PHYSIOLOGICAL EFFECTS OF SUPPRESSION OF NEUTRAL AND TRAUMATIC THOUGHTS IN POSTTRAUMATIC STRESS DISORDER

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PHYSIOLOGICAL EFFECTS OF SUPPRESSION OF NEUTRAL AND TRAUMATIC THOUGHTS IN POSTTRAUMATIC STRESS DISORDER

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PHYSIOLOGICAL EFFECTS OF SUPPRESSION OF NEUTRAL AND TRAUMATIC

THOUGHTS IN POSTTRAUMATIC STRESS DISORDER

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DISSERTATION ABSTRACT

PHYSIOLOGICAL EFFECTS OF SUPPRESSION OF NEUTRAL AND TRAUMATIC THOUGHTS IN POSTTRAUMATIC STRESS DISORDER

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Posttraumatic Stress Disorder (PTSD) is characterized by oscillation of cognitive intrusions and avoidance. Recent research findings suggest that thought suppression may lead to increased intrusive thoughts for trauma survivors, paradoxically increasing symptoms. Although the psychological effects of suppression have been studied, the possible physiological effects have yet to be investigated. Participants with trauma history, 25 with PTSD symptoms and 22 without symptoms (no-PTSD) engaged in a neutral white bear and trauma suppression task. A ten-minute adaptation period was observed in order to achieve accurate baseline recordings of galvanic skin response (GSR), heart rate (HR), and respiration. During session one, participants completed the neutral suppression task consisting of three phases, baseline, suppression, and expression. Participants returned to the lab one week later for session two, the trauma-related suppression task. During all phases of both tasks measures of GSR, HR, and respiration were collected. After each phase of both suppression tasks participants completed measures of thought control difficulty, subjective distress, and mood. Additionally, a baseline measure of salivary cortisol was collected at the beginning of session one, and a post-task saliva collection occurred five minutes after each expression phase.

The primary goals of the current study were to: (1) examine Sympathetic Nervous System (SNS) physiological effects of suppression of trauma and neutral targets between groups with and without PTSD; (2) examine Central Nervous System (CNS) response to suppression of trauma and neutral targets between groups via salivary cortisol collection; and (3) replicate the post-suppression rebound effect found for trauma thought targets, but not neutral targets, within the PTSD group only.

Patterns of target thought data revealed a post-suppression rebound effect for the no-PTSD group and the PTSD group for the neutral and trauma tasks, respectively. This data suggests that it is the content of target thoughts rather than suppression ability that leads to intrusions for those with PTSD. Suppression of neutral and trauma targets resulted in physiological reactivity; however each response system showed distinct patterns. No phasic cortisol group differences were found, although the no-PTSD group had somewhat higher post-neutral cortisol levels in comparison to the PTSD group. Overall, it appears that suppression is an effortful form of mental control that is taxing physiologically and mentally.

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I. INTRODUCTION

Most people prefer to avoid upsetting thoughts or memories and the negative emotions they elicit (Horowitz, 1976). As one of the defining symptoms of Posttraumatic Stress Disorder (PTSD) is reexperiencing the traumatic event, often in the form of intrusive thoughts, examination of mental control is important in a trauma population. Thought suppression is a frequently utilized mode of mental control (Wenzlaff & Wegner, 2000) and is commonly employed following negative experiences. However, there is emerging evidence suggesting that thought suppression use may have a negative impact (e.g., Muris, Merckelbach, & Horselenberg, 1996; Wenlzaff, 1993). Paradoxically, suppression attempts may increase unwanted thoughts among normal control populations (e.g., Wegner, Schneider, Carter, & White, 1987), and trauma survivors with PTSD (Amstadter & Vernon, 2005, Shipherd & Beck, 1999; 2005). In fact, it has been theorized that thought suppression contributes to the development and maintenance of PTSD (e.g., Wenzlaff & Wegner, 2000). Thought suppression has also been associated with sympathetic nervous system activation (e.g., Pennebaker & Chew, 1985), yet physiological measures during suppression have not been employed in a traumatized sample. Therefore, the proposed study will examine the physiological correlates of suppression of neutral and traumatic thoughts in traumatized individuals with and without PTSD.

Thought Suppression

Long before trauma researchers became interested in thought suppression it provided a means of examining mental control (e.g., Wegner et al., 1987). Studies examined the ability to hold certain thoughts, referred to as target thoughts, at bay. Thought suppression research began with the "white bear" study conducted by Wegner and colleagues, which had participants engage in a verbal thought reporting exercise (speaking the stream-of-consciousness flow of their thoughts out loud into a recorder). One group was instructed to focus on the target (a white bear) from the onset of the experiment, whereas the other group had a period of attempted suppression of target thoughts before verbal reporting. Results indicated a post-suppression rebound effect in which suppression participants demonstrated increased target thoughts relative to the non-suppression group. Although the post-suppression rebound effect has been replicated in numerous investigations using a between subjects design (e.g., Amstadter & Vernon, 2005; Clark, Ball & Pape, 1991; Clark, Winton, & Thynn, 1993; McNally & Ricciardi, 1996; Shipherd & Beck, 1999; Wegner & Gold, 1995), studies using a within-subjects design have often failed to find such an effect (e.g., Kelly & Kahn, 1994; Muris, Merckelbach, van den Hout, de Jong, 1992). This difference likely arises from the term post-suppression rebound effect being compared within versus between groups.

In addition to a post-suppression rebound effect, researchers have demonstrated that attempted thought suppression may instantly lead to increased target thoughts (e.g., Wenzlaff & Wegner, 2000), termed an immediate enhancement effect. Immediate enhancement effects are usually found in studies imposing high cognitive load, such as remembering a six to nine digit number, during attempted suppression (e.g., Wegner, Ansfield, & Pilloff, 1998; Wenzlaff & Bates, 1998). However, there is also evidence of immediate enhancement effects in situations without cognitive load due to the target thought to be suppressed being introduced in the form of the suppression instructions (e.g., Amstadter & Vernon, 2005; Salkovskis & Campell, 1994).

The use of thought suppression has been described in response to unpleasant psychopathology symptoms. For example, substantial relationships have been found between thought suppression use and symptoms of anxiety (Muris et al., 1996; Wegner & Zanakos, 1994), obsessive compulsive disorder (Janeck & Calamari, 1999; Purdon & Clark, 1994), and depression (Wenzlaff, 1993; Conway, Howell, & Giannopoulos, 1991; Howell & Conway, 1992; Wenzlaff & Bates, 1998). Thought suppression has also been identified as one of the responses to trauma.

There is mounting evidence that traumatic events are experienced frequently. In a study conducted by Breslau et al. (1996), lifetime exposure to trauma of any kind was 89.6% in a community sample. Similarly, Vrana and Lauterbach's (1994) study of college students demonstrated an 84% prevalence rate of trauma exposure. Experience of a traumatic event may lead to the development of PTSD. The presence of intrusive thoughts is a hallmark of the disorder (APA, 1994). Although intrusive thoughts are common immediately following trauma due to the assimilation and accommodation efforts into the survivor's schemas (e.g., Horowitz, 1976), individuals who develop PTSD experience intrusions at a higher frequency and duration than those who do not (Davies & Clark, 1998). Thought suppression appears to be a response to such intrusions (Amir et al., 1997) and may contribute to the development or maintenance of PTSD (e.g., Beevers, Wenzlaff, Hayes, & Scott, 1999; Purdon, 1999).

Wenzlaff and Wegner (2000) theorize that avoidance of traumatic cues stimulates an immediate enhancement effect and a post-suppression rebound, increasing avoided thoughts and activating a vicious cycle. There is some evidence in support of this theory. For example, in a longitudinal study following natural disaster, suppression of trauma-related thoughts three months post-trauma was predictive of PTSD symptomatology one year post-trauma (Morgan, Matthews, & Winton, 1995). Such findings suggest that understanding thought suppression mechanisms may be important for improving our understanding of PTSD.

Shipherd and Beck (1999) provided a vital experimental paradigm to examine thought suppression within the trauma population. In their study with female rape victims with and without PTSD, participants were interviewed about their rape, then asked to engage in a written thought reporting task to assess frequency of rape-related thoughts. Participants were then instructed to suppress rape-related thoughts during reporting (suppression phase). Finally, participants were instructed that any thought content, including their rape, was allowed during thought reporting (expression phase). When the number of trauma-related thoughts was compared across the phases, a post-suppression rebound effect was observed in those with PTSD but not in non-PTSD participants.

Amstadter and Vernon (2005) extended Shipherd and Beck's (1999) design to determine whether PTSD participants' suppression performance reflected difficulty with suppression in general or was due to difficulty suppressing trauma content. Their extension included male and female participants with a variety of traumatic experiences, half with PTSD and half without PTSD, who completed a neutral suppression task in addition to a trauma suppression task. Suppression tasks included five-minute baseline, suppression, and expression phases with verbal thought reporting. Amstadter and Vernon found that groups did not differ on their suppression performance during the neutral task. Both groups reported a high number of neutral target thoughts during suppression, but were able to dismiss them during expression. For the trauma task, however, both groups demonstrated an increase of trauma thoughts during suppression, but the PTSD group continued to have target thoughts at a higher level than the no-PTSD group during expression. Finding a group difference for the trauma task and not the neutral task suggests that it is not an individual's general suppression ability but the content of thoughts suppressed that leads to intrusions for those with PTSD. Further, the inclusion of multiple trauma types in this investigation increases the generalizability of the post-suppression rebound effect in the trauma population.

Shipherd and Beck (2005) conducted a similar investigation examining suppression of trauma related material and personally relevant neutral thoughts in motor vehicle accident survivors with and without PTSD. Results indicated a post-suppression rebound effect for the PTSD group and not the no-PTSD group for the trauma task. There was no difference in performance on the personally-relevant neutral task. These results are consistent with Amstadter and Vernon (2005) in that the post-suppression rebound effect was specific to the PTSD group, and specific to the suppression of trauma related thoughts. Taken together, these studies provide more support for the theory that thought suppression leads to the development and maintenance of a key symptom of PTSD, intrusive thoughts. Furthermore, Shipherd and Beck (1999; 2005) utilized a written thought recording method, whereas Amstadter and Vernon (2005) employed a verbal thought reporting method. Confidence in the findings is increased by the fact that they are consistent across several samples and thought reporting methodologies.

Although the trauma thought suppression investigations conducted to date (Amstadter & Vernon, 2005; Shipherd & Beck, 1999; 2005) have provided new knowledge regarding intrusive symptoms of PTSD, key variables relating to the experience of and aftermath of suppression of traumatic thoughts have yet to be studied. Thought suppression may be a maladaptive coping technique that aggravates intrusive symptoms for those with PTSD; however, the effects of suppression on the physical functioning of individuals with PTSD is unknown. Although there is no direct evidence regarding the physiological response of traumatized individuals to the suppression of trauma-related material, evidence from related areas offers a theoretical basis for such work. Three sets of findings are available that will likely have bearing on this question: Findings concerning sympathetic nervous system (SNS) differences between individuals with and without PTSD, findings related to central nervous system (CNS) effects (i.e., cortisol release) in traumatized individuals with and without PTSD, and findings of physiological changes during suppression in normal populations.

First, there is some evidence regarding SNS activity suggesting that those with PTSD are more physiologically reactive to trauma cues than are those without the disorder (e.g., Keane et al., 1998). The SNS is a branch of the autonomic nervous system involved in arousal and energy expenditure. Two broad systems are affected by SNS activity, the electrodermal system and the cardiovascular system. In the electrodermal system, increased SNS activity produces more activity of sweat glands leading to an increase in electrodermal activation (EDA), which has been found to be responsive to emotional arousal in healthy controls, and is most often measured by Galvanic Skin Response (GSR; Dawson et al., 2000). Similarly, heart rate (HR) is a cardiovascular system measurement that has been found to increase in response to SNS activation in controls (Brownley, Hurwitz, & Schneiderman, 2000). Respiration is another marker of nervous system activity that is associated with induced emotions and stress (e.g., Ritz, Steptoe, DeWilde, & Costa, 2000). Respiration is affected by both the sympathetic and parasympathetic systems (Ritz et al., 2002). GSR, HR, and respiration are the most commonly employed biomarkers in psychophysiological studies involving traumatized individuals (Blanchard & Buckley, 1999). Examination of the physiological responsivity in PTSD is not new (e.g., Dobbs & Wilson, 1960), and in fact reflects one of the DSM-IV criteria for the disorder (APA; 2000).

