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An Examination of Social Connectedness on PTSD and Freezing in a Student Military Population

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An Examination of Social Connectedness on PTSD and Freezing in a Student Military Population

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Abstract

This study investigates the impact of social connectedness (SC) and post-traumatic stress disorder (PTSD) in a military college population, and their relation to physiological measures such as body sway, heart rate (HR), and heat rate variability (HRV). According to previous research, people with PTSD are more likely to exhibit a freezing response to affective images. In the present study, we explore the potential freezing response for military personnel at the levels of PTSD symptom groups and social connectedness. We also investigate the possible buffering effect social connectedness has on the outcome of PTSD and freezing. There was a total of 38 participants with ages ranging from 19-49 (M = 31.87) and a slight majority of males (52.6%). The study was administered in a lab at the University of North Florida, in which participants were administered the following measures: The Social Connectedness Scale - Revised (Lee, Draper, & Lee, 2001), the PTSD checklist for the DSM-5 (PCL-5; Weathers et al., 2013), and the Brief Trauma questionnaire (Schnurr, Vielhauer, Weathers, & Findler, 1999). The participants also took part in a measure of mobility using the Matscan pressure mat (Tekscan Inc.), while their HR/HRV (eMotion Faros) was recorded as they watched affective (pleasant, neutral, and unpleasant) images. There was a pattern of reduced sway for military personnel regardless of PTSD symptom group or social connectedness; however, there were no significant differences in heart rate, heart rate variability, or mobility across the conditions. Analyses revealed a significantly lower PTSD symptoms scores for participants with higher levels of social connectedness. This finding is especially important as it indicates the essential role social connectedness plays in well-being. Social connection may further provide insight into intervention and treatment options for PTSD.

An Examination of Social Connectedness on PTSD and Freezing in a Student Military Population

Stress in our society has become commonplace and more prevalent (Xue et al., 2015). Studying stress and its effects in the population is necessary, as there is accumulating evidence of disorders, such as early onset cardiovascular diseases, immediately following diagnosis of a stress disorder (Song et al., 2019). While stress can lead to disease, it is essential and adaptive to our livelihood. Stress can lead to change, progress, and appropriate reactions (Mowrer, 1939; Selye, 1976). The positive products of stress have stemmed from our ability to perceive the environment rather than just react to stimuli. When our bodies experience the effects of stress, we attempt to find ways to alleviate the symptoms or the stressor through many coping methods like resolving the stressor, therapy, and breathing exercises (Seppälä, et al., 2014). However, there are instances where stress may not be so easily corrected.

Those in the military, both active and veterans, are more likely to be exposed to stressful and traumatic events. This leads their risk of developing PTSD to be higher than the average population (Prigerson, Maciejewski, & Rosenheck, 2001). Not only are they more likely to experience trauma, they are also more likely to experience more than one traumatic event. In the case of multiple traumatic events, there is an enhanced possibility of developing fear learning in which exposure to multiple traumatic events decreases the ability to properly assess the environment. This was seen within animals who experienced multiple events where they were shocked, compared to those who were only shocked once (Rau & Fanselow, 2009). The inability to assess danger may lead to inappropriate defense responses and overgeneralization of threatening stimuli (Fragkaki, Roelofs, Stins, Jongedijk, & Hagenaars, 2017).

Experiences of trauma in combat can lead to PTSD, but there are also pre-military and post-military factors that can influence whether military personnel are diagnosed or if the diagnosis is chronic or able to remit. Some pre-military factors include the age recruits entered the military, environment of childhood, economic deprivation, and family psychiatric history (Schnurr et al., 2004). Post-military factors include social support and service members' coping skills. The military does their best to ensure those who are deployed come back safe and check for complications or changes with their mental health; however, there are people who still may be more prone to developing mental health consequences after traumatic events. Anxiety, sleep disturbances, and alcoholism can be seen in individuals who experience trauma, as well these symptoms may result in development of PTSD (Macera, Aralis, Rauh, & MacGregor, 2013; Volpicelli, Balaraman, Hahn, Wallace, & Bux, 1999). One proposal to help prevent this would be to use screening prior to joining the military that would look at pre-military factors to ensure the support specific to the candidate to reduce their vulnerable to developing PTSD (Lewis et al., 2015).

According to the DSM-5, PTSD can be identified by the exposure to actual or threatened death, serious injury, sexual violation, and a main focus on the behavioral characteristics (America Psychiatric Association, 2013). The behavioral characteristics fall within clusters including: re-experiencing the event through spontaneous memories of dreams, avoiding the memories or physical reminders, negative cognition and mood, such as feeling estranged from others, and arousal, which is marked by aggressive and reckless behavior, hypervigilance, and sleep disorders (American Psychitaric Association, 2013; Andrewes & Jenkins, 2019; Murkar & Konink, 2018; Wilson, Ebenezer, McLaughlin, & Francis, 2014). Evolutionarily, our defense responses to trauma or dangerous environments is adaptive, as we have inherited strategies to evade danger through avoidance, fighting, or fleeing (Cantor, 2009; Porges, 2007); PTSD, however, is a maladaptive defense mechanism. Yet, our responses to different types of trauma can extend the length of symptoms or increase PTSD's severity (Lehavot et al., 2018).

Within PTSD research, some frameworks propose ancient defense mechanisms have been ingrained to promote our survival (Porges, 2007; Canter, 2009). Symptoms of PTSD were functional in times with more threats to attend to, as hypervigilance effectively helped with the protection of an individual and their family (Canter, 2009). As society has fewer dangerous threats, this adaptation has become less useful, yet PTSD is still prevalent (Xue et al., 2015). The environmental changes from combat to civilian life, in which there may be less threats and greater social connection, has been shown to be protective against PTSD, yet the intensity of and defense response to the trauma will strongly predict PTSD outcomes (Nayback, 2009; Baldwin, 2013). As animals are generally able to come back to a functioning state once the danger is gone due to associating the threat with survival; according to the defense cascade, defense response in humans result from primitive emotional states, which may increase the compulsion for post-combat veterans to ruminate on their experience, associated with PTSD and sleep disorders, (Borders, Rothman, & McAndrew, 2015). The variability of the symptom's lifespan and premises that only active defense (fight or flight) counts as a response to trauma, had led to a dismissal of the study of primitive defense responses (Baldwin, 2013).

Defense Cascade Model

The natural flow of the defense cascade allows us to respond appropriately, as each defense is a function of individual responses influenced by the characteristics and context of the threat (Kozlowska et al., 2015). In response to trauma the arousal state allows the body to attend to the danger, followed by an active defense response, such as fight-or-flight, to defend from the danger. In the event that there is no possibility of defense or escape, freezing may occur, which is described as fight-or-flight put on hold. Tonic immobility, which has been described as disassociation and heaviness, or collapsed immobility, in which muscle tone is lost resulting in fainting, may occur as a last resort and is described as a failed fight-or-flight. Quiescent immobility is the last step of the defense cascade in which the body is still to promote healing and rest. The capacity to recover from the defense cascade is subjective to the individual and experience, as animals have an easier recovery, but humans may find themselves responding with similar defense responses in the future (Kozlowska et al., 2015; Schalinski, Elbert, & Schauer, 2013).

According to the defense cascade theory, a typical physiological response to threat would involve a decrease in heart rate (HR) followed by an increase after perception of the threat occurs (Adenauer, Catani, Keil, Aichinger, & Neuner, 2010). Veterans exhibit quicker activation of the left side of the amygdala in response to aversive stimuli, which may indicate an increased emotional response or hypervigilance towards the threat (Badura-Brack et al., 2018). This activation is in line with the defense cascade model, as veterans with PTSD exhibited greater initial heart rate (HR) response to aversive stimuli, which may be indicative of a faster fight-or-flight reaction to threat (Adenauer et al., 2010).

Stress Response Theory

The stress response theory (SRT) proposes a triadic model of illness that occurs from stress. Stress is defined as a state which includes the nonspecific changes within the biological system (Selye, 1959). The SRT includes the General Adaptation Syndrome (GAS) in which there are three stages including the alarm reaction, resistance, and the exhaustion stage.

The alarm reaction stage is characterized by the fight or flight reaction. This stage occurs as a result of a stressor and activates the sympathoadrenal medullary system and the release of epinephrine and norepinephrine, which results in physiological responses like vasoconstriction leading to increased heart rate, the dilation of bronchi and increased respiration, blood pressure (Hussain & Maani, 2019). This is the stage in which one would decide to either confront or disengage from the perceived threat. This stage is adaptive as it can help us respond to stress or traumatic events; however, if the body is chronically in the alarm stage, negative side effects will occur (Selye, 1959). When a rat is chronically in this stage, their body will show significant changes like reduction in fat and a shrinkage of organs including spleen, thymus, and lymph glands (Sarjan & Yajurvedi, 2019; Michel, Duclos, Cabanac, & Richard, 2005).

