Examining Perceptual Bias to Benign Stimuli in PTSD

by

Jerry E. Murphy

A thesis submitted to the Graduate Faculty of Auburn University
in fulfillment of the requirements for the
Degree of Master of Science

Auburn, Alabama
December 10, 2016

Keywords: PTSD, attention bias, neutral stimuli

Approved by
Jennifer L. Robinson, (Chair) Associate Professor of Psychology
Jeffrey S. Katz, Professor of Psychology
Frank Weathers, Professor of Psychology

Abstract

Investigations of attention bias in posttraumatic stress disorder (PTSD) have primarily used overtly negative stimuli. This research strategy, while useful for maximizing differential reactions between PTSD and control groups, may not be generalizable, and may actually induce secondary harm to participants. The present project aims to investigate the effects of biases toward commonly encountered or otherwise benign trauma cues in those with PTSD. The investigation on the effects of benign traumatic cues has been identified as a need for further study (Stam, 2007). In this study I compiled and normed a generally neutral picture set of commonly encountered items to better understand the biases toward commonly encountered stimuli in PTSD. Additional analyses of the norming data revealed that differential responses in a military population with and without PTSD could be elicited using neutral stimuli. Analysis of the norming data also identified the presence of some PTSD criteria. Project findings could help identify the effects of commonly encountered items on cognitive and physiological processes with people suffering from PTSD. The results may have implications on future research design and interpretation of results from studies utilizing PTSD populations.

Table of Contents

Abstract ii

List of Tables iv

List of Figures v

List of Abbreviations vi

Introduction 1

Attention Bias 3

Models of Attention Bias 4

Negative Stimuli to Measure Attention Bias 6

Hypotheses 9

Method 9

Participants 10

Materials 11

Procedure 12

Analysis 12

Results 14

Discussion 17

Conclusion 20

References 21

Table 26

Figures 27

List of Tables

Table 1 26

List of Figures

Figure 1 27

Figure 2 28

Figure 3 29

Figure 4 30

Figure 5 30

List of Abbreviations

PTSD	Posttraumatic Stress Disorder
VA	Veterans Health Administration
DSM-5	Diagnostic and Statistical Manual of Mental Disorders (5^{th} ed.)
GAD	Generalized Anxiety Disorder
US	Unconditioned Stimulus
UR	Unconditioned Response
CS	Conditioned Stimuli
CR	Conditioned Response
IAPS	International Affective Picture System
MEDDAC	Medical Activity Alaska
GWoT	Global War on Terrorism
RaFD	Radbound Faces Database
POW/MIA	Prisoner of War/ Missing in Action
PCL5	PTSD Checklist for *DSM-5*
SPSS	Statistical Package for the Social Sciences

Examining Perceptual Bias to Benign Stimuli in PTSD

Posttraumatic stress disorder (PTSD) is a psychiatric disorder initiated by the experience of a traumatic event, triggering a cascade of chronic symptoms such as re-experiencing (e.g., recurrent and intrusive thoughts about the event) the trauma, avoidance (e.g., selecting situations in which trauma-relevant cues are absent), negative cognitions or mood, and heightened physiological arousal (American Psychiatric Association, 2013). It is assumed and expected that anyone who experiences a traumatic event may experience some of these symptoms to varying degrees, but what differentiates a normal response to trauma and natural recovery versus a more functionally impairing response is the chronicity of the debilitating symptoms and centrality of the trauma in the person's everyday life (Joseph, 2011). As such, PTSD is a pressing health care issue that carries a substantial economic and social burden. Depending on the source of the estimate, population prevalence within the United States ranges from 6.8% to 8% for lifetime prevalence (Friedman, Keane, & Resick, 2014), with some populations exhibiting an unprecedented rise in prevalence (i.e., service members) due to increases in trauma exposure (i.e., combat stress). For example, in a report by the Veterans Health Administration (VA), an estimated 363,926 Servicemen from Iraq and/or Afghanistan were seen through June of 2014 for potential or provisional PTSD (Veterans Health Administration, 2014), highlighting the current crisis our military faces from the long-term sequelae of PTSD.

