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EFFECT OF PRIOR TRAUMA EXPOSURE ON ALPHA AMPLITUDE, HEART RATE, AND SELF-REPORTED NEGATIVE AFFECT

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EFFECT OF PRIOR TRAUMA EXPOSURE ON ALPHA AMPLITUDE, HEART RATE, AND SELF-REPORTED NEGATIVE AFFECT

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ABSTRACT

EFFECT OF PRIOR TRAUMA EXPOSURE ON ALPHA

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This study was conducted to investigate whether the number of traumatic events an individual has previously experienced influences that individual's physiological and psychological reactions when exposed to a negative affective stimulus followed by a mindfulness-based stress reduction (MBSR) intervention. Twenty-eight participants were placed into intact quasi-experimental groups based on their scores on the Traumatic Life Events Questionnaire (TLEQ). The negative affective stimulus consisted of a series of photos bearing negative affective valence. The photos were selected from the International Affective Picture System (IAPS), and paralleled the areas of trauma exposure evaluated by the TLEQ. All participants were exposed to the same negative affective stimulus, but were randomly assigned to either the MBSR intervention or the inert control intervention. Alpha wave amplitude, as measured by EEG, and heart rate were assessed at three different times throughout the protocol. Participants' self-reported negative affect was also measured at those same three times using the Positive and Negative Affect Schedule (PANAS). Since only half the sample (n = 14) consistently produced oscillations in the alpha range, parametric statistical tests were not performed

on the EEG data. Separate ANOVAs were performed on both the heart rate and PANAS data. A significant interaction effect of the trauma group and intervention condition on overall heart rate was detected. Within the low trauma group, only, heart rate was significantly lower when exposed to the control condition compared to treatment. Time, overall, was found to have a significant effect on negative scale PANAS scores. Significant differences were found between baseline and the end of the intervention, as well as between the end of the photos and the end of the intervention. Significant differences were also found over time between the intervention conditions; scores differed significantly at all three time points within the treatment condition, only. No significant differences were found within the control condition over time.

Keywords: traumatic stress, EEG, alpha amplitude, heart rate, mindfulness-based stress reduction (MBSR)

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The concept of traumatic stress, as well as its official definition, has undergone much change, in recent years. In 1987, according to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) *III-R*, to be considered traumatic, a stressor "would be markedly distressing to almost anyone, and is usually experienced with intense fear, terror, and helplessness" (American Psychiatric Association, 1987, p. 247). Further, the language used to characterize Post-Traumatic Stress Disorder (PTSD) indicated symptoms often follow "a [single] psychologically distressing event that is outside the range of usual human experience" (American Psychiatric Association, 1987, p. 247). Since then, the definition of trauma has expanded to recognize that there are a number of circumstances under which trauma may be recurrent; that is, symptoms are the result of multiple events rather than a single stressor. Domestic violence situations, military combat, and high-risk occupations, for instance, all lend themselves to the likelihood that more than one traumatic event will occur. Duckworth and Follette (2012) refer to symptoms, responses, and traumatic stress reactions that occur as the result of multiple exposures to physical, psychological, or combined physical and psychological traumatic life events as *retraumatization*. In an effort to recognize and be sensitive to the actuality of retraumatization, the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) *5* allows symptoms to be linked to traumatic events in combination, rather than tethered to a single instance (American Psychiatric Association, 2013).

With specific regard to retraumatization, Duckworth and Follette (2012) assert the intensity, duration, and frequency of traumatic stress reactions all increase when an individual is subjected to multiple instances of trauma. In their 1996 study, Follette, Polusny, Bechtle, and Naugle confirmed the hypothesis that when multiple instances of trauma are experienced, post-trauma symptomatology only increases. That is, the presentation of trauma symptoms does not appear to indicate that individuals habituate to trauma; rather, trauma-related symptoms such as depression, dissociation, and anxiety appear to increase in a cumulative fashion when trauma is experienced repeatedly (Follette et al., 1996). It is worth noting these results were obtained utilizing a sample that consisted of only females, and the nature of the trauma under investigation was limited to interpersonal violence/victimization (Follette et al., 1996). The therapeutic implications of these results include potential effects on rate of recovery, the way in which trauma-related symptoms present, and overall treatment effectiveness (Follette et al., 1996).

Research into the epidemiology of trauma exposure has revealed that roughly 61-81% of men and 50-74% of women have experienced at least one event of a traumatic nature over the course of their lifetime (Norris & Slone, 2014). In the United States, alone, 64% of all individuals who reported experiencing *a* traumatic life event actually experienced multiple traumatic life events (Karam et al., 2014). Furthermore, three or greater such events were experienced by 11% of all females and 20% of all males who reported trauma exposure (Karam et al., 2014). According to the authors, these numbers hold relatively constant across segments of multiple westernized nations such as the United States, Australia, and Canada. Women generally reported more instances of rape,

other sexual assaults or molestation, and child abuse, whereas men generally reported more instances of life-threatening accidents, disasters, witnessing someone being badly injured or killed, physical assaults, combat, and being held captive (Norris & Slone, 2014). Tolin and Foa (2006) ascertained that women were significantly less likely to report trauma exposure than were men, possibly due to the stigmatized nature of the traumatic experiences women are more likely to face. Overall, it is estimated that 25% or more of the population will experience a traumatic event by the beginning of adulthood, and the majority of the population will experience such an event by age 45 (Norris & Slone, 2014).

The purpose of the present study was to determine how the psychological and physiological reactions of different types of trauma survivors differ in response to negative affective stimuli and brief interventions for stress reduction. Do individuals who have experienced multiple traumatic life events exhibit psychological and physiological responses that differ from those who have experienced one or none?

Review of Selected Literature

Traumatic events differ, subjectively, with regard to their qualitative aspects. Such aspects include complexity, frequency, magnitude, duration, controllability, and predictability (Kimerling, Weitlauf, Iverson, Karpenko, & Jain, 2014). In addition, severity, chronicity, age of onset, and relationship to one's assailant (in cases of interpersonal violence) have bearing on the degree to which traumatic events affect individuals (Kimerling et al., 2014). It is important to address the influence of these qualitative aspects of traumatic events because, often, assessments that aim to collect

information about the number of trauma exposures fail to detect subjective severity. With regard to rates of traumatic exposure between the traditional genders, men often report experiencing greater numbers of traumatic events. This does not, however, account for the fact that women are more likely to experience the types of traumatic events that carry a greater risk for the development of PTSD. Such event types include sexual assault, in which relationship to one's assailant is often a factor, and child sexual abuse, in which age of onset is a factor (Kimerling et al., 2014). These considerations are important to keep in mind when utilizing a checklist-based traumatic life event assessment measure.

Karam et al. (2014) characterize PTSD resulting from exposure to one or more life events that elicit a traumatic stress response as a public health problem that is global in nature and will require international attention to address. Since this study will focus on traumatic stress as an acute phenomenon, and will not utilize participants with clinical diagnoses, it is important to recognize the distinction. For the purposes of this review, however, the current literature regarding PTSD-experiencing individuals is potentially useful and will be explored.

Due to the fact that the present study employs stimuli with emotional content with the intention of eliciting a reaction, the Emotional Stroop Effect and *attentional bias* will be discussed. Fleurkens, Rinck, and van Minnen (2011) compared PTSD- diagnosed women who had experienced trauma of a sexual nature to those who had no history of prior traumatic experience on an emotional Stroop task. They found the PTSD-diagnosed women exhibited a greater amount of attentional bias when confronted with words of a sexual-traumatic nature, as opposed to words of an accident-traumatic nature and words

of a positive nature. This suggests that emotional triggers have the greatest effect on those who have experienced prior trauma when the trigger is specific to the trauma type experienced.

Physiological Components of Traumatic Stress

King and Liberzon (2012) attest to the fact that, physiologically, exposure to trauma carries consequences that can lead to certain risks when multiple traumas occur. Once such risk is the development of PTSD. Any discussion about the physiological consequences of exposure to a traumatic event would be remiss if it did not acknowledge the potential for individual differences to lead to a variety of outcomes. King and Liberzon (2012) apply the *diathesis-stress model* to acknowledge said potential. Diathesis refers to the specific physiological and psychological vulnerabilities that exist within any given individual, and stress refers to a life event that occurs within a given context or environment and that poses a challenge to an individual's physiological and psychological constitution. Taken together, these two concepts account for the fact that some individuals respond with dysfunction that can lead to pathology in the face of certain stressors (e.g., traumatic life events), and other individuals respond adaptively.

The following are the physiological systems known to be involved in the traumatic stress response, including some that are further thought to be differentially affected by exposure to multiple traumas. Family history and genetic variation appear to build the foundation of the physiological traumatic stress response spectrum. A number of studies outlined by King and Liberzon (2012) show that a PTSD diagnosis of an immediate family member increases the risk of the development of PTSD. At the

molecular level, recent studies exploring the contribution of certain genes to the risk of developing PTSD have found only significant interaction effects between genes and the environment; no main effects have been found (King & Liberzon, 2012). Though certain genotypes, alone, have not yet been linked to PTSD risk, King and Liberzon (2012) suggest certain *endophenotypes* (i.e., internally expressed characteristics that are the result of genotypic interaction with the environment) are likely to have bearing on the way individuals respond to traumatic stress and PTSD risk. The endophenotypic expression of the following neural components is likely to have the greatest effect on an individual's response to traumatic stress, and emotion regulation: the amygdala, anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (DLPFC), dorsomedial prefrontal cortex (dmPFC), catechol-O-methyltransferase (COMT) enzyme, tryptophan hydroxylase 2 (TPH2) enzyme, and serotonin transporter (King & Liberzon, 2012). Finally, with regard to the endophenotypic expression of neural components, King and Liberzon (2012) highlight the potential for childhood trauma to affect physiological changes in neuro-circuitry that persist long-term.

More relevant to the present study is the involvement of the sympathetic nervous system (SNS) in the traumatic stress response. The SNS precipitates the classic *fight or flight* reaction when an individual is confronted by a stressful stimulus. In accordance with the diathesis-stress model, those who have been exposed to childhood trauma and/or diagnosed with PTSD often exhibit enduring altered physiological patterns within several components of the SNS response – including heart rate.

Suendermann, Ehlers, Boellinghaus, Gamer, and Glucksman (2010) recruited a sample of 213 survivors of motor vehicle accidents or assaults to determine how the presence of a PTSD diagnosis might affect heart rate responses to pictures of a traumatic nature. In addition, they endeavored to learn whether the intensity of fear and dissociation at the time of trauma is capable of predicting an increased heart rate response to pictures related to trauma one month following the traumatic event. Their results indicated the presence of a PTSD diagnosis did result in elevated heart rate responses to pictures of a traumatic nature when compared to a group without diagnoses of PTSD (Suendermann et al., 2010). Furthermore, they learned that the intensity of peri-traumatic fear and dissociation is, in fact, capable of significantly predicting mean heart rate responses to pictures relating to trauma one month following the traumatic event (Suendermann et al., 2010). Overall, the authors' results substantiated the notion that individuals who have experienced prior trauma, specifically those who were later diagnosed with PTSD, generally exhibit heightened physiological responses when presented with reminders of trauma within at least four weeks after the traumatic experience. Based on their findings, the authors posit elevated heart rate responses to trauma-related pictures in those who developed PTSD are due to stimulus generalization. That is, fear acquired via conditioning during the traumatic experience is generalized to stimuli that bear a resemblance to the original traumatic circumstances. Pineles et al. (2013) corroborated these findings and subsequent interpretation, and went on to suggest self-reported intensity of fear and dissociation at the time of trauma, as well as psychophysiological

reactivity related to the traumatic experience, were significantly predictive of future PTSD diagnosis.

In an attempt to explore the nature of pre-existing genetic differences that may account for the elevated heart rate responses of trauma-exposed individuals when presented with aversive stimulation, Pitman et al. (2006) conducted a study wherein they compared the physiological reactivity of identical twins discordant for preexisting trauma exposure. Trauma-discordant twin pairs were divided into two groups. In one group, one twin had been exposed to trauma and subsequently developed PTSD, and in the other group one twin was trauma exposed but failed to develop PTSD. Each twin pair was exposed to 15 loud (95 dB) tones presented in succession and their heart rate responses were measured. In analyzing the data, Pitman et al. (2006) discovered a significant interaction effect between trauma exposure and PTSD diagnosis on heart rate. The heart rate responses of trauma-exposed PTSD-diagnosed twins were both greater than that of their non-trauma-exposed twin and other trauma-exposed twins who did not develop PTSD following trauma (Pitman et al., 2006).

These results indicate that tendency of trauma-exposed PTSD-diagnosed individuals to exhibit an elevated heart rate in response to loud tones cannot be attributed to genetic factors. Further, since Pitman et al. (2006) made sure to consider the potential influence of extraneous variables that could be regarded as confounds, they were able to reasonably conclude the differential heart rate responses were attributable to something other than genetic factors. They were also able to assert, since trauma exposure and subsequent development of PTSD was the most salient difference between twins in the

PTSD group, that the increased heart rate response when presented with loud tones was likely due to the development of PTSD following trauma (Pitman et al., 2006).

Those diagnosed with PTSD have been shown to differ from those who are non-diagnosed on electroencephalogram (EEG) measures, as well. Rabe, Beauducel, Zöllner, Maercker, and Karl (2006) compared the EEG measures of four groups of individuals. Three groups consisted of individuals who had experienced vehicular accidents within at least six months, and the control group consisted of individuals who had not. The four groups, specifically, consisted of PTSD-diagnosed, subsyndromal-PTSD-diagnosed, non-PTSD trauma-exposed, and healthy non-traumatized individuals. Upon being exposed to a trauma-related visual stimulus (e.g., car accident picture), readings were taken of participants' brain waves. Their findings indicate significant differences in EEG activity between both groups of PTSD-experiencers and the two non-PTSD groups. When exposed to the trauma-related visual stimulus, the two PTSD groups exhibited more activation in the right hemisphere, whereas the non-PTSD trauma-exposed group exhibited more activation in the left hemisphere. The healthy group of individuals, those who had not experienced trauma, exhibited relatively symmetrical cortical activity. There were no differences in baseline EEG readings among the four groups. The absence of differences in baseline, or resting, EEG activity between PTSD-diagnosed and non-PTSD individuals was further substantiated by Shankman et al. (2008). Their findings indicated that differences in both frontal and posterior activation asymmetry are nonexistent between PTSD-diagnosed and non-PTSD individuals.

Physiological Measures of Traumatic Stress

The primary physiological measure that will be used in this study is the EEG. The EEG works because "scalp recordings of neuronal activity in the brain…allow measurement of potential changes over time in basic electric circuit conducting between a signal (active) electrode and reference electrode" (Teplan, 2002, p. 5).

The alpha band will be the EEG feature examined in the present study. It occurs within the range of 7-14 Hz, and consists of brain waves that are known to be present during wakeful relaxation. Established properties of alpha oscillations include the Berger Effect, discovered by Hans Berger in 1929. Berger discovered that oscillations in the alpha range increase when eyes are closed, and decrease when eyes are open. Though they are the most prominent aspect of human EEG displays, alpha oscillations appear to diminish during the execution of higher-order functions such as focused attention, problem-solving, and other types of goal-driven cognitive effort (Chiang, Rennie, Robinson, van Albada, & Kerr, 2011). Ben-Simon, Podlipsky, Arieli, Zhdanov, and Hendler (2008) further elucidated the nature of alpha waves by determining that two processes occur, simultaneously, while the brain is at rest. One is referred to as induced (i.e., modulated by sensory information), whereas the second is described as spontaneous (i.e., operating, regardless of sensory stimuli changes).