Following the alarm reaction stage, the resistance stage should occur. In this stage, individual's bodies will attempt to counteract the alarm reaction stage by engaging the parasympathetic nervous system. This engagement should allow our bodies to begin to relax and typically occurs within 48 hours after the stressor event. The last stage is exhaustion. Exhaustion occurs if the stressful event continues, which can lead to fatigue, anxiety, and burnout (Selye, 1950). The first two stages are beneficial only in the short term. If the stress becomes elongated or chronic, the alarm stage will continue to activate the sympathetic nervous system. This is not adaptive and would lead to exhaustion and a continued depletion of resources. The body would have a difficult time repairing itself, because the resistance stage would not be able to take over (Selye, 1959).

Polyvagal Theory

Similar to the general adaptation syndrome, there are three dynamic systems of response within the polyvagal theory. The first is the social engagement system, which is associated with the myelinated vagus nerve and mammalian structure, since only mammals have a myelinated vagus (Porges, 2009). When the myelinated branch is activated, the parasympathetic nervous system (PNS) is engaged. The PNS is responsible for the body's ability to relax and is known to help "rest and digest" by dampening the hypothalamic-pituitary-adrenal axis (HPA). It encourages blood flow throughout the cardiovascular system, respiratory system, digestive system, and reproductive system.

Another system of the polyvagal theory is the mobilization system. It is activated by the sympathetic nervous system (SNS) and causes a reaction within the associated systems. These reactions include decreases in digestive and reproductive systems and an increase in blood flow to the heart. This function equips us to be able to respond to a threat. Blood is distributed to the cardiovascular system and away from the digestive and reproductive systems. The heart begins to pump quicker and we breathe faster, this enhances our ability to fight or run away (Porges, 1995).

The third system is known as the immobilization system, which involves the unmyelinated vagus nerve and is thought to be more ancient and reptilian (Porges, 1995). In the instance of immobilization, body sway would reduce, and heart rate would decelerate (Volchan et al., 2011). This response is often called "freezing" or attentive immobility. Freezing is an ancient response in which one "plays dead". This can be seen through animals such as opossums and mice, as they freeze in response to a predator to avoid being seen.

To be able to determine how to respond, the polyvagal theory proposes the idea of neuroception. It is the ability to determine if our environment is safe, dangerous, or life threatening. If it is safe, the parasympathetic nervous system helps dampen the sympathetic response. If the environment is determined to be dangerous, then the fight-or-flight response of the sympathetic system will engage to help us determine the best action to take (Porges, 2007).

The theory proposes that there is a hierarchy of response, the top of the hierarchy, the social engagement system, is expected to be engaged most of the time. Our first reaction would be to “tend and befriend”, which is a result of an activated PNS. The PNS is associated with higher resting heart rate variability (HRV) and prosocial behavior, cooperation, and emotion recognition (Beffara, Bret, Vermeulen, & Mermillod, 2016; Quintana, Guastella, Outhred, Hickie, & Kemp, 2012). If we perceive a threat, the hierarchy moves down to the mobilization system or fight-or-flight. This is when our SNS is activated, which is associated with physiological responses like increased heart rate and respiration. The last reaction of the hierarchy is the immobilization system or freezing. Freezing occurs as a result of a threat in which we are unable to escape (Blanchard, Giebel, & Blanchard, 2001).

These automatic responses to stress are essentially adaptive to our capacity to survive. The capacity of avoidance (flight) can lead us to be able to avoid a stressful/traumatic event, while mobility (fight) gives us the ability to defend off an attacker. The immobilization response within humans has not been as well studied as it has been within animals (Hagenaars, Roelofs, & Stins, 2014). This leads to a need for research of immobilization within humans. Understanding the psychological and physiological impacts during the immobile response to trauma may discern clinical treatment, as animals are better able to rebound from immobilization than humans and may not offer substantial treatment options (Kozlowska, Walker, McLean, & Carrive, 2015).

Freezing/Tonic Immobility and Heart Rate Variability

Within the literature surrounding reduced body sway, there is an overuse of the term “freezing”, in which it has become an interchangeable term for the different types of immobility (Volchan et al., 2017). In order to clarify this term, the physiological differences and types of threats that evoke immobile responses have been compiled in Table 1 and discussed below. While there is a need for further research on the immobile response within humans, as well as clarification of the terminology, animal models may provide insight into design setup and variables to focus on. Animal models also offer the possibility of introducing psychological disorders and assessing reactions during more extreme forms of stimuli, such as electric shocks or isolation, which are not suitable to study within humans (Borghans & Homberg, 2015).

Within animal models of immobility, differences in response pertain not only to the context of the threat, but to the species that perceives it (Eiliam, Izhar, & Mort, 2011). Observations of mice that perceive an approaching threat that is inevitable will freeze, indicated by bradycardia and reduced movement; however, if the approaching threat was perceived to be avoidable, the mice prepares to avoid the threat, indicated by increased heart rate (HR) (Wendt, Löw, Weymar, Lotze, & Hamm, 2017). Similarly, crabs that were faced with a predator on rock rather than sand, exhibited avoidant behavior and shorter tonic immobility, as they perceived escape to be possible (O’Brien & Dunlap, 1975). Counterintuitive to the polyvagal hierarchy of response, frogs that encounter a snake from a long distance will be more likely to freeze and will flee as the snake approaches, whether the snake has detected them or not (Nishiumi & Mori, 2015). Studies on baleen whales has shown different species of baleen whales may predict whether they fight or flee from an attack, in which 5 species are known to fight back with one genus more likely to flee and if caught exhibits an immobile behavior (Ford & Reeves, 2008).

The prevalence of PTSD within the military and first responders encourages a need for a greater understanding of the variance of threat experiences, symptoms, and ways to buffer its development, since humans are less capable of recovering from tonic immobility. The research that has been conducted with humans has shown the physiological characteristics that accompany freezing in response to aversive stimuli (Hagenaars et al., 2014; Fragkaki, Stins, Roelofs, Jongedijk, & Hagenaars, 2016). Freezing occurs in response to a threat in which there is no escape (Blanchard, Flannely, & Blanchard, 1986). The body's natural sway is reduced and there is a reduction in HR or bradycardia (Hagenaars, Stins, & Roelofs, 2012). During a freezing response, HR and heart rate variability (HRV) are expected to decrease in response to negative stimuli when there is no possibility of fighting or fleeing (Volchan et al., 2017). When we perceive no threat, our heart will focus on supplying the oxygen dependent central nervous system.

Freezing has also been described as attentive immobility (Volchan et al., 2011). Attentive immobility leads to heart rate reduction and reduced mobility. This type of immobile response is engaged by a detected potential threat. This form of immobility allows for greater attention to the threatening event to prepare for an active defense response (Vianna & Carrive, 2005). In the case of immobility under attack, the animal's heart rate may begin to slow down even to a point in which it is considered "too slow" (bradycardia), and the animals body sway will reduce. Immobility under attack occurs in response to threat in which there appears to be no escape (Cantor, 2009).

Tonic immobility, as opposed to attentive immobility, is characterized by a reduction in body sway and tachycardia, in which the heart will beat over 100 times per minute. This response tends to be seen in the instances where the animal believes its life is in extreme risk and occurs as a last resort. Tonic immobility also predicts poorer recovery from PTSD and an increased immobile response to other threats (Hagenaars & Hagenaars, 2020). Collapsed immobility also occurs as a last resort to a threat, like tonic immobility, which results in reduced muscle tone (hypotonia) leading to fainting and decreased heart rate. The experiences of tonic immobility and attentive immobility are automatic physiological responses to threat, as seen with fight-and-flight responses (Volchan et al., 2017).

Table 1

Defining Freezing and Differences within Immobilization

Term	**Threat**	**Heart Response**	**Body Response**
Freezing [a],[b],[c]	Threat is Close; Blocked Escape	Reduced HR, Bradycardia	Reduced Sway
Attentive Immobility [d]	Potential Threat Detected	Bradycardia	Reduced Sway
Immobility under Attack [d]	Attack with Blocked Escaped	Bradycardia	Reduced Sway
Tonic Immobility [d]	Life at Extreme Risk	Tachycardia	Reduced Sway
Collapsed Immobility [e]	Threat Induced Fainting	Bradycardia	Hypotonia

Note. [a] (Blanchard, Flannelly, & Blanchard, 1986); [b] (Vianna & Carrive, 2005); [c] (Hagenaars, Stins, & Roelofs, 2012); [d] (Volchan et al., 2011; Volchan et al., 2017) [e] (Kozlowska et al., 2015)

Perceived Social Connectedness

Social support is generally considered to involve a connection to specific relationships (type and size), whether support is received, and that support is available if needed (Platt, Keyes, & Koenen, 2014). Within social support research there is evidence for specific kinds of support that may be most influential. Firefighters were associated with lower PTSD symptom severity when they had social support, especially from their supervisors (Stanley et al., 2019). Within a veteran population, those with increased perceptions of social support were less likely to develop PTSD and played a role in successful treatment (Gros et al., 2016). Veterans were associated with lower PTSD when they reported social support from their significant other, family, and military peers compared to friends. While social support can inhibit the development of PTSD or reduce severity, PTSD can also lead to reduced social support (Platt, Lowe, Galea, Norris, & Karestan, 2016). After service in the military, many veterans have to create or join new communities, which can be challenging for some, especially for those with PTSD, as social detachment may occur (Sippel, Watkins, Pietrzak, Hoff, & Harpaz-Rotem, 2019).