Within the traumatic stress literature, two SNS research paradigms exist, baseline studies and challenge studies. Baseline studies typically compare resting physiological recordings of SNS markers between traumatized groups with and without PTSD (Resick, 2001). As long as participants' expectations of trauma cue presentation is controlled for, no group difference in baseline HR is found (McFall et al.). Challenge paradigms involve exposure to trauma-related cues (e.g., audio taped accounts of the trauma, vignettes) and measurement of resulting changes in physiological responding both between and within groups (Resick, 2001). In multiple studies, PTSD participants exhibited higher HR and EDA responses during presentation of idiosyncratic audiotapes relating to their trauma (Blanchard, Hickling, Taylor, Loos, & Gerardi, 1994; Orr, Pitman, Lasko, & Hertz, 1993). Similarly, Keane et al. (1998) found higher GSR in PTSD than non-PTSD participants in response to idiosynchratic imaginal trauma cues and to standardized trauma vignettes. Interestingly, Keane et al. reported that while groups differed on physiological measures of arousal, no such differences in self-reported arousal were found, implicating the need for multimodal assessment.

Second, another line of evidence pertaining to the CNS suggests that those with PTSD have higher cortisol responses to traumatic cues than do those without the disorder (e.g., Bernet et al., 2003). Stress induces a biochemical cascade within the hypothalamic-pituitary-adrenal (HPA) axis, resulting in the release of corticosteriod hormones, including cortisol (Bremner et al., 2003; Chappell et al., 1986). Healthy individuals show increased cortisol levels during times of stress (e.g., Ursin et al., 1978). Over-reactivity of the HPA axis, resulting in higher cortisol release in response to stress, has consistently been found in animal models of PTSD (e.g., Young et al., 1990), although the data in human participants is scarce. Interestingly, baseline cortisol levels in PTSD individuals are found to be lower than those without PTSD (e.g., Yehdua, 2001; Yehuda et al., 1990), whereas under stress (e.g., Bremner et al., 1997) and in response to traumatic cues those with PTSD show a higher cortisol response (e.g., Bernet et al., 2003; Elzinga, Schmahl, Vermetten, van Dyck, & Bremner, 2003; Heim et al., 2000; Liberzon, Abelson, Flagel, Raz, & Young, 1999). Such evidence suggests that PTSD is associated with low baseline levels of cortisol as well as a low threshold for activation.

Finally, research concerning the physiological effects of suppression in normal controls is relevant. Outside of the trauma suppression literature, findings indicate that target thought intrusions during and after suppression result in increased SNS activity in normal controls (e.g., Wegner, Shortt, Blake, & Page, 1990). For example, thought suppression has been shown to induce increased HR and BP (Wenzlaff & Wegner, 2000), lead to increased EDA (Pennebaker & Chew, 1985), and increased HR (Roemer & Salters, 2004). Furthermore, characteristics of the suppressed material have been associated with level of physiological reactivity during and following suppression. Suppression of an exciting target (e.g., sex) has been found to lead to higher EDA than suppression of a mundane target (e.g., dancing; Wegner, et al., 1990). Further, exciting target intrusions led to spikes in EDA post-suppression. Additionally, suppression of anger-producing thoughts has been associated with hypertension (Cottington, Matthews, Talbott & Kuller, 1986). In sum, suppression has been shown to have autonomic effects manifested by electrodermal and cardiovascular system changes.

Taken together, these three sets of findings suggest that suppression of traumatic thoughts may lead to SNS and CNS activity, and that nervous system effects may be higher in those with PSTD relative to those without PTSD. The first and second lines of evidence suggest that PTSD groups demonstrate more SNS reactivity (e.g., Keane et al., 1998) and CNS reactivity (e.g., Bernet et al., 2003) to trauma cues than those without the disorder. Given findings regarding the frequency of traumatic intrusions both during and following attempted suppression, it seems likely that participants with PTSD would demonstrate physiological reactivity during and post-suppression. Further, findings of increased SNS activity in response to intrusions during suppression of neutral material in normal controls (e.g., Wegner, Shortt, Blake, & Page, 1990) also suggests that at least some physiological reactivity may also be expected during neutral suppression.

The current study extends the literature in three ways. First, whereas SNS measures have been collected during thought suppression tasks (e.g., Pennebaker & Chew, 1985), the proposed study represents the first attempt at implementation of such measurement in a traumatized sample. Second, this study marks the first in the thought suppression literature to investigate the CNS cortisol response. Third, although numerous studies have included physiological measurements of PTSD and non-PTSD trauma participants, upwards of two-thirds of these studies were conducted with combat veterans, making a more general sample a welcome addition to the literature (Blanchard & Buckley, 1999).

The primary goals of the current study were to: (1) examine SNS physiological effects (i.e., GSR, HR, respiration) of suppression of trauma and neutral targets between traumatized groups with and without PTSD; (2) examine CNS response to suppression of trauma and neutral targets between groups via salivary cortisol collection; and (3) replicate the post-suppression rebound effect found for trauma targets, but not neutral targets, within the PTSD group only.

Hypotheses

The following predictions were tested for the neutral task: (1) As previous research (Amstadter & Vernon, 2006; Shipherd & Beck, 2005) has demonstrated that suppression of a neutral target does not lead to group performance differences, no group differences in number of target thoughts during suppression or expression were expected; (2) following previous research (Amstadter & Vernon) no post-suppression rebound was expected; (3) as intrusive thoughts during and after suppression is associated with increased physiological responding (Wegner et al., 1990), it was expected that HR and GSR would show elevations during these periods, whereas respiration was included as a control measure and therefore not predicted to change during suppression and expression; (4) because no group performance differences were predicted, no associated physiological responding differences were predicted; and (5) as previous studies have not found a baseline group difference for cortisol, no such difference was predicted, and further no group difference was expected in cortisol response, as the neutral task was thought to be equally stressful for both groups.

The following hypotheses were tested for the trauma task: (1) Similar to previous findings (Amstadter & Vernon, 2006), a main effect of group was expected with PTSD participants reporting more trauma target thoughts than no-PTSD participants during all three phases; (2) a post-suppression rebound effect, with more target thoughts reported during expression relative to suppression, was expected for the PTSD group only, as has been demonstrated by past research (Amstadter & Vernon; Shiperd & Beck, 1999; 2005); (3) since exposure to trauma-related cues has been found to increase physiological responding in PTSD participants (Keane et al., 1998) and the likelihood of traumatic intrusions is higher in the PTSD group (e.g., Amstadter & Vernon), it was predicted that they will show higher HR, GSR, and respiration during the suppression and expression phases of the trauma task, in comparison to the no-PTSD group; (4) similar to the predictions for the neutral task, HR and GSR were expected to display epoch effects, whereas respiration was not; and (5) in terms of cortisol levels, it is expected that PTSD participants will have a higher cortisol response to the suppression and expression phases of the trauma task than will the no-PTSD group, as PTSD individuals tend to show higher cortisol response to trauma cues (e.g., Bernet et al., 2003; Elzinga et al., 2003).

II. METHODS

Procedure

Overview

Participants completed a screening questionnaire packet containing the trauma measures needed to determine eligibility, as well as other measures of psychopathology and coping. Eligible participants came into the lab for two experimental sessions. At the beginning of each experimental session a ten-minute adaptation period was observed in order to achieve accurate baseline recordings of GSR, HR and respiration. During session one, participants completed the neutral suppression task including five-minute thought-reporting practice, suppression, and expression phases. Participants then engaged in a brief trauma writing activity. Participants returned to the lab one week later for session two, the trauma-related suppression task, including three phases parallel to the neutral task. During all phases of both tasks measures of GSR, HR, and respiration were collected. After each phase of both suppression tasks participants completed measures of thought control difficulty, subjective distress, and mood. Additionally, a baseline measure of salivary cortisol was collected at the beginning of session one, and a post-task saliva collection occurred five minutes after each expression phase.

Screening Session

Trauma History. The Life Events Checklist (LEC) taken from the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) was used to assess traumatic experiences. This measure includes a list of 17 potentially traumatic events (e.g., sexual assault, physical assault, transportation accident). Participants indicate whether they have experienced each event, have witnessed the event happening to someone else, or have learned about the event happening to someone close to them. Participants are then instructed to think about the event they consider the worst and to answer questions addressing DSM-IV-TR Criterion A1, such as whether someone's life was in danger during the event, and Criterion A2, whether they experienced fear, helplessness, or horror during the event.

Posttraumatic Stress Disorder Symptoms. The PTSD Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) was used to assess PTSD symptomotology. The PCL is a 17-item questionnaire, with each item corresponding to a DSM-IV symptom of PTSD. Using a scale from 1 (not at all) to 5 (extremely), participants indicate the degree to which they have been troubled by each symptom in the past month. The total score can be used as a dimensional index of PTSD symptom severity, or can be used categorically, with those participants scoring above a certain cutoff score considered to have PTSD. When observing a cutoff score of 44, sensitivity of the PCL is .94, specificity is .86, and overall diagnostic efficiency is .90 (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). Two-week test-retest reliability for this measure is high, .96 (Blanchard et al., 1996; Weathers et al., 1993). High diagnostic agreement has been demonstrated between the PCL and the Structured Clinical Interview for the DSM-III-R (SCID; Spitzer, Williams, Gibbon, & First, 1990), pairwise kappa = .64 (Weathers et al., 1993). Additionally, the PCL and the CAPS are highly correlated, $r = .93$, $p < .0001$ (Blanchard et al., 1995; 1996).

Demographic Questionnaire. A demographic questionnaire assessed participants' personal, historical, and medical characteristics. The questionnaire includes items concerning participant gender, ethnicity, age, level of education, and medical visit history. This information was collected in order to identify potential moderating variables in relation to suppression and to allow for analysis of between groups differences, as well as to ascertain inclusion criteria.

Inclusion and Exclusion Criteria

In order to meet study inclusion criteria, participants must have reported a Criterion A trauma experience on the LEC. Participants were included in the PTSD group if they reported experiencing a trauma since age 16 and scored above 44 on the PCL. Participants were excluded if they had experienced trauma within the last three months, since intrusive thoughts are typically at their height during this time (e.g., Horowitz, 1976). Those with trauma experiences who scored below 20 on the PCL were included in the no-PTSD group. Common exclusionary criteria for psychophysiological studies were observed (e.g., Dawson et al, 2000; McDonagh-Coyle et al., 2001): Use of medications that affect the autonomic nervous system (e.g., methylphenidate, antihypertensive medications, beta-blockers, clonidine), pregnancy because it leads to changes in cortisol levels (Bremner et al., 2003), and diagnoses of cardiovascular disease, such as angina, arrhythmia, or myocardial infarction. Participants were also excluded if they were currently experiencing withdrawal symptoms from any prescribed or illicit drug, as withdrawal symptoms induce physiological alterations (Jennings, 1981).

Participants

Undergraduate psychology students served as participants. They completed a screening packet in a large group format. Of the 257 participants who completed the screening measures, 50 met the PTSD group inclusion criteria and 42 met the no-PTSD criteria. Three participants who met criteria were excluded on the basis of medical screening questions. Of those eligible to participate, 26 PTSD participants and 24 no-PTSD participants were successfully contacted and completed session one. Twenty-five PTSD participants (96.2%) and 22 no-PTSD participants (87.0%) completed session two. Of the three participants who chose not to complete session two, one reported they did not need additional extra credit, one reported they did not have time to finish the study, and one did not show up or respond to emails querying their decision to not finish the study. Twenty-five participants (81.5% female) comprised the final PTSD group and twenty-two participants (56.5% female) served as the no-PTSD group. Participants had 2.64 years of college education on average, and ranged in age from 19 to 33 (M = 20.74, SD = 2.29). The majority of participants indicated they were Caucasian (n = 33, 66%), with African-American being the second highest racial/ethnic group represented (n = 12, 24%. Age, year in school, race, and gender were not significantly different between the PTSD and no-PTSD groups.