The PTSD diagnostic criteria are described within the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) (American Psychiatric Association, 2013). Criterion A describes the traumatic event, which is "exposure to actual or threatened death, serious injury, or sexual violence" (Friedman et al., 2014, p. 26). Criterion B outlines the re-experiencing symptoms that include intrusive thoughts or memories (B1), distressing dreams related to the

trauma (B2), dissociative reactions (B3), and psychological distress along with physiological reactions to traumatic cues or reminders (B4 and B5). The psychological distress and physiological reactions to traumatic cues describes the negative results of attention bias and are considered conditioned fear responses (Bryant, Marosszeky, Crooks, Baguley, & Gurka, 2001). Criterion C describes the avoidance symptoms (American Psychiatric Association, 2013). In avoidance, the person either refuses to attend to or is unable to attend to negative memories or traumatic reminders (Brockman et al., 2016).

The DSM-5 includes two other criteria that describe the remaining PTSD symptom clusters (American Psychiatric Association, 2013). Criterion D describes the negative alterations in cognition and mood as a result of experiencing the traumatic event (American Psychiatric Association, 2013). In Criterion D, the majority of the symptoms involve self-perceptions. Symptoms four and five within Criterion D encompass a persistent negative emotional state and diminished interest in significant activities (American Psychiatric Association, 2013). Criterion D7 describes the inability to experience positive emotions (American Psychiatric Association, 2013). Criterion E describes the symptoms pertaining to alterations in arousal and reactivity (American Psychiatric Association, 2013). Hypervigilance, as described in Criterion E, is thought to go hand-in-hand with attention bias to maintain a feedback loop that sustains high levels of stress and anxiety (Kimble et al., 2014). According to Kimble et al., hypervigilance helps explain why within PTSD we see attention bias toward a threat or trauma reminder (Criteria B4, B5, and E3) even though the person may have a desire to avoid such stimuli (Criteria C1, and C2). Therefore, attention bias, either toward or away from threat stimuli, can be considered an integral aspect of PTSD.

Attention Bias

Attention bias refers to the phenomenon of how people with PTSD, phobias, and many anxiety disorders overly attend to, or focus more on, stimuli perceived as threatening (Pergamin-Hight, Naim, Bakermans-Kranenburg, van Ijzendoorn, & Bar-Haim, 2015). The level and extent to which a person has attention bias has been shown to be an indicator or contributor to functional impairment (Chemtob et al., 1999). Research has shown that when a person experiences attention bias toward a stimulus there is a significant disruption in concurrent cognitive tasks compared to healthy controls, even if the stimulus attended to is vague or novel (Kimble, Kaloupek, Kaufman, & Deldin, 2000). These findings suggest that an accurate determination of the effects of attention bias on a patient potentially could be used as a clinical diagnostic tool for measuring PTSD severity. Attention bias away from threat stimuli is also associated with acute stress (Wald et al., 2011). In their study, Wald et al. found that the more someone showed attention bias away from threat stimuli while under stress, the greater the PTSD symptoms one year following. In contrast, however, Wald et al. found that attention bias away from threat stimuli was not significantly different from controls once some time had passed and people were no longer under stress.

There are several models that explain why attention bias occurs. One model focuses on an overactive threat detection network, indicative of a hypersensitive amygdala response (Monk et al., 2008). Another model attributes the lack of attentional control to the lateral pre-frontal cortex having diminished activation, which fails to regulate the amygdala (Bishop, Duncan, Brett, & Lawrence, 2004). Other models make use of schemas that overly generalize threat evaluations (Pergamin-Hight et al., 2015). However, given that some individuals show increased attention to threat stimuli, while others show avoidance (Sipos, Bar-Haim, Abend, Adler, &

Bliese, 2014) there may be different mechanisms that play a role in attention bias, particularly as it relates to PTSD,. In the preceding study, Sipos et al. found a high correlation between effects of attention bias (determined by slower reaction time to threat trials versus neutral trials) and reports of higher levels of PTSD and generalized anxiety disorder (GAD) symptoms. The studies discussed suggest that attention bias may be a pivotal neurocognitive measure in helping gauge the severity of PTSD and give insight into how PTSD can disrupt the daily lives of those suffering from it.