Brief Interventions for Acute Traumatic Stress

The acute phase immediately following a significant traumatic event is a sensitive time. A variety of stress reactions can occur during this time including irritability, emotional numbing, avoidance behavior, sleep disturbance, difficulty concentrating,

derealization, depersonalization, and agitation (Bryant, 2014). It is important to note that individual differences substantially affect the way in which acute traumatic stress reactions occur. In particular, four trajectories have been identified: (a) resilient – exhibiting minimal PTSD-related symptoms, (b) initial distress – symptoms remit gradually over time, (c) delayed reaction – minimal initial symptoms that increase over time, and (d) chronic distress – PTSD-related symptoms are initially high and linger (Bryant, 2014). These trajectories highlight two consequential points: (a) some individuals will recover from trauma, independently, and will not require psychotherapeutic intervention, and (b) it is challenging to anticipate which individuals will require psychotherapeutic intervention because post-trauma response trajectories are nonlinear and complex (Bryant, 2014).

Bryant (2014) recognizes certain interventions following a traumatic life event are universal – that is, they are offered and often provided to all trauma survivors. One such universally provided intervention is *critical incident stress debriefing* (CISD). It has been anecdotally established that CISD is well received, and even enjoyed, by survivors of trauma. However, empirically, it is not regarded as effective in discouraging the development of PTSD when delivered in a single session immediately following the traumatic event (Bryant, 2014). In lieu of CISD, the practice of *psychological first-aid* (PFA) is the current recommendation of many a clinician (Bryant, 2014). The functions of PFA include the provision of safety, information, access to services, and emotional support to trauma survivors without prompting them to recall details of their traumatic experience, nor discuss any emotions it has elicited (Bryant, 2014). Such prompting runs

the risk of traumatic memory consolidation via elevation of overall arousal if carried out within days of the traumatic experience (Bryant, 2014; Nagamine et al., 2007). The intended result of PFA is to leave the trauma survivor instilled with hope, knowledge of relevant self-care strategies, and the notion they are capable of mastering all aspects of traumatic stress recovery (Bryant, 2014). Though both theory and anecdotal practical outcomes support the use of PFA, further empirical research into the degree to which PFA affects psychological adjustment following trauma is required (Bryant, 2014).

Physiologically, elevated heart rate immediately post-trauma has been implicated as a predictor of future PTSD development (Bryant, 2014). This is thought to take place due to fear conditioning circuitry in the brain. Enhanced arousal, due to increased sympathetic nervous system activation, strengthens the unconditioned fear response which, in turn, has the potential to strengthen fear-based memories via hippocampal interaction with the amygdala. Pharmacologically, it has been suggested that administration of the beta blocker propranolol immediately following a traumatic experience weakens fear conditioning by reducing sympathetic nervous system activation via adrenergic pathways (Bryant, 2014). If sympathetic activation can be reduced by intervening with propranolol, it stands to reason certain cognitive and behavioral interventions that have been shown to modulate the adrenergic response may achieve similar results. Below, mindfulness meditation for the purpose of relaxation is discussed.

Though it is not currently among the psychological treatments recognized by Division 12 of the American Psychological Association, much documentation exists with regard to *mindfulness meditation* as a potentially useful therapeutic tool for addressing

stress and trauma. Follette, Palm, and Pearson (2006) characterize mindfulness as the practice of focusing one's attention. They describe mindfulness as "a state of keen awareness of mental and physical phenomena as they arise" (Follette et al., 2006, p. 47). Rather than placing judgment on mental and physical sensations and experiences, the practice of mindfulness requires individuals to simply acknowledge said sensations and experiences, and recognize their resultant state of mind from moment to moment (Follette et al., 2006). The therapeutic value of mindfulness lies in its relationship to the promotion of awareness and, ultimately, acceptance (Follette et al., 2006). Trauma, and especially any associated enduring symptomatology, may be considered a type of *suffering* when viewed through the lens of the Eastern traditions within which mindfulness has its roots (Follette et al., 2006). Conditioning processes are known to maintain avoidance behaviors such as the suppression of intrusive thoughts, emotional numbing, self-exclusion from circumstances that may arouse adverse internal experiences, and even substance use (Follette et al., 2006). These avoidance behaviors are counterproductive to developing mindfulness and, ultimately, to healing (Follette et al., 2006).

Conversely, integrating mindfulness techniques into the therapeutic approaches used to address trauma has considerable promise for mitigating habitual avoidance behaviors. Follette et al. (2006) assert that by helping trauma survivors develop their ability to acknowledge and address painful thoughts, feelings, and memories, thus discouraging their tendency to employ avoidance strategies, the effectiveness of a number of different treatment modalities may be enhanced. Follette et al. (2006) suggest several simple exercises that may engender mindfulness as a life skill. Said exercises include

counting sounds, active observation and "participation in the moment" during seemingly mundane tasks such as washing the dishes, and following one's breath (Follette et al., 2006, p. 56). Developing a life skill such as mindfulness has unique potential rewards for trauma survivors. As trauma survivors may place increasing restrictions on the life experiences they allow themselves, and continuously attempt to consciously control unwanted thoughts in an effort to avoid the anxiety said thoughts are almost certain to provoke, a limiting cycle emerges wherein the attempts to avoid feelings associated with the unchangeable historical event unremittingly remind the survivor of that historical event. However, when a trauma survivor learns how to be mindful on a regular basis, it approximates a series of exposure treatments. The ability to direct focus to the moment at present, and any thoughts, feelings, or memories therein, liberates the survivor from this deleterious pattern of reminders leading to avoidance leading to reminders (Follette et al., 2006).

Kerr et al. (2011) conducted a study that tested whether a specific type of mindfulness meditation known as *mindfulness-based stress reduction* (MBSR) would modulate the alpha rhythm of 16 meditation-naïve individuals in response to a cue. Each participant's peak alpha rhythm was determined first, so it could be taken into consideration when alpha modulation was assessed. Kerr et al. (2011) found that the participants trained in MBSR exhibited enhanced levels of both differentiation and modulation in the alpha band when a somatic attentional cue (i.e., a cued location on the body) was presented. Thus, the study's authors pioneered the notion that a MBSR protocol can significantly modulate the alpha band within a specific cortical area.

Ussher et al. (2014) utilized the same brief MBSR intervention that will be employed in the present study to investigate the potential benefits of mindfulness for chronic pain patients. Fifty-five individuals diagnosed with chronic pain were recruited and consented to participate. Participants in the mindfulness group completed a short self-report questionnaire before and after following along with an audio recording that guided them through the MBSR intervention. Participants in the control group listened to an audio recording of a natural history textbook being read aloud (White, 1997). Ussher et al. (2014) detected significant differences in self-reported pain-related distress between the mindfulness and control groups. Within each group, both pain-related distress and pain severity decreased from pre- to post-intervention. Ussher et al. (2014) acknowledge that, without collecting any physiological data to help corroborate compliance, there is no way to determine whether participants completed the MBSR intervention appropriately. Participants in the mindfulness group did report, however, listening to and following the audio recorded instructions in their entirety.

Research Question

This research was designed to investigate the psychological and physiological reactions exhibited by different types of trauma survivors in response to negative affective stimuli and brief interventions for stress reduction. Understanding the nature of the respective reactions of trauma survivors carries important implications for peri- and immediate-post-trauma care, as well as for retraumatization prevention. In addition, it is important to discover whether a mindfulness meditation intervention has the potential to be successful at reducing acute traumatic stress.

The Statistical Package for the Social Sciences (SPSS) was used to evaluate the following five hypotheses:

H1: High trauma will elicit a significantly higher average heart rate than low trauma.

H2: High trauma will elicit significantly lower average alpha amplitude than low trauma.

H3: High trauma will elicit significantly higher levels of negative affect than low trauma.

H4: The MBSR intervention will result in lower heart rate and higher alpha amplitude than the control intervention across intact groups.

H5: The MBSR intervention will decrease heart rate and increase alpha amplitude to a greater degree, on average, in individuals who have experienced low trauma when compared to individuals with high trauma.

CHAPTER II

METHODS

Participants

Participants (N = 28) were recruited from students enrolled in undergraduate psychology courses at Central Washington University. A total of 32 participants were exposed to the protocol, but a full set of data was collected for only 28 participants. Instructors directed students to the online Psychology Research Participant System (SONA), and offered extra credit for participation in studies of each student's own choosing. All participants were 18 years of age or older, and the mean age was 23.18 years. The sample consisted of seven males and 21 females. With regard to race, the sample was 89.3% white, 7.1% Asian, and 3.6% black; 17.9% of the sample identified as Hispanic or Latino/a. A full delineation of participant demographics can be found in Table 1.

Since this is an EEG study, normative neurological health (other than diabetic neuropathy) was of the utmost importance to avoid potential confounds. Furthermore, since the experiment involved a visual stimulus, and one intervention condition involved a listening task, legally blind or deaf individuals were ineligible to participate. Finally, since participation required completing questionnaires in the English language, English fluency was necessary. All 28 participants indicated they did not have a neurologic condition that would preclude them from participation, nor any visual or auditory impairments. All 28 participants indicated they were fluent in the English language.

Table 1

Participant Demographics

	Overall	Low Trauma	High Trauma
	N = 28	*n* = 14	*n* = 14
Age			
M (*SD*)	23.2 (5.72)	24.6 (7.43)	21.8 (2.94)
18 – 24 (%)	85.7	78.6	92.9
25 – 31 (%)	7.14	7.14	7.14
32 – 40 (%)	7.14	14.3	0
Gender *N* (%)			
Female	21 (75)	9 (64.3)	12 (85.7)
Male	7 (25)	5 (35.7)	2 (14.3)
Race *N* (%)			
White	25 (89.3)	12 (85.7)	13 (92.6)
Black	1 (3.57)	0 (0)	1 (7.14)
Asian	2 (7.14)	2 (14.3)	0 (0)
Ethnicity *N* (%)			
Hispanic	5 (17.9)	2 (14.3)	3 (21.4)
Non-Hispanic	23 (82.1)	12 (85.7)	11 (78.6)

In addition to basic demographic questions, participants were asked whether they regularly take heart-rate altering drugs (prescription or recreational), and whether they had taken any such drugs within the last 48 hours. A brief list of examples of such drugs was given including, but not limited to: caffeine (i.e., coffee, tea, energy drinks, Midol or Excedrin), store-bought cold medicine (i.e., DayQuil/NyQuil, Robitussin, or similar), alcohol, aspirin, ibuprofen (i.e., Advil), naproxen (i.e., Aleve), Adderall, THC (i.e., marijuana or marijuana products), MDMA (i.e., ecstasy or molly), psilocybin (i.e., "magic" mushrooms), LSD, cocaine, ketamine, nitrous oxide (i.e., whip-its). Twenty participants indicated regular use of heart-rate altering drugs, and 13 indicated that they had taken such drugs within the last 48 hours. In addition, participants were asked whether they have any known allergies to topical skin applications in an attempt to anticipate the potential adverse reactions to any solutions used in conjunction with the EEG electrodes.

Participants were asked whether they had experienced a traumatic event within the past year, had sought clinical treatment for psychological symptoms resulting from that traumatic event, and if they were diagnosed with PTSD in the past year. Lastly, they were asked if they had ever sought clinical treatment for psychological symptoms resulting from a traumatic event, and if they had ever been diagnosed with PTSD. Seven participants stated they had experienced a traumatic event within the past year. Of those seven, three stated they had sought clinical treatment for resultant symptoms. Only one indicated they had been diagnosed with PTSD within the past year. Twelve participants said they had, at some point over the course of their lives, sought clinical treatment for

symptoms resulting from one or more traumatic events. Only three participants had ever been diagnosed with PTSD (one within the past year, and two over the course of their lifetime). This information was not used for any exclusionary or screening purpose, but was rather used as a reference to account for any data anomalies. See Appendix A for a copy of the demographics and screening questionnaire.

Design

This experiment was carried out in the Psychology Building laboratory facilities at Central Washington University. In order to determine whether an MBSR meditation exercise will significantly ameliorate induced effects from negative affective stimuli, a 2 x 2 x 3 mixed factorial experiment was conducted. The intact independent variable was determined by participants' scores on the Traumatic Life Events Questionnaire (TLEQ). Participants were divided into two groups based on the amount of trauma they reported previously experiencing (i.e., low and high amounts of trauma). The distinction between low and high trauma was determined by a median split. There were no participants who reported experiencing no trauma, whatsoever. Thus, there is no group representing individuals who lack prior trauma experiences. The manipulated independent variable – the intervention that was administered following the negative affective stimuli – has two levels: MBSR meditation exercise and control. The third independent variable was time of testing.

Measurements on all three dependent variables were taken at baseline, post negative affective stimulation, and post stress-reduction intervention. The three

dependent variables were alpha amplitude, heart rate, and scores on the Positive and Negative Affect Scale (PANAS) (see Table 2).

Table 2

Experimental Design

Trauma Group	Intervention	
	Meditation (n = 16)	Control (n = 12)
Low (n = 14)	Three alpha, three heart rate, and three PANAS measurements (n = 9)	Three alpha, three heart rate, and three PANAS measurements (n = 5)
High (n = 14)	Three alpha, three heart rate, and three PANAS measurements (n = 7)	Three alpha, three heart rate, and three PANAS measurements (n = 7)

Materials

Positive Negative Affect Scale (PANAS). Watson, Clark, and Tellegen (1988) developed and first validated the PANAS. For the purposes of the present study, only the descriptors from the negative affect scale were utilized. The negative affect scale descriptors include: distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid. Participants were asked to "indicate to what extent you feel this way right now, that is, at the present moment" (Watson, Clark, & Tellegen, 1988, p. 1070). This verbiage represents the *moment* time instruction. Responses were collected using a 5-point Likert scale ranging from one, representing *very slightly or not at all*, to five,

representing *extremely* (Watson et al., 1988). Goldschmidt et al. (2014) and Smyth et al. (2009) successfully used the PANAS as an ecological momentary assessment (EMA) tool to assess aspects of negative affect that are of particular clinical and/or theoretical relevance. The PANAS was psychometrically evaluated using predominantly undergraduate college students. However, since no systematic differences emerged between college student and community populations over the course of the principal analyses, the psychometric properties reported are based upon combined college student and community data. The normative data for the negative affect scale (M = 14.8, SD = 5.4) and positive affect scale (M = 29.7, SD = 7.9) are based on a sample size of 660 individuals using the moment time instruction (Watson et al., 1988). With regard to temporal stability, the coefficient alpha for the negative affect scale using the moment time instruction was found to be .85 (Watson et al., 1988). Thompson (2007) shed light on the criterion-related validity of the of the PANAS by re-evaluating known correlations with criteria such as age and gender. The correlations Thompson (2007) calculated were weak. He highlighted the notion that identifying a promising criterion is often more challenging than establishing its predictor.