While there is evidence for the importance of social support, this study aims to assess the effectiveness of social connection on PTSD symptoms and immobile responses. Social connectedness has been defined as an enduring sense of self in connection to the world and the attitudes held about relationships with others (Lee & Robbins, 2000; Lee, Draper, & Lee, 2001).

Social connectedness is a valuable resource for improving one's health, as research has shown it can help increase longevity, lead to stronger gene expression for immunity, and help decrease mood disorder symptomatology (Capitanio & Cole, 2015; Yoo, Miyamoto, & Ryff, 2016). A lack of social connectedness is a strong risk factor for the development and maintenance of PTSD (Brewin, Andrews, & Valentine, 2000). However, social connectedness' relation with PTSD is bidirectional, as some examples of the symptomatic criteria for PTSD diagnosis include experiencing negative beliefs about oneself or others and feelings of detachment or estrangement from others (American Psychiatric Association, 2013; Center for Substance Abuse Treatment, 2014). Continued post-trauma social connectedness can help reduce or stave off PTSD, but symptoms of PTSD can lead to decreased social connection (Platt, Lowe, Galea, Norris, & Koenen, 2016). This may lead those with PTSD to underreport their social connectedness, as they may perceive it to be poor when it is not.

Since we are social beings, this would suggest that feelings of social connection and support is adaptive. The polyvagal theory proposes that there is a social engagement system (myelinated vagus) that is used to help us relax and when frequently engaged people exhibit higher self-regulation and socialization (Porges, 2009; Geisler, Kubiak, Siewert, & Weber, 2013). If a threat is detected, the social engagement system would shift into the mobilization or immobilization system; however, once the threat is gone, a shift back into the social engagement system should occur. According to the hierarchy of the polyvagal theory, individuals should remain in the social engagement system to a greater degree than the mobilization or immobilization systems; however, this may be hindered for those with increased PTSD symptoms of detachment. Feeling socially connected may benefit those with PTSD, as they may be less likely to perceive a threat as life threatening and may not move down the polyvagal hierarchy (Fernandes Jr. et al., 2013). However, remaining in the social engagement system may be more difficult, as perceptions of threat may be distorted through a heightened engagement of the mobilization and immobilization systems (Adenauer, Catani, Keil, Aichinger, & Neuner, 2010; Young et al., 2019). This ability may also be hindered for those diagnosed with PTSD due to fear learning (Careaga et al., 2016; Lee et al., 2016). In fear learning, the defense response to trauma, especially a reoccurring trauma, may be repeated (Kozlowska et al., 2015). This would be detrimental, as research has shown that an increased tonic immobility response to trauma leads to more severe PTSD symptomology and worse treatment outcomes (Fiszman et al., 2008; Portugal et al., 2012).

Factors that may help predict PTSD development within our environment includes understanding the subjective and objective ratings of risk factors (Luthar et al., 2000), as veterans who felt negatively towards their community may have persistent PTSD while those who positively view their community exhibit PTSD remission (Koenen et al., 2003). Positive perceptions of social connectedness may buffer immobility, as it helps reduce the potential "freezing" response for those with PTSD. While this relation has not been thoroughly studied, some studies with conspecific rats have shown a decreased freezing response, as well as decreased fear learning when the rats were shocked together rather than by themselves (Lee & Noh, 2016). Social threat has been examined as a greater cue for freezing than other stressors, as those who experience social exclusion experienced increased tonic immobility symptoms (Mooren & Minnen, 2014), which may indicate why the perception of being socially connected can buffer the physiological response of tonic immobility (Roelofs, Hagenaars, & Stins, 2010; Mooren et al., 2014).

The Present Study

This study aims to test the reliability of physiological measures to provide accurate options for future research of stress and PTSD. It also hopes to understand the potential use of social connectedness as a measure of prevention and maintenance of PTSD.

Hypotheses

Based on the theoretical framework proposed above, participants with higher levels of PTSD symptoms would exhibit an increased "freezing" response, which would include reduced mobility and bradycardia during unpleasant images in comparison to pleasant or neutral images. It is also expected that participants with increased social connectedness scores would show decreased physiological signs of a "freezing" response to unpleasant images, which would include higher heart rate, heart rate variability, and increased mobility compared to those with lower social connectedness scores. It is hypothesized that participants with an increased perception of social connectedness would score lower on the DSM 5 PTSD scale, as those with greater social connectedness tend to be less susceptible to developing PTSD or have less severe symptoms (Stanley et al., 2019). The ability to flexibly shift from one system (social engagement) to another (mobilization or immobilization) is essential for being able to cope with threat and stress (Roelofs, 2017; Kozlowska, Walker, & Carrive, 2015). However, this ability may be hindered for those diagnosed with PTSD, which is why it is hypothesized that social connectedness would buffer the "freezing" response to unpleasant images for those with higher PTSD symptoms.

Method

Participants

Participants included 38 people (18 women and 20 men, M_{age} = 31.87 years, *SD* = 7.357) recruited online through the University of North Florida's SONA-System, flyers posted on campus, and through email blasts sent by the University's Military Veterans Resource Center (MVRC). To be eligible for the study, the participants needed to be 18 years of age or older and be a veteran or currently in the military. Data was collected between October 2017 to March 2020 from volunteers ages ranging from 19 - 49. The majority of participants were Caucasian (65.8%), followed by African American (13.2%), Hispanic/Latino (7.9%), Asian/Pacific Islander (7.9%), and Other/Multiple (2.6%). All of the participants were either veterans or currently enlisted within the Navy (47.4%), Army (23.7%), Air Force (13.2%), Marine Corps (13.2%), and Other (2.6%). 86.8% of the participants were no longer serving active duty with 2.6% serving active duty, 7.9% were Reserve Members serving active duty, and 2.6% serving as active duty National Guard. A power analysis using G*Power (Kiel, Faul, Erdfelder, Lange, & Buchner, 2007) determined there should be at least 43 participants in order to have an 80% chance of finding a statistically significant ($p < .05$) medium effect size ($f = .35$).

Procedure

Volunteers signed informed consents at the beginning of each session, after which they completed questionnaires through Qualtrics. The questionnaires included the Social Connectedness Scale - Revised (Lee, Draper, & Lee, 2001), the PTSD checklist for the DSM-5 (PCL-5; Weathers et al., 2013), the Brief Trauma questionnaire (Schnurr, Vielhauer, Weathers, & Findler, 1999), questions regarding military experience, and demographics.

Upon completion, participants attached a heart rate variability (HRV) monitor and sat for a two-minute baseline where they were instructed to remain quiet and still. After replacing their shoes with disposable shoe covers, they completed a step on calibration based on their estimated weight. The participants were instructed to stand on the Matscan pressure mat (Tekscan Inc.), press the heart rate monitor to mark the beginning and end of each slide show, and to watch the monitor that stands one meter away with arms at their sides for the duration of 60 seconds, which was repeated four times. Participants stood off the mat for a duration of 60 seconds in between conditions. The slide shows included three conditions: pleasant, unpleasant, and neutral that were randomly selected to be counterbalanced among the participants. The images in the slideshow were chosen from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). The recorded postural sway was measured as average area using the SAM™ (Sway Analysis Module) software. The participants sat for another two-minute baseline, removed the HRV monitor, and were provided a debriefing form following the end of the session.

Participant information (e.g., name, email) was collected and kept in a single binder and locked in a cabinet at the end of each session. No identifying information was collected on the Qualtrics survey. Participation was voluntary, and compensation was provided in the form of a twenty-dollar gift card and extra credit after completion.

Heart Rate Recording

Participants were given privacy to attach the eMotion Faros sensors in three locations (under left and right collarbones, and the left rib cage), as instructed by the researchers. Device ID numbers were recorded prior to each session, and at the end of the session the data would be downloaded onto an external hard drive. Using eMotion Faros Manager, the clock was set to the Eastern Time Zone to ensure the time of recording and markers during tasks were comparable. Heart rate (HR) and heart rate variability variability (HRV) data was visually inspected and edited offline using Kubios software. The data was calculated with procedures developed by Porges (1985). HRV is an established measure of vagal influence on the heart in which decreased HRV is associated with higher stress and PTSD (Porges, 2009; Tan, Dao, Farmer, Sutherland, & Gevirtz, 2011). To assess the differences between freezing and immobility, both average HR and the root mean square of successive differences between normal heartbeats (RMSSD) will be analyzed. RMSSD is correlated with high frequency band but is less influenced by breathing, making it more successful at assessing several tasks (Hill, Siebenbrock, Sollers, & Thayer, 2009; Shaffer & Ginsberg, 2017). The data will be analyzed using the Automatic Artifact Correction within Kubios. The automatic correction detects artifacts, such as extra beats and misaligned beats, in each beat interval that exceed the average R-R interval (Tarvainen, Lipponen, Niskanen, Ranta-aho, 2018).