There is a normal response to a traumatic event that changes the way our body reacts and protects itself from threats. In most cases, a normal physiological response to a traumatic stressor would run its course and the person would return to a pre-event homeostasis. This normal stress reaction produces temporary symptoms similar to the defining characteristics of PTSD (i.e., heightened arousal/vigilance, intrusive memories, negative emotional state, and so forth), but as the stress reaction abates and time passes, so do the symptoms. This normal physiological course of events occurs in the majority of people who experience trauma and is known as natural recovery (Foa & Cahill, 2001). For the small percentage of people who remain in the stress reactive state, symptoms persist, become chronic, and symptoms become pathological. The person then "strengthens its defensive reflexes and responds more vigorously to a variety of previously neutral stimuli" (Stam, 2007, p. 532). There are several psychological theories as to why this may occur.

Models of Attention Bias

One model that helps explain attention bias is classical conditioning. In Pavlov's (1927) classical conditioning model an Unconditioned Stimulus (US) produces an Unconditioned Response (UR). In the case of PTSD, the US would be the traumatic event and the UR would be

the emotions associated with a typical response to such an event such as fear, shame, guilt, and/or remorse. The US is then paired with previously unrelated stimuli creating Conditioned Stimuli (CS) that then produce a Conditioned Response (CR) similar or even identical to the UR. Many researchers have incorporated Pavlov's classical conditioning theory to explain the attention bias toward traumatic cues indicative of PTSD (Field, 2006; Friedman et al., 2014; Lissek et al., 2005). The extent to which a person experiences the CR to items more and more remote or less similar to the US is known as generalization (Fani et al., 2012). In PTSD, the more generalized the items that produce the CR, the more severe and treatment resistant the person's PTSD appears to be (Dunsmoor, Mitroff, & LaBar, 2009; Fani et al., 2012). One prominent theory that utilizes classical conditioning as a foundation is the Cognitive Theory of PTSD put forth by Ehler and Clark (2000). The only notable exception is that it is not the trauma event, but the meaning or appraisal the person gives to the event that is the US (Friedman et al., 2014).

Another model that explains attention bias is the Emotional Processing Theory (Foa & Cahill, 2001). In this model, Foa and colleagues (2001) propose that we develop emotional structures around events that produce salient emotions. Emotional structures are described as "representations of emotion-related stimuli, responses, the meanings associated with these stimuli and responses, and the associations among these representations" (Friedman et al., 2014, p. 169). When confronted with information that closely resembles the emotional structure (e.g., a reminder of the trauma), we focus on them, feel the emotions, and act accordingly. This process is normal and adaptive in most circumstances. In the case of PTSD, the emotions experienced with the traumatic event create a strong emotional structure that produces a large emotional response that becomes rigid and provides a blueprint for action that does not accurately represent reality and interferes with normal processes of thought and action. Therefore, the person with

PTSD could see any reminder of the situation, people, or circumstances surrounding the traumatic event, attune to it, and respond cognitively and behaviorally the same way they would if confronted with the original traumatic event (Foa & Cahill, 2001). This pathological response to items that inherently are not dangerous is the target of the popular Prolonged Exposure Therapy.

Finally, the Defense Cascade Model refers to the natural protective reactions an organism has in identifying a threat and preparing itself for escape, avoidance, or a fight (Bradley, Codispoti, Cuthbert, & Lang, 2001). According to this model, attention bias is a function of an orienting mechanism where an organism detects a possible threat and then focus on that treat to evaluate the potential danger (Bradley et al., 2001). For those with PTSD, the defense system leans towards priming the body for action which leads to reacting to more neutral stimuli that would not normally elicit a response (Bradley et al., 2001). One benefit to this model is that it explains the physical responses to the threat and why we see increases in heart rate, skin conductance, and respiration (Pappens et al., 2010).

Together, these models provide a theoretical basis for attention bias as well as how it can be maladaptive in people with PTSD when they are in an otherwise safe situation. As discussed, this involuntary reallocation of attention resources to otherwise innocuous stimuli disrupts ongoing cognitive processes (Constans, 2005), and can be an indicator of functional impairment (Chemtob et al., 1999). Therefore, attention bias has potential diagnostic properties if we are better able to detect and measure its effects.