Perceived Stress Scale (PSS). Cohen, Kamarck, and Mermelstein (1983) developed the PSS to evaluate "the degree to which situations in one's life are appraised as stressful" (p. 385). The present study will employ the 10-item version of the PSS. Each question inquires how often respondents have felt certain feelings or have exercised certain abilities within the last month (Cohen et al., 1983). The instrument utilizes a Likert scale from 0 (*never*) to 4 (*very often*). Scoring the PSS involves reverse coding

responses to the items stated in a positive format, then summing all responses (Cohen et al., 1983). The instrument has been normed on both men (M = 12.1, SD = 5.9) and wome (M = 13.7, SD = 6.6), as well as individuals ranging in age from 18 to 29 (M = 14.2, SD = 6.2). The sample size of each norm group exceeded 500 participants (Cohen et al., 1983). In the present study, responses on PSS were intended to be analyzed as covariates. Responses on the PSS were collected to shed valuable light on the amount of stress participants perceive to be present in their lives, over all, in addition to their perceived self-efficacy with regard to coping. Taylor (2015) conducted further psychometric analyses of the 10-item measure. The correlated two-factor model that resulted from the ordinal confirmatory factor analysis (CFA) he conducted corroborated previous findings that suggest *perceived helplessness* and *perceived self-efficacy* are the two factors that characterize the PSS-10 (Taylor, 2015). Taylor (2015) was also able to rule out a previously suspected gender bias within the instrument using ordinal logistic regression.

Traumatic Life Events Questionnaire (TLEQ). The TLEQ evaluates the nature and extent of prior exposure to 21 types of trauma (Kubany et al., 2000). It functioned, in this experiment, as a screening tool to create intact groups based on prior amounts of experienced trauma. The 21 types of trauma exposure that the measure evaluates are delineated in Table 3. Participants were asked to respond with the number of times they have experienced each type of traumatic event. The response options include *never*, *once*, *twice*, *three times*, *four times*, *five times*, and *more than five times*. Quasi-experimental, intact groups were formed based on low and high trauma reported on this measure.

The TLEQ has been validated across a variety of populations, including college students, veterans, survivors of domestic violence, and those enrolled in a substance

Table 3

Twenty-One Types of Traumatic Events Evaluated by the TLEQ

Number	Event Type
1	Natural disasters
2	Motor vehicle accidents
3	Other accidents involving injury or death
4	Exposure to warfare or combat
5	Sudden death of a close friend or loved one
6	Robbery involving a weapon
7	Severe physical assault by an acquaintance or stranger
8	Witnessing severe physical assault of an acquaintance or stranger
9	Being threatened with death or serious bodily harm
10	Childhood physical abuse
11	Witnessing family violence
12	Physical abuse by an intimate partner
13	Sexual abuse before age 13 by someone five or more years older
14	Sexual abuse before age 13 by someone close in age
15	Sexual abuse during adolescence
16	Sexual abuse as an adult
17	Stalking
18	Experiencing life-threatening illness
19	Life-threatening or permanently disabling event for a loved one
20	Miscarriage
21	Abortion

abuse recovery program. The measure has shown stability across the aforementioned populations. Across time, the consistency in responses was strongest for items relating to the following trauma types: witnessing family violence (kappas = .60 to .79), physical abuse experienced in childhood (kappas = .63 to .91), sexual abuse experienced in childhood by someone more than five years older (kappas = .70 to .90), and stalking (kappas = .59 to .84; Kubany et al., 2000). The item that showed the weakest temporal consistency was the one related to non-vehicular accidents (kappa < .40; Kubany, 2004). Efforts to establish concurrent validity included drawing comparisons between the TLEQ and structured interview responses. Such comparisons resulted in similar disclosures (mean kappa = .71).

No significant differences in the amount of disclosures were found between the structured interview method and administration of the TLEQ (Kubany, 2004). Kubany (2004) emphasizes the fact that the content validity of the TLEQ is its strongest feature. Similar measures of trauma history fail to capture the broad range of events addressed by the TLEQ. Miscarriages, abortions, witnessing family violence in childhood, and stalking are among the life events similar measures of trauma history neglect to address. The TLEQ was purchased from the publisher for use in this study.

International Affective Picture System (IAPS). The IAPS consists of a large number of semantically varied, full-color, emotionally evocative photographs, each of which possesses its own rating of affective valence and arousal (Lang, Bradley, & Cuthbert, 2008). The rating of affective valence is measured on a semantic differential from *pleasant* to *unpleasant*, and the rating of arousal is measured on a semantic

differential from *calm* to *excited* (Lang et al., 2008). The photograph ratings were normed on a sample of 100 undergraduate college students; the original sample consisted of an equal number of males and females (Lang et al., 2008).

Guntekin and Basar (2010) explored the dynamics of brain wave oscillatory behavior in response to pictures from the IAPS that are characterized as having negative, positive, and neutral emotional valence. They endeavored to determine whether pictures with negative emotional valence would increase oscillations in the beta band. Guntekin and Basar (2010) utilized 30 IAPS photos, 10 of each type (i.e., negative, positive, and neutral), to conduct their experiment. They administered each photo four times in two different design formats. One format, the "block" design, displayed pictures with similar emotional content in succession (i.e., 10 negative pictures, followed by 10 positive pictures followed by 10 neutral pictures). The other format, the "random" format, displayed the 30 pictures in pseudo-random order. Each picture was displayed for one second. Guntekin and Basar (2010) ultimately confirmed that pictures with negative content do increase oscillations in the beta band when compared to neutral pictures. Guntekin and Basar's (2010) finding most relevant to the current study is that only pictures presented in the "block" design format yielded significant results. That is, changes in the oscillatory behavior of brain waves in response to pictures were only observed when a number of photos with similar emotional content were displayed in succession. When the emotional content was randomized (i.e., each type of picture was displayed relatively independently of the picture type preceding and succeeding it), not

enough of an effect was produced to result in observable event-related oscillatory changes (Guntekin & Basar, 2010).

Guntekin and Tulay (2014) expounded upon Guntekin and Basar's (2010) findings by designing a protocol to specifically investigate the effects of the "block" method versus the "random" method of IAPS photo administration. Guntekin and Tulay (2014) hypothesized that greater changes in both beta and gamma band activity would result from consecutive presentation of negative affective photos, and lesser changes would result from negative photos presented randomly among photos with varied affective content. A negative block design, positive block design, negative random design, and positive random design were compared. Guntekin and Tulay (2014) state clearly that the negative block design yielded the most significant results, and assert that "continuous exposure to negative stimulation affects the brain more than the infrequent exposure to negative stimulation" (Guntekin & Tulay, 2014, p. 52).

It is worth pointing out the aforementioned research is specific to beta and gamma band activity, and does not substantiate the notion that the effect of the "block" design extends to the alpha band. Guntekin and Basar (2014) provide a comprehensive review of the literature documenting oscillatory responses, across all frequencies, to IAPS photos. Following their review of the literature specific to the alpha band, they could only state it is currently uncertain how the alpha band is affected by emotional processes. They conclude further research is needed. They go on to point out that, due to the variety of methodologies at play in this area of inquiry, it is difficult to make direct comparisons among results (Guntekin & Basar, 2014).

Twenty-five IAPS photos were selected for use in the current study. Said photos are characterized as having *negative affective valence*. The photos were selected, strategically, to represent every traumatic event type included in the TLEQ. That is, each TLEQ event type is represented by at least one of the 25 photos. Some photos can be interpreted as representative of more than one type of traumatic event, thus the unequal number of photos (i.e., 25) versus TLEQ event types (i.e., 21). This strategic selection method was carried out to address the potential impact of trauma type specificity on participant arousal.

Electroencephalogram (EEG). The EEG equipment required to complete this experiment is listed in Table 4.

Table 4

EEG Equipment

Equipment Type
PC and monitor
iWorx-214 data recording unit
Custom electrode isolating devices
Digital multi-meter
FRI 60” reusable leads with gold clips
FRI Disposable Ag/AgCl cup electrodes
Custom-designed hand-made elastic headbands
Parker Spectra 360 salt-free hypoallergenic electrode gel

The electrodes and leads were purchased from Florida Research Instruments (FRI). EEG data were collected and using the LabScribe 3 software compatible with the

iWorx data recording unit. Headbands were designed and hand-fabricated from raw materials by researchers using templates conforming to specifications for sizes small through extra-large. Size specifications were drawn from commercial bands distributed by FRI. Samples were collected at a rate of 1,000 samples per aggregate second. A fixation cross was utilized to ensure each participant consistently looked at the same location throughout the protocol, thus minimizing potential variation in EEG measurements due to differences in visual stimulation. The raw alpha data were processed by a real-time fast Fourier transformation (FFT) in order to determine spectral power density and demonstrate the presence of signals within the alpha band. The raw alpha data were further processed by digital filtering in order to eliminate 'noise' outside the common frequencies associated with the alpha band. The mean alpha amplitude within selected segments was compared across sampling times, trauma levels, and intervention conditions.

Heart rate (HR). Heart rate was also measured by the iWorx data recording unit and processed using the LabScribe 3 software. A Narco Biosystems Cardiac Coupler was utilized to acquire cardiac data. The mean heart rate within the same segments selected for EEG analysis was filtered and compared across sampling times, trauma levels, and intervention conditions.

Stimulus Generation System (SGS). The heart rate and EEG data collection was time-linked to a stimulus generator to ensure consistency by presenting a comprehensive temporal snapshot of each participant's physiological responses within the time periods of interest. A custom application program was written in Object Pascal using the Lazarus

programming environment to present visual and auditory stimuli in the appropriate sequence. An Arduino Uno microcontroller was employed to temporally mark the biometric data stream at each significant point throughout the protocol. A LCD projector (Sony VPL-PX11) was used to project the visual stimuli on a blank wall; a set of standard computer speakers was used to auditorily administer the interventions. The subject sat in a reclining chair in a darkened room oriented toward the screen. Projected 8'x 6' images were presented to the participant at a viewing distance of 7 feet. Volume levels were adjusted to produce a sound pressure level of 60 decibels SPL at a distance of one meter.

Intervention

Mindfulness-Based Stress Reduction (MBSR) Intervention. Kabat-Zinn (2005) details a stress-reduction meditation exercise based upon a mindfulness technique known as a body scan. The body scan involves a series of steps that instruct participants to focus on their breathing while consciously feeling their body, first as a whole then as one specific part at a time beginning with the left foot. Participants carried out the body scan for 12.34 mins as guided by audio-recorded instructions (Kabat-Zinn, 2002). This use of Kabat-Zinn's (2002) body scan is similar to the protocol implemented by Ussher et al. (2014). The steps of the exercise, adapted for this protocol, can be found in their entirety in Appendix B. The adaptation made for this protocol instructed participants to keep their eyes open and fixed on the cross on the screen instead of closed. This adaptation did have the potential to lessen the impact of the exercise, however, is favorable given that the alternative (i.e., eyes closed) would have invoked the Berger Effect. The Berger Effect (i.e., the increased observation of alpha wave activity when

eyes are closed) would have introduced a potential confound in the measurement of average alpha amplitude throughout the protocol.

Therapeutically-Inert Control Intervention (TICI). The control intervention involved an audio recording of a natural history text (White, 1789), which can be found in Appendix C. Utilizing the recording of the natural history text along with Kabat-Zinn's (2005) MMBS allows for direct comparison with the studies conducted by Ussher, Cropley, Playle, Mohidin, and West (2009) and Ussher et al. (2014). Participants in the control condition were instructed to sit quietly and focus on the fixation cross displayed on the screen while the audio recording of the natural history text played throughout the 12.34-minute intervention portion of the protocol.

Human Subjects Review Council Approval

Human Subjects Review Council (HSRC) approval for this project was sought in October 2015. The HSRC required a full board review, which was carried out successfully in November 2015. Carter-Visscher, Naugle, Bell, and Suvak (2007) offer insight about the ethical implications of asking trauma-related questions. Two hundred and three undergraduate women were evaluated with regard to their reactions about participation in research related to trauma. Participants were asked whether they experienced childhood abuse, neglect, and/or maltreatment. If they indicated they did, they were asked to what extent. Symptoms related to PTSD were also assessed. Participants were asked the following questions about potential negative reactions to participation twice during the experimental protocol, and again one week following the protocol: (a) "rate how upsetting participating in this study has been for you", (b) "rate

how difficult participating in this study has been for you", (c) "rate how bothered you are by thoughts about aspects of this study", and (d) to "rate your emotional reactions to participating in this study" (Carter-Visscher et al., 2007, p. 36).

The following questions about potential positive reactions to participation were asked along with the questions about potential negative reactions: (a) "rate how beneficial it has been for you to participate in this study", and (b) "knowing what you do about this study, rate how willing you would be to participate again" (Carter-Visscher et al., 2007, p. 36). The data Carter-Visscher et al. (2007) collected suggest participants' experiences were predominantly positive. Mean ratings on the 6-point Likert scale for almost every item fell around 3, indicating participants found the study only "somewhat" upsetting, difficult, etc. (p. 40). Ninety-five to 100% of participants reported they found the study at least somewhat interesting, and greater than 75% reported they found the study at least somewhat beneficial and enjoyable (Carter-Visscher et al., 2007). Only 6% of participants stated, given their acquired knowledge following participation, they would decline to participate again. Based on the data, it was concluded that neither PTSD symptomatology nor a history of childhood abuse, neglect, or maltreatment was a significant factor that influenced willingness to participate. Furthermore, the authors ultimately found no indication that trauma survivors constitute a vulnerable population in need of special protections. Finally, as evidenced by the results of their analyses, Carter-Visscher et al. (2007) offer that individuals who exhibit a low degree of PTSD-related symptoms "do not warrant exclusion from experimental research protocols, even if the

protocol includes stimuli that may seem particularly upsetting for individuals with these characteristics" (p. 52).

In an additional attempt to ensure participant protection, my thesis chairperson contacted researchers at Northern Illinois University (NIU) with experience administering the TLEQ to college undergraduates. The NIU researchers provided the following safety information. After administering the TLEQ to over 1,500 college undergraduates over the course of multiple semesters, no problems or adverse events associated with the measure were experienced. They further stated that their IRB has never taken issue with the TLEQ, nor denied approval of its use with college undergraduates (M. Lilly, personal communication, May 13, 2015).

Procedure

In the months following HSRC approval, supplies were ordered, lab construction was finished, and pilot tests of the protocol were run. In April 2016, the study was posted on SONA (see Appendix D). Prospective participants were directed to sign up for a specific two-hour time slot via SONA by in-class announcements and recruitment flyers posted in the Psychology Building. Once participants signed up, they were instructed to go to the Psychology Building's second floor participant waiting area.

The researcher met them in the waiting area and walked them back to the lab room. They were asked, upon entering, to please turn off their phone so it would not interfere with the equipment used to collect the physiological data. The researcher introduced each participant to the study, then gave each participant time to read through the informed consent document on their own. Once done, the researcher verbally

explained each section of the informed consent document, which can be found in Appendix E, that required participant initials. Finally, participants were asked if they had any questions before signing. Participants then completed the demographics questionnaire. Participant numbers were randomly assigned to either the MBSR meditation exercise or control condition by random draw with replacement prior to any participants arriving. Using replacement resulted in an even number of participant numbers assigned to the MBSR and control conditions.