Social Connectedness

The Social Connectedness Scale - Revised (SCS-R, Lee, Draper, & Lee, 2001) was used to measure participants' perceptions of social connectedness and support. The 20-question scale included statements such as “I feel close to people”, “I am able to relate to my peers”, and “I fit well in new situations”, which participants responded with a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree). The 10 negatively worded items were reversed scored and the scale was summed together with higher rated scores reflecting a stronger sense of social connectedness. The internal item reliability of the scale was $\alpha = .92$ within a college population from a large southwestern university (Lee, Draper, & Lee, 2001). The convergent validity was examined by Lee, Draper, and Lee (2001) showing a negative correlation with loneliness ($r = -.80$) and positive correlation with collective self-esteem (membership $r = .49$, private $r = .42$, public $r = .39$). They also examined discriminant validity of the SCS-R, which was not correlated with personal responsibility and controlling behaviors, distinguishing social connectedness from these constructs.

PTSD and Trauma

Participants responded to the 20 question PTSD checklist for the DSM-5 (PCL-5; Weathers et al., 2013). Of the three formats of the PCL-5, participants were given the one without a Criterion A component, as trauma was measured using the Brief Trauma Questionnaire (Weathers, Litz, Keane, Palmeieri, Marx, & Schnurr, 2013). Participants responded to questions such as "In the past month, how much were you bothered by: Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?" using a 5-point Likert-type scale ranging from 0 (not at all) to 4 (extremely). A total sum composite of the PCL-5 was calculated to be used within the study where a higher rating indicates higher PTSD symptoms. The measure was found to be reliable, with internal consistency (α = .94), convergent validity with other PTSD measures (*r* s = .74 to .85), and discriminant validity with measures ranging from lowest (Antisocial Personality features) to highest (Depression) (*r* s = .31 to .61) (Belvins, Weathers, Davis, Witte, & Domino, 2015). The measure also demonstrated good test-retest reliability (*r* = .82) (Weathers et al., 2013).

To determine the extent of trauma in which each participant has experienced, they answered the Brief Trauma questionnaire (Schnurr, Vielhauer, Weathers, & Findler, 1999), which consisted of 25 questions. An example item included "Have you ever served in a war zone, or have you ever served in a noncombat job that exposed you to war-related casualties (for example, as a medic or on graves registration duty?)". The BTQ was designed to assess trauma according to the DSM-IV to complete assessment of Criterion A (life threat and serious injuries) (Schnurr et al, 1999). Participants indicated agreement with each question by answering “yes” or “no”. Kappa coefficients for the interrater reliability of the presence of trauma meeting DSM-IV criterion A was .70 (.74 – 1.00), with illness and “other” life-threatening events not covered by the other categories (Schnurr, Spiro, Vielhauer, Findler, & Hamblen, 2002).

Analysis

After running frequencies, which indicated no outliers to be removed, we ran analyses of variance (ANOVA) to observe mean differences in the demographic variables and PTSD and social connectedness, as well as bivariate correlations to assess the relation of PTSD, social connectedness, heart rate, heart rate variability, and mobility. Chi-squared analyses were used to observe differences in PTSD symptom severity groups and military demographic variables, such as deployment zone (peaceful or combat). Separate repeated measures analysis of variance (ANOVA rm) were used to analyze PTSD and social connectedness with the postural measures during each condition (pleasant, unpleasant, and neutral), heart rate (HR), and heart rate variability (HRV) as the within-subjects variables. Current age, image order, and eyes open HR/HRV were used as control variables for the ANOVA rm. To assess the buffering effect of social connectedness on PTSD symptom group and mobility, we ran a multiple regression to assess moderation against an interaction model in SPSS software package (IBM – version 24).

Participant samples were excluded if they diverted their eyes during the mobility mat measure (n = 1). Due to human error or malfunctions in the equipment, mobility mat data is missing for three participants in the neutral condition, two participants in the pleasant condition, one participant in the unpleasant condition, and heart rate variability data for 8 participants, which were not included in final analyses using case deletion.

Results

Demographics, Social Connectedness, and PTSD

Analyses of variance (ANOVA) were run to observe any differences in the means of demographic variables and the sum scores of social connectedness (SC) and PTSD (summary of results listed in Table 2). The comparison of sex, annual income, race, and marital status did not differ significantly on SC and PTSD sum scores. The difference between service status (Active/Reserve/Guard and Veteran) approached significance, as those who were still in an active status reported increased social connectedness [F (1, 36) = 3.47, p =.071] and decreased PTSD symptoms [F (1, 36) = 3.62, p = .065]. Similarly, participants who were separated from the military reported lower social connectedness [F (1, 36) = 7.91, p = .008] and increased PTSD symptoms [F (1, 36) = 4.79, p = .035]. Participants that reported VA disability had significantly lower social connectedness means [F (1. 36) = 6.41, p = .016] and higher PTSD symptom means [F (1, 36) = 8.63, p = .006]. Participants who deployed in a combat zone reported higher PTSD symptoms [F (1, 20) = 7.86, p =.011] and lower social connectedness [F (1, 20) = 8.35, p = .009] than those that served in peaceful zones.

Table 2

Analyses of Variance for Demographics, Social Connectedness, and PTSD

		Social Connectedness		PTSD	
Variables	n	*M*	*SD*	*M*	*SD*
Sex					
Male	20	79.95	22.42	21.41	16.87
Female	17	74.17	22.16	27.01	18.71
Annual Income					
< $39,999	19	79.37	18.77	20.79	15.05
>$ 40,000	19	74.95	25.42	27.63	19.43

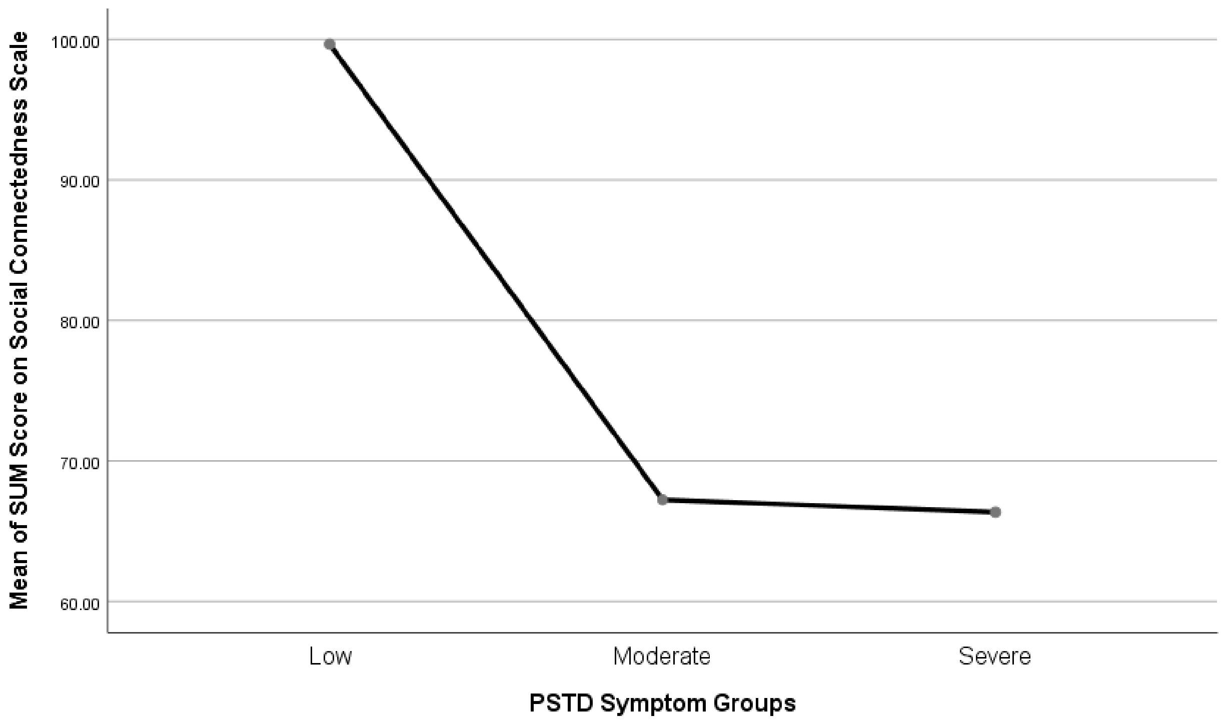
Race					
Caucasian	25	75.92	22.43	25.28	15.77
African American	5	71.60	19.58	25.80	19.41
Hispanic/Latino	3	82.00	32.79	36.33	32.35
Asian/Pacific Islander	3	89.00	28.83	8.67	10.69
Other/Multiple	1	78.00		9.00	
Marital Status					
Married	17	75.53	25.28	24.59	19.78
Not Married	20	78.48	19.82	23.45	16.17
Service Status					
Active/Reserve/ Guard	5	93.80 +	22.02	10.80 +	9.23
Veteran	32	74.94 +	21.38	26.03 +	17.87
Separated from the Military					
No	8	95.13*	25.72	12.75*	13.19
Yes	30	72.37*	18.81	27.27*	17.39
VA Disability					
No	16	87.13**	25.87	15.69*	15.69
Yes	22	69.91**	15.99	16.09*	16.09
Deployment Zone					
Peace	4	87.75**	9.95	10.50*	13.08
Combat	18	64.56**	15.19	33.67*	15.26

Note: + Approaching significance at .07; * $p < .05$; ** $p < .01$.

