, stress tasks have provided the opportunity to investigate stress in controlled settings; however, research conducted in the lab fails to account for the fact that stress is continuous, not conditional.

### **Continuous Stress and Cardiovascular Responses and Therapies**

Longitudinal studies are the best way to study the lasting effects of stress on individuals. Within the last decade, much research has been conducted on this topic. Boylan, Jennings, and Matthew (2016) investigated the effects of low socioeconomic status in childhood on cardiovascular reactivity and recovery. Lower childhood socioeconomic status predicted increased heart rate and systolic blood pressure during the cardiovascular recovery from a stressor across all ages, races, body masses, lifestyles, current socioeconomic status, and type of stress in the case of a lack of development of psychological resources to “buffer” such effects. Interestingly, lower socioeconomic status during childhood did not predict cardiovascular levels of sensitivity during baseline or reactivity during the stressor-only during recovery. Race had significant effects during baseline; however, SES had no effect. For Caucasians, socioeconomic status was related to higher baseline diastolic blood pressure. Cole and colleagues (2017) followed up with participants over six years. Abnormal heart rate recovery was a prominent predictor of mortality (more than half who died had low heart rate recovery during the duration of testing). Ultimately, the results of these studies provide evidence of the lifelong effects of prolonged stress exposure that exists for those with lower socioeconomic status.

Although longitudinal studies are vital for examining prolonged stress exposure during critical periods of development, some of the greatest levels of stress are experienced during combat and these levels are hard to replicate. Deployed military personnel live with constant stress necessary for survival (Barlow, 2002). The need for a larger sympathetic drive with limited variability creates a “cardioprotective” element observed in veterans (Gantt, Dadds, Burns, Glaser, & Moore, 2017). A positive outcome of stress research with veterans is the development of treatment. One such treatment is binaural beat technology (BBT) for cardiovascular stress

response. Cardiovascular functioning is made up of rhythmic processes; therefore, therapies target these rhythms to improve the functioning, which in turn lowers stress reactivity (Gantt et al., 2017). BBT procedure includes clients listening to two ‘mistuned’ tones that create a third tone, which is the binary beat. The binary beat is not actually presented but formed in the auditory integration regions of the brain such as the superior olivary nucleus, which in turn affects the reticular activating system (RAS). RAS is connected to alertness and consciousness of the brain. This alteration changes the frequencies in the brain (synchronization with presented stimulus), which in turn affects emotional, physical, and mental stress (Gantt et al., 2017).

Treatments for the physical symptoms of anxiety have included surgery, cardiac defibrillators, and medication. Medications lower symptomology of stress; however, chronic use of pharmaceuticals creates hypertension and is associated with arrhythmias and the onset of supraventricular arrhythmias (Tan & Morgan, 2015; Cazarim, de Freitas, Penaforte, Achcar, & Pereira, 2016). As the literature on the direct relations that mental stress has on physical responses has expanded, more therapies that target mental health for the betterment of physical health have evolved. Some current therapies are Cognitive-Behavioral Therapies (CBT) and pet therapy with an emphasis on dog ownership and are independently significantly related to lower anxiety (Tan & Morgan, 2015). Music therapy also contributes to ability to lower blood pressure and heart rate as a type of relaxation (Lee et al., 2016).

### **Purpose of Current Study**

Perseverative cognitions play an essential role in the development of stress-diseases; however, few studies have made progress in pinpointing contributing factors (Pieper et al., 2005). Pieper et al. (2006) also proposed that perseverative cognition exacerbates and prolongs physiological responses to stress, such as heart rate and heart rate variability and contributes to

disease, such as cardiovascular disease (Brosschot, Gerin, & Thayer, 2006). Accumulated studies have shown that participants exhibit higher and lower heart rate variability when perseverative thoughts related to a foreseeable stressor is present; however, due to lack of control over the type of duration and intensity of the stressor, the results varied considerably between participants (Pieper et al., 2007).

The current study increased experimental control by utilizing a laboratory paradigm to induce stress to ensure the intensity and duration of the stressor making. By monitoring heart rate before, during, and around twenty-four hours after the stressing event, the current study investigated trends related to perseverative cognition, such as rumination, worry, and anticipatory stress, in connection to affective and physiological activation (Pieper et al., 2010). Investigating the effects of time before, during, and after a controlled stressor on levels of worry and rumination was the primary aim of the current study. Those who experienced elevated levels of anxiety would have a longer recovery time (amount of time heart rate takes to return to baseline levels) than those who experienced moderate levels of anxiety. Support of these hypotheses would reinforce efforts in the growing campaign to examine the complex interaction of mental and physiological health and risk factors of stress-related disease that may underlie other physical risk factors.

### **Hypotheses**

Trait anxiety was predicted to have a longer recovery over a 24-hour period. Further, we hypothesized that trait perseverative cognition would have an indirect effect on the relationship between trait anxiety and stress recovery. Further, those with higher trait anxiety were expected to show less stress recovery between time points two and three. In other words, we hypothesized that perseverative cognition is an underlying mechanism of the trait anxiety-stress recovery

association.

## CHAPTER 3

### Method

#### Participants

Participants ( $n = 32$ ) were recruited through multiple means such as word of mouth, social media, and handouts, as well as others, around a large midwestern university campus and surrounding areas. Participants included students and members from nearby communities. After participants were recruited for the study, they were screened by email or orally to determine eligibility for the study and were notified within 48 hours regarding their eligibility for participation in the study. Eligible participants were contacted and scheduled for an initial assessment by lab personnel and documented in Google Calendars using subject ID numbers. Further illustration of the recruitment process is noted in *Figure 1*. Inclusion criteria for participation included: be at least 18 years old, speak English, have access to a phone capable of text messaging and accessing the internet, and be willing to wear a Fitbit monitor for 48 hours. As the study required 48 hours of continuous involvement, including three visits to the lab on sequential days, potential participants who were unavailable to attend all three visits for the study were excluded from participation.

#### Materials

To facilitate brief Qualtric surveys while the participants were outside the lab, the current study utilized EZ Texting. EZ Texting is an open-source, freely available on computer, no reply platform. The EZ website allows users to set specific times and days to send pre-made text messages, as well as allows texts to be sent without the use of a personal phone number. EZ

Texting does not save numbers through contacts and requires manual insertion of the participant's phone number for every text sent. Since the data from the questionnaires are collected through Qualtrics, EZ Texting received no data. A link to the Qualtrics survey was sent to participants through this system.

## Measures

**Demographics.** The sample included 32 individuals from a Midwestern university and surrounding communities. The mean participant age was  $M = 22.9$  ( $SD = 5.57$ ), and most participants were white ( $n = 19$ ; 59.4%) and female ( $n = 28$ ; 87.5%). Participants were recruited in a multitude of ways. One recruitment strategy was recruiting from various psychology courses and student organizations around campus. Another source of recruitment came from posting flyers around campus and the surrounding communities. Participants were compensated with a twenty-dollar Amazon gift card. Lastly, some students received compensation via extra credit in specific psychology courses.

**Physiological Measures.** Participants' sympathetic arousal was measured at each of the three-time points.

***Skin conductance responses (SCRs).*** A non-invasive measurement, which was used as an autonomic correlate of sympathetic arousal. We used an electrodermal response amplifier GSR 100C unit (BIOPAC systems, Inc.). The GSR 100C measures both the skin conductance level (SCL) and response (SCR) as they vary with sweat gland activity due to stress, arousal or emotional excitement. The GSR 100C uses a constant voltage (0.5 V) technique to measure skin conductance. SCR was measured through the use of disposable electrodes (sensors) that were placed on participants' index and middle fingers (EL500 series, BIOPAC systems, Inc.).

***Heart rate.*** Heart rate was obtained throughout the experimental sessions using an

automated Biopac MP-150 data acquisition system with AcqKnowledge software (Biopac Inc.: Goleta, CA). Two disposable sensors (electrodes) were attached above the individual's inner ankles and one was attached on the individual's dominant-hand wrist.

**Respiration.** Respiration was also be measured through a belt with a sensor positioned around the individual's midline. These measures via the Biopac were utilized at all three time points.

**Fitbit.** Heart rate was also assessed continuously via Fitbit Charge 2 devices following time point 1 through time point 3, a period of 48-hours. Participants reported their current heart rate as indicated by the Fitbit when instructed to complete the brief assessment sent via text.

**State-Trait Anxiety Inventory (Spielberger et al., 1968).** State and Trait anxiety levels were measured with the State-Trait Anxiety Inventory (STAI) forms Y-1 and Y-2. Form Y-1 is a twenty-item measure to measure state anxiety that includes a four-point scale (*Not at all, Somewhat, Moderately So, Very Much So*). In contrast, form Y-2 is a twenty-item measure that includes a four-point scale (*Almost Never, Sometimes, Often, Almost Always*) that measures trait anxiety. Scoring is completed by adding the weight of each item chosen with the reverse coded items. Higher scores on the inventory indicate greater levels of anxiety. The measure has excellent internal consistency within the current study ( $\alpha=.95$ ).

**Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988).** The PANAS is a twenty-item measure that is utilized to quantify levels of positive and negative affect by asking participants to indicate how often they have felt a range of feelings over the past week based on a five point-scale (1 = *Very Slightly or Not at All*, 2 = *A Little*, 3 = *Moderately*, 4 = *Quite a Bit*, 5 = *Extremely*). Ten of the items measure positive affect such as '*Excited*' and '*Proud*.' Scores for each section are summed. Higher scores on the positive affect portion

indicate elevated levels of positive affect. Negative affect is scored with the remaining ten items and includes statements such as, 'Upset' and 'Afraid.' Scores lower on the negative affect scale indicate low levels of negative affect. The measure has good internal consistency within the current study ( $\alpha=.86$ ).

**State Repetitive Negative Thinking Rating.** A single statement created for the current study was administered for all three-time points of the study. It states, "*How much have you worried, ruminated, or been preoccupied IN THE LAST 4 HOURS?*" This item was used to assess present worry in the participants.

**State Stress Item Rating.** A state stress single item rating was created for the current study and collected at all times points -*If you have experienced a significant stressor IN THE LAST 4 HOURS (e.g., break-up, robbery, failing a test, death in the family), please indicate that here: \_\_\_\_\_*). Qualitative data was collected to track life stressors outside the human experience that participants may encounter that might have skewed data collection.

**Attentional Control Scale (ACS; Derryberry & Reed, 2002).** The ACS is a twenty-item scale to measure attentional capacities and is based on a four-point scale (1 = *Almost Never*, 2 = *Sometimes*, 3 = *Often*, 4 = *Always*). Responses are summed together and include reverse scored items such as, "*It's very hard for me to concentrate on a difficult task when there are noises around.*" Higher scores indicate good attentional control. The ACS has demonstrated good internal consistency, convergent validity and concurrent validity (Derryberry & Reed, 2002; Ólafsson et al., 2011). The measure has good internal consistency within the current study ( $\alpha=.82$ ).

**Social Phobia Inventory (SPIN; Connor, 2000).** SPIN is a seventeen-item measure based on a five-point responding scale (0 = *Not at all*, 1 = *A little bit*, 2 = *Somewhat*, 3 = *Very*



*much*, 4 = *Extremely*). Items are summed with very severe social phobia being indicated by a score of 51 or higher. The measure has adequate internal consistency within the current study ( $\alpha=.78$ ).

**Physiological Activation When Stressed (PAWS) Stress Questionnaire (PAWS; Pieper et al., 2010):** The PAWS Questionnaire was created to measure activity levels, mood activity, and biological variables between time points. PAWS Questionnaire was used between each of the time points to track influences on heart rate variability while outside the lab. Some examples of items include, “*Since the last assessment, how often have you felt SAD or GLOOMY?*”, “*What has your activity level been since the last assessment?*”, and “*Since the last assessment, how many units of alcohol have you consumed?*”.

### **Procedure**

A summary of the procedure is presented in Figure 2. Participants were involved in the study for 48 hours. The first lab assessment (Time 1) included the administration of the informed consent form, self-report measures, and the distribution of the Fitbit. Participants wore the Fitbit continuously for 48 hours to assess heart rate and complete brief (< 5 minute) measures administered via text. This first assessment was predicted to last around 2-3 hours. The following day (Time 2) the participants returned to the lab to complete the laboratory assessments and a stress task. The second session lasted approximately 1-2 hours. Participants continued to wear the Fitbit device and complete brief questionnaires for the next 24 hours. The last lab assessment (Time 3), which lasted approximately 1 hour, was scheduled 24 hours after the Time 2 assessment. The Time 3 assessment included completing another set of brief assessments and returning the Fitbit.

**Time 1:** During the first laboratory assessment, participants provided informed consent, followed by the completion of a battery of assessments completed uniformly for all participants: (1) State and Trait Anxiety Inventories, (2) Positive and Negative Affect Schedule, (3) Perseverative Thinking Questionnaire, (4) State Repetitive Negative Thinking Item, (5) Attentional Control Scale, the (6) Social Phobia Inventory, the (7) State Stress Item, and (8) a demographic questionnaire. Participants were then prepared for baseline physiological data collection. All data were obtained using an automated Biopac MP-150 data acquisition system. Participants were instructed to sit quietly for 25 minutes. Once the assessments had been completed, the participants were given a Fitbit with instruction on locating the heart rate function and scheduled for a lab visit the next day.

**Between Time 1 and Time 2 (24 Hours):** Participants continuously wore the Fitbit to assess heart rate. Participants were texted four times throughout this period to complete the Positive and Negative Affect Schedule and the PAWS Stress Questionnaire through Qualtrics via a link sent through EZ Texting. The PAWS Stress Questionnaire was developed for this study (see full measure in the Appendix).

**Time 2:** Participants returned to the lab and physiological data was collected through Biopac MP-150 data acquisition system for the duration of the session. Participants completed the (1) Positive and Negative Affect Schedule, the (2) State Repetitive Negative Thinking Item, and (3) the State Stress Item. Participants completed a stressor task. The stressor task followed the protocol for a modified Trier Social Stress Task (Kirschbaum, Pirke, & Hellhammer, 1993). They were informed that they would be preparing a 5-minute speech on why they are an ideal candidate for their dream job, and that their speech would be recorded and reviewed by a panel of faculty. Participants were told that they would be given feedback on their speech when they

returned to the lab 24 hours later for Time 3. Participants were given a 10-minute period to prepare their speech. They then delivered their speech in front of a camera. Following the speech, participants were instructed to complete a math performance task for 5 minutes, which consists of sequentially subtracting the number 13 from 1,022. The stressor task was video recorded. Next, a 15-minute habituation period allowed participants to rest quietly before leaving the lab.

***Between Time 2 and Time 3:*** Participants continuously wore the Fitbit to assess heart rate. Participants were contacted four times throughout this period to complete the Positive and Negative Affect Schedule and the PAWS Stress Questionnaire through Qualtrics via a link sent with EZ Texting.

***Time 3:*** Participants returned to the lab and again the Biopac MP-150 was used to collect the physiological data. Participants were informed that their speech was not reviewed by a panel of faculty and that they would not receive feedback regarding their speech. Three measures were completed: (1) Positive and Negative Affect Schedule, (2) State Repetitive Negative

## CHAPTER 4

### Results

**Preliminary Data Analysis.** The assumption of normality was evaluated for all study variables. STAI-Trait and PTQ yielded an approximately normal distribution. However, latency of stress recovery was tested for significant z score (2.85) and kurtosis (1.27). The cutoff level for determining significant skew and kurtosis was set at  $z = 1.96$ ,  $p = .05$ , as recommended by Kim (2013) for small sample sizes ( $n < 50$ ). Therefore, the latency of stress recovery violated the normality assumption. Given the violation to the assumption of normality, analyses should be

interpreted as preliminary evidence until replication with a larger sample is possible.

**Preliminary Results.** Before conducting primary analyses, descriptive statistics were calculated. See Table 1 for means, standard deviations, and Pearson's correlations across study variables. Given that the sample was comprised of traditional students and non-traditional students/community members, we examined potential group differences in study variables associated with the two groups. The sample was coded as 1) Traditional Students or 2) Non-Traditional Students/Community Members. The cut off age was set at 23 (the mean age of the sample), thus those under the age of 22 years or younger were labeled as Traditional students while those 23 years and older were coded as Non-Traditional/Community members. To examine differences between-groups, *t*-tests were conducted with Group as the independent variable and scores on the perseverative thinking, trait anxiety, and latency of stress recovery as the dependent variables. Group differences were associated with STAI-Trait in that Traditional students scored slightly higher on trait anxiety scales than Non-traditional students and community members. An independent-samples *t*-test was conducted to compare trait anxiety in Traditional Students and Non-Traditional Students/Community Members. There was a significant difference in the scores for Traditional Students ( $M=27.1$ ,  $SD = 3.24$ ) and Non-Traditional Students/Community Members ( $M=24.7$ ,  $SD = 1.73$ );  $t(30,2)=5.25$ ,  $p = .03$ . Therefore, these group differences were entered as covariates in subsequent analyses. Reference Table 2 for illustration of non-transformed normality data.

**Primary Analyses.** The current study utilized the PROCESS macro for SPSS, which performs a series of regressions to estimate the indirect effects of perseverative thinking on the relationship between trait anxiety and latency of stress recovery as illustrated in Figure 3. The PROCESS macro is an adjunctive software for IBM SPSS, which can quantify the relationship

between two variables while computing the indirect effect via a third variable on the link between the independent and dependent variables. The PROCESS macro simultaneously tested the direct relationship between trait anxiety, measured by the STAI-Trait Form, and latency of stress recovery time, which was measured by the time point participants' heart rates returned to baseline (first hypothesis), as well as the indirect effect of perseverative cognition, measured by the PTQ, on the link between trait anxiety and stress recovery time (second hypothesis). See Figure 3 for an illustration of the hypothesized model. Group differences between Traditional students and Non-traditional students/community members were entered as a covariate in the model.

The overall model of the indirect effect of perseverative thinking on the relationship between trait anxiety and latency of stress recovery was significant  $F(2, 30) = 4.27, p = .014$ . Hypothesis 1 was examined via the direct effect of trait anxiety on latency to stress recovery (i.e., the *c* path). The direct effect of trait anxiety on latency of stress recovery was not significant,  $t(29) = -.038, p = .97$ . However, as predicted in the second hypothesis, there was a significant indirect effect of trait anxiety on latency of stress recovery via perseverative negative thinking (i.e., the *a* and *b* path), Effect = .102,  $SE = .05$ ,  $CI = -.16; .15$ ,  $R^2 = -.0028$ . Table 2 provides detailed indirect effects and confidence intervals.