Once participants completed the demographics questionnaire, the preparation portion of the protocol commenced. The first step in the preparation process involved measuring the participant's head to determine headband size. Once the appropriate headband was selected, five disposable silver-silver chloride cup electrodes were clipped into the headband using the gold clips on 60-inch reusable leads. Once the headband was assembled, the five scalp areas on which the electrodes would rest (see Figure 1) were exfoliated with alcohol swabs to remove any lipid matter that might impede their bioelectric current. The headband with electrodes clipped in was applied to the participant's head, and hair was moved out from between each electrode and the scalp using a wooden end of a long cotton swab. Once direct scalp contact was established, pediatric conductive gel was injected into each electrode using a disposable applicator tip and syringe. After the gel was applied, the impedance of each individual electrode was checked using custom-designed devices that allowed isolation of each electrode and evaluation of its individual impedance with a digital multi-meter. The electrodes were

adjusted with regard to gel amount and scalp contact until an impedance of under 100 kilohms (kΩ) was achieved.

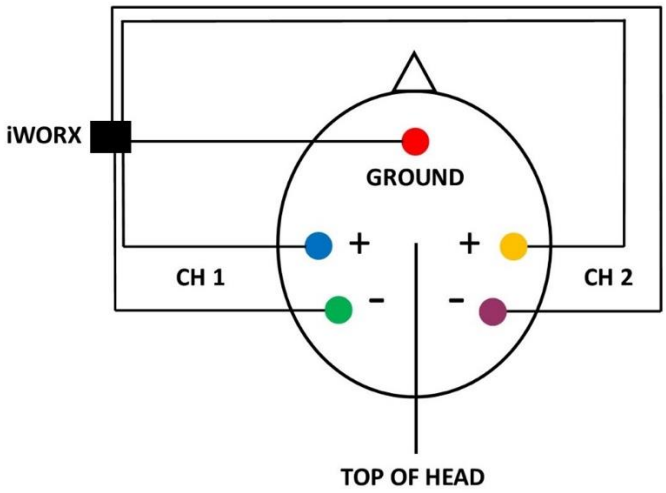

Figure 1. Electrode placement.

The cardiac electrodes were applied using the same method of alcohol swabbing the forearms, followed by the attachment of disposable electrodes to adhesive collars and the application of gel. The desired impedance threshold for the cardiac electrodes was 2 megohms (MΩ). The higher threshold is due to the fact that their placement on the body was farther from the reference electrode than the scalp electrodes. Once all seven electrodes (i.e., four EEG, two cardiac, and one ground) were attached, data collection was ready to commence.

Prior to the start of data collection, participants were instructed to: (a) keep their eyes open at all times, and to stay focused on the fixation cross whenever it was present, (b) sit still and move as little as possible, (c) take in the content of any photo that may appear in front of them, and (d) follow along with any audio recording they might hear.

The lights were then turned off, and physiological data recording began. Physiological data were recorded continuously throughout the protocol, but only three 10-second segments were selected for analysis. The 10-seconds prior to the administration of the first PANAS, the final 10-seconds during the block of negative affective photos, and the final 10 seconds of the intervention were analyzed. Following collection of the baseline physiological data, and the administration of the first PANAS, the negative affective photos were administered based on arousal rating (i.e., from lowest to highest) for 10 seconds each. The administration of the second PANAS directly followed. Finally, the intervention and third PANAS were administered. After the third PANAS, participants were informed that the portion of the protocol during which they were required to be hooked up to the equipment had concluded. Electrodes were removed, and participants were asked to fill out the PSS and TLEQ. Once all questionnaires were complete, participants were taken through the debriefing process. The debriefing document can be found in Appendix F. During the debriefing process, control group participants were offered the MBSR intervention. Following the debriefing process, participants were offered water and thanked for their participation. Physiological data files were saved and the lab was cleaned and prepared for the next participant. All disposable materials (e.g., electrodes, syringe tips, headbands) were discarded and all reusable materials (i.e., electrode leads and the chair) were sterilized for future use. See Appendix G for an exhaustive list of protocol steps. See Figure 2 for a visual depiction of the protocol sequence. The protocol is similar to one carried out by Prinsloo et al. (2011) and Prinsloo, Rauch, Karpul, and Derman (2013).

Administration of the PSS and TLEQ was strategically placed at the end of the protocol for two important reasons – one methodological and one relating to participant safety. The methodological reason for administering the PSS and TLEQ at the end of the study was to avoid the potential confound of inadvertently inducing a physiologically and emotionally stressful state near the start of the protocol. If the PSS and TLEQ were administered at the beginning of the protocol, the initial set of measurements could potentially reflect the induced stressful state rather than representing the participant's true baseline.

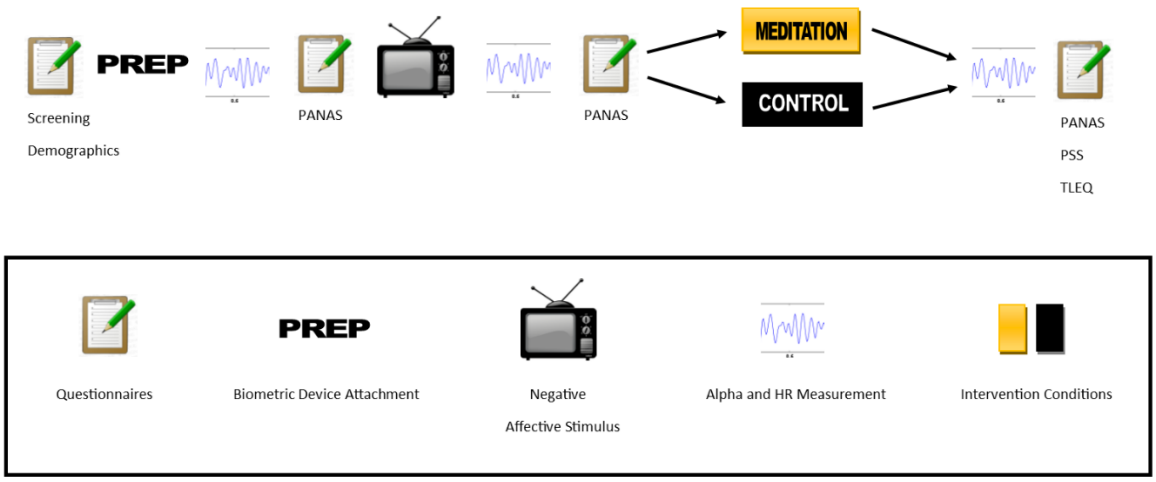

Figure 2. Protocol sequence.

The safety reason for administering the PSS and TLEQ at the end of the study is so that, if a participant should become agitated or otherwise distressed following the evaluation of their stress and recall of prior trauma, the participant could be immediately taken or directed to a clinical practitioner who could provide further assistance. Although

a licensed psychologist was in the building and available to meet, no individual participant indicated a need for such contact following the study.

CHAPTER III

RESULTS

TLEQ Results

Data analysis began with data screening. Descriptive statistics were obtained for all variables, including the TLEQ. The total number of traumatic episodes reported was 609. The episodes reported, per person (M = 21.75, SD = 19.16), ranged from 2 to 67 with a median of 12.5. Table 5 displays frequency counts of episodes reported for the 21 types of traumatic events evaluated by the TLEQ. Fifty-two events were reported that did not fall into one of the prescribed TLEQ categories. Such events are characterized on the TLEQ as "other events that were life threatening, caused serious injury, or were highly disturbing or distressing" (Kubany, 2004, p. 7). These events are included in the per person and overall event counts, but do not appear in the table.

Three of the event types were underreported by one or more participants. The participants indicated on the questionnaire that they had experienced one of the three events, but declined to provide an episode count. As such, the episode counts, both per person and overall, are slightly lower due to these omissions. The underreported event types are marked in the table with an asterisk.

Following data screening, factorial analyses of variance (ANOVAs) were carried out to determine the effect of the intervention (i.e., MBSR meditation versus control), amount of previous trauma experienced (i.e., low and high as determined by a median split of TLEQ episodes reported), and time on the three dependent variables (i.e., EEG, heart rate, and scores on the PANAS).

Table 5

Prevalence of 21 Types of Traumatic Events Evaluated by the TLEQ in the Sample

Number	Event Type	Episodes Reported
1	Natural disasters	17
2	Motor vehicle accidents	9
3	Other accidents involving injury or death	16*
4	Exposure to warfare or combat	0*
5	Sudden death of a close friend or loved one	67
6	Robbery involving a weapon	3
7	Severe physical assault by an acquaintance or stranger	5
8	Witnessing severe physical assault of acquaintance or stranger	24
9	Being threatened with death or serious bodily harm	36
10	Childhood physical abuse	53
11	Witnessing family violence	74
12	Physical abuse by an intimate partner	38
13	Sexual abuse before 13 by someone five or more years older	44
14	Sexual abuse before 13 by someone close in age	22
15	Sexual abuse during adolescence	36
16	Sexual abuse as an adult	48*†
17	Stalking	24
18	Experiencing life-threatening illness	1
19	Life-threatening or permanently disabling event for loved one	33
20	Miscarriage	4
21	Abortion	3

*One or more participants indicated experiencing this event type, but did not provide an episode count.

†Includes indications of sexual harassment.

EEG Results

Upon review of the mean peak frequency produced by each subject over time, it was discovered that only half of the individuals in the sample consistently produced oscillations in the alpha band (7-14 Hz). A subsample (n = 14) was created of these individuals. Individuals who did not consistently produce alpha oscillations were omitted from further analysis. Table 6 displays the percentage of the original experimental groups that consistently produced alpha oscillations.

Table 6

Percentage by Group of Individuals Who Reliably Produced Alpha Oscillations

	Low Trauma	High Trauma
Meditation		
Original Sample	9	5
Subsample (%)	4 (44.4%)	5 (100%)
Control		
Original Sample	7	7
Subsample (%)	2 (28.6%)	3 (42.9%)

Since the creation of the subsample reduced most group sizes to under five individuals, it was not advisable to perform parametric statistical tests. Descriptive statistics for alpha activity, measured in microvolts (μV), from only the individuals who consistently produced alpha oscillations can be found in Tables 7 and 8.

Table 7

Descriptive Statistics for Alpha Activity (μV) in the Left Hemisphere Over Time

	Low Trauma		High Trauma	
	n	*M* (*SD*)	*n*	*M* (*SD*)
Baseline				
Meditation	4	.001062(.0027618)	5	.000829(.0013023)
Control	2	.000100(.0009925)	3	.001616(.0007271)
After Photos				
Meditation	4	.000217(.0008289)	5	.001248(.0027207)
Control	2	.000612(.0018761)	3	-.000207(.0020370)
After Intervention				
Meditation	4	-.000085(.0010734)	5	.000011(.0018621)
Control	2	.001705(.0014139)	3	-.000636(.0003670)

Table 8

Descriptive Statistics for Alpha Activity (μV) in the Right Hemisphere Over Time

	Low Trauma		High Trauma	
	n	*M* (*SD*)	*n*	*M* (*SD*)
Baseline				
Meditation	4	.000246(.0010274)	5	.000867(.0013054)
Control	2	-.000927(.0013954)	3	.000105(.0005550)
After Photos				
Meditation	4	-.000484(.0013813)	5	.000667(.0018712)
Control	2	.000906(.0005531)	3	.000732(.0030437)
After Intervention				
Meditation	4	.000992(.0011824)	5	.000047(.0018091)
Control	2	.002258(.0005024)	3	.000023(.0005533)

Heart Rate Results

Descriptive statistics for the heart rate data, as measured in beats per minute (BPM), can be found in Table 9. Boxplots were examined to identify outliers within the heart rate data; none were found. Univariate normality was assessed using both Shapiro-Wilks' and Kolmogorov-Smirnov tests. Both tests showed the heart rate data met the assumption of normality at all time points ($p > 0.001$). Data were not found to be skewed nor kurtotic based on a criterion of plus or minus one. Levene's test was employed to gauge homogeneity of variance, and was found to be non-significant ($p > 0.001$) at all time points. Finally, a two-way ANOVA was carried out on the baseline heart rate values to determine whether the groups differed significantly in mean BPM at baseline. Statistically significant differences were not found at baseline between the high and low trauma groups, $F(1, 24) = 0.037$, $p = 0.849$, $\eta_p^2 = 0.002$, nor between the treatment and control groups, $F(1, 24) = 1.09$, $p = 0.307$, $\eta_p^2 = 0.043$. For this reason, baseline measurements were not treated as covariates within the heart rate data analysis.

The results of the 2x2x3 mixed factorial ANOVA on the heart rate data are as follows. Heart rate, overall, was not found to differ significantly over time, $F(2, 48) = 0.829$, $p = 0.443$, $\eta_p^2 = 0.033$, suggesting that the experimental manipulations built into the protocol did not have an overall effect on mean BPM. High and low trauma groups were not found to differ significantly over time, $F(2, 48) = 0.284$, $p = 0.754$, $\eta_p^2 = 0.012$, either. This suggests that amount of trauma previously experienced does not have an effect on BPM responses to negative affective photos and a brief intervention for

Table 9

Descriptive Statistics for Heart Rate (BPM) Over Time

	Low Trauma			High Trauma		
	n	M(*SD*)	95% CI	*n*	M(*SD*)	95% CI
Baseline						
Meditation	9	114.22(47.98)	[88.06, 140.39]	7	87.57(40.56)	[57.90, 117.24]
Control	5	69.40(13.13)	[34.30, 104.50]	7	101.71(30.92)	[72.05, 131.38]
After Photos						
Meditation	9	113.67(50.65)	[87.31, 140.03]	7	83.86(32.76)	[53.97, 113.75]
Control	5	63.20(16.15)	[27.83, 98.57]	7	100.14(34.71)	[70.25, 130.03]
After Intervention						
Meditation	9	112.11(54.85)	[84.38, 139.84]	7	85.71(30.81)	[54.27, 117.16]
Control	5	66.00(10.58)	[28.80, 103.20]	7	104.86(38.24)	[73.42, 136.30]

traumatic stress. Similarly, no significant differences were found between the treatment and control groups over time, $F(2, 48) = 0.289$, $p = 0.75$, $\eta_p^2 = 0.012$. Finally, no significant interaction was found when comparing trauma groups with treatment conditions over time, $F(2, 48) = 0.379$, $p = 0.686$, $\eta_p^2 = 0.016$. The main effects of the intervention condition, $F(1, 24) = 1.073$, $p = 0.311$, $\eta_p^2 = 0.043$, and trauma group, $F(1, 24) = 0.081$, $p = 0.778$, $\eta_p^2 = 0.003$, on heart rate were both found to be non-significant. There was, however, a significant interaction effect of both the trauma group and intervention condition on overall heart rate, $F(1, 24) = 4.642$, $p = 0.041$, $\eta_p^2 = 0.162$. Since only 16.2% of the variance in the mean BPM is attributable to the interaction, however, this effect should be considered weak. Simple effects analysis revealed the source of the interaction effect to be a significant difference between the treatment ($M = 113.3$, $SE = 12.75$) and control ($M = 66.2$, $SE = 17.1$) conditions within the low trauma group only, $F(1, 24) = 4.882$, $p = 0.037$, $\eta_p^2 = 0.169$. No other simple effects were significant. See Table 10 for complete results of the ANOVA, and Figure 3 for a graph of the significant interaction.