Negative Stimuli to Measure Attention Bias

Researchers routinely utilize overtly negative stimuli within their research designs to measure the effects of attention bias within a PTSD population. The reason for using such

negative images is that the strongest responses will come from the most negative stimuli (Bradley et al., 2001). Therefore, it would make sense for researchers to seek the largest measurable differences using very negative stimuli. For some, the choice of which pictures to use may be as simple as looking at available psychologically normed pictures and choosing ones that have high scores on negative valences such as fear (Pappens et al., 2010). One such study conducted by Andrade, Kavanagh, and Baddeley (1997) sought to look into the effects of eye movement on traumatic images to see if the eye movements reduced the vividness and emotive effect of those images. In their study, they chose "the 24 most unambiguously negative stimuli" with the images being described as images of "war, death, and disaster" (Andrade, Kavanagh, & Baddeley, 1997, p. 212). In a study into second-order conditioning along with extinction levels in healthy controls versus a trauma-exposed group, researchers pretested pictures to determine which picture would be the most relevant to the trauma exposed group as well as the most aversive (Wessa & Flor, 2007). These studies used the International Affective Picture System (IAPS) (Lang, Bradley, & Cuthbert, 2008) as the source of their images. Other studies have used similar approaches (e.g., capitalizing on the most salient negative stimuli), but have created their own stimulus sets (Hayes et al. 2011; Attias, Bleich, Furman, & Zinger, 1996).

While using negative images does elicit strong differential reactions that have led to significant results, there are two main limitations with this approach. First, the nature of the negative stimuli are such that it is unlikely that the person with PTSD would encounter such items outside of the laboratory setting, making the research unlikely to represent how the person with PTSD responds to their daily environment (i.e., lack of generalizability). Additionally, there is also a possible secondary harm inflicted on the participants. It has been suggested that traumatic memories that are brought to the surface aid in the maintenance of the disorder and

lead to re-traumatization (McFarlane, 2000). To overcome these issues, it has been suggested that research should aim toward understanding the psychophysiological responses toward more neutral, naturalistic stimuli (Stam, 2007). By doing so, one may be able to uncover the generalizability of the effects, which in turn could have the potential for increased diagnostic ability, as research suggests that the more generalized trauma reminders are that elicit a differential response, the more severe or even treatment resistant the person's PTSD (Fani et al., 2012).

In the current study, I captured the effect of trauma related cues that are more in-line with what would happen in the daily lives of those with PTSD. First, I created a stimulus set that is more general and neutral in nature, with the intent of providing stimuli that are closely matched to the type of items that one might encounter outside of a lab setting. As noted previously, there is a gap in the literature looking at the effects of real-world stressors (Stam, 2007). The aim was to show experimenters that attention bias can be incorporated into research designs without the need of using overt trauma cues that could potentially further traumatize the participants in both the experimental and control groups (McFarlane, 2000), and draw attention to more subtle influential factors (such as generalizability) that are not presently accounted for in research designs. Additionally, through the use of indirect measures, (i.e. norming data) it may be possible to identify the presence of several PTSD criteria (i.e. B4, D5, D7, and E3) without overtly testing for them. In the Army, every time a Soldier goes to a medical appointment they are asked to fill out a form, which asks questions about PTSD symptoms. Most Soldiers know that if they answer the questions in a certain way that they will be screened further for PTSD. As a result, most Soldiers answer the questions in such a way as to not draw any attention to them and many continue to go untreated. The possibility of developing testing instruments that can

identify the presence of PTSD symptom clusters without directly asking about them could have significant utility in identifying service members in need of help but who don't want to ask for it.

Hypotheses

Hypothesis 1: The average valence and arousal ratings for the stimulus set in this project will be more neutral (centered close to zero for valence) than other commonly used stimulus sets.

Hypothesis 2: Military veterans with combat related PTSD will rate combat associated stimuli differently according to valence and arousal compared to military veterans without PTSD.

Hypothesis 3: Differences will emerge among military populations with and without PTSD and the General Population that may reflect PTSD criteria such as psychological distress at exposure to traumatic cues (B4), diminished interest in activities (D5), inability to experience positive emotions (D7), and hypervigilance (E3).

Method

The focus of this project is to test the effect of potential trauma cues/triggers that are typically viewed as neutral in nature, and are encountered on a more frequent, everyday basis. This involved collecting pictures that are absent of contextual cues as much as possible and neutral in nature across a diverse set of content areas. This is an important contribution given that current, publicly available stimuli sets, such as the International Affective Picture System (IAPS) (Lang et al., 2008), contain contextual information that may elicit varying reactions amongst participants. Additionally, no data set exists to examine how otherwise neutral stimuli may be affectively different in military populations with and without PTSD. Therefore, a completely new stimulus set was compiled to specifically meet the needs of this project. The stimulus set was then presented to participants through online surveys to collect norming data. These surveys allow for the analysis of differences between the groups of Military with PTSD and Military

without PTSD, and make comparisons with the General Population group. A secondary aim of this project is to use the norming data to create a cognitive task for follow on PTSD research.