## CHAPTER 5

### Discussion

The current study sought to examine the effect of perseverative thinking on the relationship between trait anxiety and latency of stress recovery. Our results suggest that trait anxiety is not directly associated with the latency of stress recovery. Although the relation between trait

anxiety and latency of stress recovery was not statistically supported, the significant findings of the indirect effect perseverative thinking on the relationship supports the theory that negative, perseverative cognitions play a significant role in the prolonging of stress recovery, which we infer is related to the development of pathological states in individuals.

Although perseverative thinking does not explain the relationship in entirety, the current study does expose a need to further investigate mechanisms that may be influencing the tested affiliation. Further investigation should focus on mechanisms indirectly associated to the relationship along with facets of the direct relationship because had the current study not tested the indirect effects of perseverative thinking on the relationship between trait anxiety and latency of stress recovery we would conclude that no association between trait anxiety and latency of stress recovery exists. However, in the case as described in, as supported by Pieper et al. (2005), the current results indicate that a significant relationship does exist.

**Relations to Previous Studies.** Results of the current study along with those of Pieper and colleagues (2005, 2007, 2010) conclude that perseverative thinking is one factor that influences prolonged physiological responses to stress, including heart rate and heart rate variability (Pieper et al., 2007). Similarly, we, along with Pieper (2007), found that psychological traits, such as trait anxiety, were not predictive of longer latency of stress recovery. Pieper did find, however, that the psychological state of trait anxiety was related to an increase in the prevalence of worry episodes, which were found to be related to increased cardiac activity. Although the current study did not specifically analyze the independent effects of worry episodes, these findings do integrate into the past literature to form a more cumulative understanding of the relationship.

Within the current study, worry episodes were integrated into the design by prolonging the TSST across assessment points, which adds an element of external validity to a contrived task.

Worry episodes are not always predictive of trait anxiety, however, which lends importance to understanding the significant effects of state anxiety. Studies done by Pieper and colleagues concluded that worry episodes and stressful events are independently significant from each other in predicting elevated heart rate and longer stress recovery. In relation to the current study, the procedure for the TSST included a statement that induced prolonged stress exposure by initiating worry episodes about feedback that participants believed they would be receiving on their speech. Through telling participants that they would be receiving feedback on the speech portion of the task during the second assessment, the current study initiated worry episodes in participants. Including this statement to the task, facilitated a longer duration of stress exposure by enabling rumination over an approximate 24-hour period outside the lab concerning their performance during the task and worry about the feedback they were told they would be receiving the following day.

Future studies should take note that neither Pieper et al., (2007) or the present study found a significant relationship between trait anxiety and latency of stress recovery. Emotion is often a construct used to measure trait anxiety as used in the current study within the State Trait Anxiety; however, these findings suggest that emotion may not be a valid construct for predicting trait anxiety. As found in Pieper et al.'s., (2007) study, cardiovascular effects were independent of emotion. These findings lead to the assumption that emotion can be largely dismissed as a working mechanism on the relationship between trait anxiety and latency of stress recovery.

As an extension of the research conducted by Pieper et al., (2010), the current study supports the perseverative cognition hypothesis theorized by Pieper. The perseverative cognition hypothesis states that worry, rumination, and anticipatory stress are associated with enhanced

cardiovascular activity, such as heart rate and heart rate variability (Brosschot et al., 2005).

Based on this hypothesis, Pieper and colleagues' studies conclude this prolonged activation of the cardiovascular system results in decreased arterial elasticity and increased atherosclerosis (Pieper et al., 2010), which in turn leads to poorer cardiovascular health over time. Results from Pieper's studies via heart rate data collected suggest that the increasing prevalence of cardiovascular disease along with the similar timing of the rise of anxiety disorders are not mutual exclusive. The past literature infers that the physical attributes of cardiovascular symptoms interact with the cognitions of anxiety, which leads to the assumption that implementing interventions for one will induce decrease in the other accordingly. More research can be done to investigate comorbidity rates of anxiety in those with cardiovascular disease.

Pieper et al., (2007) added to the literature by examining the effects of naturally occurring stress outside of a laboratory paradigm, which is more externally valid than the current study; however, the current study utilized the laboratory paradigm to increase experimental control, which increased internal validity. An advantage to the laboratory approach is that it allows the researchers to have a greater manipulative ability over the characteristics of stress such as difficulty, controllability, and sustained effort. Consequently, the task lowers external validity of the study. Few studies have specifically investigated the effects of perseverative thinking on the relationship between trait anxiety and latency of stress recovery, and those who have lacked experimental control over experienced stress across participants. The current study strengthens experimental control by incorporating a standardized stress task. By including two different performance based tasks in the form of a speech for one task and a socially evaluated math portion for the second task, we have controlled for some participants may have more robust responses than others. Although Pieper et al., (2007) studied both the physical effects



experienced in participants during worry episodes and stressful events, the current method induced and monitored only reactions formed in consequence to a stressful event; however, by doing so, we were also able to establish clear beginnings and endings of the stress that were held consistent across participants (Pieper et al., 2010). Consequently, however, it is unclear whether the results will translate into naturally occurring stress experienced outside the lab in uncontrolled situations (Chida & Steptoe, 2009).

An element of trait anxiety is continuous stress and worry outside of direct exposure to stressful stimuli. To analyze the effects of this continued perseverative thinking outside of the lab, outside monitoring of participants, which included the method collecting data in take home surveys, was utilized. Doing so was another strength of the present study because it established experimental control over stress that occurred during “neutral” times such as evening and sleep hours (Pieper et al., 2005). Finally, unlike past research, the study’s design includes three-time points, which allows a baseline to be collected, and allowed for data collection over the course of 48 hours. By collecting a baseline, the present study could more clearly identify when physical effects from created by the study began and ended. Further, the partial- cross sectional design was necessary to track latency of stress recovery as participants were found to not have recovered until after leaving the lab. Consequently, the partial cross-sectional design, which limits our ability to test causal claims related to in anxiety, perseverative thinking, and stress responses over time. The emphasis on experimental control resulting in stronger internal validity in the present study strengthens Pieper’s claims by supporting their hypothesis while compensating for limitations of in the previous research.

**Implications.** The current study’s findings add to the field by showing that the relationship between the trait anxiety and latency of stress recovery dissolves without the presence of

perseverative thinking. Evidence provided from the current study and past literature show a relationship between stress and prolongation of physical responses such as heart rate. Prolongation of pressure on arteries has been found to increase risk of cardiovascular disease. Based on our findings, the development of treatments to decrease stress response may be improved by targeting perseverative cognition for individuals with increased risk of cardiovascular complications. In contrast, we infer that those with trait anxiety who experience perseverative cognitions are at greater risk for developing cardiovascular disease; furthermore, trait anxiety may be an early predicting factor for the onset of cardiovascular issues, which may lead to prevention of further development with appropriate cognitive behavioral therapy.

**Limitations.** The findings of the study should be considered in light of its limitations that surround it. One of the limitations of the current study was that self-report measures were used to measure primary constructs such as perseverative thinking and trait anxiety. Participants' responses may have been biased by social evaluation. Future studies should rely on more than one measure to quantify and draw conclusions regarding psychological states. However, a unique strength of the study is that measures such as heartrate that were collected outside of the lab, which are less prone to reporter bias. Similarly, results may be skewed due to the volunteer nature of the study and, therefore, may not generalize to all individuals. Further, due to the narrow sample of the population, the study's results may not be generalizable to populations not widely represented in the population, such older or younger populations than college aged individuals, ethnicities other than Caucasian, and males. Another limitation of the of the study was the small sample size, which limited statistical power that may account for non-significant findings.

**Future directions.** Given the identified limitations, replication is warranted to use a larger,

more diverse sample to increase statistical power necessary for complex models and increase the generalizability of results beyond a limited demographic. Moreover, future studies should further examine the relationships among anxiety, perseverative cognition, and latency of stress recovery over time to clarify the temporal precedence proposed in the current model. Increasing the understanding of the temporal relationship between perseverative thinking on the association between trait anxiety and latency of stress recovery may result in development of a more effective worry intervention which may result in a decrease in physical activation. In turn, this cognitive intervention may lower risk for pathogenic states as supported by past literature and the present study.

**Conclusions.** In conclusion, the current study makes noteworthy strides in understanding the effects of perseverative thinking behavior on the relationship between psychological states and latency of stress recovery while increasing necessary experimental control. The present study found that perseverative thinking is associated to the relationship between trait anxiety and latency of stress recovery. Based on these findings, we infer that prolongation of strain on the cardiovascular system in relation to stress increases risks for cardiovascular complications. This evidence suggests supplemental therapy with a concentration on perseverative thinking for those who are at increased risk for cardiovascular disease. Limitations of the current study include temporal precedence, which limits our ability to make causal claims such as claiming perseverative thinking mediates the relationship between trait anxiety and latency of stress recovery. We suggest that more experimentation in the future focus on identifying mechanism that may mediate the direct relationship between trait anxiety and latency of stress recovery as well as understand the nature of the role perseverative thinking on the association. By doing so, the present study adds to the literature supporting the importance of understanding what

mechanisms are associated with this relationship in future studies.