Since the main analysis of the heart rate data failed to detect any strong significant effects, follow-up exploratory analyses were conducted with the understanding that doing so would increase the likelihood of encountering a type I error. First, a 2x2 mixed factorial ANOVA was carried out which compared the high and low trauma groups on heart rate within the first 10 seconds and last 10 seconds of the administration of the negative affective photos. This was done to see if the amount of trauma previously experienced would result in a differential BPM response to the negative affective stimuli,

specifically. Levene's test was found to be non-significant ($p > 0.001$), showing homogeneity of variance at all time points.

Table 10

ANOVA Summary Table for Heart Rate by Trauma Group and Intervention

Source	*df*	*SS*	*MS*	*F*	*p*	η_p^2
Intervention (I)	1	4709.63	4709.63	1.073	.311	.043
Trauma Group (TG)	1	356.29	356.29	.081	.778	.003
TG x I	1	20368.93	20368.93	4.642	.041	.162
Error (S/TG x I)	24	105317.16	4388.22			
Total	25					

The overall effect of these two time points on heart rate was not found to be significant, $F(1, 26) = 0.553$, $p = 0.464$, $\eta_p^2 = 0.021$, nor was the interaction effect of time and trauma group, $F(1, 26) = 0.044$, $p = 0.836$, $\eta_p^2 = 0.002$. This suggests the amount of trauma previously experienced does not result in a differential heart rate response to negative affective stimuli. The main effect of trauma group on heart rate was also found to be non-significant, $F(1, 26) = 0.083$, $p = 0.775$, $\eta_p^2 = 0.003$.

Another 2x2x2 mixed factorial ANOVA was carried out which compared the high and low trauma groups and intervention conditions on heart rate within the first 10 seconds and last 10 seconds of the intervention. This was done to determine whether the amount of trauma previously experienced and intervention condition would result in a differential BPM response to the intervention, specifically. Levene's test was found to be

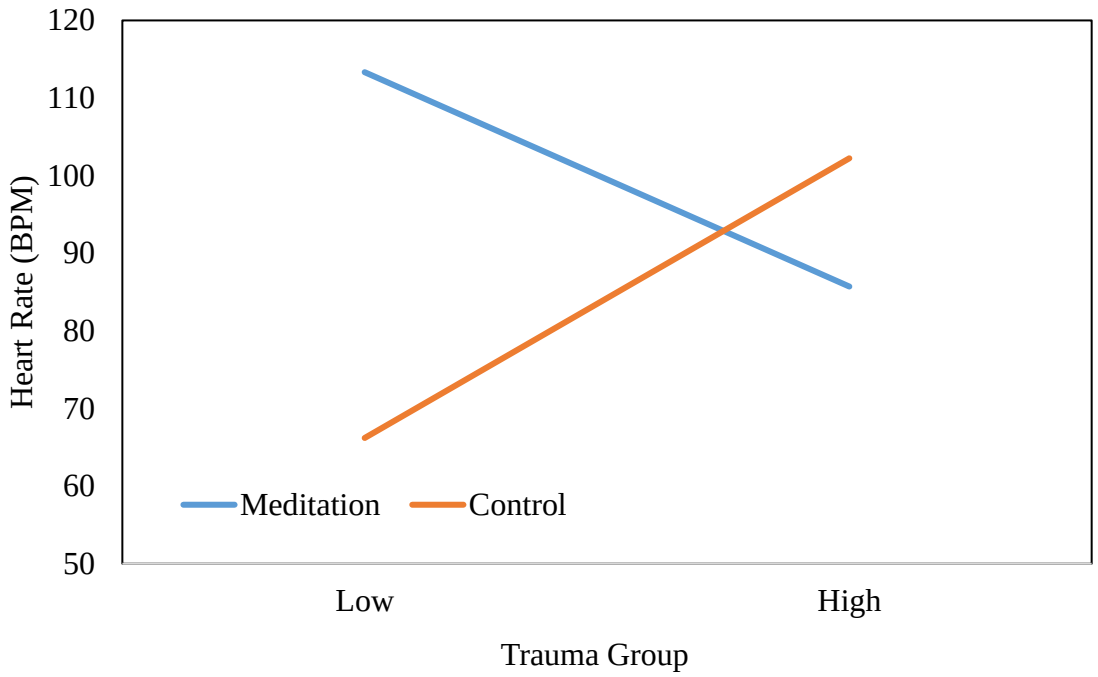

Figure 3. Mean heart rate (BPM) by intervention and trauma group.

non-significant ($p > 0.001$), showing homogeneity of variance at all time points. The overall effect of these two time points on heart rate was not found to be significant, $F(1, 24) = 0.205$, $p = 0.655$, $\eta_p^2 = 0.008$. Both the trauma group, $F(1, 24) = 0.458$, $p = 0.505$, $\eta_p^2 = 0.019$, and intervention condition, $F(1, 24) = 0.296$, $p = 0.592$, $\eta_p^2 = 0.012$, were found to be non-significant over time, as well. Lastly, interaction effect of time, trauma group, and intervention condition was not significant, $F(1, 24) = 0.000097$, $p = 0.992$, $\eta_p^2 = 0.000004$. One significant effect was found by this analysis, and that is the interaction effect of trauma group and intervention condition on overall heart rate, $F(1, 24) = 5.203$,

$p = 0.032$, $\eta_p^2 = 0.178$. Based on this, it can be said that 17.8% of the variance in mean BPM is attributable to the interaction between trauma group and intervention condition.

The final follow-up exploratory analysis involved calculating difference scores on heart rate and comparing them by trauma group and intervention condition at three times throughout the protocol. The difference scores were calculated by taking the mean BPM within the first 10 seconds of a given protocol event (i.e., baseline, negative effective photo administration, and intervention) and subtracting it from the mean BPM within the last 10 seconds of that same event. The absolute values of the difference scores (i.e., change magnitudes) were then analyzed between trauma groups and intervention conditions.

Data screening revealed the difference scores to be highly skewed and kurtotic. There were many outliers which, furthermore, caused the assumption of normality to be violated based upon both Shapiro-Wilks' and Kolmogorov-Smirnov tests. For these reasons, a Log 10 transformation was performed on the difference scores. The Log 10 transformation satisfactorily resolved all issues of skewness and non-normality.

No significant differences were found among the transformed difference scores at baseline, so baseline scores were not treated as covariates. Thus, 2x2x3 mixed factorial ANOVA was performed. The only significant result with regard to time was the interaction effect of both trauma group and intervention condition on the transformed difference scores from baseline to the administration of the photos to the intervention, $F(2, 32) = 6.15$, $p = 0.005$, $\eta_p^2 = 0.278$. Based on these results we can say the relationship between the amount of trauma experienced and intervention condition significantly

affects the change magnitude in mean BPM across the three main protocol events (i.e., baseline, negative effective photo administration, and intervention). Furthermore, 27.8% of the variance in change magnitude can be accounted for by the interaction of the trauma group and intervention condition over time.

PANAS Results

Univariate normality was assessed using both Shapiro-Wilks' and Kolmogorov-Smirnov tests. Both tests showed the PANAS data met the assumption of normality at times one and two, but did not at time three ($p < 0.001$). The PANAS data were found to be both skewed and kurtotic at time three, as well. Skewness and kurtosis at times one and two were within the plus or minus one range. Given the assumption violations at time three, a Log 10 transformation was performed on the PANAS data at all time points. Following the Log 10 transformation, skewness, kurtosis, and normality were reevaluated. The Log 10 transformation did not fully resolve the assumption violations, so univariate outliers were identified using boxplots and evaluated, individually, prior to determining whether to omit. Ultimately, three subjects were removed from the analysis bringing the sample size to 25. Once outliers were removed, skewness, kurtosis, and normality were reevaluated a final time prior to analysis. Following the transformation and removal of outliers, the data were normal and were no longer heavily skewed or kurtotic. Descriptive statistics for the PANAS data can be found in Table 11.

In accordance with the original plan to treat scores on the PSS ($M = 17.75$, $SD = 7.321$) as self-report covariates, an ANCOVA was carried out on the PANAS data. The PSS scores ultimately did not show significance as covariates, $F(1, 20) = 0.396$, $p =$

0.536, $\eta_p^2 = 0.019$, so the PSS was removed from the self-report analysis. See Table 12 for complete results of the ANCOVA.

Table 11

Descriptive Statistics for Negative Scale PANAS Scores Over Time

	Low Trauma			High Trauma		
	n	M(*SD*)	95% CI	*n*	M(*SD*)	95% CI
Baseline						
Meditation	8	12.87(1.64)	[11.21, 14.54]	6	12.17(2.64)	[10.25, 14.09]
Control	5	12.80(3.42)	[10.70, 14.90]	6	12.17(1.17)	[10.25, 14.09]
After Photos						
Meditation	8	13.50(2.62)	[11.35, 15.65]	6	15.17(4.45)	[12.68, 17.65]
Control	5	13.00(2.55)	[10.28, 15.72]	6	11.17(1.17)	[8.68, 13.65]
After Intervention						
Meditation	8	10.88(0.99)	[9.81, 11.95]	6	10.00(0.63)	[8.76, 11.24]
Control	5	11.80(2.05)	[10.45, 13.15]	6	11.17(1.94)	[9.93, 12.40]

Table 12

ANCOVA Summary Table for PANAS Scores by Trauma Group and Intervention with Perceived Stress Scale Scores as Covariate

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Covariate (PSS)	1	.004	.004	.396	.536	.019
Intervention (I)	1	.005	.005	.542	.47	.026
Trauma Group (TG)	1	.003	.003	.258	.617	.013
TG x I	1	.004	.004	.421	.524	.021
Error (S/TG x I)	20					
Total	21					

As was done with the heart rate data, a two-way ANOVA was performed on the baseline PANAS data to determine whether significant differences exist at that time point. Levene's test was employed to gauge homogeneity of variance at time one, and was found to be non-significant ($p > 0.001$). Given the lack of main effects of trauma group, $F(1, 21) = 0.009$, $p = 0.926$, $\eta_p^2 = 0.00042$, and intervention condition, $F(1, 21) = 0.454$, $p = 0.508$, $\eta_p^2 = 0.021$, as well as the lack of an interaction effect at time one, $F(1, 21) = 0.082$, $p = 0.777$, $\eta_p^2 = 0.004$, baseline PANAS data were not analyzed as covariates within the main data analysis.

Following the data screening activities, the main 2x2x3 mixed factorial ANOVA was carried out on the PANAS data to determine whether subjective self-report of feelings of negative affect differed significantly across the three protocol time points. The result of Levene's test showed the variance of the PANAS data was homogenous ($p >$

0.02). Time, overall, was found to have a significant effect, $F(2, 42) = 9.716$, $p = 0.00034$, $\eta_p^2 = 0.316$, suggesting the protocol manipulations resulted in significant differences in subjective feelings of negative affect. In fact, 31.6% of the variance in self-reported negative affect is attributable to the protocol manipulations over time. A post hoc analysis revealed PANAS scores differed significantly between baseline ($M = 12.5$, $SE = 0.46$) and the end of the intervention ($M = 10.96$, $SE = 0.3$; $p = 0.002$), as well as between the end of the negative affective photos ($M = 13.21$, $SE = 0.59$) and the end of the intervention ($p = 0.002$). Significant results were also found for the intervention condition over time, $F(2, 42) = 4.586$, $p = 0.016$, $\eta_p^2 = 0.179$. Post hoc analyses revealed the source of this interaction effect to be significant differences between all three time points within the treatment condition. PANAS scores after the photos ($M = 14.33$, $SE = 0.79$; $p = 0.017$) and after the intervention ($M = 10.44$, $SE = 0.39$; $p = 0.001$) both differed significantly from baseline ($M = 12.52$, $SE = 0.61$); additionally, scores after the photos and after the intervention differed significantly from one another ($p < 0.001$). This suggests differential self-reporting of negative affective feelings took place within the treatment condition in response to the three protocol time points. No significant differences were found between any time points within the control condition. The interaction of the intervention condition and time accounts for 17.9% of the variance in the PANAS scores. See Figure 4 for a depiction of this interaction.

The interaction of trauma group with time, $F(2, 42) = 0.155$, $p = 0.857$, $\eta_p^2 = 0.007$, as well as the three-way interaction between trauma group, intervention condition, and time, $F(2, 42) = 1.884$, $p = 0.165$, $\eta_p^2 = 0.082$, were not significant. These

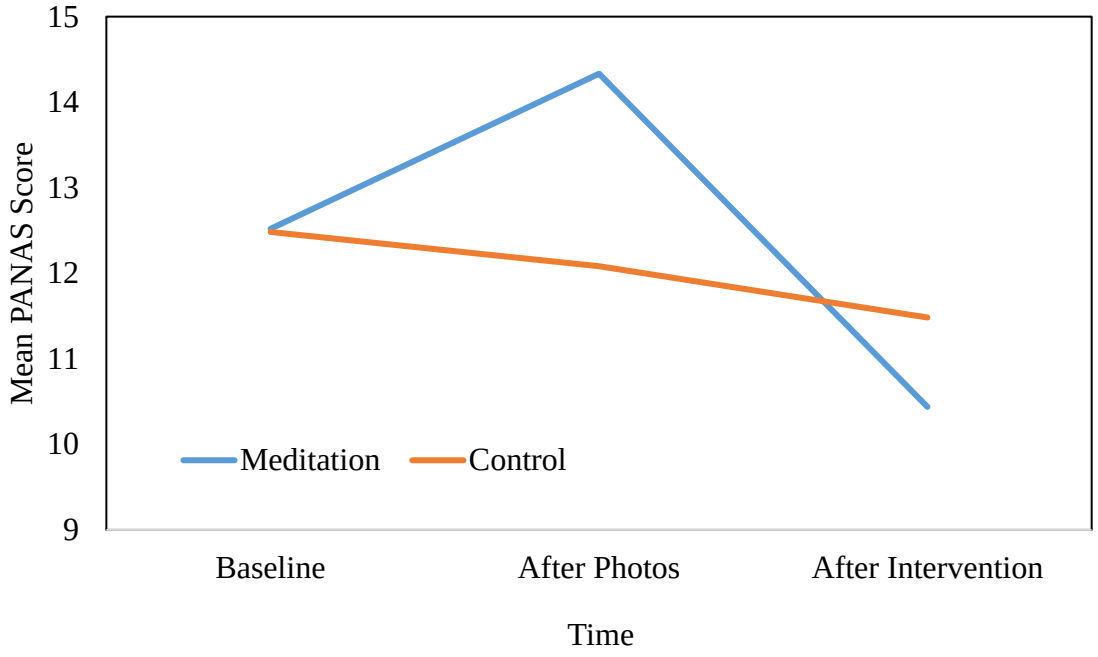

Figure 4. Mean negative-scale PANAS scores by intervention and time.

non-significant results suggest that the amount of trauma previously experienced does not influence subjective self-reporting of negative affective feelings when exposed to negative affective stimuli and a brief intervention for traumatic stress. Between-subjects comparisons made by this analysis were all found to be not significant. For a complete delineation results, see Table 13.