A Chi Squared analysis was used to assess mean differences of PTSD symptom severity (low, moderate, severe) and deployment zones (combat and peace). The difference between expected and observed frequencies is 15.24 times greater than what would be expected by chance or if null were true. The results revealed a significant relationship between the two variables, where the participants with low PTSD symptoms were deployed in peace zones, those with moderate PTSD symptoms served in combat zones, while those with severe PTSD symptoms were deployed in combat zones with one participant serving in a peace zone X^2 (2, N = 21) = 15.24, $p < .001$. As predicted in hypothesis three, a One-Way ANOVA indicated a significant effect of social connectedness on PTSD symptom groups [F (2, 35) = 16.78, $p <$ .001]. Post hoc comparisons using Bonferroni indicated that the social connectedness mean score for low PTSD symptoms (*M* = 99.67, *SD* = 13.96) was significantly different than the moderate (*M* = 67.25, *SD* = 15.37) and severe PTSD symptom groups (*M* = 66.36, *SD* = 18.67). The social connectedness mean score for moderate PTSD symptom group did not significantly differ from the severe PTSD symptom group.

Figure 1

One-Way ANOVA of Sum Score Social Connectedness at the Levels of PTSD Symptom Groups



Bivariate Correlations

Bivariate correlations of the variables of interest are presented in Tables 3 and 4. PTSD was significantly and positively correlated with loneliness, BTQ event, BTQ danger, and BTQ injury. PTSD was also significantly and negatively correlated with social connectedness. Social connectedness (SC) was significantly and negatively correlated with PTSD, BTQ event, danger, injury, and age. Age was moderately and negatively correlated with social connectedness, as the age of participants went up, their perceptions of social connectedness decreased. SC was also moderately and negatively correlated with BTQ events and BTQ danger, as traumatic events and perceptions of being in danger increased, feelings of social connectedness decreased. PTSD was positively and moderately correlated with unpleasant area but was not correlated with heart rate variability. SC was moderately correlated with neutral mobility, while relationship status was moderately correlated with pleasant mobility. Pleasant and unpleasant heart rate variability was moderately correlated with SC. Age was negatively and moderately correlated with pleasant HRV and negatively and strongly correlated with unpleasant HRV.

Table 3

Bivariate correlations of PTSD Sum, BTQ events, BTQ Danger, BTQ Injury, Social Connectedness, and age

	1.	2.	3.	4.	5.	6.
PTSD	1	.342*	.397*	.394*	- .614**	.282
BTQ Event		1	.825**	.597**	- .458**	.313
BTQ Danger			1	.533**	- .469**	.371*
BTQ Injury				1	- .366*	.232
SC					1	- .444**
Age						1

Note. * $p < .05$; ** $p < .01$. SC = Social Connectedness.

Table 4

Bivariate correlations of PTSD Sum, Social Connectedness, Age, Mobility, and HRV

	1	2	3	4	5	6	7	8	9	10	11
PTSD	1	-.614**	.355*	-.276	.351*	-.296	-.214	-.304	-.244	-.114	.521**
SC		1	-.444**	.07	.009	.339*	.346*	.386*	.143	-.223	-.435**
Age			1	.184	-.253	-0.02	-.497**	-.514**	-0.3	.427**	.525**
PA				1	.157	.325	-.002	.004	.131	.407*	.208

UA	1	.312	0.05	.102	.177	-.11	.052
NA		1	-.077	-.056	.061	.216	-.094
P RMMSD			1	.838**	.691**	-.237	-.323
U RMSSD				1	.709**	-.174	-.320
N RMSSD					1	.168	-.214
RS						1	.516**
PTSD-D							

Note. * *p* < .05; ***p* < .01. SG = Symptom Groups, SC = Social Connectedness, PA = Pleasant Area, UA = Unpleasant Area, NA = Neutral Area, P = Pleasant, U = Unpleasant, N = Neutral, RS = Relationship Status, PTSD-D = PTSD diagnosis.

Hypothesis Testing

ANOVA rm were computed for PTSD and social connectedness (SC) in relation to the log transformed mobility conditions, heart rate, and heart rate variability data. Mobility was transformed using Natural Log 10 to account for the non-normal distribution that was identified during initial analyses. Image order, age, and eyes open heart rate/heart rate variability were identified as variables to control. Preliminary analyses were conducted to ensure the variables met ANOVA assumptions: normality (using natural log transformation), no significant outliers, and sphericity (using Mauchly's test of sphericity). The repeated measures ANOVA for SC and RMSSD did violate sphericity and was corrected using Huynh-Feldt.

PTSD

Hypothesis one predicted participants with higher PTSD symptom severity would exhibit decreased body sway and HR/HRV in response to unpleasant images. The 3 (pleasant, unpleasant, neutral) x 3 (low, moderate, severe) ANOVA rm indicated that mobility conditions did differ on PTSD symptom group mean scores but not significantly [F (4, 56) = 2.51, p = .503, ηp^2 = .057]. A pairwise comparison using Bonferroni correction showed an increase in mobility for the pleasant condition compared with unpleasant and neutral conditions (p = .376 and p = .291, respectively), while the unpleasant condition had lower means than pleasant and neutral conditions (p = .376 and p = 1, respectively); however, it was not significant.

Table 5

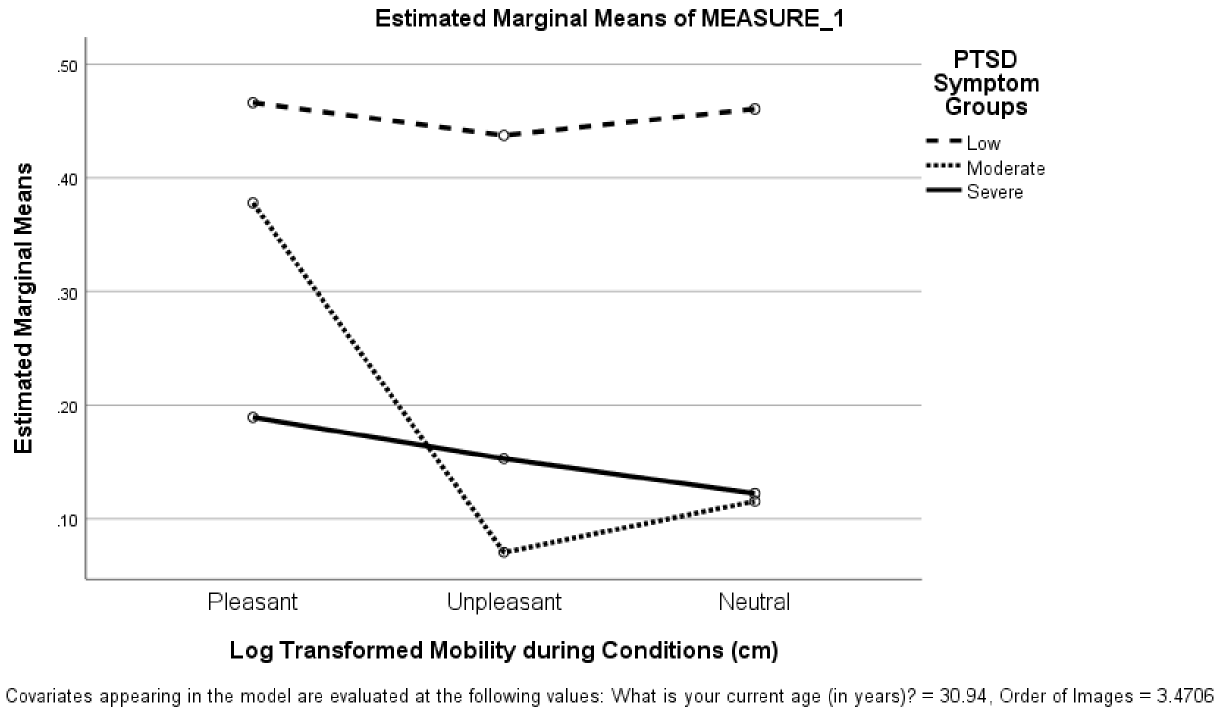
Mobility Condition Means by PTSD Symptom Groups

Variable	PTSD Symptom Group			
LT Mobility	Low	Moderate	Severe	Average Across PTSD groups
Pleasant	.41	.32	.33	.35
Unpleasant	.22	.14	.19	.18
Neutral	.19	.41	.04	.22
Average Total	.28	.29	.19	

Note. LT= Log Transformed.