Multiple types of traumas were included in the sample to: (1) attempt to eliminate the gender/trauma type confound that is typical of trauma research using specific gender-prevalent trauma types, such as rape for women or combat for men; (2) to increase generalizability; and (3) to expand upon past research, which has typically only examined a sample with a single type of traumatic experience. Of those in the PTSD group, 33.4%

reported sudden violent or unexpected death as their most distressing trauma, 18.2% reported sexual assault, 15.2% reported physical assaults, 9.1% reported experiencing transportation accidents, 9.1% reported serious illness or injury, and 12.1% reported an event not captured by the categories above. Of those in the no-PTSD group, 16.2% reported sexual assault, 16.2% reported sudden violent or unexpected death, 13.5% reported experiencing transportation accidents, 10.8% reported natural disaster or fire/explosion, 8.1% reported physical assaults, 8.1% reported serious illness or injury, and 21.6% reported experiencing an event not captured by the categories above. None of the other types of traumas endorsed accounted for more than 5% of reported traumas. The PTSD group, based on the PCL, reported significantly greater intrusive reexperiencing, $t(43)=-14.04$, avoidance and numbing, $t(43)=-12.22$, and hyperarousal, $t(43)=-14.76$, ps<.001, than the no-PTSD group.

Session One: Neutral Suppression Task.

Adaptation Period. At the beginning of the neutral task, an adaptation period occurred to obtain accurate baseline physiological measures. For ten minutes participants were instructed to rest quietly with their eyes closed. GSR, HR, and respiration were collected throughout this period to acclimate the participants to the data collection procedures.

Neutral Task. Following the resting phase, participants engaged in the neutral suppression task. Participants were provided with a digital recorder and instructed to say into the recorder any thought that crossed their mind. Instructions adapted from similar studies (Wegner et al., 1987; Wenzlaff, Wegner, & Roper, 1988; Shipherd & Beck, 1999) were as follows: *"Spend the next five minutes speaking into this recorder whatever* *information is present in your awareness from moment to moment. Your report might include, but is not limited to, descriptions of images, memories, feelings, fantasies, plans, sensations, observations, daydreams, objects that catch your attention, or efforts to solve a problem."* The experimenter then instructed the participant to "begin," and left the room, returning after a five-minute period. The experimenter watched the participant through a one-way mirror to record excess movement, sneezing, or other activity that would affect physiological recording as is recommended by current practice and publication guidelines for cardiovascular measurement (Jennings, 1981; Shapiro et al., 1996). After the baseline recording, the participant completed a measure of controllability of their thoughts, subjective distress, and mood ratings, all of which are described in the post-task ratings section. Measures of GSR, HR, and respiration were collected during the phase.

Next, during the suppression phase the experimenter again instructed the participant to say into the recorder any thought that crossed their minds, but this time they were asked not to think about a neutral target thought, a white bear. They were instructed to say the words "white bear" aloud whenever the thought of a white bear entered their minds. Again, post-task ratings, GSR, HR, and respiration were collected.

The participant then completed the expression phase. They were instructed as before, but this time they were told that they could think of anything that they wished, including a white bear. They were instructed to say the words aloud whenever the thought of a white bear entered their mind. Again, post-task ratings and physiological measures were collected.

Following the expression phase, a five minute rest-period was observed to allow for cortisol to be accurately measured via the saliva stream. Following this five-minute rest phase salivary cortisol was collected.

Trauma Writing. Participants were then provided with a copy of their LEC to remind them of their most upsetting traumatic experience. They were asked to write a detailed paragraph about their traumatic event, focusing on their thoughts and feelings about the event. Participants were provided with an envelope for their paragraph and it was collected by the experimenter. When participants returned for session two, they were given their written account of their traumatic event and asked to read it prior to commencement of the suppression phase of the trauma suppression task.

Session Two: Trauma Suppression Task

At the beginning of this session, an adaptation period occurred, as described above. Physiological data collection mirrored that of the neutral task. Following the resting period, a five-minute verbal reporting baseline was collected, parallel to the neutral practice phase, including post-tasking ratings and physiological recording.

Next, intentional suppression of traumatic thoughts was assessed. Participants were provided with their written account of their traumatic event and asked to read it. Participants were again verbally instructed, including the directive "*Except this time, please try not to think about the traumatic experience you wrote about. If a thought relating to your traumatic experience crosses your mind, please say it aloud and continue on with the task.*" During the five-minute phase, physiological measures and post-task ratings were collected.

Similar to the neutral expression phase, during the trauma expression phase participants were given permission to think of their trauma and instructed to speak any trauma-related thoughts aloud. Again, a five-minute adaptation period occurred, followed by saliva collection for cortisol analyses. Following the saliva collection participants were asked to write a list of any trauma-related words they said during the task. This list was completed to assist in identification of trauma thoughts for coding purposes.

Physiological Data Collection.

Apparatus. All data were collected in a 11’X17.5’ sound, light, and temperature controlled room. Participants were seated in a comfortable low-back chair facing a blank wall. A cubical divider separated the participant from the physiological data collection device, BIOPAC Model MP35 (Santa Barbara, California), which was connected to a computer that used the AcqKnowledge software (BIOPAC Systems, Inc., Goleta, California) for off-line analysis of analogue waveforms. All data were collected at a rate of 200 Hz. A one-way mirror allowed the experimenter to observe any movements or behaviors (e.g., sneezing) that could interfere with the physiological signal, while providing privacy for the participant.

Galvanic Skin Response (GSR). The stress-related changes measured by GSR are almost instantaneous (0.2-0.5 second) and are a marker of SNS activation. The exosomatic technique used to quantify EDA is the recommended and most often utilized method (Fowles, 1981), and entails measuring skin conductance via the passage of a small electrical current between two electrodes. BIOPAC disposable Ag-AgCl electrodes

(2.5 cmX 4.5 cm) with NaCl isotonic gel-filled snap electrodes, (model EL507) were attached to the distal phalanges of the second and third digits of the left hand (Fowles). BIOPAC GSR leads (model SS57L) are able to record .1-100 μMho (normal human range is 1-20 μMho), and produce a constant voltage (.5 V). Skin conductance was measured throughout the adaptation phase, as well as throughout all phases of both suppression tasks at a rate of 200 samples per second.

Heart Rate (HR). HR measures the peak in the electrocardiogram, referred to as the peak R wave. Current practices in HR measurement utilize electrodes placed on the chest, or an arm-leg lead (Jennings et al., 1981). The latter is the frequently used method of data collection, especially when the quantification of interest is the mean HR over a specific period of time. Data collection for HR adhered to publication and practice guidelines for these measurements (Jennings, 1981). The arm-leg method was used by first cleaning the participant's ankles and right wrist with a BIOPAC provided cleansing device. Disposable electrodes (35mm) pre-filled with NaCl isotonic gel (model EL503) were used. One electrode was placed on the medial surface of each leg, just above the ankle, and a third electrode was placed on the right anterior forearm at the wrist. Shielded electrode leads (model SS2L) were attached to each electrode for measurement of biopotentials. HR was measured continuously through the adaptation period, as well as throughout the duration of both suppression tasks at a rate of 200 Hz.

Respiration. Respiration was measured using a strain assembly that measures the change in thoracic circumference. A nylon strap collection device (BIOPAC model SS5LB) allowed for variable resistance output from 50-150 K, and by use of a phneumograph transducer the rate and depth of the breathing cycle are converted into changes in voltage. Shown as a waveform, increasing voltage depicts inspiration and those changes that are decreasing in value represent expiration. The respiratory transducer was attached around the chest below the armpits and above the nipples of the participant, over their clothing. It was adjusted so that it was slightly tight at the point of maximal expiration. Respiration was measured during the adaptation period and throughout all phases of both suppression tasks at a rate of 200 samples per second.

Physiological Data Reduction. Data reduction for physiological measures was handled in two manners. First, following Beck et al. (2006) data from each phase was averaged and divided into three epochs, each of which were 90-s. Second, to obtain a more fine-grained analysis of the data, 30-s epochs were formed.

GSR was examined in two manners, by the number of peaks during each 30-s and 90-s epoch, and by the overall reactivity demonstrated during each epoch. A GSR peak was quantified as an increase change of .5 microsiemens (Andreassi, 2000). In order to obtain the number of GSR responses (peaks), a difference function was first applied to the data to match the sampling rate of 200 Hz. This difference function resulted in one data point per second. This waveform was then transformed via a threshold function, set as a dichotomous variable that is one when the criterion (.5 mS) is met and zero when the criterion is not met. The number of GSR responses was then obtained for each epoch as discussed above. Overall electrodermal reactivity was also examined in a similar manner as employed by Beck et al. (2006).

Salivary Cortisol. Cortisol can be collected through various bodily fluids, such as cerebral spinal fluid, urine, blood, and saliva. The release of corisol under stress is nearly instantaneous, allowing for an accurate online assessment of responses to stimuli

(Chappell et al., 1986); however, an approximate 10-min delay is expected for free unbound cortisol release into the saliva (e.g., Tunn, Mollman, Barth, Derendorf, & Krieg, 1992). Salivary cortisol was collected following the precedent of earlier studies (e.g., Bremner et al., 2001) as it is the least invasive method of measurement and avoids the stress-inducing effects of blood sampling.

Participants received an email detailing instructions for salivary cortisol collection, including directions to refrain from eating and drinking one and a half hours before the experimental session, as recommended by current research protocols (e.g., Polk, Cohen, Doyle, Skoner, Kirschbaum, 2005). Participants were reminded of the instructions during two phone calls from the experimenter, one during scheduling and one during a session reminder approximately two hours before the session. During both laboratory sessions, prior to salivary collection the experimenter asked participants if they had complied with instructions. The one participant who reported failing to follow instructions was reminded of the necessary parameters, rescheduled, and sent home with partial extra credit. Consistent with past research (e.g., Elzinga et al., 2003) all samples were collected in the afternoon to control for diurnal cortisol variations. Three saliva samples were collected, one at the beginning of the neutral task, and one five minutes after the expression phase of each task. Saliva samples were obtained by Salivette collection devices (i.e., plastic vials with hard-packed cotton). Participants were instructed to place the cotton on top of the tongue for one minute and to try to get as much saliva on the cotton as possible. The participant then placed the cotton back into the vial using their mouth to avoid contamination from their fingertips. The vial was then capped by the participant and immediately placed in a freezer. Saliva samples were stored at -70ºC. Samples were centerfuged (0-4ºC) for preparation for analysis by means of an immonuassay kit from Salimetrics (State College, PA), which measures bound cortisol from the reaction of the peroxidase enzyme on the substrate tetramethylbenzidine. The range of standard coefficients was from .98 pg/ml to .99 pg/ml, which was consistent with previous research (e.g., Bremner, 2003). The day-to-day coefficients of variation for low (398 pg/ml) and high (4.12 ng/ml) concentration quality assessment samples were .08, and 1.48, respectively.

Post-Task Ratings

Subjective Units of Distress Scale (SUDS). Participants rated subjective distress using a scale from 0 (comfortable, no distress at all) to 100 (extremely uncomfortable, as much distress as you can imagine), adapted from Barlow, Hayes, and Nelson (1984).

Mood. The Positive Affect (PA) and Negative Affect (NA) subscales of the Positive and Negative Affective Schedule – Expanded Form (PANAS; Watson & Clark, 1991) were used to measure mood. The PA and NA subscales each consist of ten affective adjectives rated on a scale of 1 (not at all) to 5 (extremely). The PA and NA subscales have demonstrated strong reliability (Clark & Watson, 1991).

Thought control. Participants rated the controllability of their thoughts using a scale from 0 (no difficulty at all) to 100 (extreme difficulty), adapted from Kelly and Kahn (1994).

Coding

White Bear Coding. To assess the presence of white bear thoughts during suppression and expression a trained undergraduate rater, blind to condition, recorded the frequency of white bear thoughts per phase. To examine rater accuracy, 50% of tapes were randomly selected for coding by an additional rater. Interrater reliability was r=.99 for the suppression phase, and r=.98 for the expression phase. This reliability coefficient was sufficiently high to ensure reliability of the coding process and the ratings of the single rater that were used in all analyses. The initial phase of the neutral task will be referred to as "practice" rather than "baseline" since it was participants' first experience with the free association speaking task and no baseline recording was necessary because of the rarity of spontaneous white bear thoughts (Wenzlaff & Wegner, 2000). Thus, no ratings of number of target thoughts during the practice phase were coded.

Trauma Coding. The frequency of trauma-related thoughts during baseline, suppression, and expression were assessed independently by two trained undergraduate raters blind to condition. To learn about the participant's trauma, raters read the participant's trauma description and list of trauma thoughts prior to coding. Raters then tallied the frequency of discrete trauma-related thoughts. Thoughts were defined as statements on a single topic, without topic change or interruption, regardless of the duration. All participant tapes were coded independently by two raters. Interrater reliability was strong: baseline phase, r=.99, suppression phase, r=.95 , and expression phase, r=.98.