Participants.

Participants were recruited through online surveys collected in four distinct iterations. The initial survey recruited participants through the Auburn University Psychology Department Research Participation program, which recruits undergraduate students currently enrolled in Psychology courses (n=261, 93 males, 168 females, age= 20.60±2.87). A second survey was published simultaneously with recruitment geared toward active duty Army personnel. People who participated in the second survey were mostly members of the Officer Candidate School at Fort Benning, as well as members of MEDDAC Alaska (n=284, 235 males, 49 females, age= 27.64±6.24). The last two surveys were published on Amazon's MTurk platform, to increase the number of participants, and to ensure generalizability. One survey asked for participants who fell within the age range of 29 to 45 in order to sample an age matched population to those who would have served in the Global War on Terrorism (GWoT) and provide a larger age range than what was collected from the undergrad participants (n=523, 243 males, 280 females, age= 33.29±6.32). The second MTurk survey specifically asked for participants who were veterans of the GWoT having served in Iraq, Afghanistan, or both (n=211, 137 males, 74 females, age= 31.9±9.4). In total there were 1,279 participants between all four surveys. Participants were excluded who completed the survey in less than 3 min, took longer than 1 hour, or had obvious patterns in their responses (most answers being 1,1 or 9,9 for valence and arousal). In total, 226 participants were excluded. The remaining 1,053 participants were used in two separate analyses.

Materials.

Ten categories of pictures were chosen that encompass a good variety of daily encountered stimuli. The categories chosen were Flags (state, group, and international), Art (classic and contemporary), Symbols (black symbols on a white background), Objects (on a white background), Vehicles (private, commercial, recreational, and military), Weapons (antique and modern), Aircraft (fixed wing and rotary wing, commercial, private, and military), Monuments (domestic and international), Animals, and Faces/Emotion (taken from the Radbound Faces Database or RaFD) (Langner et al., 2010). The pictures chosen contained as little context as possible. Most pictures are of items placed on a white background. A total of 33 pictures per category were chosen to be normed. Of the 33 pictures in each category, four of the pictures were of items that could be associated with military service, Iraq/Afghanistan combat theaters, or general danger. These potential threat or trauma cues will be hereafter referred to as "distractors" for the purpose of this project. The distractors are of a general nature such that it is possible for anyone to encounter the stimuli on any given day (e.g., either walking down the street, at work (specifically military), or exposure via the television). The distractors were also chosen to fall on a gradient from having a specific relationship with combat trauma (Mujahedeen flag or dog tags) to more generalized associations (POW/MIA flag or a canteen). The gradient of distractors from specific to general associations with military combat trauma should allow for the measurement of attention bias generalization and thus the severity of PTSD (Dunsmoor et al., 2009) in the cognitive task to be built.

Procedure.

Participants viewed the pictures in a Qualtrics survey, where every picture was displayed along with a Self Assessment Manikin (Bradley & Lang, 1994). The SAM is composed of a 9-point Likert scale with graphical representations to measure valence and arousal (Figure 1). The pictures were randomized so that each participant viewed and rated 110 of the 330 total pictures. The computer counterbalanced presentations so that each picture was rated approximately an equal number of times. Along with the pictures in the survey, participants provided information on gender, age, any military service, combat experience, and any trauma exposure other than combat. The participants also completed the PTSD Checklist for *DSM-5* (PCL5) (Weathers et al., 2013).

Analysis

For all analyses, data was transferred from Qualtrics directly into IBM Corp (2015) Statistical Package for the Social Sciences (SPSS). For Hypothesis 1, data was analyzed from participants from the Psychology Department Research Participation program and the MTurk age specific survey. The respondents to these surveys make up the General Population group because they provide more generalized population norming data. This norming data was used to accomplish the secondary aim of building the cognitive task for follow on PTSD research. Participants (n= 784, 336 males, 448 females, age=29.05±8.07) included in this analysis did report some military experience (20 military experience no combat, 145 military combat experience). Additionally, 447 participants reported having experienced trauma exposure other than combat. 620 participants completed the PCL5 (27.2±21.6). Using the cutoff of 35 for the PCL5, 223 (36%) met the cutoff for PTSD. Valence and arousal means and standard deviations were computed for each picture and placed in a table in the supplemental data. Valence and

arousal means were compiled to create the affective space for this stimulus set and then compared to the affective space of the IAPS (Bradley et al., 2001).