Figure 2

Changes in Mobility at the level of PTSD Symptom Groups



Note. Participants in the moderate condition exhibit greater decreased mobility within the unpleasant condition, while those with severe PTSD symptoms decrease in mobility most at the neutral condition.

RMSSD means did differ on PTSD symptom groups but not significantly [F (4, 48) = .618, p = .652, ηp^2 = .049]. A post hoc pairwise comparison using Bonferroni correction showed non-significant increases in RMSSD during the neutral condition compared to the pleasant and unpleasant conditions (p = 1). There was a non-significant increase in HRV for participants in the high PTSD symptom severity condition during the unpleasant condition (and for all conditions), which may reflect a decreased freezing pattern. HR means did moderately differ on PTSD symptom groups, but not significantly [F (4, 32) = .778, p = .548, ηp^2 = .089]. Bonferroni pairwise comparisons revealed a significant decrease of unpleasant HR in comparison to neutral HR (p = .034).

Table 6

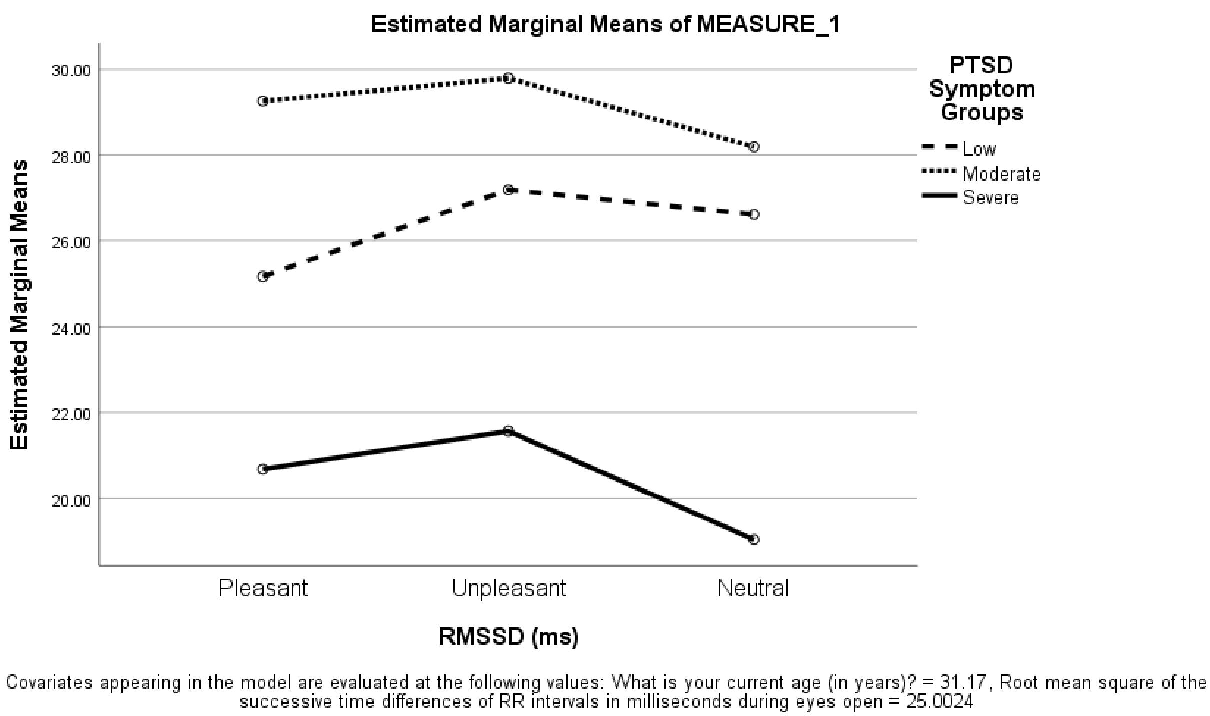
RMSSD and HR Condition Means by PTSD Symptom Group

Variables	PTSD Symptom Group			
RMSSD	Low	Moderate	High	Average Across PTSD Groups
Pleasant	26.16	28.02	20.79	24.75
Unpleasant	28.29	28.48	21.63	25.91
Neutral	27.09	27.26	19.37	24.31
Average Total	27.18	27.92	20.59	
HR				
Pleasant	79.01	76.32	87.34	81.05
Unpleasant	77.14	75.67	86.75	79.99
Neutral	80.52	76.33	88.08	81.83
Average Total	78.89	76.11	87.39	

Note. RMSSD is recorded in milliseconds. HR is recorded as the average beats per minute.

Figure 3

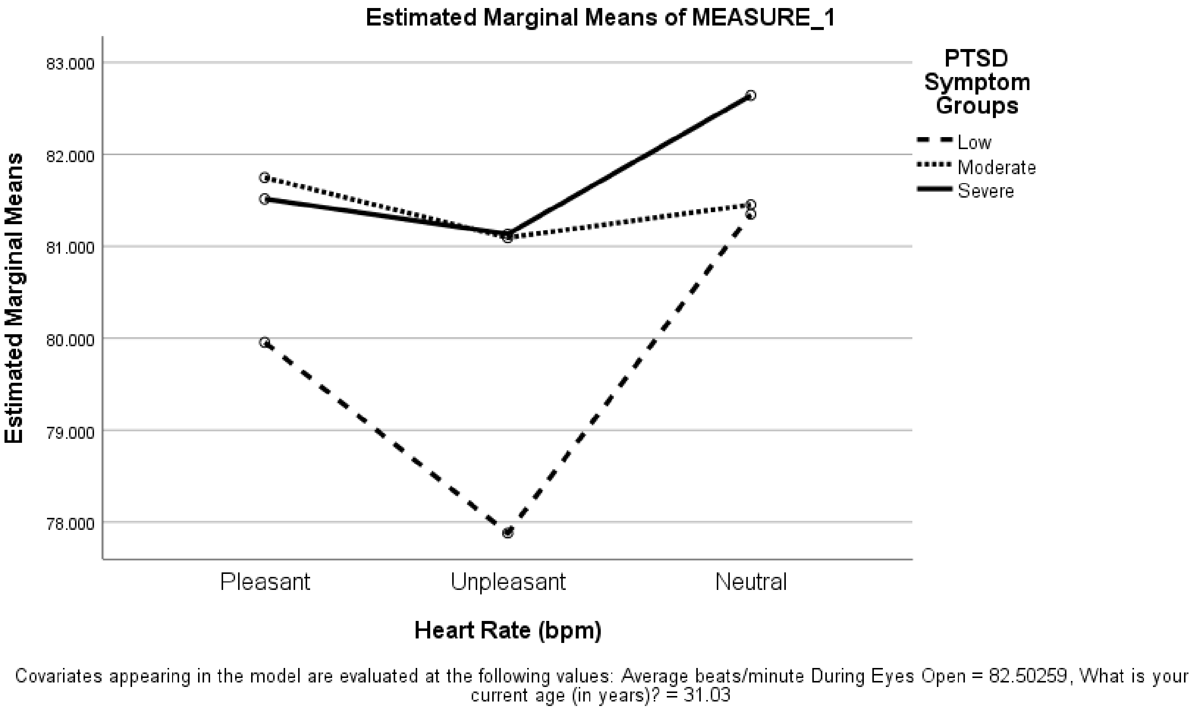
Changes in RMSSD during Conditions at the Levels of PTSD Symptom Groups



Note. The severe PTSD group exhibited overall lowest RMSSD across conditions, with an increase during the unpleasant condition.

Figure 4

Changes in HR during Conditions at the Levels of PTSD Symptom Groups



Note. HR for the low PTSD group, compared to moderate and severe, was lowest at the level of unpleasant. All PTSD symptom groups exhibit a decrease in HR during the unpleasant condition in comparison to pleasant and neutral.

Social Connectedness

Hypothesis two predicted participants with decreased perceptions of social connectedness would exhibit lower body sway and reduced HR/ HRV in response to unpleasant images. A 3 (low, moderate, high) x 3 (pleasant area, unpleasant area, neutral area) ANOVA rm revealed a moderate difference of mobility conditions at the social connectedness levels, although not significantly, [F (4, 54) = 2.12, $p = .09$, $\eta p^2 = .136$]. A post hoc pairwise comparison using Bonferroni correction showed the mean for pleasant area was greater than unpleasant and neutral

($p = .069$, $p = .059$, respectively), while unpleasant area mean was lower than both neutral and pleasant ($p = .065$; $p = .068$, respectively). However, the area differences between pleasant, unpleasant, and neutral were not statistically significant.