III. RESULTS

Data Analytic Strategy

To examine changes between phases of each suppression task for non-physiological variables, repeated measures ANOVAs comparing phases (baseline, suppression, expression) were conducted for each suppression task variable (target thoughts, distress, control difficulty, NA, PA) as a single dependent variable, and group (PTSD, no-PTSD) as the between subjects factor. For example, to determine if a post-suppression rebound effect was present in either group for the neutral target, a repeated measures ANOVA (suppression, expression) was conducted with number of white bear thoughts as the dependent variable and group as the between subjects factor. To compare the neutral and trauma tasks, repeated measures ANOVAs were conducted for each suppression task variable as a dependent variable, task (neutral, trauma) as the independent variable, and group as the between subjects factor. To examine psychophysiological measures, two series (30-second epochs, 90-second epochs) of repeated measures ANOVAs were conducted with epoch as repeated factor, and group (PTSD, no-PTSD) as a between subjects factor. Baseline data was used as a covariate in all psychophysiological analyses to control for individual variability. Analysis of cortisol was conducted via a repeated measures ANOVA with three phases (neutral baseline, neutral post-task, trauma post-task) and group as a between subjects factor (PTSD, no-PTSD). This omnibus test was chosen over independent samples *t*-tests to decrease family-wise alpha, and therefore the results from both the neutral and trauma tasks were yielded from one analysis. In all ANOVAs, follow-up contrasts using an M-Matrix or an L-Matrix were conducted when appropriate. Due to the large number of analyses, only significant effects will be reported.

Descriptive statistics for all phases by group for the neutral and trauma tasks are shown in Tables 1 and 2, respectively.

Determination of Covariate Baseline. It has been demonstrated that individuals have differing baseline levels of physiological responding (e.g., Andreassi, 2000). Therefore, the use of baseline as a covariate in analyses is a suggested practice (e.g., Fowles, 1981). As previous studies have reported a habituation effect of distress and mood during baseline verbal reporting (Amstadter & Vernon, 2006), the 30-s epochs of the neutral and trauma baseline phases for each physiological measure were analyzed via a repeated measures ANOVA to determine if there was a within-phase difference of epoch in the baseline phases.

Examination of GSR peaks during each 30-second epoch of the baseline phase of each task did not yield a significant effect of epoch for the neutral or trauma task, Fs(9,37)=1.68, 1.14, *ns*, suggesting the entirety of the baseline phase for GSR peaks can be used as the baseline covariate. Alternatively, when GSR overall activity was examined for 30-s epochs during the neutral and trauma tasks significant effects of epoch were found, Fs(9,37)=2.54, 2.59, respectively, ps<.05, suggesting that electrodermal activity was more variable in the beginning of the phase and steadied out near the end of the phase. Examination of the last two minutes of each baseline phase did not show significant effects of epoch for either task, Fs(3,43)=.74, 1.23, respectively, *ns*, suggesting the appropriateness of the use of the last two minutes of the baseline phase as the "baseline" to be used as the covariate for GSR reactivity. In short, two separate baseline covariates were used for the two measures of electrodermal activity.

Similar to GSR reactivity, HR was significantly higher in the beginning of the phase than in the end of the phase for the neutral and trauma tasks, *F*s(9,37)=3.26, 2.31, respectively, *p*s<.01, whereas there was no significant difference between the 30-s epochs of the last two minutes of each baseline phase, *F*s(3,43)=.71, .65, respectively, *ns* suggesting the use of the last two minutes of the baseline as the covariate for HR analyses.

There were no significant effects of 30-second epoch in analyses of baseline respiration for either the neutral or trauma task, *F*s(9,37)=2.02, 1.33, respectively, *ns*, suggesting that the entirety of the baseline phase of respiration can be used as the covariate for respective analyses. As respiration is measured in the number of breathing cycles per minute, the five minutes of the baseline phase were averaged to form the covariate.

Neutral Suppression Analyses

Neutral Thoughts. No analysis of the practice phase was conducted, since target thoughts were not coded due to the rarity of spontaneous white bear thoughts (Wegner et al., 1987). Contrary to expectations, examination of target thoughts showed a trend for an interaction of group and time, *F*(1,47)=1.92, *p*=.13 (see Figure 1). There was a trend for the no-PTSD group to show a post-suppression rebound effect, whereas the PTSD group did not show this trend. In other words, the no-PTSD group had more white bear thoughts during expression compared to suppression, and the opposite pattern was found for PTSD participants. Target thought frequency during suppression (see Table 3) and expression (see Table 4) was related to thought control difficulty during the respective phase, *r*s=.36, .31, respectively, *p*s<.01. Interestingly, no other post-phase ratings or physiological measures were related to thought frequency during the neutral suppression task.

Electrodermal Responding. Analysis of GSR peaks for the neutral task, using the average number of peaks during baseline as the covariate, did not result in any significant effects of epoch, group, or interaction when using 30-second epochs. However, when analyzing the data in 90-second epochs a trend for an effect of epoch was found, $F(5,42)=2.19$, $p=.07$. The number of GSR peaks was highest during the beginning of suppression and then gradually decreased throughout the suppression phase. There was an increase at the beginning of the expression phase, then another gradual decrease.

When GSR reactivity was examined by 30-second epochs, a trend for an epoch by group interaction, $F(19,27)=1.84$ $p=.07$, was found. When the phases were divided into 90-second epochs, a significant effect of epoch was found, $F(5,41)=2.87$, $p<.01$, (see Figure 2). As suppression was expected to be associated with electrodermal activity, it was not surprising to find that all participants had a steady increase of electrodermal activity during the suppression phase. During the expression phase GSR reactivity during the middle epoch was higher than that during the first or last epochs.

Although the variability of the 30-s epochs obscured any effects of time for either measure of GSR, examination of the 90-s epochs hinted at some interesting patterns which were best revealed by the reactivity data. The GSR reactivity data suggests that the suppression task was increasingly arousing for all participants, with some initial release with the removal of suppression instructions. Interestingly, a somewhat contradictory pattern appeared in the measure of peaks, which are extreme responses in GSR, with the beginning of each phase inducing more peaks.

Heart Rate. When examining the 30-second epochs, HR showed a significant effect of epoch, $F(19,27)=2.06$, $p<.05$. Interestingly the no-PTSD group had a higher average HR during all epochs of the suppression phase than did the PTSD group, however, the groups did not differ consistently during expression (see Figure 3). When analyzing 90-second epochs, this pattern was still apparent, but no longer statistically significant. Although both groups reported equal numbers of target thoughts during suppression, apparently suppression was more taxing on the SNS for the no-PTSD participants as compared to the PTSD participants. In contrast, there was no difference found in HR for the expression phase, when there was a group difference in number of target thoughts.

Respiration. Respiration was examined only by 60-second epochs, as it is measured in breathes per minute. As respiration is a less sensitive measure of SNS activity, no effects of epoch were predicted, and as expected analysis of the neutral suppression task did not result in significant effects of epoch nor an interaction. However, a marginally significant effect of group was found, $F(1,45)=3.49$, $p=.07$, with the PTSD participants having more breathing cycles than the no-PTSD participants, which was contrary to the hypothesis of no group effects for the neutral task.

Salivary Cortisol. A significant effect of time was found $F(2,45)=6.47$, $p<.01$, and statistical trends were found for group $F(1,46)=2.45$, $p=.12$, and an interaction $F(2,45)=1.95$, $p=.15$ (see Figure 4). Interpretation of only the main effect of time would suggest that participant's cortisol at baseline was higher than the other two time points. However, when taking into account the group and interaction trends a more complex pattern is revealed. Follow-up contrasts indicated no group difference at baseline, as hypothesized. Interestingly, the groups did differ in their post-neutral cortisol level, with the no-PTSD group displaying a higher cortisol concentration than the PTSD group, $F(1,46)=4.61$, $p<.05$. When post-neutral cortisol level was correlated with the other suppression and expression phase variables, a significant relationship between the number of post-suppression target thoughts and the post-neutral cortisol level was found, $r=.37$, $p<.01$.

Post-phase Ratings. Analyses of SUDS, control difficulty, and PA all revealed significant time effects, *F*s(2,45)=3.81, 5.06, and 18.46, respectively, *p*s<.05. Distress, and PA were generally at their height during practice. Reported distress during expression was significantly less than during either baseline or suppression, *F*s(1,46)=5.92 and 5.80, respectively, *p*s<.05. Similarly, NA was highest during baseline, decreased significantly during suppression, $F(1,46)=26.12$, $p<.001$, and decreased further during expression, $F(1,46)=4.38$, $p<.05$. Difficulty controlling thoughts showed a distinct but expected pattern, and was lowest at baseline, increased significantly during suppression, $F(1,46)=10.35$, $p<.01$, then decreased during expression, $F(1,46)=3.63$, $p=.06$. Analysis of NA revealed a significant interaction, $F(2,45)=3.48$, $p<.05$, and a significant effect of time, $F(2,45)=9.78$, $p<.001$. The PTSD group's report of NA was highest at baseline, decreased during suppression, then decreased again during expression. The no-PTSD group reported a consistently low level of NA during all three phases. Surprisingly, suppression instructions did not appear to increase subjective distress or NA relative to the baseline phase when there were no such instructions. The unfamiliarity of the task may have induced negative reactions during practice that decreased as task familiarity increased. Thought control difficulty, distress, and NA within each phase were consistently positively correlated, whereas PA's relation to the other task variables was less consistent, as shown in Tables 3 and 4.

Trauma Suppression Analyses

Trauma Thoughts. Examination of trauma-related thought frequency indicated a significant effect of time, $F(2,45)=5.38$, $p<.01$, and a significant effect of group, $F(1,46)=6.04$, $p<.01$ (see Figure 1). Not surprisingly, for both groups, target thought frequency increased significantly when their trauma was introduced in the form of suppression instructions, $F(1,46)=9.53$, $p<.01$. Trauma thoughts then decreased following suppression, $F(1,46)=10.42$, $p<.01$; however, the PTSD group reported significantly more trauma thoughts post-suppression than did the no-PTSD group, $F(1,46)=4.78$, $p<.05$, indicating a between-groups post-suppression rebound. Surprisingly, target frequency during suppression was not related to thought control difficulty (see Table 5), as it was in the neutral task, although it was related to distress, $r=.38$, and NA, $r=.33$, ps<.01. During expression, number of thoughts was significantly related to thought control difficulty, distress, NA, and GSR peaks, rs=.32, .36, .47, .34, respectively, ps<.05 (see Table 6). Of note, the relationship between trauma thought frequency during expression and GSR peaks was the only significant correlation observed between thought frequency and a physiological measure.

Electrodermal Responding. Examination of 30-s epoch GSR peaks for the trauma task, using the average number of peaks during baseline as the covariate, resulted in a trend for an effect of epoch, $F(19, 27)=1.89$, $p=.07$. When looking at the 90-s epochs, the trend found in the 30-s epoch analysis was significant, $F(5,38)=3.61$, $p<.01$ (see Figure 5). The number of peaks was generally steady during suppression, then increased during the first 90-s epoch of expression and then decreased steadily.

When examining the overall GSR activity across 30-s epochs, a trend for an effect of epoch was found, $F(19, 27)=1.77$, $p=.08$. Analysis of 90-s epochs revealed a significant effect of epoch, $F(5,42)=3.93$, $p<.01$, (see Figure 6). Both 30- and 90-s epoch analyses revealed the same general pattern in that participants had a steady increase of electrodermal activity during the suppression phase, a decrease during the first epoch of expression, then a steady rise again.

Of note, the patterns of electrodermal activity, as shown by GSR peaks and overall activity for each suppression task were similar. A downward linear trend of GSR peaks appeared in both tasks, suggesting that the number of extreme responses decreased over the course of the experiment. However, perhaps more interesting is that overall activity of GSR actually increased over the course of each phase, which is consistent with theories of behavioral and thought inhibition which predict increased physiological responding during attempted suppression (e.g., Fowles, 1981).

Heart Rate. Analysis of the 30-s epochs resulted in a significant effect of epoch, $F(19,26)=2.87$, $p<.01$. When the epochs were 90-s, there was no longer a significant multivariate epoch effect, but a within subjects effect of epoch was significant, $F(5,42)=2.73$, $p<.05$ (see Figure 7). As expected, HR was consistently high during suppression, and then began to decrease steadily after suppression instructions were lifted. Interestingly, the immediate-enhancement effect found during the trauma task was accompanied with higher HR, as compared to the gradual decrease found during the expression phase when the frequency of trauma-related thoughts was lower.