## References

- Angst, J., (2008). Bipolar disorder—methodological problems and future perspectives. *Dialogues in Clinical Neuroscience, 10*(2), 129-139.
- Austin, A. W., Kushnick, M. R., Knutson, M. J., McGlynn, & Patterson, S. M. (2015). Resting plasma lipids and cardiovascular reactivity to acute psychological stress. *Journal of Psychophysiology, 29*(3), 99-106.
- Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. New York: Guilford Press.
- Bertsch, K., Hagemann, D., Naumann, E., Schachinger, H., & Schulz, A. (2012). Stability of heart rate variability indices reflecting parasympathetic activity. *Psychophysiology, 49*(5), 672-682.
- Bibbey, A., Carroll, D., Ginty, A. T., & Phillips A. C. (2015). Cardiovascular and cortisol reactions to acute psychological stress under conditions of high verse low social evaluation Associations with the type D personality construct. *Psychosomatic Medicine, 77*, 599-608.
- Boylan, J. M., Jennings, J. R., & Matthews, K. A. (2016). Childhood socioeconomic status and cardiovascular reactivity and recovery among black and white men: Mitigating effects of psychological resources. *Health Psychology, 35*(9), 957-966.
- Brindle, R. C., Ginty, A. T., Phillips, A. C., & Carroll, D. (2014). A tale of two mechanisms: A meta-analytic approach towards understanding the autonomic basis for cardiovascular reactivity to acute psychological stress. *Psychophysiology, 51*, 964-976.

- Brosschot, J. F., Geurts, S. A. E., Kruizinga, I., Radstaak, M., Verkuil, B., Quirin, M., & Kompier, M. A. J. (2014). Does unconscious stress play a role in prolonged cardiovascular stress recovery? *Stress and Health, 30*, 179-187.
- Brosschot, J. F., Gerin, W., & Thayer, F. J. (2006). The perseverative cognition hypothesis: A review for worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research, 60*, 113-124.
- Cao, X., Wong, E. L., Chow Choi, K., Cheng, L., & Ying Chair, S. (2016). Interventions for cardiovascular patients with type D personality: A systematic review. *Worldviews On Evidence-Based Nursing, 13*(4), 314-323. doi:10.1111/wvn.12153
- Cazarim, M. S., de Freitas, O., Penaforte, T. R., Achcar, A., & Pereira, L. L. (2016). Impact assessment of pharmaceutical care in the management of hypertension and coronary risk factors after discharge. *Plos ONE, 11*(6), 1-14. doi:10.1371/journal.pone.0155204
- Chemaeva, N., Hintsanen, M., Pulkki-Raback, L., Merjonen, P., Elovainio, M., Hinsta, T., ... Keltikangas-Jarvinen, L. (2015). Stress-induced cardiac autonomic reactivity and preclinical atherosclerosis: Does arterial elasticity modify the association? *Stress, 18*(6), 622-630.
- Chida, Y., & Steptoe, A. (2010). Greater cardiovascular responses to laboratory mental stress are associated with poor subsequent cardiovascular risk status: A meta-analysis of prospective evidence. *Hypertension, 1026-1032*.
- Cole, C. R., Blackstone, E. H., Pashkow, F. J., Snader, C. E., & Lauer, M., S. (2017). Heart-rate recovery immediately after exercise as a predictor of mortality. *The New England Journal of Medicine, 341*(18), 1351-1357.

- Dragomir, A. I., Gentile, C., Nolan, R. P., & Antono, B. D. (2014). Three-year stability of cardiovascular and autonomic nervous system responses of psychological stress. *Psychophysiology, 51*, 921-931.
- Ehring, T., & Watkins, E. R. (2008). Repetitive negative thinking as a transdiagnostic process. *International Journal of Cognitive Therapy, 1*(3), 192-205.
- Gantt, M. A., Dadds, S., Burns, D. S., Glaser, D., & Moore, A. D. (2017). The effect of binaural beat technology on the cardiovascular stress response in military service members with post deployment stress. *Journal of Nursing Scholarship, 49*(4), 411-429.
- Hamer, M. (2012) Psychosocial stress and cardiovascular disease risk: The role of physical activity. *Psychosomatic Medicine, 74*, 896-903.
- Harada, T., Aoi, S., Ishizaki, F., Ikeda, H., Inoue, M., Tamura, N., Nitta, Y., ... Nitta, K. (2016). Psychological stressor affects autonomic cardiovascular function and peripheral circulation. *International Medicine Journal, 23*(6), 611-614.
- Kajantie E., & Phillips D. (2006). The effects of sex and hormonal status on the physiological response to acute psychosocial stress. *Psychoneuroendocrinology, 31*, 151-78.
- Kelly-Hughes, D. H., Wetherell, M. A., & Smith, M. A. (2014). Type D personality and cardiovascular reactivity to an ecologically valid multitasking stressor. *Psychology & Health, 29*(10), 1156-1175.
- Kierkegaard, S., (1844). The concept of dread. *The Value of Knowledge: A Miniature Library of Philosophy*. Retrieved from <https://www.marxists.org/reference/subject/philosophy/works/dk/kierkega.htm>

- Kirsch, J. A., & Lehman, B., J. (2015). Comparing visible and invisible social support: Non-evaluative support buffers cardiovascular responses to stress. *Stress Health, 31*, 351- 364.
- Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'— A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology, 28*(1-2), 76-81.
- Lee, Y. S. C. (2011). Perceived social support, coping styles, and Chinese immigrants' cardiovascular responses to stress. *International Society of Behavioral Medicine, 19*, 174-185.
- Lee, K. S., Jeong, H. C., Yim, J. E., & Jeon, M. Y. (2016). Effects of music therapy on the cardiovascular and autonomic nervous system in stress-induced university students: A randomized controlled trial. *The Journal of Alternative and Complementary Medicine, 22*(1), 59-65.
- Linden, W., Earle, T.L., Gerin, W., & Christenfeld, N. (1997.) Physiological stress reactivity and recovery: Conceptual siblings separated at birth? *Journal of Psychosomatic Research, 42*(2), 117–135.
- Martin, L. A., Critelli, J. W., Doster, J. A., Powers, C., Purdum, M., Doster, M., & Lambert, P. (2013). Cardiovascular risk: Gender differences in lifestyle behaviors and coping strategies. *International Society of Behavioral Medicine, 20*(97), 97-105.
- Mata, J. L., Rodriguez-Ruiz, S., Ruiz- Padial, E., Turpin, G., & Vila, J. (2009). Habituation and sensitization of protective reflex: Dissociation between cardiac defense and eye-blink startle. *Biological Psychology, 81*, 192-199.



- 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.
- Olive, L. S., Telford, R. M., Byrne, D. G., Abhayarantna, W. P., & Telford, R. D. (2016). Psychological distress leads to reduced physical activity and fitness in children: The Australian longitudinal LOOK study. *Journal of Behavioral Medicine*, 39, 587- 596.
- Ottaviani, C., Medea, B., Lonigro, A., Tarvainen, M., & Couyoumdjian, A. (2015). Cognitive rigidity is mirrored by autonomic inflexibility in daily life perseverative cognition. *Biological Psychology*, 107, 24-30.
- Panaite, V., Saloman. K., Jin, A., & Rottneberg, J. (2015). Cardiovascular recovery from psychological and physiological challenge and risk for adverse cardiovascular outcomes and all-cause mortality. *Psychosom Med*, 77(3), 215-226.
- Pieper, S., & Brosschot, F. J. (2005). Prolonged stress-related cardiovascular activation-Is there any? *The Society of Behavioral Medicine*, 30(2), 91- 103.
- Pieper, S., Brosschot. F. J., van der Leeden, R., & Thayer, F., J. (2007). Cardiac effects of momentary assessed worry episodes and stressful events. *Psychosomatic Medicine*, 69, 901-909.
- Pieper, S., Brosschot. F. J., van der Leeden, R., & Thayer, F., J. (2010). Prolonged cardiac effects of momentary assessed stressful events and worry episodes. *Psychosomatic Medicine*, 72, 570-577.
- Selye, H. (1936). A syndrome produced by diverse nocuous agents. *Nature*, 138, 32.