Table 13

ANOVA Summary Table for PANAS Scores by Time, Trauma Group, and Intervention

Source	*df*	*SS*	*MS*	*F*	*p*	η^2
Time (T)	2	.072	.036	9.716	.00034	.316
T x Intervention (I)	2	.034	.017	4.586	.016	.179
T x Trauma Group (TG)	2	.001	.001	.155	.857	.007
T x I x TG	2	.014	.007	1.884	.165	.082
Error (S/T x I x TG)	42	.155	.004			
Total	44					

CHAPTER IV

DISCUSSION

The discussion of the EEG portion of this research would be remiss if it did not include substantiation of the fact that not all people are capable of producing alpha oscillations under all circumstances. A number of factors affect whether an individual is likely to produce enough alpha power to constitute a detectable signal through the background signal pollution inherent to a traditional EEG.

Bazanova and Nikolenko (2016) concluded that biological sex affects EEG measures due to fundamental neurohormonal differences. They assert that the various stages of the menstrual cycle and its associated neurohormonal changes in females further alter EEG measures in significant ways. Leuchter et al. (2016) investigated effects of the selective serotonin reuptake inhibitor (SSRI) escitalopram on quantitative EEG (qEEG) measures and found that alpha power was diminished when compared to placebo. It is worth noting this study was limited anatomically and temporally to prefrontal cortical activity and one week of treatment, respectively. Taken together, these two studies illustrate the fact that there are factors that significantly affect alpha power that were not previously considered, and for which no methodological controls were put in place.

With specific respect to trauma, PTSD, and other affective disorders, Eidelman-Rothman, Levy, and Feldman (2016) conducted a review of correlational studies to elucidate the ways in which oscillations in the alpha band differ among individuals with clinical diagnoses. The discussion proved to be complex. Many factors were found to be associated with differences in alpha activity in ways that are not always predictable.

However, a few noticeable trends emerged. It appears an increase in alpha is exhibited in those experiencing depression and generalized anxiety, while those with obsessive-compulsive disorder exhibit a decrease (Eidelman-Rothman et al., 2016). The results specific to PTSD-diagnosed individuals were highly inconsistent regarding the relationship between diagnosis and alpha power. Based on their review, Eidelman-Rothman et al. (2016) attribute inconsistencies to a number of factors. These factors include, but are not limited to, comorbidity, medication, methodological differences (e.g., EEG reference montage and task versus resting state condition), and control group characteristics. It is possible, if not likely, some of the same factors thought by Eidelman-Rothman et al. (2016) to affect the relationship between alpha power and clinical diagnosis affected the sample in the present study.

Three significant results were detected with respect to the cardiac measure. A significant interaction was detected between trauma group and intervention condition when the raw cardiac data were analyzed across all three protocol time points. This suggests that the relationship between trauma group membership and randomly-assigned intervention condition, but neither variable alone, affected overall cardiac rate significantly. With respect to the specific pattern of results, in the low trauma group, individuals in the control group exhibited a lower heart rate than did those in the treatment group; in the high trauma group, this pattern was reversed (i.e., the control group exhibited a higher heart rate than did the treatment group). The simple effects analysis revealed that the mean difference between treatment conditions within the low trauma group was the source of this significant interaction. Why did the low trauma

group exhibit greater mean differences than did the high trauma group in response to the protocol? Perhaps, a direction for future research.

Another significant interaction was detected between trauma group and intervention condition when the raw cardiac data were analyzed at only two time points, the beginning and end of the intervention. A final interaction was detected when transformed change magnitude scores were analyzed across all three protocol time points. A plausible reason why three significant interaction effects, but no main effects, were detected upon analysis of heart rate is that a crossover phenomenon does exist between the four groups, but group membership, alone, is not influential enough to produce significantly different means. Finally, there was a fourth interaction effect that was not significant ($p = 0.056$) but, given greater statistical power provided by a larger sample in the future, could be. This was the interaction effect of trauma group and intervention condition at baseline.

Two significant results were detected with respect to negative scale PANAS scores. Time, overall, was found to have a significant effect on PANAS scores, suggesting the protocol manipulations resulted in measurable differences in subjective feelings of negative affect. This offers some confidence in the fact that the experimental protocol, intended to induce differences in both self-reported subjective feelings and physiology, performed as planned, at least with regard to self-reported subjective feelings. Significant differences were also found between the intervention conditions over the three protocol time points. These differences were, however, only observed within the treatment condition. This suggests random assignment to the treatment condition resulted

in different experiences, or at least self-reporting of experiences, of subjective negative feelings over the course of the protocol. Several confounding factors could have influenced the observed results of the analysis of the PANAS scores. Such factors include, but are not limited to, reactivity and practice effects, participant fatigue, or participant desire for consistency. There may be significant effects at play that the analyses failed to detect due to the low statistical power inherent to a small sample size.

Overall, the results of this study offer few defensible conclusions with regard to the five proposed hypotheses. Due to the small sample size, low statistical power, and various confounds, further research is needed to determine whether amount of trauma experienced and treatment versus control group membership contribute to significant effects on two physiological variables and one negative affective self-report measure after exposure to a protocol that includes both a negative affective stimulus and brief intervention for traumatic stress.

Strengths

The laboratory facility was designed, specifically, to accommodate the study protocol. Furthermore, both the laboratory facility and protocol were designed to minimize variability between data collection sessions, and hold as many procedural elements constant as possible. A number of the study procedures were automated such as collection of the EEG and heart rate data, presentation of the IAPS photos, and administration of the intervention. Automated collection of the EEG and heart rate data was synchronized with the automated presentation/administration of the

photos/intervention to ensure the biometrical data collected accurately reflect each subject's physiological reaction to the stimuli.

In addition to designing the laboratory facility and study protocol to eliminate as much procedural variability as possible, pilot testing, a digital multimeter, and a pre-baseline screening period were employed to ensure biometric data were collected as accurately as possible. Pilot testing consisted of attaching electrodes to members of the research team to identify and eliminate any procedural elements that might result in artefacts, increased electrical impedance, or other types of data contamination. The digital multimeter allowed the impedance of each individual electrode to be checked prior to the beginning of data collection. If the impedance of any given individual electrode was excessive, adjustments were made so that the impedance was brought down below a specified threshold. The pre-baseline data screening period occurred between the time each subject was completely attached to the electrodes and impedances were checked and the time baseline data were collected. During the pre-baseline period, the biometric traces were observed coming into the software program, each trace was examined, and scaling adjustments were made prior to the actual collection of data. These three processes relating to biometric data collection afford the researchers more confidence in both the conclusions of this study and the data from which they are drawn.

Another strength involves the level of ethical oversight and procedural elements that emphasize the importance of participant protection. This study acknowledges the fact that, while they are not officially included among legally vulnerable populations, trauma survivors involved in research ought to be afforded certain considerations. Not only was

this study subject to a full-board HSRC review resulting in comprehensive informed consent and debriefing processes, each participant was given the option to discontinue participation following the administration of the negative affective photos.

Limitations

Upon execution of the experiment, a number of limitations came to light. Possibly the most significant of which is the fact that many participants found the recording of the MBSR intervention "weird" or otherwise unsettling. A few participants found Kabat-Zinn's voice and delivery off-putting, and one participant even indicated that it made her feel uncomfortable when the recording directed her to focus on certain body parts. This is in direct opposition to the intent of the MBSR intervention recording (i.e., to induce a relaxed state where the participant felt at ease).

A second limitation involves the timing of the collection of the baseline physiological data. In order to maximize temporal proximity of the pre- and post-stimulus physiological measures, baseline physiological data should have been collected *after* the baseline administration of the PANAS and immediately prior to the administration of the photos. Designing the experiment in this way would have resulted in a more reliable difference measure by ensuring no potentially-confounding variable intervened between the first and second measure of physiological data.

A third limitation involves the noise-to-signal ratio within the laboratory space. The level of noise was too high compared to the strength of the signal(s) generated by the equipment. Some data were not able to be isolated because they were, essentially,

drowned out by the ambient noise in and around the lab. A more acoustically-controlled and private lab space should be used in future experiments.

A fourth limitation was the lack of a mechanism that would allow the researcher to view each participant at all times throughout the protocol. The lab was set up in such a way that participants were on the other side of an opaque curtain facing away from the researcher whenever physiological data were being collected. Due to this limitation, there was no experimental check in place to determine whether participants closed their eyes (i.e., potentially induced the Berger Effect). Future experiments should employ the use of a mirror or camera to ensure each participant is visible to the researcher during all portions of the protocol – specifically, those wherein alpha amplitude is recorded. Such a mechanism would also allow the researcher to monitor myogenic artefacts (i.e., those brought about by muscle movement), as it was audibly apparent that many participants did not remain still.

A fifth limitation has to do with the determination of normative neurological health. Since there was no time within the already lengthy protocol to include a neurological examination or cranial nerve test, the determination of normative neurological health relied only on participant self-report. It is worth noting the self-report method was effective at identifying one ineligible participant who disclosed a history of stroke. Due to this disclosure, the participant was ultimately designated a screen failure, and was omitted from the study. It is unclear, however, whether other serious neurological conditions and/or elements of medical history went unreported.

A sixth limitation involves the potentially-confounding effect of anticipatory anxiety. A number of participants indicated that, prior to the start of data collection, they were anxious about the graphic nature and content of the photos. This anxiety could have inadvertently inflated their baseline level of physiological arousal, as well as their baseline self-reported negative affect. If enough participants were more anxious at baseline than at any other point during the protocol, this could have had a serious confounding effect on both the experimental manipulation and subsequent efficacy of the intervention.

A seventh limitation takes into consideration the effect of prior desensitization to graphic images. This desensitization, established by regular viewing of popular movies and television shows, certain news outlets, general internet content, and violent video games, could have resulted in lower levels of physiological arousal as certain participants viewed the photos. A few participants even indicated that the images used in the study were no more graphic than images they see over the course of their regular media consumption.

An eighth limitation has to do with the way in which the TLEQ was scored for the purpose of creating intact groups. The "more than five times" response was recorded as having occurred exactly six times rather than accurately reflecting the number of occurrences. Recording the response in this way was done to ensure consistency between participants, but does not necessarily accurately capture the participant's level of trauma experience. Not having an accurate count of the number of times an event occurred in a participant's life may have resulted in certain participants being misclassified in either the

low or high trauma group. Additionally, the median split resulted in intact groups that were separated by a margin of only one traumatic episode (i.e., individuals who reported 12 episodes were placed in the low trauma group, while individuals who reported 13 episodes were placed in the high trauma group). This narrow margin with regard to group membership is likely to have diminished the effect size of the intact groups.

A ninth limitation involves the administration of the PANAS. The order of the affective descriptors was not randomized at each administration. Had it been, the practice effects that accompany multiple administrations of the same scale in a relatively short timeframe would have been combatted.

A tenth limitation regards the timing of the administration of the PSS. Since scores on the PSS were analyzed as covariates, the PSS should have been administered prior to any experimental manipulation. This would have ensured the covariate operates independently of any experimental factors. Instead, the PSS was administered at the end of the protocol, leaving it subject to influence by the true, manipulated independent variable (i.e., the intervention).

An eleventh limitation has to do with the participant recruitment materials. The recruitment flyer, as well as the announcement on the online system, referenced the fact that this study was about traumatic events and prior trauma exposure. The fact that this information was featured during recruitment could have resulted in participant self-selection bias. Participants could have selected themselves in or out of the study based on their perception of this information.

A twelfth limitation is the gender disparity within the sample. Three times as many females were enrolled as males, which resulted in uneven distribution across both intact and experimental groups. Given the obvious physiological, as well as the aforementioned neurohormonal, differences between men and women, equal representation of the genders within each intact and experimental group would afford much more confidence in conclusions.

Directions for Future Research

There are several directions in which researchers could further explore the relationships between these variables. One is the idea of analyzing the physiological data by each individual photo as well as by trauma type experienced. Would specific photos elicit stronger physiological reactions, in general? Would reactions be modulated by the specific types of trauma experienced by each individual person (i.e., would photos depicting the type of trauma congruous with that experienced result in a more pronounced and detectable physiological reaction)?

It would also be useful to utilize a larger, denser electrode array. In addition to increasing the size and density of the array, it would be beneficial to conduct the study in a facility designed to minimize signal pollution (e.g., Faraday cage or similar). With regard to the intervention, employing a different, more universally-accessible recording for the treatment (i.e., MBSR) condition and a less soothing recording for the control condition would help maximize the difference between the two conditions. With regard to the trauma groups, it would be beneficial to maximize the effect size of group membership by creating the groups using a method other than a median split of TLEQ

scores. Future experiments may benefit from comparing upper and lower quartiles, or pre-screening individuals and selecting those who report only especially high or especially low levels of traumatic exposure.

Another direction for future research may be the establishment of large-scale population norms on the TLEQ. At present, it appears no such norms are established on a large scale. That is, what constitutes high, low, and average amounts of trauma experienced by specific populations (e.g., undergraduate college students)? The TLEQ manual offers reports of occurrence in the form of percentages of samples of specific populations (Kubany, 2004). This information was collected for the purposes of establishing test-retest reliability and content validity by comparison with a structured interview, but the manual offers no large-scale normative data. One study, conducted by Frazier et al. (2009), exposed a large sample of undergraduate students (N = 1,528) to the TLEQ in order to estimate population prevalence. The gender distribution in the sample bore resemblance to the present study in that it roughly consisted of a 3:1 ratio of women and men, respectively. The number of events reported (M = 2.79, SD = 2.45), per person, in the study conducted by Frazier et al. (2009) appears to be much lower than what was measured in the present study (M = 21.75, SD = 19.16). The variance among the traumatic events reported, per person, however, must be similar between the two studies since their coefficients of variation, 1.1388 in the study conducted by Frazier et al. (2009) versus 1.1352 in the present study, are almost identical.

While the present study employed a sub-clinical sample, future research could compare PTSD-diagnosed versus trauma-exposed-but-not-PTSD-diagnosed populations.

If they differ significantly on the three dependent variables when exposed to the protocol, it could be suggested that symptoms severe enough to warrant a clinical diagnosis result in physiological differences when processing of negative affective stimuli. Results would also shed light on any differential effectiveness of brief mindfulness-based interventions for acute traumatic stress between diagnosable versus non-diagnosable populations.

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APPENDIXES

Appendix A

Demographics Questionnaire

1. What is your gender? _____
2. What is your age? _____
3. What is your race?

   American Indian or Alaska Native

   Asian

   Black or African American

   Native Hawaiian or other Pacific Islander

   White

   Other: _____

4. What is your ethnicity?

   Hispanic or Latino

   Not Hispanic or Latino

5. Do you speak, read, and understand English fluently?

   YES

   NO

6. Do you have any visual or auditory impairments?

   YES NO

7. Do you regularly take any drugs, prescription or recreational, that affect your heart rate?

    Such drugs may include:

    - Caffeine (i.e., coffee, tea, energy drinks, Midol, or Excedrin)
    - Store-bought cold medicine (i.e., DayQuil/NyQuil, Robitussin, or similar)
    - Alcohol
    - Aspirin
    - Ibuprofen (i.e., Advil)
    - Naproxen (i.e., Aleve)
    - Adderall
    - THC (i.e., marijuana or marijuana products)
    - MDMA (i.e., ecstasy or molly)
    - Psilocybin (i.e., “magic” mushrooms)
    - LSD
    - Cocaine
    - Ketamine
    - Nitrous oxide (i.e., whip-its)

    YES

    NO

8. Have you taken any such drugs in the last 48 hours?

   YES

   NO

9. Would you consider your sleep patterns relatively normal?

   YES

   NO

   If no, what types of sleep disturbances do you regularly experience?