Respiration. When examining the respiration cycles during the trauma task, a trend for an effect of epoch was observed, $F(9,37)=2.06$, $p=.06$. All participants showed an increase in respiration during suppression. The expression phase was high at the beginning and end of the phase, and lower in the middle.

Salivary Cortisol. As the omnibus repeated measures ANOVA was used to examine cortisol collected over the three time points, the results of the test were the same as reported in the neutral results section. Again, a significant effect of time was found, as were trends for an interaction and group effects (see Figure 4). Follow-up contrasts, contrary to our hypothesis, did not reveal a group difference for the trauma task. In terms of time effects, baseline cortisol level was marginally higher than post-trauma cortisol level, $F(1,44)=3.36$, $p=.07$. When post-trauma cortisol was correlated with the other suppression and expression variables, the only significant associations were found with GSR peaks at both suppression and expression, $r=.40$, .34, respectively, ps<.01.

Post-phase Ratings. Significant effects of time were found for NA and PA, Fs(2,43)=3.78 and 4.14, respectively, ps<.05, and a trend for an interaction for NA was found, $F(2,43)=3.01$, $p=.06$. No group differences were found for either NA or PA. NA was lowest at baseline, increased significantly during suppression, $F(1,44)=6.13$, $p<.05$, then stayed at a consistently high level during expression. Examination of the interaction indicated that the PTSD group's NA stayed at a high level post-suppression whereas it decreased for the no-PTSD group. In contrast, both group's report of PA was highest at baseline, compared to suppression and expression, Fs(1,44)=8.16 and 5.16, respectively, *p*s<.01. Analysis of distress revealed a significant time by group interaction, $F(2,43)=3.43$, $p<.05$, and no main effects. Both groups reported a similarly low level of distress during baseline and displayed a parallel increase when trauma suppression instructions were introduced. Post-suppression, the PTSD group's report of distress increased significantly, whereas the no-PTSD group reported a decrease. No significant effects of time or interaction were found for thought control difficulty; however, a trend for a group difference was found $F(1,44)=4.28$, $p=.12$, with the PTSD group consistently reporting higher control difficulty than the no-PTSD group. As shown in Tables 5 and 6, similar to the neutral task, thought control difficulty, distress, and NA were interrelated. Not surprisingly, participants' self-reported post-phase ratings were consistently correlated, and often correlated with actual suppression performance. Conversely, physiological measures were not consistently interrelated, and at times were negatively related.

IV. DISCUSSION

Neutral Task

Consistent with previous findings, our results demonstrated an immediate enhancement effect (e.g., Amstadter & Vernon, 2006; Merckelbach et al., 1991; Muris et al., 1992), with participants reporting white bear thoughts during suppression. More interesting is that there was a trend for a post-suppression rebound effect for the no-PTSD group, and a post-suppression decline in the PTSD group on the neutral task. In fact, in comparison to the PTSD group a post-suppression rebound effect was found for the no-PTSD group. This finding was unexpected, as previous investigations between PTSD and no-PTSD groups did not find a difference on the white bear suppression task (Amstadter & Vernon). However, this finding is fitting in a theoretical context. For example, given that suppression is a frequently reported response employed by those with PTSD (Amir et al., 1997), it is possible that the PTSD group are seasoned suppressors and therefore did not experience the negative aftereffect of a post-suppression rebound effect when the suppressed material was an irrelevant neutral stimulus.

Examination of physiological activity during the neutral task revealed some interesting patterns. Most notable was the interaction effect of epoch and group for HR that was found for the 30-s analyses. Contrary to our hypothesis, the no-PTSD group had consistently higher HR during the suppression phase than did the PTSD group, which is interesting given there was not a performance difference during this phase. Moreover, during expression, when there was a performance difference in target thoughts, HR for both groups was commensurate. Furthermore, the no-PTSD group's HR was higher during suppression than during expression, which was opposite to the pattern of reported target thoughts frequency. Past studies have reported that suppression is effortful and often associated with increased SNS activity (e.g., Wegner et al., 1990), and for the no-PTSD group this appears to be the case for HR.

Another interesting finding from the neutral suppression physiological data is that GSR activity and GSR peaks, both measures of electrodermal activity thought to indicate increased SNS activity, displayed distinctly different patterns across the suppression and expression phases. The two scoring systems of electrodermal activity do not commonly covary because the number of GSR peaks only includes responses meeting a magnitude criterion, whereas GSR activity scores reflect all changes in skin conductance, assessing both frequency and magnitude (Dawson et al., 2000). GSR peaks are strong surges in electrodermal activity and both groups had the highest number of peaks during the first 90-s epoch of suppression. Relative to the end of suppression, there was a substantial increase in GSR peaks during the first 90-s epoch of expression, followed by a gradual decrease. Alternatively, when electrodermal responding was measured by overall GSR activity, a steady increase was found across the suppression phase, accompanied by a decrease when the suppression instructions were lifted, and then increasing again across the expression phase. In short, it appeared that each phase was associated with an increase in GSR activity and a decrease in GSR peaks.

Two sets of findings from experimental psychology shed light on these seemingly contradictory GSR peaks and activity findings. First, the orienting response habituation paradigm involves repeated presentation of an innocuous stimulus, such as a tone lasting one second, and measures GSR peaks (Lockhart & Lieberman, 1979). With repeated stimulus presentation the frequency of peaks in electrodermal activity decreases, demonstrating habituation. Second, under a challenge situation, such as being asked to solve complex arithmetic problem in the presence of an authority figure, the overall frequency of GSR activity increased over time, which the author conjectured was due to the application of sustained effort (Bohlin, 1976). Applying such findings to our present GSR results would suggest that GSR peaks exhibited habituation, and simultaneously exhibited steadily increasing frequency of responses of smaller magnitude, perhaps demonstrating continued effort.

Respiration was included largely as a physiological control measure and was not expected to change significantly across suppression and expression, and consistent with our predictions, respiration did not show significant effects of epoch. However, analysis of respiration led to an unexpected pattern in that the PTSD group had more breaths per minute than did the no-PTSD group across both suppression and expression. Interestingly, this was the only significant group difference for any physiological measure. Also of note is that respiration is typically not considered as sensitive of a measure of peripheral autonomic nervous system activity than measures such as HR and GSR (e.g., Orr et al., 2000).

Taken together, suppression of neutral material was associated with various patterns of physiological responding. Similar to other studies finding a lack of linear association between measures of SNS activity (e.g., Keane et al., 1998; Orr et al., 1993), the present study did not find clear and consistent linear increases or decreases among the physiological channels recorded. Physiological responses tended to be dynamic and variable and different measures did not tend to correlate with one another, as has been found elsewhere (e.g., Beck et al., 2006; Orr et al., 1993). Further, there is ample evidence that not all individuals respond physiologically in all response systems, and therefore multisystem recording is suggested to maximize the chance of capturing the various responses the sample will display (Orr et al., 2000). Whereas clear linear relationships between the various measures would have afforded a more simple interpretation of the data, the complexity of the nervous system does not allow for that.

As predicted, our sample did not show a significant tonic difference in cortisol between groups, which is consistent with previous studies that compare PTSD groups to traumatized controls (e.g., Elzinga et al., 2003; Heim et al., 2000). However, significant effects of time were noted, as well as trends for group and an interaction. Interestingly, although there was no group difference for target thought frequency during neutral suppression, the no-PTSD group appears to have had higher cortisol concentrations following the neutral task than did the PTSD group. This effect is consistent with the pattern of thoughts during this task, as the no-PTSD group reported significantly more post-suppression thoughts than did the PTSD group. Also of interest is that the number of post-suppression thoughts and the post-neutral cortisol concentration were significantly positively associated. As cortisol takes approximately 10 minutes to be released from the HPA axis and released into the saliva stream, it is unclear what our post-suppression cortisol results are measuring. Due to the temporal imprecision of this measure, our results could be reflective of a response to suppression, to expression, or of a generalized response to the task as a whole. Cortisol level was intended to be representative of suppression effects, as we collected the samples five minutes following the expression phase, approximately ten minutes from the end of suppression. In any event, it is clear that the experimental suppression paradigm had some effect on the participants, as there was a significant change in cortisol concentration in comparison to baseline. It should be noted, however, that the initiation of the experimental protocol stressors (e.g., being asked to talk aloud into a recorder, having arm, leg, and finger sensors and a respiration belt on, being watched from a one-way mirror, being asked not to move) included the highest intensity of stressors and therefore, the decrease in cortisol may represent habituation.

Reported distress, NA and PA showed the same pattern that was found in our previous study (Amstadter & Vernon, 2006). All three measures were at their height during the baseline phase then decreased throughout the suppression task. This finding is likely due to initial discomfort with the novel thought-reporting task. Consistent with our previous investigation (Amstadter & Vernon), suppression versus expression instructions did not appear to affect reported distress or mood, which both remained stable across the two phases. Although both studies employed the same set of instructions and rating scale, participant reports of difficulty controlling thoughts displayed a different pattern from our previous study. In the present sample, there was a more predicted pattern (relative to our previous results) in that participants' reported control difficulty was low during baseline, increased during suppression, then decreased back to nearly baseline level during expression. Interestingly, thought control difficulty did not show a group difference or interaction, despite a performance difference during the task. Thus, although participants did not report feeling distressed by their failure to suppress, they did experience intentional suppression as difficult.

Consistent with previous research reporting little to no correlation between self-reported emotional states and physiological arousal or HPA axis activity (Eifert & Wilson, 1991; Lang, 1985), the present study did not find that self-reported emotional states of distress, PA, and NA were related to physiological levels. Therefore, the two types of measurement should be considered separate data points rather than interchangeable indices of the same construct.

To our knowledge, ratings of difficulty controlling thoughts, mood, and distress are not commonly collected in neutral suppression tasks after each phase. Instead, post-task ratings are frequently used (e.g., Kelly & Kahn, 1994; Markowitz & Borton, 2002). Taken together with our previous findings (Amstadter & Vernon, 2006), our current results provide additional support for the notion that such ratings should be collected after each phase, as they are fairly variable. Ratings collected after completion of all phases cannot detect trends nor can they distinguish the effects of suppression from other effects, such as acclimation to a novel task. Of note, the continuous collection of physiological data provided additional support for within-phase habituation during baseline, which was apparent for the majority of SNS measures.

Trauma Task

Findings of trauma-related thoughts replicated earlier work in our lab (Amstadter & Vernon, 2006). As hypothesized, main effects of group and time were found. Consistent with our prediction, the main effect of group revealed that the PTSD group reported more trauma-related thoughts than did the no-PTSD group. Further contrasts revealed that the groups' post-suppression frequency accounted for this effect, as the groups did not differ in thoughts reported during baseline or suppression. Examination of the time effects revealed that both the PTSD and no-PTSD groups experienced an increase of trauma thoughts during suppression. This parallels our neutral suppression immediate enhancement effect. Following trauma suppression, number of trauma thoughts remained at a relatively high frequency for those with PTSD, in fact, they reported on average six trauma intrusions post-suppression. In contrast, the no-PTSD group did not report post-suppression trauma intrusions at a high frequency. Specifically, they reported on average less than one trauma intrusion during the five minutes following suppression. In short, a between-groups post-suppression rebound effect was found for the PTSD group relative to the no-PTSD group, which was consistent with our hypotheses and past research (e.g., Amstadter & Vernon; Shipherd & Beck, 1999; 2005).

Interestingly, between subjects post-suppression rebound effects were found in the neutral task for the no-PTSD group alone, and in the trauma task for the PTSD group alone. In other words, the PTSD group easily dismissed white-bear thoughts but not trauma thoughts post-suppression, and vice-versa for the no-PTSD group. This suggests that the post-suppression group difference is not accounted for by suppression ability, as both groups displayed similar performance during suppression phases of both tasks, but more likely by the nature of the thought to be suppressed.

Since recurrent thoughts are expected during trauma recovery, different responses to them may play an important role in outcome. From a theoretical standpoint, the experience of a traumatic event leads to painful affect and thoughts which are brought into consciousness and experienced as intrusive thoughts. These intrusions are then met with suppression attempts. Wenzlaff and Wegner (2000) have proposed that suppression attempts could stimulate an immediate enhancement effect and a post-suppression rebound, activating a cycle of intrusive and avoidance PTSD symptoms. In short, a positive-feedback cycle is created. Suppression attempts are met with reinforcement, as intrusions temporarily decrease, and therefore are continued upon the presence of the subsequent intrusive thoughts they create. The present findings support such theories, as intentional suppression led to an increase in trauma-related thoughts during attempted suppression and afterwards, especially for PTSD participants. PTSD is a disorder characterized by oscillation of intrusions and avoidance, and suppression appears to increase such symptoms (Amstadter & Vernon, 2006; Beevers et al., 1999; Purdon, 1999; Shipherd & Beck, 1999; 2005).