- Smith, T. W., Birmingham, W., & Bert, U. N. (2012). Evaluative treat and ambulatory blood pressure: Cardiovascular effects of social stress in daily experience. *Health Psychology, 31*(6), 763-766.
- Tan, M. P., & Morgan. K. (2015). Psychological interventions in cardiovascular disease: An update. *Psychiatry, Medicine and the Behavioural Sciences, 28*(5), 371-377.
- Vella, E. J., & Friedman, B. H. (2009). Hostility and anger in: Cardiovascular reactivity and recovery to mental arithmetic stress. *International Journal of Psychophysiology, 72*, 253-259.
- Verkuil, B., Brosschot, J. F., Gebhardt, W. A., & Thayer, J. F. (2010). When worries make you sick: A review of perseverative cognition, the default stress response and somatic health. *Journal of Experimental Psychopathology, 1*(1), 87-118.
- Wawryzniak, A. J. (2016). Decreased reaction time variability is associated with greater cardiovascular responses to acute stress. *Psychophysiology, 53*, 739-748.
- Yusuke, N. & Usui, H., (2017). The very low-frequency band of heart rate variability represents the slow recovery component after a mental stress task. *PLoS ONE, 12*(8).
- Zimmer-Gembeck, M. J. (2016). Peer rejection, victimization, and relational self system processes in adolescence: Toward a transactional model of stress, coping, and developing sensitivities. *Child Development Perspectives, 10*(2), 122-127. doi:10.1111/cdep.12174

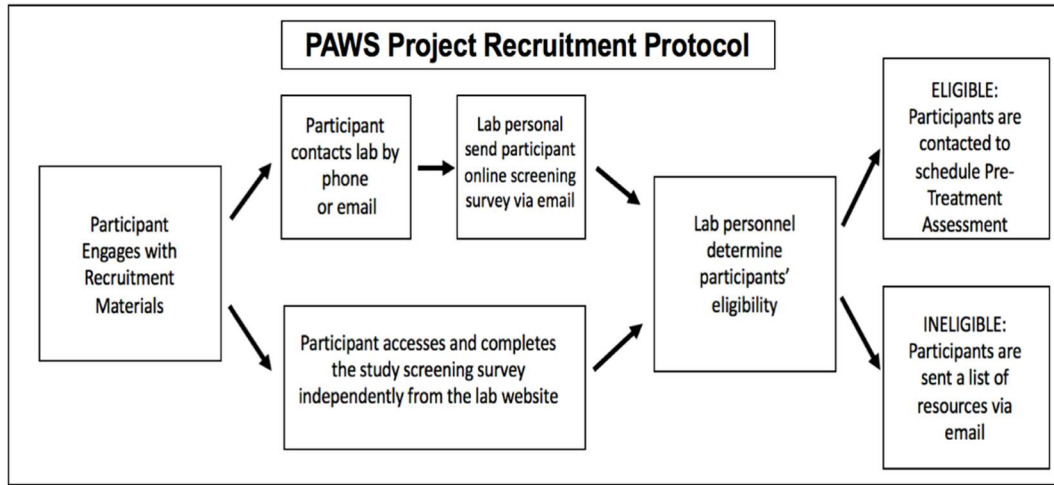


Figure 1. Design of the protocol used to recruit participants for the study

## PAWS Participation Procedure

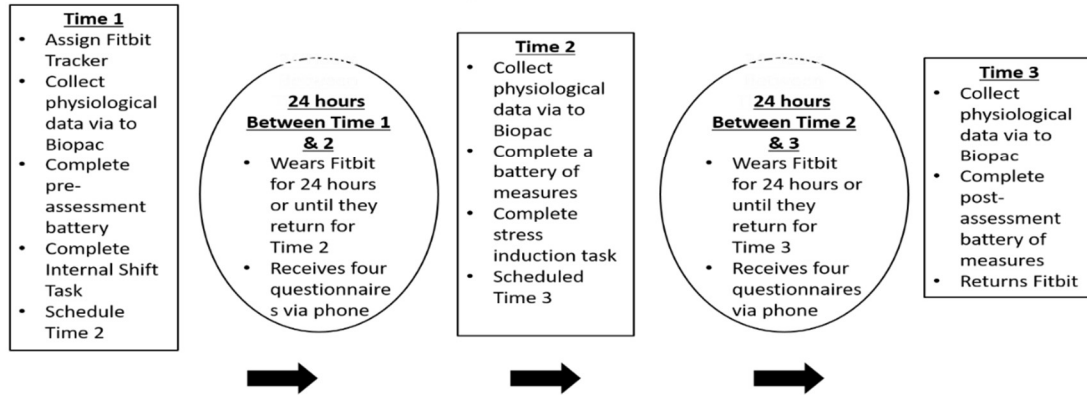
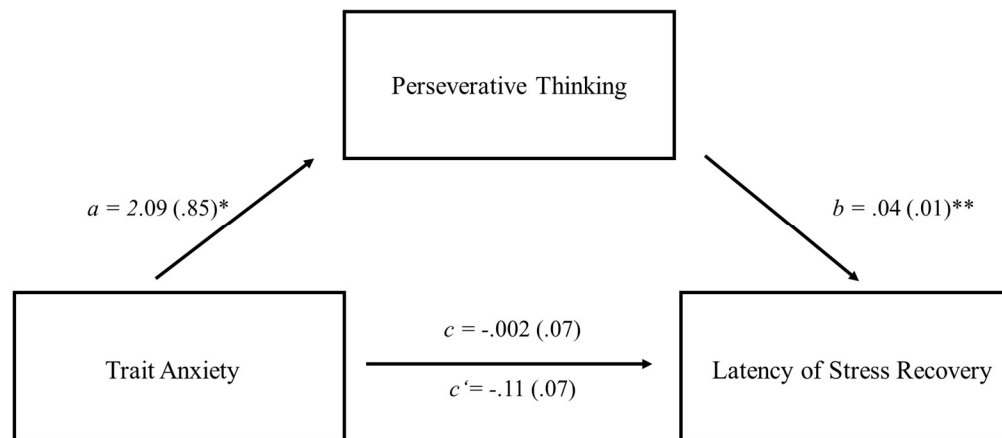


Figure 2. Diagram of the procedure of each time point completed by participants

## Mediation Model



*Figure 3.* This figure illustrates the mediating nature of perseverative thinking on the relationship between trait anxiety and latency of stress recovery.

**Table 1.***Correlations Between Study Variables*

<b>Measure Name</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>Mean</b>	<b>Standard Deviation</b>	<i>Note.</i>
1. PTQ	-			43.8	2.49	PTQ =
2. STAI- Trait	.401*	-		26.3	.534	
3. Latency of Recovery	.473**	.066	-	5.7	.203	

Perseverative Thinking Questionnaire, STAI - Trait= State Trait Anxiety Inventory- Trait Form; Latency of recovery = Stress recovery time was estimated by calculating the number of hours necessary for the participant to return to their baseline heart rate \* =  $p < .05$ , \*\*  $p < .01$ .

**Table 2.***Non-transformed Normality Data*

	<b>Skewness</b>	<b>Standard Error</b>	<b>Z Score</b>	<b>Kurtosis</b>	<b>Standard Error</b>	<b>Z Score</b>
<b>STAI-Trait</b>	0.74	0.41	1.78	-0.04	0.83	0.05
<b>PTQ</b>	-0.05	0.41	0.11	-0.07	0.81	0.08
<b>Latency to Stress recovery</b>	1.22	0.43	2.85	1.27	0.81	1.56

*Note.* PTQ = Perseverative Thinking Questionnaire, STAI - Trait= State Trait Anxiety Inventory- Trait Form; Latency of recovery = Stress recovery time was estimated by calculating the number of hours necessary for the participant to return to their baseline heart rate. The cutoff level for determining significant skew and kurtosis was set at  $z = 1.96$ ,  $p = .05$ , as recommended by Kim (2013) for small sample sizes ( $n > 50$ ).

**Table 3.*****Mediation Results: Total, Direct, & Serial Indirect Effects***

	<i>R</i> <sup>2</sup>	<i>F/t</i>	<i>p</i>	Lower CI	Upper CI
<b>Overall Model</b>	-.0028	4.21	.03	-	-
<b>Total Effect</b>	-	-.0376	.97	-.16	.15
<b>Direct Effect</b>	-	-.148	.15	-.25	.040
<b>Indirect Effect</b>	-	-	-	.01	.22

*Note.* CI= Bootstrapped Bias Corrected 95% Confidence Intervals



## Appendices

### APPENDIX I. EMAIL AND VERBAL PHONE SCRIPT

#### **Email Template (if the potential participant emails the ABC Research Lab):**

Thank you for your interest in this study examining physiological activations when stressed (PAWS) to investigate the duration of physical responses during and after mental stress. Please submit your contact information and complete our brief screener to see if you qualify for the study using the following link:

<<[\*\*link to Qualtrics PAWS Screener here\*\*](#)>>

We will contact you after you submit the following information to set up a day and complete the screener letting you know whether you qualify for the study. After submitting your contact information, you will be redirected to an online screening survey that will be used to determine your eligibility for the study. More details about the study will be provided at the start of that survey.

If you have any questions, please don't hesitate to contact us.

Thank you,

ABC Research Lab

Southern Illinois University, Life Sciences II, Room 270, Carbondale, IL 62901

Phone: (618) 453-3572 ;

Email: [anxietybehaviorcognitionlab@gmail.com](mailto:anxietybehaviorcognitionlab@gmail.com) ;

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)*

### **Verbal Phone Script**

#### **Script (if the potential participant calls the ABC Research Lab):**

Thank you for your interest in this study examining physiological activations when stressed (PAWS) to investigate the duration of physical responses during and after mental stress. In order to contact you after our call today, I'd like to first collect your contact information.

<Lab Personnel will navigate to a Qualtrics Link and read aloud the Contact Information Form while caller is on phone.

“Thank you for that information. This study requires 48 continuous hours of participation and three visits to the lab within those 48 hours. Will this be possible with your schedule coming up? We have the following days and times available for you to come in for the first session in the lab.”

“Please note: The first lab visit will last around 2-3 hours and the second lab visit will last around 1- 2 hours. The final assessment will be around 1 hour. “

“Again, thank you for your time today, and have a nice day.”