For Hypothesis 2, all participants (n=445, 349 males, 96 females, age 29.33±6.74) with military experience were selected to test that military veterans with combat related PTSD (Military with PTSD group) would rate combat associated stimuli differently according to valence and arousal compared to military veterans without PTSD (Military without PTSD group). Two participants were excluded based on having non-combat related PTSD. Participant's military experience was predominantly active duty with the rest split evenly between Reserves and National Guard (260 Active duty, 92 Reserves, and 93 National Guard). Most participants reported combat experience (Combat tours=191 none, 198 one to two, 44 three to four, 12 five or more). Scores reported for the PCL5 ranged from 0 to 80 with a mean of 24.01± 22.75. A conservative cutoff score of 35 on the PCL5 was used to delineate between PTSD and no PTSD resulting in 290 without PTSD and 155 with combat related PTSD. The means for valence and arousal were computed for the two groups (Military with PTSD and Military without PTSD). An independent samples t-test was conducted for each picture (valence and arousal) to test if our target population means are significantly different from each other.

For Hypothesis 3, the data and results from the analyses from the previous two hypotheses were searched for patterns that could be explained by PTSD symptom criteria. Additionally, specific pictures known to elicit positive or negative valence (based on population norming data) were chosen for further comparison between the Military with PTSD group, Military without PTSD group, and General Population to test for effects of some PTSD symptoms.

Results

The analysis for Hypothesis 1 resulted in norming values for valence and arousal for each of the 330 pictures. Total norming values based on ratings from all participants from the population surveys were calculated as well as separate ratings for men and women. The complete results of norming data are contained in the supplemental information. One of the aims of choosing the pictures was to have a more neutral picture set than the currently available normed picture sets that are not neutral enough to fit the scope of this project. Therefore, to determine if this picture set is in fact more neutral in nature is to compare this stimulus set to the IAPS. Figure 2 depicts the affective space reported for the IAPS (Bradley et al., 2001) next to the affective space calculated from our norming sample. What can be seen from Figure 2 is that the pictures normed in this study are more centered on a neutral valence (clustered around a valence of zero) as compared to the IAPS. Additionally, the pictures in this study have a smaller range of arousal, as depicted on the X-axis, as compared to the IAPS and only have a range in valence from 2.0 to -2.07 as described in Figure 3.

Hypothesis 2 involved a comparison between Military with PTSD versus Military without PTSD through independent-samples t-test (α=0.05) performed in SPSS (IBM_Corp., 2015) on all valence and arousal ratings for all 330 pictures. Each picture was rated by a unique sub-set of all the participants due to the randomization of the survey. The unique samplings for each picture negated any need to include repeated measures correction. Of the 330 pictures, 95 (28.8%) were significantly different for valence ratings, and 260 (78.8%) were significantly different in arousal ratings. Of the original 41 pictures that were identified as possible distractors, 21 (51%) were significant for valence and 37 (90.2%) were significant for arousal (see supplemental data for complete results). An independent samples t-test of the average ratings for

Military with PTSD (V= 0.23±0.65; A= 4.19±0.75) and Military without PTSD (V= 0.58±0.64; A= 2.87±0.48) was also significant. The overall valence ratings for Military without PTSD was significantly higher than those with PTSD, $t(658)=6.85$, $p < 0.001$. Additionally, the overall arousal ratings for Military without PTSD was significantly lower than Military with PTSD, $t(658)= -26.86$, $p < 0.001$ (see Figure 4).

Hypothesis 3 results are more nuanced than the results of the previous two. There were a few pictures chosen for this project directly targeted at eliciting psychological distress as defined by criteria B4 (American Psychiatric Association, 2013). The pictures chosen were of a barking dog or "mean dog," a brown recluse spider, a rattlesnake, and a wasp. These pictures depict animals that pose a legitimate threat or danger. The pictures of the mean dog, brown recluse, and wasp were all significantly different for arousal but not valence. However, the picture of the rattlesnake was significant for valence, but not arousal (Table1). The results for these pictures were not consistent with our hypothesis that a pattern of psychological distress could be identified (Table 1).