   _____

   _____

10. Are you allergic to any topical skin applications?

    YES

    NO

11. Have you ever been diagnosed with any neurological problems (other than diabetic neuropathy)?

    YES

    NO

12. Have you experienced psychological symptoms such as intense fear, helplessness, or horror resulting from one or more traumatic events within the past year?

    YES NO

    How long since the most recent event that caused the symptoms?

    _____

Have you sought clinical treatment to address your symptoms?

YES NO

Were you diagnosed with PTSD in the past year? YES NO

Have you ever sought clinical treatment to address psychological symptoms resulting from one or more traumatic events? YES NO

Have you ever been diagnosed with PTSD? YES NO

Appendix B

Treatment Intervention Script

The following is a script of the 12-minute Mindfulness Meditation Body Scan (MMBS) audio as recorded by Kabat-Zinn (2002) and adapted for this protocol:

You are breathing. Not manipulating your breath in any way, but simply experiencing it as air moves in and out of your body. Directing your attention in particular to your belly, to your abdomen, and feeling the sensations in that region as the breath comes into your body and the abdomen expands gently and as the breath moves out of your body and the belly deflates. The in-breath, and the out-breath following, rhythmically, one on the other. Now, when you feel ready to, let's shift the focus of our attention to the toes of the left foot. Just taking your mind and moving it away from your belly down the left leg all the way to the foot, and all the way out to your toes and just becoming aware of whatever the feelings are in this region of your body. Just breathing with the sensations, experiencing the big toe and, if you can, the little toe. Not moving them, but just feeling them individually, and perhaps the toes in between. As you breathe in, just imagining that the breath is moving right down through the lungs and through the belly and down the left leg all the way to your toes. As you breathe out, the breath is just moving back up from your toes and ultimately out your nose. So that you're breathing in down to your toes, and breathing out from your toes. And when you're ready, just on the out-breath, letting go of your toes completely, allowing this region of your body to just dissolve in your mind's eye. Your attention and bring it to focus on the bottom of your left foot. Breathing with it, feeling the bottom of your foot. On the out-breath, breathing out from

the bottom of your foot. Not so much thinking about your foot as just being here with it, feeling it, letting it predominate in the field of your awareness at the moment, and letting that awareness spread to the ankle as well. Feeling your own left ankle, breathing with it, and on the out-breath just letting go of the ankle and the entirety of your left foot as you relax into a deeper state of stillness and awareness. Become aware of the left lower leg, the shin in front and the calf muscle in back, experiencing this region as it is, not trying to make it be any different. Letting the focus now move up to your knee, feeling your knee, kneecap, and the sides and back of the knee, and deep into the joint just experiencing your left knee. Breathing with it, and on an out-breath just letting it dissolve, as well. Moving now to the region of the thigh. Above-the-knee, on the surface and deep and all the way up to the groin on the inside and the hip on the outside. Just experiencing your left thigh, letting it be as soft and relaxed as possible. Then, let's move over to the right leg and become aware of the feelings in the right toes, the toes of the right foot. Breathing, directing the in-breaths down into the foot and right to the toes and on the out-breath just letting the breath come up from the toes and right out through your nose. Letting your toes dissolve in the field of your awareness, and letting the attention shift onto the bottom of your right foot. And when you're ready, just on an out-breath letting go of the bottom of your foot as you relax, as you let go of this region, and let the attention gently move to the ankle. Breathing in, and breathing out, experiencing this region of your body. And when you're ready, just letting it go as you become aware of the lower leg. When you're ready, breathing in to it, and as you breathe out just letting go of it as well. Become aware of your right knee, breathing down into the knee, and on the

out-breath letting go of the knee, as well. And now the right thigh. The entire the entire region of the upper leg between the hip and pelvis and groin all the way to the knee. Feeling your right thigh, any sensations at all, and when you're ready breathing into the thigh, and as you breathe out just letting go of this region, too. Let's direct our attention now to the lower back. On the in-breath, and on the out-breath just letting any tension and tightness any holding on or any intensity. Just be there and flow out with the out-breath to the extent that it will. Moving up into the region of your upper back. Just feeling the sensations in this region, breathing with them and any tension or tightness or reservoirs of fatigue or discomfort in the upper back region or central back region, just letting them dissolve, just allowing the awareness to expand from the belly and the front of your body to the chest as well. Just for a moment, experiencing the chest as it expands on the in-breath, and contracts somewhat on the out-breath. Allowing your attention to move to your fingertips, just becoming aware of the sensations now in the tips of your fingers and thumbs, and letting the field of your awareness expand to include the palms of your hands, and the backs of your hands, and the wrists. Becoming aware, as well, of the forearms, and the elbows. Just experiencing your body as it is, and in particular now your arms. Now, let's let the focus of our attention move on to the neck, and to the throat, and feeling the entirety of this region of your body, experiencing what it feels like perhaps when you swallow, and when you breathe, as the air goes from the head to the chest through the neck region. On the out-breath, just letting go of the neck, as well, letting it relax and dissolve. Becoming aware of your face, let's focus first on the jaw and the chin, breathing with this region. On the out-breath, when you're ready, just letting it dissolve.

Becoming aware of your lips and your mouth, and the roof of your mouth, and just breathing with this region and the sensations and the feelings of your mouth and lips and cheeks. On an out-breath, just letting this region dissolve as well. Now, feeling the breath as it moves in and out at the nostrils. Be aware of your eyes and the entire region around your eyes, allowing your temples to relax and dissolve as you experience the sensations on the side of your head. Breathing to your ears, and breathing out from your ears and letting them go as well. Now, becoming aware of the back of the head, and the top of the head, the entire region of the cranium and upper regions of the skull, breathing in and out to this whole region, breathing out from this region, so that you're imagining your breathing now from the top of the head right through the body out the bottoms of the feet. The entire length of your body, all of your muscles in a deep state of relaxation, and the mind simply aware of this flow of energy, of this flow of breath. Experiencing your entire body breathing. When you're ready, just feeling your body as a whole. As the program ends, now you might want to wiggle your toes and fingers and to remember that this state of relaxation and clarity is accessible to you by simply attending to the in-breath and to the out-breath in any moment no matter what's happening at any time of the day.

Appendix C

Control Intervention Script

The Natural History of Selborne. Letters addressed to Thomas Pennant, Esquire. Letter one. The parish of Selborne lies in the extreme eastern corner of the county of Hampshire, bordering on the county of Sussex, and not far from the county of Surrey; is about fifty miles southwest of London, in latitude 51, and near midway between the towns of Alton and Petersfield. Being very large and extensive, it abuts on twelve parishes, two of which are in Sussex, viz., Trotton and Rogate. If you begin from the south and proceed westward the adjacent parishes are Emshot, Newton, Valence, Farringdon, Hartley Mauduit, Great Ward le ham, Kingsley, Hedleigh, Bramshot, Trotton, Rogate, Lysse, and Greatham. The soils of the district are almost as various and diversified as the views and aspects. The high part to the southwest consists of a vast hill of chalk, rising three hundred feet above the village; and is divided into a sheep down, the high wood, and a long hanging wood called the Hanger. The cover of this eminence is altogether beech, the most lovely of all the forest trees, whether we consider its smooth rind or bark, its glossy foliage, or graceful pendulous boughs. The down, or sheep-walk, is a pleasing park-like spot, of about one mile by half that space, jutting out on the verge of the hill-country, where it begins to break down into the plains, and commanding a very engaging view, being an assemblage of hill, dale, wood-lands, heath, and water. The prospect is bounded to the southeast and east by the vast range of mountains called the Sussex Downs, by Guild-down near Guildford, and by the downs round Dorking, and Ryegate in Surrey, to the northeast, which altogether, with the country beyond Alton and

Farnham, form a noble and extensive outline. At the foot of this hill, one stage or step from the uplands, lies the village, which consists of one single straggling street, three-quarters of a mile in length, in a sheltered vale, and running parallel with the Hanger. The houses are divided from the hill by a vein of stiff clay (good wheat-land), yet stand on a rock white stone, little in appearance removed from chalk; but seems so far from being calcareous, that it endures extreme heat. Yet that the freestone still preserves somewhat that is analogous to chalk, is plain from the beeches which descend as low as those rocks extend, and no farther, and thrive as well on them, where the ground is steep, as on the chalks. The cart-way of the village divides in a remarkable manner two very incongruous soils. To the southwest is a rank clay, that requires the labor of years to render it mellow; while the gardens to the northeast, and small enclosures behind, consist of a warm, forward, crumbling mould, called black malm, which seems highly saturated with vegetable and animal manure; and these may perhaps have been original site of the town; while the wood and coverts might extend down to the opposite bank. At each end of the village, which runs from southeast to northwest, arises a small rivulet: that at the northwest end frequently fails; but the other is a fine perennial spring little influenced by drought or wet seasons, called Well-head. This breaks out of some high grounds joining to Nore Hill, a noble chalk promontory, remarkable for sending forth two different streams into two different seas. The one to the south becomes a branch of the Arun, running to Arundel, and so falling into the British Channel: the other to the north. The Selborne stream makes one branch of the Wey; and meeting the Black-down stream at Hedleigh, and the Alton and Farnham stream at Tilford-bridge, swells into a considerable

river, navigable at Golalming; from whence it passes to Guildford, and so into the Thames at Weybridge; and thus at the Nore into the German Ocean. Our wells, at an average, run to about sixty three feet, and when sunk to that depth seldom fail; but produce a fine limpid water, soft to the taste, and much commended by those who drink the pure element, but which does not lather well with soap. To the northwest, north and east of the village, is a range of fair enclosures, consisting of what is called white malm, a sort of rotten or rubble stone, which, when turned up to the frost and rain, moulders to pieces, and becomes manure of itself. Still on to the northeast, and a step lower, is a kind of white land, neither chalk nor clay, neither fit for pasture or for the plough, yet kindly for hops, which root deep into the free-stone, and have their poles and wood for charcoal growing just at hand. This white soil produces the brightest hops. As the parish still inclines down towards Wolmer-forest, at the juncture of the clays and sand the soil becomes a wet, sandy loam, remarkable for timber, and infamous for roads. The oaks of Temple and Blackmoor stand high in the estimation or purveyors, and have furnished much naval timber; while the trees on the freestone grow large, but are what workmen call shakey, and so brittle as often to fall to pieces in sawing. Beyond the sandy loam the soil becomes an hungry lean sand, till it mingles with the forest; and will produce little without the assistance of lime and turnips. Letter two. In the court of Norton-farmhouse, a manor farm to the northwest of the village, on the white malms, stood within these twenty years a broad-leaved elm, or wych hazel of Ray, which, though it had lost a considerable leading bough in the great storm in the year 1703, equal to a moderate tree, yet, when felled, contained eight loads of timber; and, being too bulky for a carriage, was

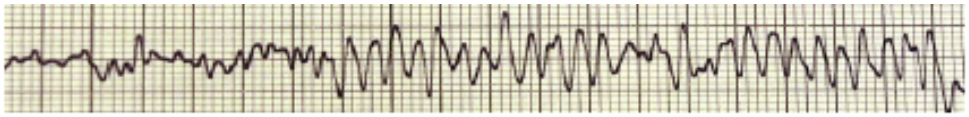
sawn off at seven feet above the butt, where it measured near eight feet in diameter. This elm I mention to show to what a bulk planted elms may attain; as this tree must certainly have been such from its situation. In the center of the village, and near the church, is a square piece of ground surrounded by houses, and vulgarly called the Plestor. In the midst of this spot stood, in old times, a vast oak, with a short squat body, and huge horizontal arms extending almost to the extremity of the area. This venerable tree, surrounded by stone steps, and seats above them, was the delight of old and young, and a place of much resort in summer evenings; where the former sat in grave debate, while the latter frolicked and danced before them. Long might it have stood, had not the amazing tempest in 1703 overturned it at once, to the infinite regret of the inhabitants, and the vicar, who bestowed several pounds in setting it in its place again: but all his care could not avail; the tree sprouted for a time, then withered and died. This oak I mention to show to what a bulk planted oaks also may arrive: and planted this tree must certainly have been, as will appear from what will be said farther concerning this area, when we enter on the antiquities of Selborne. On the Blackmoor estate there is a small wood called Losel's, of a few acres, that was lately furnished with a set of oaks of a peculiar growth and great value; they were tall and taper like firs, but standing near together had very small heads, only a little brush without any large limbs. About twenty years ago the bridge at the Toy, near Hamptoncourt, being much decayed, some trees were wanted for the repairs that were fifty feet long without bough, and would measure twelve inches diameter at the little end. Twenty such trees did a purveyor find in this little wood, with this advantage, that many of them answered the description at sixty feet. These trees were sold for twenty

pounds apiece. In the center of this grove there stood an oak, which, though shapely and tall on the whole, bulged out into a large excrescence about the middle of the stem. On this a pair of ravens had fixed their residence for such a series of years that the oak was distinguished by the title of the Raven-tree. Many were the attempts of the neighboring youths to get at this eyry: the difficulty whetted their inclinations, and each was ambitious of surmounting the arduous task. But when they arrived at the swelling, it jutted out so in their way, and was so far beyond their grasp, that the most daring lads were awed, and acknowledged the undertaking to be too hazardous. So the ravens built on, nest upon nest, in perfect security, till the fatal day arrived in which the wood was to be levelled. It was in the month of February, when those birds usually sit. The saw was applied to the butt, the wedges were inserted into the opening, the woods echoed to the heavy blows of the beetle or mallet, the tree nodded to its fall; but still the dam sat on. At last, when it gave way, the bird was flung from her nest; and, though her parental affections deserved a better fate, was whipped down by the twigs, which brought her dead to the ground. Letter three. The fossil-shells of this district, and sorts of stone, such as have fallen within my observation, must not be passed over in silence. And first I must mention, as a great curiosity, a specimen that was ploughed up in the chalky fields, near the side of the down, and given to me for the singularity of its appearance, which, to an incurious eye, seems like a petrified fish of about four inches long, the cardo passing for an head and mouth. It is in reality a bivalve of the Linnaean genus of Mytilus, and the species of Crista Galli; called by Lister, Rastellum; by Rumphius, Ostreum plicatum minus; by D'Argenville, Auris porci, s. crista galli, and by those who make collections

cock’s comb. Though I applied to several such in London, I never could meet with an entire specimen; nor could I ever find in books any engraving from a perfect one. In the superb museum at Leicester-house, permission was given me to examine for this article; and though I was disappointed as to the fossil, I was highly gratified with the sight of several of the shells themselves in high preservation. This bivalve is only known to inhabit the Indian Ocean.

Appendix D

Participant Recruitment Materials



HAVE YOU EVER EXPERIENCED A TRAUMATIC EVENT IN YOUR LIFE?

DO YOU WANT TO USE THAT EXPERIENCE TO HELP

ADVANCE THE UNDERSTANDING

OF

TRAUMATIC STRESS AND ITS TREATMENT?

If so, please visit SONA and sign up for the following research study:

Effect of Prior Trauma Exposure on EEG and Heart Rate after Viewing Graphic Photos

The study also needs individuals who have not experienced trauma, so feel free to sign up regardless of your personal history.

https://cwu.sona-systems.com/

You could earn up to 12 extra credit points for your participation.