Table 7

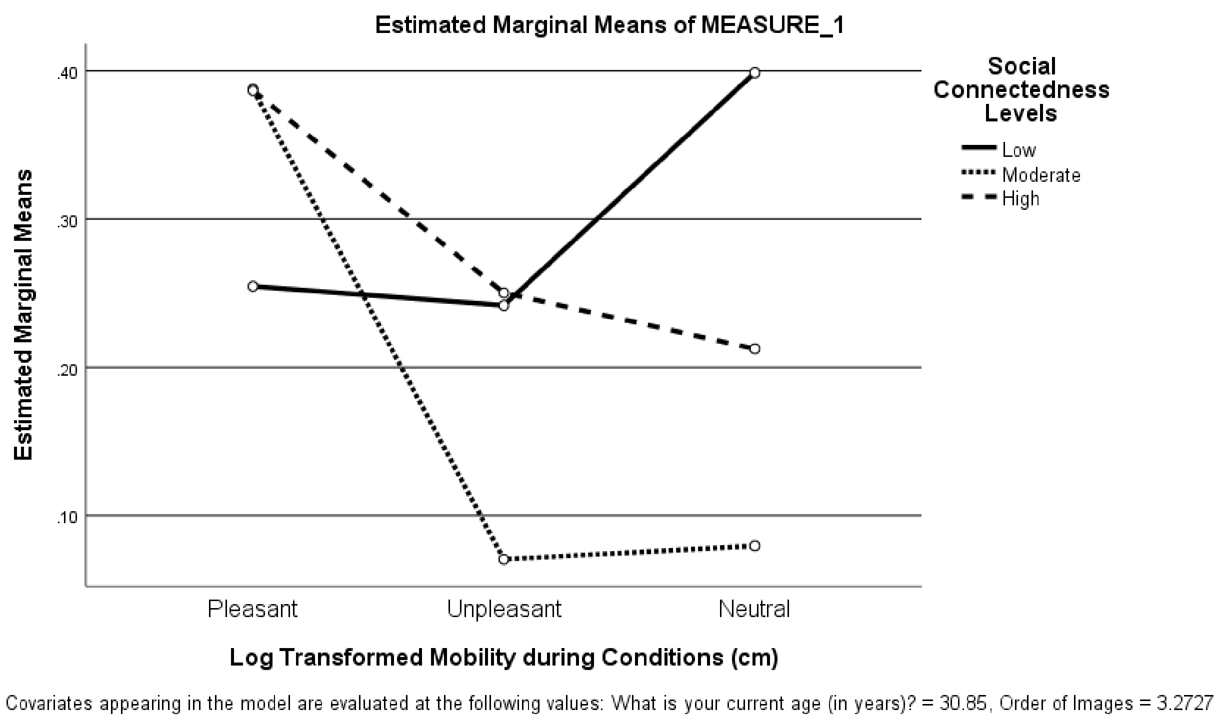
Mobility Condition Means by Social Connectedness Levels

Variable	Social Connectedness Levels			
LT Mobility	Low	Moderate	High	Average Across SC Levels
Pleasant	.30	.37	.37	.35
Unpleasant	.30	.08	.19	.18
Neutral	.47	.07	.17	.22
Average Total	.36	.17	.24	

Note. LT = Log Transformed

Figure 5

Changes in Mobility Conditions at Social Connectedness Levels



Note. Social connectedness levels by area during conditions. Participants with low perceptions of social connectedness had the highest overall area means. The unpleasant condition had the lowest overall area with participants reporting moderate perceptions of social connectedness moving the least.

RMSSD means did differ, non-significantly, between the mean social connectedness levels [F (3.79, 45.46) = .552, p = .689, ηp^2 = .042], and due to a violation of sphericity [$X^2(2)$ = 8.30, p = .016], the df values were transformed using Huynh-Feldt ε = .947 (Muller & Barton, 1989). The pairwise comparison using Bonferroni correction indicated greater RMSSD mean differences for the unpleasant condition; however, it is not significant (p = 1). There were also non-significant mean differences between social connectedness levels and mean HR [F (4, 34) = .38, p = .823, ηp^2 = .043]. The pairwise comparison using Bonferroni correction indicated lower HR for the unpleasant condition than the pleasant or neutral conditions (p = 1; p = .256, respectively) and an increase in HR in the neutral condition than the pleasant and unpleasant conditions (p = .110; p = .256, respectively).

Table 8

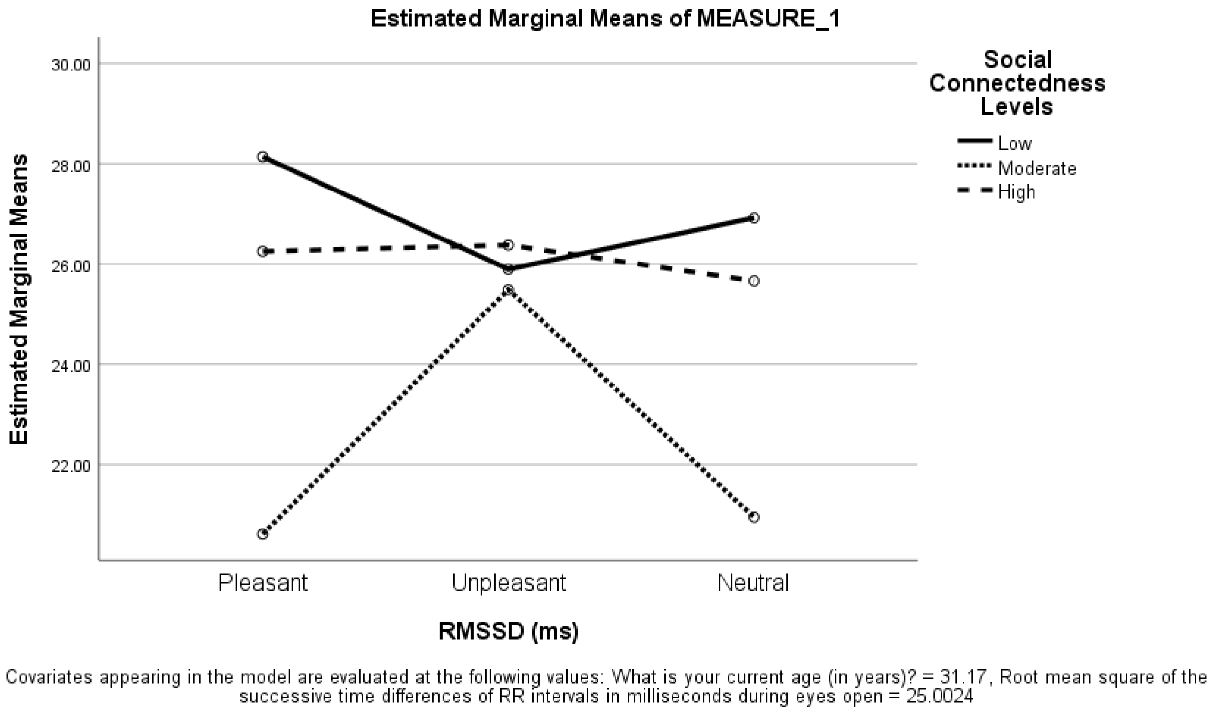
RMSSD and HR Condition Means by Social Connectedness Levels

Variables	Social Connectedness Levels			
RMSSD	Low	Moderate	High	Average Across SC Levels
Pleasant	23.57	23.68	26.99	24.75
Unpleasant	23.68	28.50	27.04	25.91
Neutral	23.44	23.38	26.13	24.31
Average Total	23.56	25.85	26.72	
HR				
Pleasant	79.04	84.56	79.35	81.05
Unpleasant	78.31	84.22	77.29	79.99
Neutral	79.29	84.42	80.51	81.82
Average Total	78.88	84.74	79.05	

Note. RMSSD is recorded in milliseconds. HR is recorded as the average beats per minute.