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)*

**APPENDIX II. SCREENER SUPPLEMENTS****Qualtrics Screening Form****Order of Qualtrics Questionnaires:**

*Introduction to Qualtrics Screener*

*Informed Consent for Qualtrics Screener*

*Participant Questions*

**Introduction to Qualtrics Screener**

Dear Prospective Participant,

Thank you for your interest in this study examining physiological activations when stressed (PAWS) to investigate the duration of physical response to mental stress. The following online survey will be used to determine your eligibility for the study. In order to contact you, I'd like to first collect your contact information. More details about the study will be provided at the start of the survey.

Before beginning the survey, please note that:

- The survey will take approximately 5-10 minutes
- The survey will need to be completed in one sitting

Please click the arrow to complete the survey at this time.

If you have any questions about the survey, please feel free to call/email us:

Thank you,

**ABC Research Lab**

Southern Illinois University, Life Sciences II, Room 270, Carbondale, IL 62901

Phone: (618) 453-3572

Email: [anxietyresearchlab@siu.edu](mailto:anxietyresearchlab@siu.edu)

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

**Click CONTINUE**

**Click EXIT SURVEY AND COMPLETE AT A LATER TIME**

**(Next Page if CONTINUED)**

**Informed Consent for Qualtrics Screener**

This study involves research designed to increase our knowledge of the ways individuals think and their emotional and stressful experiences. We are interested in examining how effects of stress relate to thoughts and emotions.

The following questions are used to determine if you are eligible for the research study. You may refuse to answer or withdraw from the study at any time without penalty. If you have any questions about this survey, you may contact the ABC Research Lab at (618) 453-3572 or the faculty supervisor Dr. Sarah Kertz at (618) 453-3551 for more information.

All material received from your participation will be kept confidential and both your name/identity will in no way be connected with your answers or performance. Instead, only a research ID number will be used in association with your answers.

1. I have read and understand the information above (YES / NO)
2. I would like to be contacted about future research studies on anxiety and sadness  
(YES/NO)

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, SIUC, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu).*

*If the participant responds NO to the first question, he/she will be routed to a page that says:*

Thank you for completing our survey!

Someone from our lab should be contacting you by phone or email within a week about study eligibility. If you have any questions about the survey, please don't hesitate to contact us.

Sincerely,

ABC Research Lab

Southern Illinois University, Life Sciences II, Room 270, Carbondale, IL 62901

Phone: (618) 453-3572

Email: [anxietyresearchlab@siu.edu](mailto:anxietyresearchlab@siu.edu)

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

*If the participant marks YES to each question, then he/she will be routed to the Screening Page*

**Qualtrics Administered Screening Questions**

1. Name:

2. Cell Phone Number:

3. Alternative Phone:

4. Email Address:

5. Best Time to Call:

a. 8 am to Noon

b. Noon to 4 pm

c. 4 pm to 7 pm

d. No preference

6. Best Day(s) to Call:

a. Monday

b. Tuesday

c. Wednesday

d. Thursday

e. Friday

7. Okay to leave a voicemail over phone?

a. Yes



b. No

8. Okay to send text messages?

a. Yes

b. No

9. Okay to email?

a. Yes

b. No

10. What is your date of birth (mm/dd/yyyy)?

11. Are you fluent in written and spoken English?

a. Yes

b. No

12. Do you have access to a cell phone that has internet access?

a. Yes

b. No

13. Do you have a cell phone with the ability to receive texts?

a. Yes

b. No

14. Are you willing to wear a Fitbit for a continuous 48 hours?

a. Yes

b. No

15. Are you willing and able to come into the lab 3 days in a row for assessments and tasks?

Each session is expected to range from 1 to 3 hours.

a. Yes

b. No

20. The next couple questions are inquiring about your availability for the study. As a participant, you will not only be asked to wear a Fitbit for 48 continuous hours, but also to come into the lab in Life Science II room 270 theart rateee days in a row for assessments ranging from 1 to 3 hours.

To ensure we can collect all the data we need, the only times that we can schedule these assessments is between the times of 10 a.m. and 3 p.m. The first visit to the lab will last around 2- 3 hours. Following that visit, the second day of assessments will take around 1-2 hours. Finally, the next day (third and final visit) will last about 1 hour.

Please proceed to fill out your availability.

21. Does your schedule allow you to schedule sessions of 1 to 3 hours between the times of 10 a.m. and 3 p.m. three days in a row? (Weekends are also available)

a. Yes

b. No

22. If so, what days? (1<sup>st</sup> assessment- 2<sup>nd</sup> assessment- 3<sup>rd</sup> assessment)

a. Monday- Tuesday- Wednesday

b. Tuesday- Wednesday- Thursday

c. Wednesday- Thursday- Friday

d. Thursday- Friday- Saturday

e. Friday- Saturday- Sunday

f. Saturday- Sunday- Monday

g. Sunday- Monday- Tuesday

23. For the sequential days chosen above, please fill in the times you are available:

a. Time 1 (2-3 hours): Fill in text option

b. Time 2 (1-2 hours): Fill in text option

c. Time 3 (1 hour): Fill in text option

24. Thank you for completing a study through the ABC Research Lab. We would like to invite you to take part in our future volunteers registry. The purpose of the registry is to create a list of adults (age 18 or older) who may want to participate in future studies through the ABC Research Lab. Your registration enables us to contact you about additional studies in the future.

Participation is voluntary. If you choose to participate, it will take approximately 10 additional

minutes of your time today. (Note: You may register anytime in the future by visiting our website, [anxietybehaviorcognitionlab.com](http://anxietybehaviorcognitionlab.com))

25. Please choose from the following:

a. I would like to register today. (You will be redirected to the website for registry.)

b. I am not interested in registering my information in the registry at the present time.

25. Thank you for completing our survey!

Someone from our lab should be contacting you by phone or email within a week about study eligibility. If you have any questions about the survey, please don't hesitate to contact us.

Sincerely,

ABC Research Lab

Southern Illinois University, Life Sciences !!, Room 270, Carbondale, IL 62901

Phone: (618) 453- 3572

Email: [anxietyresearchlab@siu.edu](mailto:anxietyresearchlab@siu.edu)

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

**Email Response indicating Eligibility*****If they do not meet criteria:***

Dear Participant,

Unfortunately, after reviewing the information provided, you do not meet criteria for the current study. However, there may be future studies for which you may be interested and may qualify.

Therefore, please contact us or check our website periodically for future studies.

[www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

If you are experiencing any distress or thoughts about suicide, please contact one of the resources below. Thank you for your time and interest in our studies.

**1. University Clinical Center: 618-453-2361**

Location: Wham Building, Room 141, 625 Wham Drive, Carbondale, IL 62901

**2. Centerstone: 618-457-6703**

Location: 2311 S. Illinois Ave., Carbondale, IL 62903

**3. National Suicide Prevention Hotline: 1-800-273-TALK (8255)**

Online Website: <http://www.suicidepreventionlifeline.org/>

Thank you,

ABC Research Lab

Southern Illinois University, Life Sciences II, Room 270, Carbondale, IL 62901

Phone: (618) 453-3572 ;

Email: [anxietybehaviorcognitionlab@gmail.com](mailto:anxietybehaviorcognitionlab@gmail.com) ;

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)*

***If they DO qualify for the study:***

Dear Participant,

After reviewing information provided, you qualify for the current study. The goal of this study is to better understand how stress is influenced by your thoughts and emotions. The results from this study may benefit future individuals suffering from anxiety and sadness. We greatly appreciate your participation.

We will schedule an initial meeting with you that will last approximately 2- 3 hours. During this meeting, study personnel will provide more detailed rationale for the study as well as provide you with a Fitbit to wear. The study takes place for 48 hours. You will schedule an initial visit to

the lab, followed by a 24 hour period during which you will wear the Fitbit and respond to 4 text-based surveys. You will return to the lab for a second visit, which will again be followed by a 24-hour period during which you will wear the Fitbit and respond to 4 text-based surveys. You will then return to the lab for the third and final visit. There's no cost associated with the study. For completing all parts of the study, you will be compensated \$20 or extra credit determined by your instructor. All of the sessions will be held in room 270 of Life Science Building II on the Southern Illinois University campus.

We currently have openings on XX days at XX times. Please reply and select one of the following times for your appointment. Someone will call you to confirm soon after.

We have attached a campus map to this email. We will send you an email reminder the day before all of your appointments. Please let us know if you have any questions or concerns!

Thank you,

ABC Research Lab

Southern Illinois University, Life Sciences II, Room 270, Carbondale, IL 62901

Phone: (618) 453-3572

Email: [anxietybehaviorcognitionlab@gmail.com](mailto:anxietybehaviorcognitionlab@gmail.com) ;

Web: [www.anxietybehaviorcognitionlab.com](http://www.anxietybehaviorcognitionlab.com)

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the*

*Committee Chairperson, Office of Sponsored Projects Administration, Southern Illinois*

*University, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)*



**APPENDIX III. INFOMRED CONSENT****Informed Consent for Participation**

*Purpose:* This study involves research designed to increase our knowledge of the ways individuals respond physiologically to stress, and their continued response over time. We are interested in examining how effects of stress relate to thoughts and emotions

*Procedure:* As a participant in this study, you will be asked to wear a Fitbit for 48 hours as well as answer questions about how you think, your daily activities, and your experiences with stress and anxiety sent via text message 8 times. We will also ask you to come into the lab to complete a task intended to initiate a moderate level of stress. You will be videotaped during the task. This task will be in the form of giving a speech on some topic given that day as well as completing a math portion. By inducing stress, we have the ability to monitor physiological changes before, during, and after the experienced stress. Physiological data will be collected at all lab visits. The questions and tasks will at times be personal and sensitive. It is possible that you may find some of the questions and/or the tasks uncomfortable, but may refuse to answer or withdraw from the study at any time without penalty. Your participation in this research is voluntary.