Study Information

Study Name	Effect of Prior Trauma Exposure on EEG and Heart Rate after Viewing Graphic Photos
Study Type	**Standard (lab) study** This is a standard lab study. To participate, sign up, and go to the specified location at the chosen time.
Study Status	**Visible to participants :** Approved **Inactive study :** Does not appear on list of available studies
Duration	120 minutes
Points	12 Points
Description	Participation in this study will ask you to disclose the traumatic life events that you have experienced throughout your life by responding to a questionnaire. You will have electrodes applied to your scalp with a conductive gel and an elastic headband. You will then be exposed to photos that bear negative emotional content, some of which might resemble a traumatic event you have personally experienced. Lastly, you will carry out either a treatment or control intervention. Over the course of the experiment, you will be asked to report any negative emotional symptoms you are experiencing.
Eligibility Requirements	18+ years of age, English fluency, not legally blind or deaf, neurologically healthy (other than diabetic neuropathy)
Preparation	Please make sure your hair is free of all product (hairspray, gel, mousse, etc.) and wear loose-fitting clothing. Please do not significantly alter your normal drug use behavior (if any) 48 hours prior - this includes caffeine and nicotine.

Appendix E

Informed Consent Document

CENTRAL WASHINGTON UNIVERSITY
RESEARCH PARTICIPANT INFORMED CONSENT

Study Title: Effect of Prior Trauma Exposure on Alpha Amplitude, Heart Rate, and Self-Reported Negative Affect

Principle Investigator: Gina DeNoble denobleG@cwu.edu

Faculty Sponsor: Susan Lonborg, Ph.D. lonborg@cwu.edu

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1. What you should know about this study:

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- Ask questions about anything you do not understand now, or when you think of them later.
- You are a volunteer. If you do join the study and change your mind later, you may quit at any time, during or right after testing, without fear of penalty or loss of benefits.

2. Why is this research being done?

This research is being done to determine whether individuals who have experienced various amounts of traumatic life events respond differently, both emotionally and physiologically, when exposed to traumatic images followed by a mindfulness-based stress-reduction meditation intervention.

3. Who can take part in this study?

Participation in this study requires that you be free of clinically-diagnosed neurological conditions (other than diabetic neuropathy), not legally blind or deaf, able to read and understand English, and 18+ years of age.

Signing this form acknowledges that you are aware of these exclusion criteria, and you attest that they do not apply to you.

4. What will happen if you join this study?

If you agree to be in this study, we will ask you to do the following things:

- Have five electrodes applied to your scalp with a conductive gel solution and medical tape
- Wear a heart rate monitor around your chest
- Report any negative emotional symptoms you are currently experiencing *three times* during the protocol
- Be exposed to photos that are graphic and potentially disturbing to some people. Some of the photos might resemble a traumatic life event you have personally experienced.
- Carry out an intervention by listening to and following along with a recording

- Complete a questionnaire that asks about the traumatic events you have experienced over the course of your lifetime
- Your participation, from start to finish, could take up to 2 hours (120 minutes)

_____ ***Please initial if you understand the study procedures.***

5. What are the risks or discomforts of the study?

The following risks are present:

- Emotional distress caused by disclosure of previously experienced trauma
- Minor discomfort and possible skin irritation resulting from the application and wearing of EEG electrodes
- Emotional distress caused by the photos that are graphic and potentially disturbing to some people
- Side effects and discomforts that are not yet known

_____ ***Please initial if you understand the risks and discomforts associated with this study.***

6. Are there benefits to being in the study?

Yes. You may have a positive reaction to the intervention, and decide to employ it as a stress-reduction tactic in your everyday life! Also, your contributions will help further the understanding of traumatic stress reactions and the effectiveness of certain interventions when it comes to addressing traumatic stress treatment.

7. What are your options if you do not want to be in the study?

You do not have to join this study. If you do not join, it will not affect your grade in any class or any of your privileges as a CWU student.

8. Will it cost you anything to be in this study?

The study procedures will be provided at no cost to you.

9. Will you be paid if you join this study?

There is no financial compensation associated with participation in this study. You will receive extra course credit for your participation.

10. Can you leave the study early?

You can agree to be in the study now and change your mind later. If you wish to stop at any time, please tell us right away. Leaving this study early will not affect your standing at CWU in any way. If you leave the study early, the investigator may use information already collected from you.

_____ ***Please initial if you understand participation is voluntary; you can quit at any time.***

11. Why might we take you out of the study early?

You may be taken out of the study if:

1. Staying in the study would be harmful to you.
2. You fail to follow instructions.
3. You fail to pass the cranial nerve test
4. The study is cancelled.
5. There may be other reasons that we don't know at this time to take you out of the study.

12. What information about you will be kept private and what information may be given out?

All the information collected will remain private and confidential. No information (e.g., name, student number, race, gender) linking your identity to the forms you fill out will be present on the forms. Only your participant number will be present on the forms. All data will be stored in a locked, private office separate from the master code list matching participant name with participant identifiers.

De-identified raw data from this study may be used in future studies. If that happens, no identifiers linking you to your data will be retained.

MANDATED REPORTER STATEMENT:

> The researcher and faculty sponsor of this study are ***mandated reporters***. That means, if you disclose a plan to harm yourself or someone else OR reveal knowledge or suspicion of ongoing child abuse, they are mandated by law to break confidentiality and report it.

13. What other things should you know about this research study?

a. What is the Institutional Review Board (IRB) and how does it protect you?

This study has been reviewed by the CWU Human Subject Review Council. The HSRC is made up of faculty from many different departments, ethicists, nurses, scientists, non-scientists and people from the local community. The HSRC's purpose is to review human research studies and to protect the rights and welfare of the people participating in those studies. You may contact the HSRC if you have questions about your rights as a participant or if you think you have not been treated fairly. The HSRC office number is (509) 963-3115.

b. What do you do if you have questions about the study?

Email the principal investigator, Gina DeNoble at denobleg@cwu.edu or her faculty sponsor, Dr. Susan Lonborg, at lonborg@cwu.edu.

c. What should you do if you are injured, ill, or emotionally upset as a result of being in this study?

I. If you think you are injured or ill as a result of being in this study, call the principal investigator, Gina DeNoble, at 253-259-0935.

_____ ***Please initial if you understand the information provided in point #13cI.***

II. If you have an emergency medical or mental health problem related to your participation in this study, please call 911. If the problem is not an emergency, the Student Counseling Clinics can be reached at the following number:

509-963-1391 (Counseling)

_____ ***Please initial if you understand the information provided in point #13cII.***

III. This study is not able to offer financial compensation nor to absorb the costs of medical treatment should you be injured as a result of participating in this research. However, the services at the Student Medical and Counseling Clinics are available to you as they are to all CWU students.

_____ ***Please initial if you understand the information provided in point #13cIII.***

14. What does your signature on this consent form mean?

By signing this consent form, you are not giving up any legal rights. Your signature means that you understand the study plan, have been able to ask questions about the information given to you in this form, and you are willing to participate under the conditions we have described.

Participant's Name (print): _____

Participant's Signature: _____ Date: _____

Signature of Investigator: _____ Date: _____

CWU Human Subjects Review Approval: November 4, 2015
Do not use after this date: November 3, 2016

Appendix F

Debriefing Document

CENTRAL WASHINGTON UNIVERSITY
RESEARCH PARTICIPANT DEBRIEFING DOCUMENT

Study Title: Effect of Prior Trauma Exposure on Alpha Amplitude, Heart Rate, and Self-Reported Negative Affect

Principle Investigator: Gina DeNoble denobleg@cwu.edu

Faculty Sponsor: Susan Lonborg, Ph.D. lonborg@cwu.edu

Half the participants in this study were randomly assigned to the mindfulness-based stress-reduction (MBSR) meditation intervention, and half acted as a control group. If you did not participate in a body scan meditation exercise, you were randomly assigned to the control group.

How do you feel the study went, overall?

Do you have any questions about the study procedures?

How are you feeling right now, physically and emotionally?

At this time, do you feel any distress caused by this experiment?

_____ **Yes** _____ **No**

Do you feel the need to speak with a mental health professional about any distress caused by this experiment? _____ **Yes** _____ **No**

How do you anticipate feeling after you leave here today? Later tonight? Tomorrow?

At this time, you may complete the MBSR meditation intervention in order to ethically ensure all participants receive the potential benefits from this study. If you **do not** wish to complete the intervention, please initial below.

_____ **I would rather not complete the intervention and understand that, in doing so, I might not receive all the anticipated benefits from study participation.**

_____ I would rather not complete the study.

If you chose not to complete the study, it would be helpful for the researchers to know why. Please list your reasons below. (OPTIONAL)

_____

_____

_____

_____

If you experience a mental health emergency after you leave here today, please call 911 or one of these crisis lines:

Central Washington Comprehensive Mental Health:

Ellensburg - (509) 925-4168

Cle Elum - (509) 674-2881

OR

Call 1-800-273-TALK (8255)

If you experience any mental health concerns after you leave here today that are not an emergency, contact the Student Counseling Clinic at 509-963-1391.

If you believe anyone in your family is a victim of abuse, contact ASPEN at 1-866-925-9384.

If you have any concerns about the study procedures today, you may contact the faculty sponsor, Dr. Susan Lonborg (lonborg@cwu.edu) or the Human Protections Administrator at 509-963-3115 (hsrc@cwu.edu).

Your SONA credit will be added to your account immediately following your departure today.

If you are interested in finding out the general pattern of results, or if you have any questions after you leave here today, you can email the researcher, Gina DeNoble (denobleg@cwu.edu).

Thank you for your effort! Your participation is greatly appreciated.

CWU Human Subjects Review Approval: November 4, 2015
Do not use after this date: November 3, 2016

Appendix G

Protocol Steps

1. Arrive at lab and turn on both stimulus and biometric computers, cardiac coupler, and projector
2. Write date and time next to participant number on log sheet
3. Consult log sheet for pre-determined random condition assignment for participant
4. Open appropriate condition-specific template file on stimulus computer and save file as participant number
5. Begin stimulus program ensuring initial blank screen is queued up
6. Open data collection template on biometric computer using LabScribe 3 software and save file as participant number
7. Ensure syringe is filled with conductive gel
8. Prepare adhesive electrode collars that will attach cardiac electrodes to arms
9. Ensure sufficient quantities of sterile supplies (e.g., gloves, syringe tips, electrodes, headbands, alcohol prep pads, swabs)
10. Perform conductivity check on reusable electrode leads using multimeter
    a. Set multimeter to beep when circuit is complete
    b. Use selector knob to select each lead individually
    c. When each lead is selected, touch gold clip to gold clip on ground lead
    d. Listen for beep indicating circuit completion/conductivity
11. Remove questionnaire packed bearing participant number from stack

12. Ensure questionnaires are organized in order of administration beginning with informed consent forms and ending with debriefing forms
13. Place clipboard bearing informed consent form on chair
14. Greet participant by name in waiting area
15. Upon entering lab, ask participant to turn of cell phone and place it and other personal items in corner
16. Give participant a copy of the informed consent form and ask them to read it in its entirety
17. When they are finished, verbally go through all sections that require participant initials
18. Ask participant if they have questions; answer
19. Ask participant to sign informed consent form if they wish to continue
20. Collect signed informed consent form and provide participant with a copy for their records
21. Ask participant to complete demographics questionnaire; collect
22. Put on latex-free disposable exam gloves
23. Measure participant's head circumference with tape measure; determine appropriate headband size
24. Ensure headband fits comfortably on participant's head
25. Attach five disposable electrodes to appropriate size headband using reusable leads

26. Clean areas of scalp where electrodes will sit with an alcohol prep pad – really scrub!
27. Place headband with electrodes attached on participant's head
28. Ensure ground electrode sits in the middle of the forehead and occipital/temporal electrodes sit approximately one inch above and behind ears
29. Using the wooden end of sterile swab, move all hair from under electrodes ensuring each electrode is sitting directly on scalp
30. Using syringe and disposable tip, inject a generous amount of gel into each electrode
31. Ask participant to indicate when they feel the gel on their skin
32. Select each individual electrode using selector knob
33. Work with electrode – moving hair, adding gel, and allowing body heat to warm the gel – until multimeter reads < 100 kΩ for each
34. **Do not let gel from one electrode run into gel from another electrode!**
35. Clean inner forearms with alcohol prep pads
36. Attach disposable electrodes to adhesive electrode collars using reusable leads
37. Apply electrodes to inner forearms with adhesive collars
38. Using syringe and disposable tip, inject a generous amount of gel into each electrode
39. Ask participant to indicate when they feel the gel on their skin
40. Select each individual electrode using selector knob

41. Work with electrode – allowing body heat to warm the gel – until multimeter reads < 1.5 MΩ for each
42. Ensure all selector knobs are set back to neutral position
43. Remove gloves and inform participant that they are now properly connected to the biometric devices
44. Give participant the following instructions:
    a. Keep eyes open at all times
    b. Whenever a gray plus sign (i.e., the fixation cross) is on the screen, focus on it
    c. When a picture appears on the screen, take in the content
    d. When a recording is audible, follow along with the content whether it is a story or instructions
    e. Move as little as possible (i.e., stay still)
    f. When a questionnaire is placed in front of you, it is okay to move
45. Inform participant that you will be turning off the lights, and that once the gray plus sign appears the experiment is under way
46. Inform the participant that that they can expect to hear mouse clicking in the back of the lab at first
47. Ask participant if they have any questions and whether they are ready to begin
48. Turn off lights and move to the back of the lab
49. Press ‘F9’ on the stimulus computer to initiate the stimulus program and queue up the fixation cross

50. Click ‘Record’ on the biometric computer
51. Auto scale traces until all waveforms occur within the trace parameters
52. When all traces look consistent and participant is still, press ‘F9’ to begin baseline data collection
53. Following baseline data collection, hand participant the T1 PANAS on clipboard
54. When T1 PANAS is complete, collect it and press ‘F9’ to begin administration of the negative affective photos
55. Following the negative affective photos, hand participant the T2 PANAS on clipboard
56. When T2 PANAS is complete, collect it and check in with the participant before continuing
    a. Observe participant’s demeanor and emotional state
    b. Ask how they are feeling
    c. Ask if they feel any distress
    d. Ask if they wish to continue
57. If the participant elects to continue, press ‘F9’ to begin administration of the intervention recording
58. Following the intervention recording, hand participant the T3 PANAS on clipboard
59. When T3 PANAS is complete, collect it and inform the participant that the portion of the protocol where must be connected to the biometric devices is complete

60. Describe the remaining protocol activities, including debriefing, so the participant knows what to expect moving forward
61. Save the stimulus and biometric data files
62. Turn on lights and remove all electrodes
63. Offer participant paper towels and as much time as they need to remove gel and freshen up
64. Verify that both files saved successfully!
65. Administer PSS and TLEQ on clipboard
66. Log into SONA and award credit for participation
67. Add any pertinent notes to the log sheet
68. Debrief the participant according to the debriefing document
69. Give participant copy of debriefing document for their records
70. Thank participant for their time, offer water and directions out of the lab area
71. Organize all completed questionnaires in envelope marked with participant number
72. Put on gloves and dispose of all disposable materials
73. Clean reusable leads with alcohol prep pad
74. Wipe down chair with disinfecting wipe
75. Shut down computers, cardiac coupler, and projector
76. Turn off lights and lock lab