Figure 6

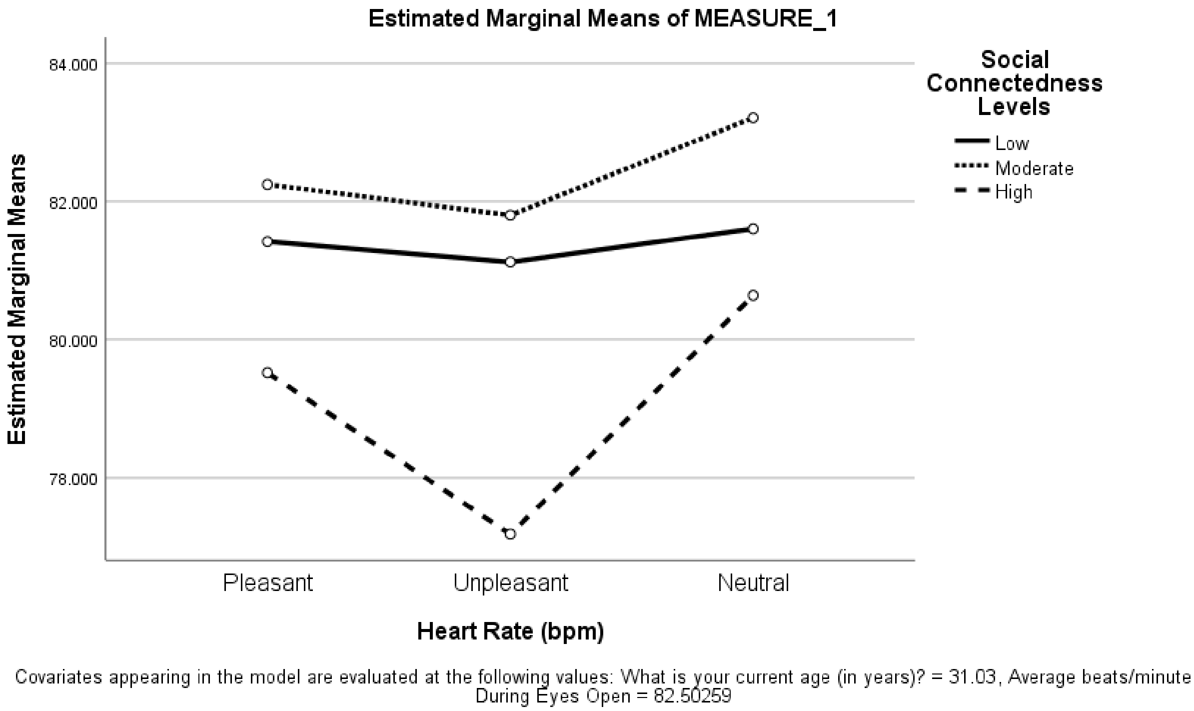
Changes in RMSSD during Conditions at Social Connectedness Levels



Note. Participants with high social connectedness had the highest RMSSD during the unpleasant condition.

Figure 7

Changes in HR during Conditions at Social Connectedness Levels



Note. Participants with higher levels of social connectedness exhibited decreased HR in comparison to low and high social connectedness levels. At the levels of social connectedness, all participants HR reduced during the unpleasant condition, with the largest decrease for those with higher social connectedness.

To test the third hypothesis that predicted unpleasant body sway as a function of PTSD symptom severity, and more specifically whether levels of social connectedness moderated the relationship, a linear regression was conducted. Specifically, it hypothesized that higher perceptions of social connectedness (SC) would buffer the impact of higher PTSD symptom scores on body sway in response to unpleasant images, resulting in a reduced freezing response. The model was assessed using regression and Process 3.5 (Hayes, 2017). The relation of PTSD and body sway was not significant, yet the moderation model was run, as SC was expected to significantly change the results. PTSD groups were first dummy coded and unpleasant area was transformed using Log10. The first step included two variables: PTSD symptom group to assess if there was a difference in the moderation model (model 1) and the uncentered interaction model (model 2), then a linear regression was computed. Model 2 [$F(3, 32) = 1.211$, $p = .322$] did not significantly account for more variance than Model 1 [$F(1, 34) = 2.764$, $p = .106$] SC and PTSD by themselves, $R^2 = .027$, $p = .625$, indicating that there is not a significant moderation between SC on PTSD and mobility. The Durbin-Watson score of 2.36 indicates that there is no autocorrelation within the data. The implications of this inability to analyze the final hypothesis is discussed below.

Discussion

The current investigation examined the relations of social connectedness and PTSD on mobility and HR/HRV. Due to COVID-19 we were unable to continue the study, leading to a lack of participants and power. While there is not enough power, the analyses done can estimate potential patterns based on means. Nevertheless, the results revealed effects for further exploration. A descriptive approach was used to examine military personnel and how differences in their experiences in the military impact PTSD symptoms and social connectedness. Participants who were not separated from the military at the time of study had higher perceptions of social connectedness and lower PTSD symptoms, which is consistent with research on continued support from colleagues and superiors (Stanley et al., 2019). Participants who reported VA disability had significantly lower perceptions of social connectedness and higher PTSD symptoms. This trend is consistent with the literature on increasing frequency of PTSD and in turn the use of VA disability services (Hermes, Holff, & Rosenheck, 2014). Military personnel survive wounds, once they are in a treatment facility, more so than they have in the early 1900s (Champion, Bellamy, Roberts, & Leppaniemi, 2003), which may explain the increase in PTSD symptoms for those that were deployed in combat zones than peaceful zones.

PTSD

Consistent with the literature which has established a freezing-like response to threat (Volchan et al., 2017; Hagenaars et al., 2014; Vianna & Carrive, 2005), a similar pattern emerged showing decreased mobility for participants with moderate and severe PTSD symptoms in response to affective pictures. While hypothesis one was not fully supported, a trend of decreased mobility was seen for participants across PTSD groups when viewing the unpleasant images. Heart rate variability (HRV) was expected to decrease for participants with higher levels of PTSD symptoms (Pulopulos, Vanderhasselt, & De Raedt, 2018); however, an insignificant trend of increased HRV during the unpleasant condition was indicated for participants with low and severe PTSD symptoms. Heart rate (HR) was also insignificantly related to PTSD symptom group with very small mean differences between conditions. The trend of increased HRV may be due to a low sample size and characteristics of PTSD, such as impaired risk assessment and hypervigilance (Adenauer et al., 2010; Kozlowska et al., 2015). A plausible explanation for this result comes from research by Fragkaki, Roelofs, Stins, Jongedijk, and Hagenaars (2017), whose work indicated an increased freezing-like response within healthy veteran controls but not with veterans who had PTSD. This was also exhibited within this study, as those with PTSD did not freeze, but rather attended to the stimuli. As discussed in Table 1, the results for those with low, moderate and severe PTSD indicate an attentive immobile response to unpleasant stimuli.

Social Connectedness

Contrary to previous findings of decreased mobility for those with higher social support (Lee et al., 2016; Mooren et al., 2014), participants that reported high perceptions of social connectedness showed similar mobility to those with low perceptions of social connectedness.

Participants with moderate perceptions of social connectedness exhibited the greatest decrease in mobility during the unpleasant condition. Participants with low levels of social connectedness had insignificantly lower HRV during the unpleasant condition, reflecting a freezing-like pattern. Participants with low levels of social connectedness did have higher levels of HR during the unpleasant condition; however, it was not significant. Both hypothesis one and two were not fully supported, which may be a result of hypervigilance and impaired risk assessment, as well as low sample size (Adenauer et al., 2010; Kozlowska et al., 2015; Fragkaki et al., 2017). As discussed in Table 1, those with moderate and high perceptions of SC reflected an attentive immobile response, while those with low SC indicated a freezing response.

Social Connectedness and PTSD

One part of hypothesis three was supported, as social connectedness was significantly related to PTSD symptom groups. Participants who had high levels of social connectedness did not score as highly on PTSD symptom groups as those with low to moderate perceptions of social connectedness. Unfortunately, the third hypothesis, a moderation model of social connectedness on immobility for those with PTSD symptoms, was unable to be analyzed. There was a lack of association between PTSD symptom groups and mobility. A main reason for this non-significance is likely due to the small sample size of the study. Another may be the missing data due to human error.

Conclusion

As predicted, participants with increased social connectedness were less likely to have moderate to severe PTSD symptoms. Although PTSD symptom groups mean scores were not significant with mobility, HR, and HRV, a pattern of decreased body sway is indicated for severe

PTSD symptoms. Overall, participants showed decreased body sway during the unpleasant images. Even though the moderation model was not able to be computed, the background of this research may be used to build a more comprehensive model

Limitations and Implications

The most evident limitation in the study is the lack of participants. As a result of the Coronavirus, the study had to end to ensure the safety of both the participants and researchers. Another limitation is the inability to make causal statements, due to poor temporal precedence and third variables. The confounding variables that were controlled for include age and image order. The third limitation is the length of the surveys and procedure, while it took up to an hour to complete all measures the participants could possibly have grown fatigued, therefore decreasing validity and accuracy.

While the results of the study did not turn out as expected, a few variables of interest were identified that encourage a focus on post-trauma interventions. Interventions may include increased programs for first responders to be able to identify and treat those who are at a high-risk for developing PTSD, as only a small amount of people exposed to trauma are likely to be diagnosed (Subramaniam et al., 2009; Kessler et al., 2019). Placing a focus on community after deployment/service may drastically enhance the outcome of service members, as the initial response to someone who experiences trauma may reduce PTSD outcomes (Brewin et al., 2000; Platt et al., 2016). Social connectedness also has medical implications for treatment, as oxytocin is associated with this important risk factor. The use of intranasal oxytocin immediately following the aftermath of a trauma or before therapy have been shown as promising treatments (Frijling et al., 2014; Koch et al., 2014; Acheson et al., 2013).

Future research should analyze the role of social connectedness as a buffer to PTSD within a long-term setting in the military. Future directions should include assessing different types of trauma (interpersonal vs. non-interpersonal) in relation to various social support structures and PTSD outcomes. As well, replicating the current studies methods with a larger participant pool would help accurately predict the impact of PTSD and social connectedness on immobility.

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