*Data Management:* Data, including video recordings, will be stored in a password protected, encrypted server locked in our lab. Further, data will also be stored in a locked filing cabinet, which is locked in the lab as well. Data will be stored for the duration of the study and up until 10 years following data collection to ensure dissemination and replication if necessary.

*Study Design:* This study will require you to visit the lab 3 times (once a day for three days). The first day (Time 1) in the lab you will receive a Fitbit that you will be asked to wear for 48 hours continuously. You will also receive short questionnaires 8 times by phone during this 24-hour period. The following day (Time 2) you will return to the lab to complete an assessment as well as participate in a stress task. After completing these tasks, you will continue to wear the Fitbit for another 24 hours and will continue to receive brief questionnaires. The last day of participation (Time 3) will include returning to the lab for the final time to complete a brief assessment and to return the Fitbit. Failure to return the Fitbit at this time will be considered theft of Southern Illinois University property and will result in consequences such as fines or police involvement that will jeopardize the confidentiality agreement.

*Compensation:* Once you've completed the study, you will receive a \$20 gift card to Amazon or extra credit determined by your instructor.

*Confidentiality:* Neither your name/identity will be connected with your answers or performance. Instead, only a research ID number will be used in association with your answers. Video files will be stored on the password protected, encrypted server.

*Benefits of Participation:* As participants in our study, you will receive a \$20 gift card to Amazon or extra credit. Further, an additional benefit of participation is that you will be

contributing to a growing body of evidence for improving treatments for individuals suffering from anxiety and depression.

*Risks of Participation:* Some of the questions in the questionnaires do address personal information about you. Also, participation in the study requires consistent time and effort for the duration of a full 48 hours, which may be burdensome at times. Further, by sharing personal information and completing heart rate assessments. There is a risk of confidential information being shared with non-study personnel; however, the use of encrypted, password protected data collection and storage methods, and use of subject identification numbers will safeguard against this risk. Lastly, the stress task may be uncomfortable at times; however, the intensity of the discomfort will not surpass stress experienced during other common activities (e.g., job interview, giving a speech in class).

If you report extreme distress on any of the questionnaire items, we will be unable to provide follow-up contact during the course of the study. If you have any concerns or experiences any distress or thoughts about suicide, please talk to the researcher before you leave any of the sessions, or contact one of the resources below.

Confidentiality is limited if you verbally state to the researcher plans to harm or endanger yourself or others. Confidentiality is also limited if you verbally report harm, danger, or abuse to children or the elderly. If any of these situations arise, we will be required to report this information to the proper agencies and will refer you to resources. If you have any questions

about this study, you may contact the ABC Lab at 618-453-3572 or the lab supervisor Dr. Sarah Kertz at 618-453-3551 for more information.

**1. University Clinical Center:** 618-453-2361; Location: Wham Building, Room 141, 625 Wham Drive, Carbondale, IL 62901

**2. Centerstone:** 618-457-6703; Location: 2311 S. Illinois Ave., Carbondale, IL 62903

**3. National Suicide Prevention Hotline:** 1-800-273-TALK (8255); Online Website:  
<http://www.suicidepreventionlifeline.org/>

**4. Call 911 or go to the nearest Emergency Department**

I have read and understand the information above, and give my consent to participate in the study as outlined above. I have been given an opportunity to ask questions about the study and understand that I can withdraw from the study at any time without penalty.

Signature \_\_\_\_\_ Date \_\_\_\_\_

I give my permission to be videotaped, under the terms outlined above.

Signature \_\_\_\_\_ Date \_\_\_\_\_

Witness \_\_\_\_\_ Date \_\_\_\_\_

This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, SIUC, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)

**APPENDIX IV. DEBRIEFING STATEMENT****Debriefing Form**

The purpose of this study was to examine the physiological effects before, during, and after a stressful event. Specifically, we are interested in factors contributing to heart rate, including worry and stress. During this study, you completed a stress task in the form of giving a speech along with a math section that was video recorded. This was a vital piece to the research as it created an increased level of stress, which allowed us to monitor and record how your heart rate varied due to that stress through the Biopac technology. The purpose of this task was to measure how your heart rate varied while you were stressed. By wearing a Fitbit, we could track your heart rate variability throughout the entire duration of the study and see how it related to your emotions and thoughts. Please do not tell others about the stress task as they may become participants and must also be naïve to the procedure in its entirety.

Your participation in this study has contributed to a growing body of data showing links between mental and physiological events. Specifically, studies have shown that thinking styles contribute to the long-lasting physical effects of stress. Data from this study will help us to better understand effects of mental processes on physical functioning. Ultimately, we hope that information from this and similar studies will help us to improve behavioral treatments for anxiety and depression. Your participation in this study is greatly appreciated!

If you feel any distress as a result of this study, please consult with the resources below about further treatment options.

If you experience distress, we recommend that you contact one of the resources identified below.

If you have any concerns or if you are experiencing any distress or thoughts about suicide please talk to the researcher before you leave the study, or contact one of the resources below:

**1. University Clinical Center: 618-453-2361**

Location Wham Building, Room 141, 625 Wham Drive, Carbondale, IL 62901

**2. Centerstone: 618-457-6703**

Location: 2311 S. Illinois Ave., Carbondale, IL 62903

**3. National Suicide Prevention Hotline: 1-800-273-TALK (8255)**

Online Website: <http://www.suicidepreventionlifeline.org/>

**4. Call 911 or go to the nearest Emergency Department**

If you have any questions, concerns, or would like more information regarding this study, please feel free to contact the ABC Research Lab directly via phone: 618-453-3572 or email:

[anxietyresearchlab@siu.edu](mailto:anxietyresearchlab@siu.edu) or the lab supervisor (Dr. Sarah Kertz) directly via phone: 618-453-3551 or email at [skertz@siu.edu](mailto:skertz@siu.edu).

*This project has been reviewed and approved by the SIUC Human Subjects Committee.*

*Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Sponsored Projects Administration, SIUC, Carbondale, IL 62901-4709. Phone (618) 453-4533. E-mail: [siuhsc@siu.edu](mailto:siuhsc@siu.edu)*

**APPENDIX V. MEASURES****I. Demographics**

Demographics:

- Gender
  - Male, Female, Other, Prefer not to respond
- Height
- Weight
- Race/Ethnicity
  - American Indian or Alaskan Native, Asian, Black or African American, White or Caucasian, Native Hawaiian or Pacific Islander, Caribbean Islander, Latino/Latina, Do not know, Prefer not to answer
- Do you identify as-
  - Hispanic, Non- Hispanic
- If you are Latino/a, where is your place of ancestry? (choose all that Apply):
  - Dominican Republic, Puerto Rico, Cuba, Central America, South America, Mexico, Other
- Age
- Marital Status:
  - Single, Married, Divorced, Separated, Partner, In a relationship, Prefer not to respond
- Highest education level you have received
  - 8<sup>th</sup> Grade, Some High School, High School Graduate/GED, Associate's Degree, bachelor's Degree, Master's Degree, Post Graduate Degree (MD, PhD, etc.)



- Average Family Income
  - Less than \$10,000
  - \$10,000 - \$25,000
  - \$25,000 - \$50,000
  - \$50,000 - \$75,000
  - \$75,000 - \$100,000
  - More than \$100,000

II.  
State  
Trait

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name \_\_\_\_\_ Date \_\_\_\_\_ S \_\_\_\_\_  
Age \_\_\_\_\_ Gender (Circle) M F T \_\_\_\_\_

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

NOT AT ALL  
SOMEWHAT  
MODERATELY SO  
VERY MUCH SO

- 1. I feel calm..... 1 2 3 4
- 2. I feel secure ..... 1 2 3 4
- 3. I am tense ..... 1 2 3 4
- 4. I feel strained ..... 1 2 3 4
- 5. I feel at ease ..... 1 2 3 4
- 6. I feel upset ..... 1 2 3 4
- 7. I am presently worrying over possible misfortunes ..... 1 2 3 4
- 8. I feel satisfied ..... 1 2 3 4
- 9. I feel frightened ..... 1 2 3 4
- 10. I feel comfortable ..... 1 2 3 4
- 11. I feel self-confident..... 1 2 3 4
- 12. I feel nervous ..... 1 2 3 4
- 13. I am jittery ..... 1 2 3 4
- 14. I feel indecisive..... 1 2 3 4
- 15. I am relaxed ..... 1 2 3 4
- 16. I feel content ..... 1 2 3 4
- 17. I am worried ..... 1 2 3 4
- 18. I feel confused..... 1 2 3 4
- 19. I feel steady..... 1 2 3 4
- 20. I feel pleasant..... 1 2 3 4

Copyright 1968, 1977 by Charles D. Spielberger. All rights reserved.