As expected, suppression and expression of one's trauma induced physiological changes, as seen in all four physiological measures used in the present study. This effect of epoch was observed consistently across all measures during the trauma task, whereas during the neutral suppression task the results were more variable. Overall, examination of the 90-s trauma task epochs revealed significant effects of time whereas analyses using the 30-s epochs resulted in only marginally significant effects. This is likely due to the variability of the 30-s epochs, which were more sensitive to such noise.

Similar to the neutral task, electrodermal responding as assessed by peaks and by overall activity differed. Again consistent with the neutral task, overall GSR activity increased during each phase of the trauma task, suggesting more activation of the electrodermal system. Conversely, the effect of epoch found for GSR peaks indicated more extreme responses in the beginning of each phase, and slowly decreasing thereafter across both phases. Again, this finding is disparate on the surface, but fitting with data on the electrodermal response system and findings of magnitude versus frequency methodologies for defining GSR (e.g., Bohlin, 1976; Lockhart & Lieberman, 1979).

Interestingly, HR, another SNS marker, did not show a consistent pattern during the trauma suppression and expression phases. HR was significantly different across 30-s epochs of the phases, whereas HR was not variable during the covariate baseline phase, suggesting that the suppression and expression attempts did affect this system. When looking at the overall pattern of mean HR of all participants across the epochs of both phases of the trauma task, however, a clear trend was apparent. Suppression elicited a higher HR for both groups, perhaps due to the effortful nature of this task (Wenzlaff & Wegner, 2000), compared to expression, when HR tended to decrease gradually over the course of the phase. It may be the case that when taxing suppression attempts were lifted, some cardiovascular relief was seen. Interestingly, the overall HR pattern mirrored that of reported trauma thought frequency, which was also higher during suppression than expression.

Examination of respiration did not show a consistent pattern, and was quite variable across the epochs of the phases of trauma suppression and expression. However, respiration was generally higher during suppression than expression, again suggesting the effortful nature of suppression. This finding was unexpected, as respiration was included largely as a control measure, as it is not thought to be as responsive as other SNS markers (Orr et al., 2000)

In short, suppression of trauma related material elicited different patterns of physiological arousal, which is consistent with other studies reporting a low linear relationship among physiological markers (e.g., Orr et al., 1993). Counter to our expectations, there were no group differences or interaction effects found for any of the physiological measures collected during the trauma task. These findings were contrary to several models of PTSD suggesting that intrusive thoughts are accompanied by physiological hyperarousal (e.g., Brewin, Dalgleish, & Joesph, 1996). There are multiple possible explanations for our failure to find such effects. It is possible that trauma thoughts experienced during the suppression tasks were not sufficiently valenced to elicit the arousal in the SNS reported by studies using more specific, detailed, and evocative stimuli, such as audiotapes of trauma cues (e.g., Keane et al., 1998), or scripts with vivid imagery (e.g., Orr et al.). Such studies have typically reported a PTSD versus no-PTSD group difference. Therefore, the thoughts that our participants experienced during the suppression task could have been similar to those experienced in everyday life and therefore may not have evoked a SNS response. However, when taking into consideration our time effects across the trauma suppression task it is also possible that suppression itself was so effortful and therefore taxing on the SNS that the accompanying surge of autonomic activity we hypothesized to be coupled with intrusive thoughts was not apparent. This explanation is consistent with current theories of suppression (e.g., Gross, 1998; Wenzlaff & Wegner, 2000) that suggest that suppression or inhibition of thoughts or emotions comes at a physiological cost. Likely adding to such physiological strain is the dissonance resulting from the attempts to suppress trauma material versus the instructions to report aloud such thoughts when they are experienced.

Examination of salivary cortisol post-trauma suppression task did not reveal a significant group difference, contrary to expectations. Of note is that most studies reporting a group difference have used a non-trauma control group with a clinical PTSD group (e.g., Bremner et al., 2003; Liberzon et al., 1999), which represent two extreme ends of the distribution. Furthermore, it was unexpectedly found that the cortisol concentrations following the trauma task were marginally *lower* for both groups in comparison to their tonic cortisol level. One explanation for this seemingly contradictory finding is that the participants' anticipatory anxiety prior to the baseline cortisol collection was elevated, and therefore, by the time the participants had experienced the laboratory protocol, their anticipatory anxiety had decreased accounting for a lower phasic cortisol level. Most protocol stressors were also likely most salient during baseline. Another possibility is that the stimuli of trauma-related thoughts or the suppression task as a whole was not sufficiently stressful to elicit an HPA axis response. Previous studies that reported differences in tonic and phasic levels typically have used arguably more valenced stimuli, such as combat related sounds (Liberzon et al., 1999). In order to conclude that suppression of trauma related material does not yield time or group cortisol effects, future work is needed. For example, subsequent studies should employ more detailed trauma scripts as stimuli, as well as multiple baselines to examine whether anticipatory anxiety accounted for our findings.

Taking the neutral and trauma suppression data together, there was a surprising lack of correspondence between suppression success, as operationalized by the number of target thoughts, and SNS activity. However, this finding is consistent with other studies of thought suppression and physiology (e.g., Beck et al., 2006; Wegner et al., 1990) which have found that patterns of physiological data did not correspond well with patterns of target thoughts. There are various interpretations for these findings. First, it could be the case that suppression and post-suppression effort employed, not actual performance, is what is associated with SNS activation. Alternatively, it could be the case that the thought reporting method employed is sufficiently flawed that it does not accurately represent actual thoughts experienced and thus any associations with SNS activation are masked. Clearly, the need for more investigations that examine the mental, emotional, and physical concomitants of deliberate thought suppression are called for to help elucidate some of the apparently discrepant findings.

Participants' self-report measures following each phase of the trauma task yielded some interesting results. Perhaps most striking was the interaction between group and phase found for distress. The no-PTSD participant's report of distress and NA followed an expected pattern in that distress was low during baseline, increased during suppression, then decreased during expression. Interestingly, the PTSD participants reported increasing distress and NA throughout the task (lowest during baseline, increasing during suppression, increasing further during expression). Of note is that post-suppression the PTSD participants reported more trauma thoughts, when compared to the no-PTSD participants, which may explain why their distress and NA were elevated. Also of interest is that a trend for a group effect was found for thought control difficulty, in that the PTSD participants found it more difficult across the entire trauma task to control their thoughts compared to the no-PTSD participants. All participants apparently experienced trauma thoughts as difficult to control, as evidenced by the association between target thought frequencies and reported thought control difficulty during suppression and expression. As seen in the neutral task, PA was highest during baseline and decreased during suppression then stayed at a stable low level. Similar to results from the neutral task, the correspondence between the self-reported valenced states and measures of physiology was lacking, which again fits with previous reports of less than 10% of shared variance between self-report of emotion and physiological arousal (Lang, 1985).

Limitations and Future Directions

As with most studies utilizing a college population, the current study is limited by the relative homogeneity of the sample. Additional suppression research should be conducted with trauma survivors of a wider range of demographic characteristics, including older adults and those from more diverse ethnic and cultural backgrounds. The present study was also limited by a small sample size. Specifically, if the sample size was greater, it is likely that the marginally significant findings may meet the required.05 alpha level for statistical significance. Future studies should utilize a larger sample with equal representation of male and female trauma survivors to assess for potential group differences. The inclusion of a treatment-seeking traumatized group and a non-trauma control group may also help elucidate the relations between thought suppression and physiology in that the full distribution (non-trauma control, no-PTSD, PTSD, and treatment-seeking PTSD) would be represented. Further, although the PCL has been shown to have high diagnostic agreement with the CAPS and the Structured Clinical Interview for the DSM-III-R (SCID; Spitzer, Williams, Gibbon, & First, 1988), using a questionnaire measure to determine diagnostic status has its limitations. Although the physical health exclusionary criteria were needed for this study as it entailed physiological measurement affected by certain physical conditions or medications, the exclusion of these participants limits the generalizability of the findings.

Results from this study provide additional evidence that PTSD symptomatic and asymptomatic individuals differ in their performance of purposeful suppression of trauma-related thoughts, but not of neutral thoughts, replicating earlier work (Amstadter & Vernon, 2006). Between-subjects post-suppression rebound effects were found in the no-PTSD group for the neutral task and the PTSD group for the trauma suppression task. These findings rule out the hypothesis that individuals' general suppression ability accounts for our results. Rather, the content of suppressed thoughts and PTSD symptom level appear to have led to the group difference on trauma suppression. These results provide additional support for the theory that suppression plays a role in the development and maintenance of PTSD. The physiological findings suggest that suppression is accompanied by some SNS activity, however, the results were not consistently linearly related across physiological markers. Post-suppression, the SNS activation was more variable than it was during the covariate baselines, suggesting that suppression has carry-over effects. Results of salivary cortisol suggest that traumatized college students with and without PTSD do not differ in their tonic cortisol levels, however, following suppression of the neutral target the no-PTSD participant's level of cortisol was higher than that of the PTSD group. No group or time cortisol differences were found for the trauma task. Further investigation of the physiological concomitants of deliberate thought suppression of personally relevant and irrelevant material in traumatized, as well as nontraumatized, samples is needed.

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APPENDICES

APPENDIX A

Tables

Table 1

Descriptive Statistics for Neutral Suppression Variables by PTSD Symptom Group

		PTSD		No-PTSD	
		M	*(SD)*	*M*	*(SD)*
Baseline	GSR Peaks	117.52	(67.32)	129.36	(58.19)
	GSR Reactivity	-0.003	(0.04)	0.00	(0.04)
	Heart Rate	88.04	(16.08)	92.19	(25.38)
	Respiration	23.67	(4.81)	23.73	(5.35)
	Difficulty Controlling Thoughts	32.31	(26.47)	21.36	(20.94)
	Distress	26.54	(21.16)	26.18	(22.09)
	Negative Affect	17.42	(5.09)	14.41	(2.92)
	Positive Affect	28.58	(7.27)	25.36	(6.08)
Suppression	Target Frequency	4.23	(5.01)	4.87	(3.82)
	GSR Peaks	103.36	(80.43)	100.08	(58.19)
	GSR Reactivity	-0.02	(0.06)	-0.02	(0.03)
	Heart Rate	84.58	(13.84)	91.63	(26.99)
	Respiration	23.49	(4.46)	22.54	(4.50)
	Difficulty Controlling Thoughts	37.92	(27.74)	33.64	(27.74)
	Distress	23.54	(17.31)	27.64	(22.03)
	Negative Affect	15.65	(4.19)	14.41	(3.32)
	Positive Affect	25.50	(7.51)	23.23	(7.26)
Expression	Target Frequency	2.88	(3.81)	6.09	(8.14)
	GSR Peaks	94.79	(98.38)	92.12	(59.82)
	GSR Reactivity	-0.03	(0.12)	-0.00	(0.03)
	Heart Rate	84.37	(15.13)	89.04	(26.20)
	Respiration	22.65	(3.72)	21.43	(3.73)
	Difficulty Controlling Thoughts	30.38	(26.00)	28.64	(22.69)
	Distress	19.81	(18.14)	19.41	(18.18)
	Negative Affect	13.50	(3.04)	13.55	(3.28)
	Positive Affect	24.42	(7.58)	22.41	(7.25)