© Copyright 1968, 1977 by Charles D. Spielberger. All rights reserved.  
Published by Mind Garden, Inc., 1690 Woodside Rd, Suite 202, Redwood City, CA 94061

STAI-P-AD Test Form Y  
www.mindgarden.com

Anxiety Inventory (Forms Y-1 & Y-2)

**SELF-EVALUATION QUESTIONNAIRE**

STAI Form Y-2

Name \_\_\_\_\_ Date \_\_\_\_\_

**DIRECTIONS**

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

ALMOST NEVER  
SOMETIMES  
OFTEN  
ALMOST ALWAYS

- 21. I feel pleasant..... 1 2 3 4
- 22. I feel nervous and restless ..... 1 2 3 4
- 23. I feel satisfied with myself..... 1 2 3 4
- 24. I wish I could be as happy as others seem to be ..... 1 2 3 4
- 25. I feel like a failure ..... 1 2 3 4
- 26. I feel rested ..... 1 2 3 4
- 27. I am "calm, cool, and collected" ..... 1 2 3 4
- 28. I feel that difficulties are piling up so that I cannot overcome them..... 1 2 3 4
- 29. I worry too much over something that really doesn't matter..... 1 2 3 4
- 30. I am happy ..... 1 2 3 4
- 31. I have disturbing thoughts ..... 1 2 3 4
- 32. I lack self-confidence..... 1 2 3 4
- 33. I feel secure ..... 1 2 3 4
- 34. I make decisions easily ..... 1 2 3 4
- 35. I feel inadequate..... 1 2 3 4
- 36. I am content ..... 1 2 3 4
- 37. Some unimportant thought runs through my mind and bothers me ..... 1 2 3 4
- 38. I take disappointments so keenly that I can't put them out of my mind ..... 1 2 3 4
- 39. I am a steady person..... 1 2 3 4
- 40. I get in a state of tension or turmoil as I think over my recent concerns and interests ..... 1 2 3 4

Copyright 1968, 1977 by Charles D. Spielberger. All rights reserved.

### III. Perseverative Thinking Questionnaire

#### Perseverative Thinking Questionnaire

Instructions: In this questionnaire you will be asked to describe how you typically think about negative experiences or problems. Please read the following statements and rate the extent to which they apply to you when you think about negative experiences or problems.

0 = Never  
1 = Rarely  
2 = Sometimes  
3 = Often  
4 = Almost Always

1. The same thoughts keep going through my mind again and again.
2. Thoughts intrude into my mind.
3. I can't stop dwelling on my thoughts.
4. I think about many problems without solving any of them.
5. I can't do anything else while thinking about my problems.
6. My thoughts repeat themselves.
7. Thoughts come to my mind without me wanting them to.
8. I get stuck on certain issues and can't move on.
9. I keep asking myself questions without finding an answer.
10. My thoughts prevent me from focusing on other things.
11. I keep thinking about the same issue all the time.
12. Thoughts just pop into my mind.
13. I feel driven to continue dwelling on the same issue.
14. My thoughts are not much help to me.
15. My thoughts take up all my attention.

#### IV. Attentional Control Scale

Items are scored on a 4-point scale (1 = *almost never*; 2 = *sometimes*; 3 = *often*; 4 = *always*). R = reverse-scored item.

It's very hard for me to concentrate on a difficult task when there are noises around. (R)

When I need to concentrate and solve a problem, I have trouble focusing my attention. (R)

When I am working hard on something, I still get distracted by events around me. (R)

My concentration is good even if there is music in the room around me.

When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.

When I am reading or studying, I am easily distracted if there are people talking in the same room. (R)

When trying to focus my attention on something, I have difficulty blocking out distracting thoughts. (R)

I have a hard time concentrating when I'm excited about something. (R)

When concentrating I ignore feelings of hunger or thirst.

I can quickly switch from one task to another.

It takes me a while to get really involved in a new task. (R)

It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures. (R)

I can become interested in a new topic very quickly when I need to.

It is easy for me to read or write while I'm also talking on the phone.

I have trouble carrying on two conversations at once. (R)

I have a hard time coming up with new ideas quickly. (R)

After being interrupted or distracted, I can easily shift my attention back to what I was doing before.

When a distracting thought comes to mind, it is easy for me to shift my attention away from it.

It is easy for me to alternate between two different tasks.

It is hard for me to break from one way of thinking about something and look at it from another point of view. (R)

**V. Positive and Negative Affect Schedule**

This scale consists of a number of words that describe feelings you may experience. Read each item and then mark the appropriate answer. Indicate to what extent you feel this way **right now, at this moment**. Use the following scale to record your answer:

	1	2	3	4	5
	very slightly	a little	moderately	quite a bit	extremely
	or not at all				
1.	interested	1 2 3 4 5		11.	irritable 1 2 3 4 5
2.	distressed	1 2 3 4 5		12.	alert 1 2 3 4 5
3.	excited	1 2 3 4 5		13.	ashamed 1 2 3 4 5
4.	upset	1 2 3 4 5		14.	inspired 1 2 3 4 5
5.	strong	1 2 3 4 5		15.	nervous 1 2 3 4 5
6.	guilty	1 2 3 4 5		16.	determined 1 2 3 4 5
7.	scared	1 2 3 4 5		17.	attentive 1 2 3 4 5
8.	hostile	1 2 3 4 5		18.	jittery 1 2 3 4 5
9.	enthusiastic	1 2 3 4 5		19.	active 1 2 3 4 5
10.	proud	1 2 3 4 5		20.	afraid 1 2 3 4 5

### **VI. State Ruminating Negative Thinking**

“Since the last assessment, how much have you worried, ruminated, or been preoccupied”

- 0-100 Likert Scale

### **VII. State Stress Item**

“If you have experienced a significant stressor since the last assessment (e.g. break-up, robbery, failing a test, death in the family), please indicate that here:”



**VIII. PAWS Stress Questionnaire**

1. Subject Number
  
2. Please complete the following items reporting on the hours since your last response. If this is your first response, please report on the last four hours
  
3. According to your Fitbit, what is your heart rate currently? (To locate the heart rate function, please press the button on the side of the Fitbit. If other measures besides heart rate are showing, slide your finger across the screen until your heart rate measure is shown.)
  
4. Since the last assessment, how often have you felt ANGRY or IRRITATED?
  - a. Not at all
  
  - b. Some
  
  - c. A bit
  
  - d. Much
  
  - e. Very much
  
5. Since the last assessment, how often have you felt SAD or GLOOMY?
  - a. Not at all
  
  - b. Some
  
  - c. A bit
  
  - d. Much
  
  - e. Very much

6. Since the last assessment, how often have you felt TENSE or RESTLESS?

- a. Not at all
- b. Some
- c. A bit
- d. Much
- e. Very much

7. Since the last assessment, how often have you felt HAPPY or CHEERFUL?

- a. Not at all
- b. Some
- c. A bit
- d. Much
- e. Very much

8. Since the last assessment, how much have you worried, ruminated, or been preoccupied?

- a. Scale from 0- 100

9. What has your activity level been since the last assessment?

- a. Not at all
- b. Some
- c. A bit

d. Much

e. Very Much

10. Since the last assessment, how often have you been doing the following postures?

a. Lying down: Not at all- Some- A bit- Much- Very much

b. Sitting: Not at all- Some- A bit- Much- Very much

c. Standing: Not at all- Some- A bit- Much- Very much

d. Walking: Not at all- Some- A bit- Much- Very much

e. Biking: Not at all- Some- A bit- Much- Very much

11. Since the last assessment, did you participate in any other activities not listed in the question above?

a. Yes

b. No

12. What activities did you participate in?

a. Fill in text option

13. How often did you do this activity since your last assessment?

a. Not at all

b. Some

c. A bit

d. Much

e. Very much

14. Since the last assessment, how many unites of these substances have your consumed?

a. Alcohol: 0- 1- 2- 3- 4- 5+

b. Caffeine: 0- 1- 2- 3- 4- 5+

c. Tobacco: 0- 1- 2- 3- 4- 5+

15. If you have experienced a significant stressor since the last assessment (e.g. break- up, robbery, failing a test, death in the family), please indicate what that was here:

a. Fill in text option

### IX. Social Phobia Inventory

Please read each statement and select a number 0, 1, 2, 3, or 4 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any one statement. This assessment is not intended to be a diagnosis. If you are concerned about your results in any way, please speak with a qualified health professional.

0= Not at all      1= A little bit      2= Somewhat      3= Very much      4= Extremely

1. I am afraid of people in authority
2. I am bothered by blushing in front of people
3. Parties and social events scare me
4. I avoid talking to people I don't know
5. Being criticized scares me
6. I avoid doing things or speaking to people for fear of embarrassment
7. Sweating in front of people causes me distress
8. I avoid going to parties
9. I avoid activities in which I am the center of attention
10. Talking to strangers scares me
11. I avoid having to give speeches

12. I would do anything to avoid being criticized

13. Heart palpitations bother me when I am around people

14. I am afraid of doing things when people might be watching

15. Being embarrassed or looking stupid are among my worst fears

16. I avoid speaking to anyone in authority

17. Trembling or shaking in front of others is distressing to me

Total Score =

Severity: None (Less than 20); Mild (21- 30); Moderate (31-40); Severe (41-50); Very Severe (51 or more)