Table 2

Descriptive Statistics for Trauma Suppression Variables by PTSD Symptom Group

		PTSD		No-PTSD	
		M	*(SD)*	*M*	*(SD)*
Baseline	Target Frequency	3.22	(11.52)	0.00	(0.00)
	GSR Peaks	101.78	(159.83)	83.86	(51.85)
	GSR Reactivity	-0.01	(0.04)	-0.01	(0.04)
	Heart Rate	85.97	(14.58)	83.80	(16.53)
	Respiration	23.31	(3.42)	22.66	(4.24)
	Difficulty Controlling Thoughts	21.94	(21.94)	17.62	(19.01)
	Distress	21.79	(21.94)	18.57	(16.44)
	Negative Affect	13.16	(3.33)	13.43	(3.52)
	Positive Affect	23.40	(8.21)	20.48	(6.98)
Suppression	Target Frequency	10.52	(12.64)	5.09	(4.81)
	GSR Peaks	81.87	(61.57)	112.62	(162.96)
	GSR Reactivity	-0.02	(0.03)	-0.01	(0.03)
	Heart Rate	81.96	(12.74)	82.47	(15.63)
	Respiration	22.68	(4.28)	21.73	(2.91)
	Difficulty Controlling Thoughts	28.60	(29.63)	23.38	(21.47)
	Distress	23.84	(25.51)	22.62	(22.22)
	Negative Affect	15.80	(6.49)	13.86	(4.13)
	Positive Affect	21.28	(8.24)	19.90	(6.89)
Expression	Target Frequency	7.72	(12.82)	0.95	(1.96)
	GSR Peaks	88.33	(74.61)	86.24	(61.07)
	GSR Reactivity	-0.02	(0.03)	-0.01	(0.04)
	Heart Rate	81.21	(11.30)	82.39	(17.12)
	Respiration	22.32	(4.86)	22.03	(3.94)
	Difficulty Controlling Thoughts	30.38	(26.00)	28.64	(22.69)
	Distress	19.81	(18.14)	19.41	(18.18)
	Negative Affect	13.50	(3.04)	13.55	(3.28)
	Positive Affect	24.42	(7.58)	22.41	(7.25)

Table 3

Correlations of Neutral Suppression Variables

	Thoughts	GSR Peaks	GSR Reactivity	Heart Rate	Respiration	Distress	Control Difficulty
GSR Peaks	.19						
GSR Reactivity	.01	-.03					
Heart Rate	.06	.02	-.08				
Respiration	.05	-.25	.01	-.38**			
Distress	.15	-.15	.16	.06	-.11		
Thought Control Difficulty	.36**	-.03	-.08	.13	-.21	.39**	
Negative Affect	.11	-.12	.10	-.26	.10	.57***	.23
Positive Affect	.20	.22	-.24	.14	-.05	-.10	-.02

*p <.05. **p <.01. ***p <.001.

Table 4

Correlations of Neutral Expression Variables

	Thoughts	GSR Peaks	GSR Reactivity	Heart Rate	Respiration	Distress	Control Difficulty	Negative Affect
GSR Peaks	-.03							
GSR Reactivity	.10	.08						
Heart Rate	-.14	-.12	-.03					
Respiration	-.09	-.44**	-.02	-.27				
Distress	.23	-.28	-.30	.00	.25			
Thought Control Difficulty	.31*	-.03	-.02	.00	.13	.26		
Negative Affect	.10	-.18	-.17	-.31*	.38**	.42**	.18	
Positive Affect	-.17	.18	.20	.19	-.05	-.12	-.02	-.27

**p* <.05. ***p* <.01. ****p* <.001.

Table 5

Correlations of Trauma Suppression Variables

	Thoughts	GSR Peaks	GSR Reactivity	Heart Rate	Respiration	Distress	Control Difficulty
GSR Peaks	.03						
GSR Reactivity	.23	-.09					
Heart Rate	-.05	.04	.04				
Respiration	-.13	-.11	.09	-.09			
Distress	.38*	.06	.08	.11	.10		
Thought Control Difficulty	.08	-.13	.01	-.08	.27	.35*	
Negative Affect	.33	.15	-.18	.02	.21	.77***	.42**
Positive Affect	.10	.07	.12	-.03	-.01	-.11	-.10

*p <.05. **p <.01. ***p <.001.

Table 6

Correlations of Trauma Expression Variables

	Thoughts	GSR Peaks	GSR Reactivity	Heart Rate	Respiration	Distress	Control Difficulty
GSR Peaks	.34*						
GSR Reactivity	.01	.09					
Heart Rate	-.09	-.07	.10				
Respiration	-.16	-.23	.01	.21			
Distress	.36*	-.19	.08	-.03	.09		
Thought Control Difficulty	.32*	-.05	.15	-.03	-.07	.58***	
Negative Affect	.47**	-.05	.01	-.04	.09	.83***	.46**
Positive Affect	-.01	.10	-.05	.10	.04	-.22	-.003

**p* <.05. ***p* <.01. ****p* <.001.

APPENDIX B

Figures

Figure Captions

Figure 1. Mean number of target thoughts reported during phases of neutral and trauma suppression tasks, by group.

Figure 2. Mean GSR activity, measured in microsiemens, during the suppression and expression 90-s epochs of the neutral suppression task, by group.

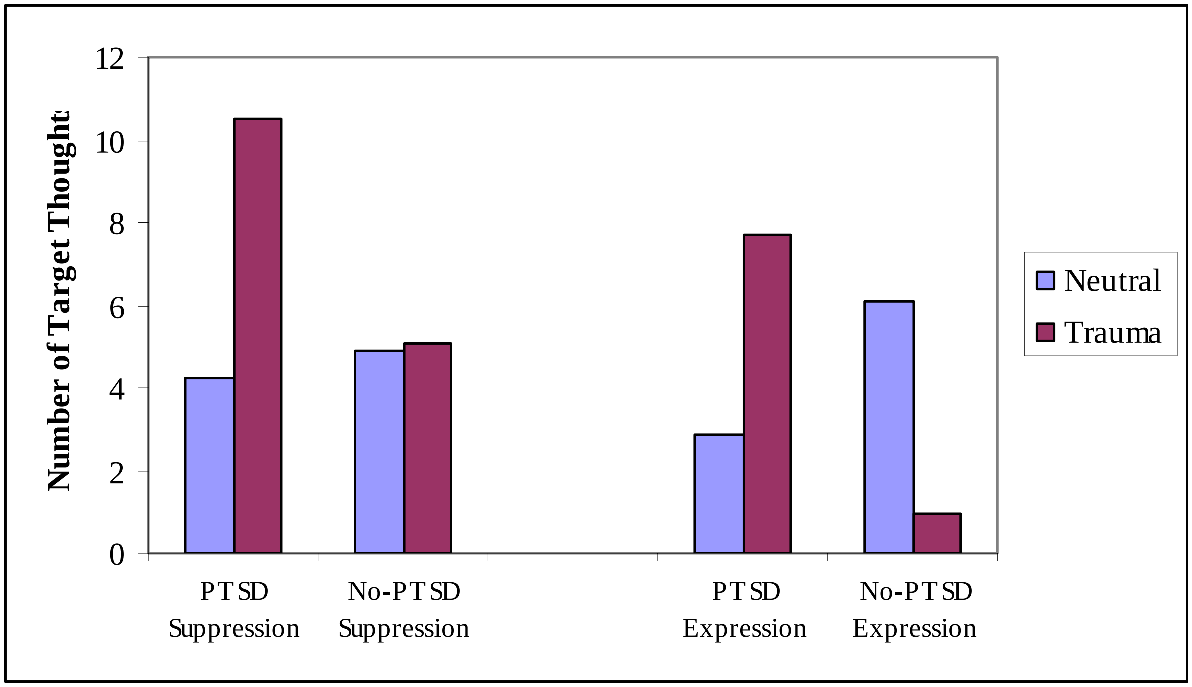
Figure 3. Mean HR, measured in beats per minute, during the suppression and expression 30-s epochs of the neutral suppression task, by group.

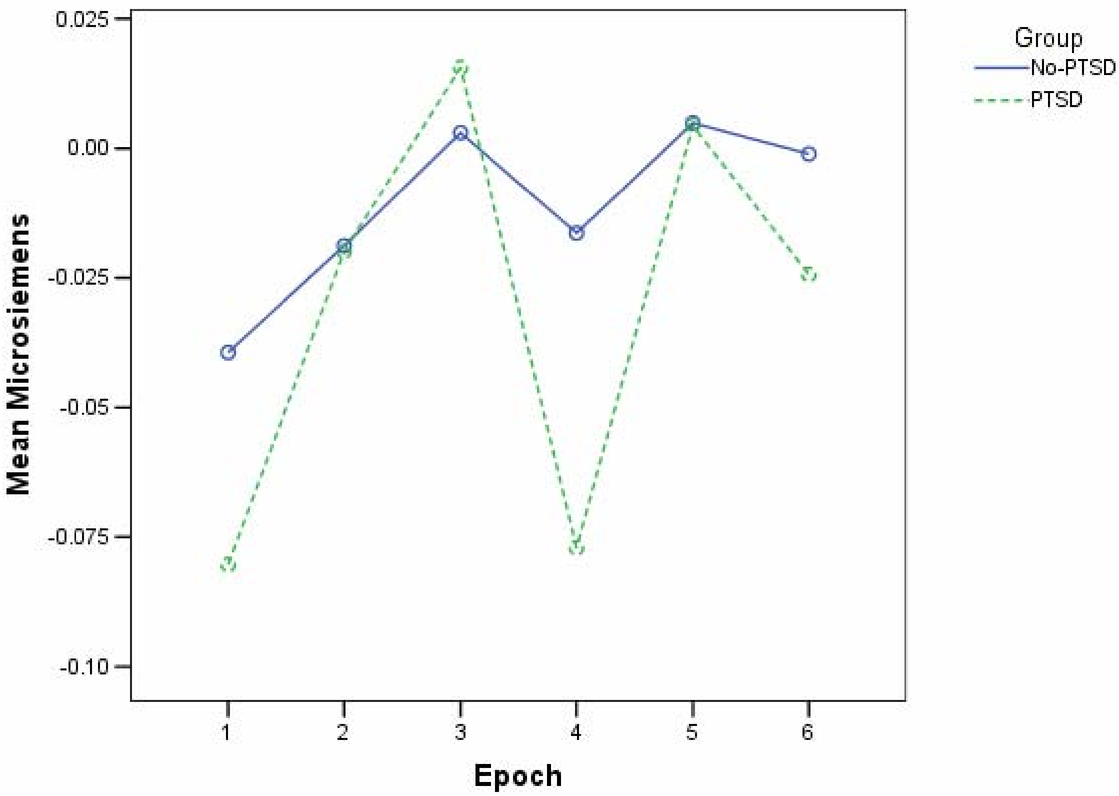
Figure 4. Salivary cortisol concentration, as measured in ug/dl, during baseline, post-neutral, and post-trauma, by group.

Figure 5. Mean GSR peaks, quantified as .5 or greater increase in microsiemens, during the suppression and expression 90-s epochs of the trauma suppression task, by group.

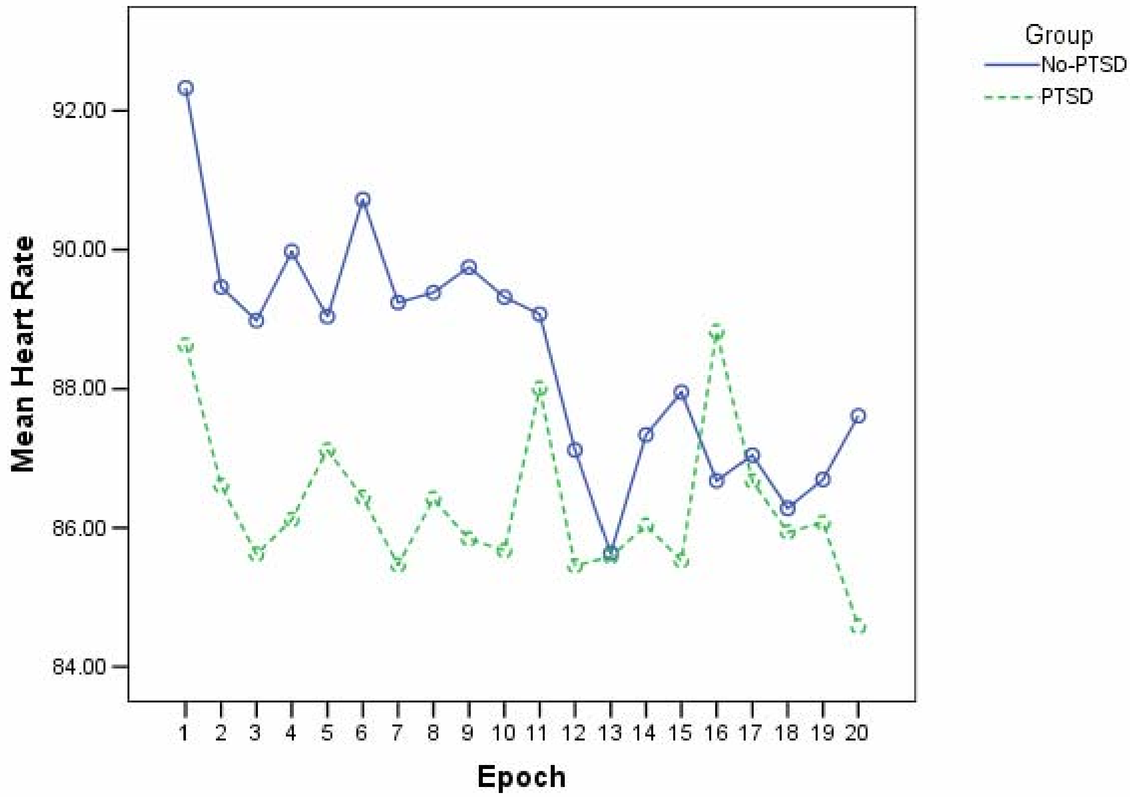
Figure 6. Mean GSR activity, measured in microsiemens, during the suppression and expression 90-s epochs of the trauma suppression task, by group.

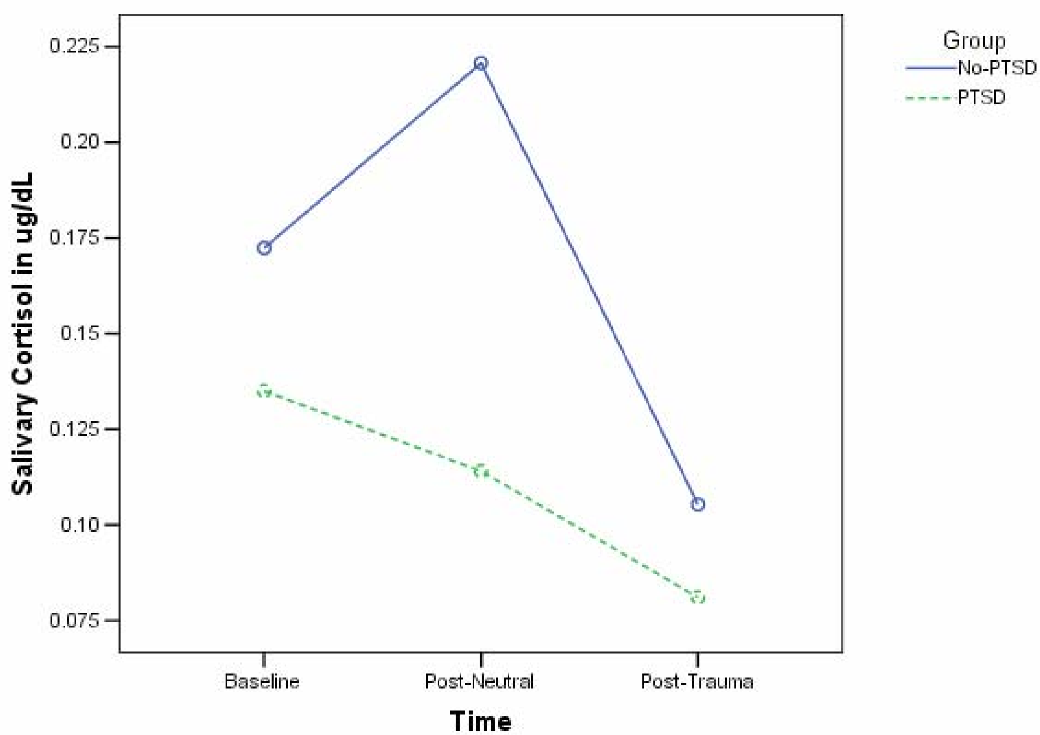
Figure 7. Mean HR, measured in beats per minute, during the suppression and expression 90-s epochs of the trauma suppression task.

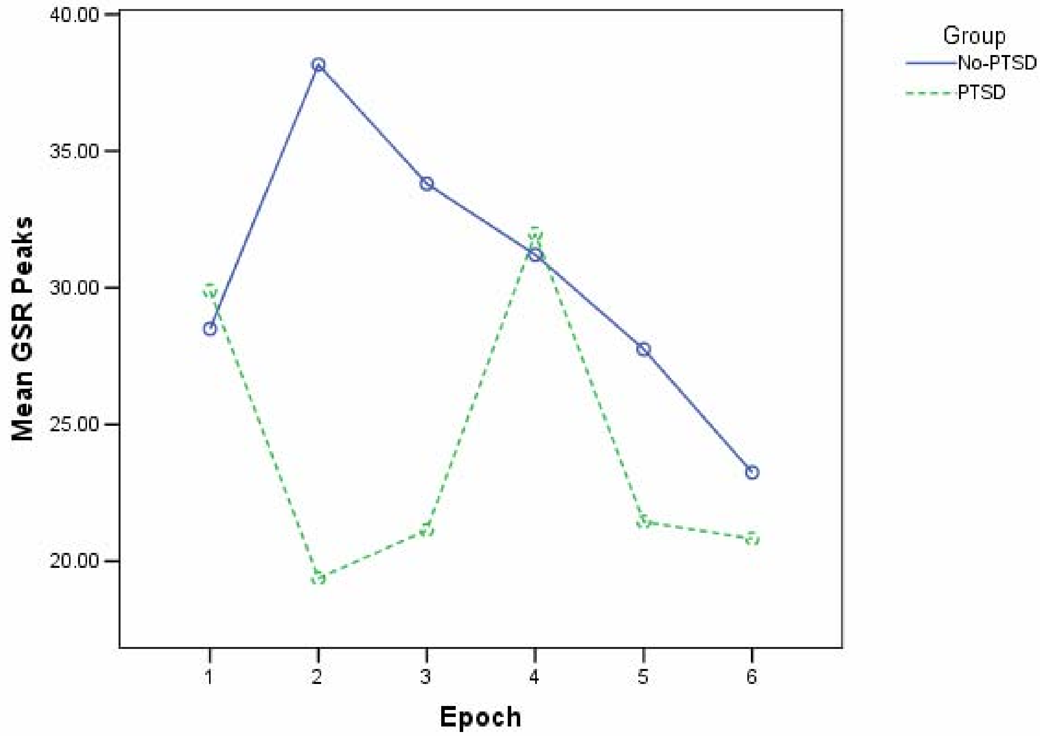

12
10
8
6
4
2
0
Number of Target Thought
PTSD Suppression
No-PTSD Suppression
PTSD Expression
No-PTSD Expression
Neutral
Trauma



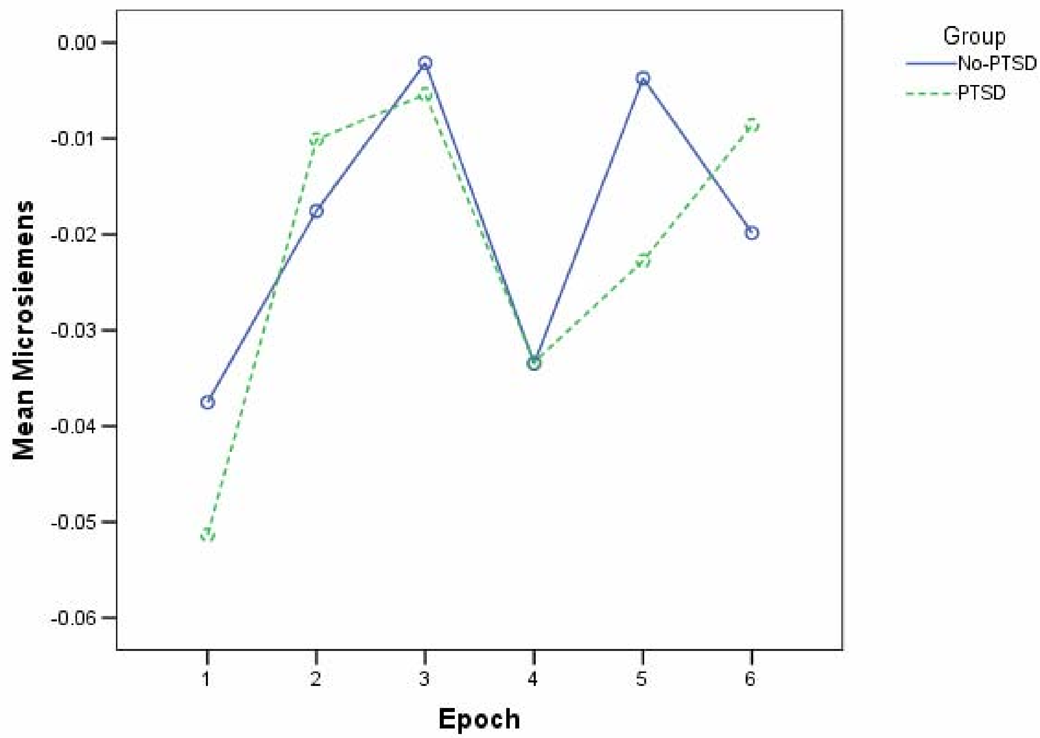
Mean Microsiemens
0.025
0.00
-0.025
-0.05
-0.075
-0.10
1
2
3
4
5
6
Epoch
Group
No-PTSD
PTSD

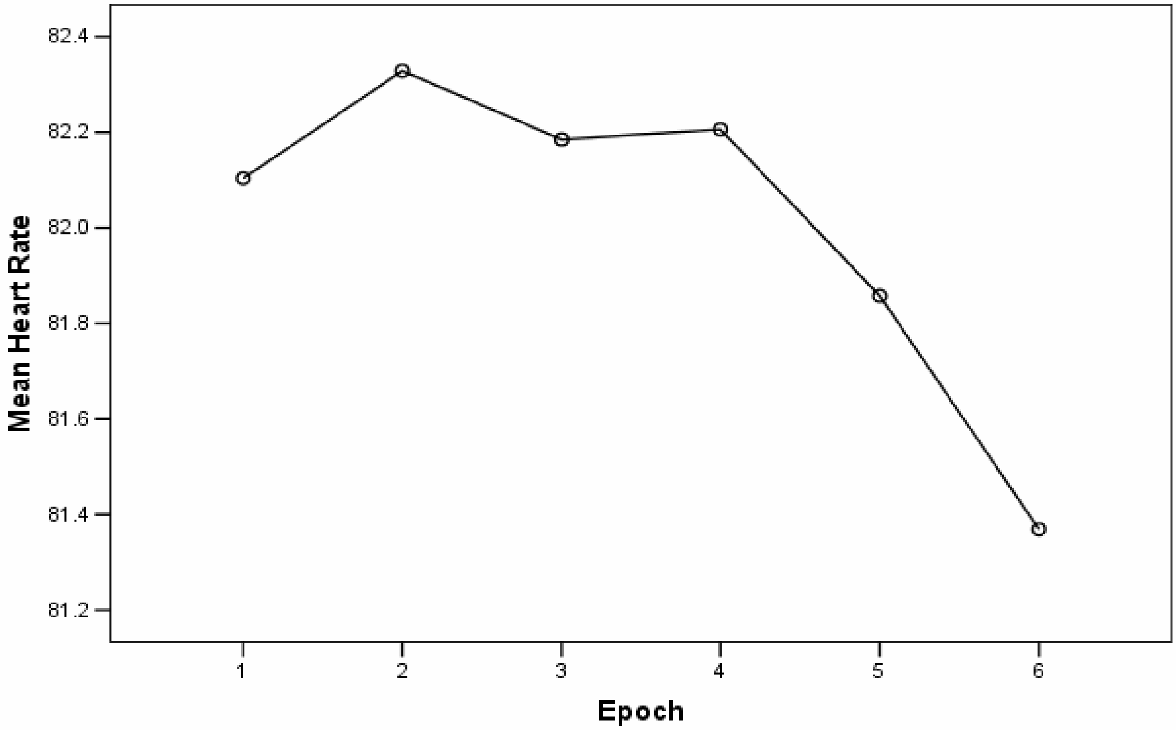

Group
No-PTSD
PTSD
Mean Heart Rate
92.00
90.00
88.00
86.00
84.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Epoch


Salivary Cortisol in ug/dL
0.225
0.20
0.175
0.15
0.125
0.10
0.075
Baseline
Post-Neutral
Post-Trauma
Time
Group
No-PTSD
PTSD



40.00
35.00
30.00
25.00
20.00
Mean GSR Peaks
1
2
3
4
5
6
Epoch
Group
No-PTSD
PTSD


Group
No-PTSD
PTSD
Mean Microsiemens
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
1
2
3
4
5
6
Epoch


82.4
82.2
82.0
81.8
81.6
81.4
81.2
Mean Heart Rate
1
2
3
4
5
6
Epoch