Diminished interest in significant activities as defined by the PTSD criterion D5 (American Psychiatric Association, 2013) was noted within the data. The aircraft and weapons categories were chosen for inclusion in this stimulus set due to the close affiliation the military has with them. Due to the frequent interaction service members have with weapons and aircraft, it was expected that a military population would show a higher valence rating for these items showing that military service members in general have an interest in activities surrounding weapons and aircraft. For the weapons category, the Military without PTSD (0.812±0.43) had significantly higher valence ratings than the General Population (-0.71±0.30), $t(64)=16.49$, $p<0.001$. Similar results were observed for the aircraft category, with the Military without PTSD

(1.05±0.23) having a significantly higher valence than the General Population (0.26±0.27), $t(64)=12.51$, $p<0.001$. Figure 5 shows the significant differences in valence ratings between Military without PTSD and the General Population. Comparing Military with PTSD to Military without PTSD, most pictures within the categories of weapons and aircraft were significant for both valence and arousal (29 out of 33 for weapons and 25 out of 33 for aircraft). The t-test values for all images within the weapons and aircraft categories are all negative, reflecting that the Military with PTSD group rated the images more negatively than the Military without PTSD group. The differences are split with the average valence ratings for Military with PTSD (Weapons= -0.34±0.41; Aircraft= 0.12±0.35) and the General Population (Weapons=-0.71±0.3; Aircraft=0.27±0.27). The Aircraft category was not significantly different between Military with PTSD and the General Population, $t(64)=1.87$, $p= 0.066$, but the Weapons category was significant, $t(64)=4.15$, $p<0.001$. The data suggest that within a military population, weapons and aircraft in general are viewed in a positive light with PTSD diminishing the positivity of these items. In the case of Aircraft, the diminished positivity brought the Military with PTSD valence ratings down to the General Population level, but with Weapons, the diminished valence ratings of Military with PTSD dropped below that of the General Population. The additional drop in the Weapons category valence ratings could be due to an added threat assessment of the weapons.

These data marginally reflect an inability to experience positive emotions as described in the PTSD criterion D7 (American Psychiatric Association, 2013). Within the stimulus set, the category of Art contained pictures of artwork that were both positively and negatively rated for valence. Although the artwork chosen for this stimulus set was not too overt either way, it was the category with the largest number of pictures rated over 1.0 positive valence. Thirteen of the art pictures were rated at 1.0 or higher in valence. The highest rating in valence outside of the art

category was the picture of a bunny (1.98) (Figure 3). Taking these 14 pictures together, there is one difference in the average valence ratings of the Military with PTSD (1.08±0.35), Military without PTSD (1.2±0.25), and the General Population Mean (1.41±0.36). The Military with PTSD group was significantly different from the General Population mean ($t(26)=2.48$, $p=0.02$). However, the Military without PTSD was not significantly different from either the Military with PTSD, ($t(26)=1.1$, $p=283$) or the General Population ($t(26)= 1.77$,$p=0.09$). These results suggest that the difference between the Military with PTSD group and the General Population incorporates the effects of military service and attributing the difference only to PTSD may lead to inaccurate conclusions.

This study was perhaps best able to detect Hypervigilance as described in PTSD criterion E3 (American Psychiatric Association, 2013). Arousal is a measurement of how intense the emotions are that one feels and consistent high arousal ratings are indicative of a heightened emotional state. Hypervigilance is linked to increased arousal, even to neutral stimuli (Kimble et al., 2014). Significant differences in arousal ratings between Military with PTSD and Military without PTSD were by far the most robust of all the findings. As stated before, 260 or 78.8% of the pictures were significant for arousal ratings. In every instance, the t-test value was positive, meaning that Military with PTSD group had a higher arousal rating. This finding is consistent with the chronic state of hyperarousal commonly seen in PTSD (Kendall-Tackett, 2000).

Discussion

This study was conducted to accomplish several aims. First, I sought to collect and norm a more neutral stimulus set that could be used for PTSD research. To this end, this project was very successful. Although a generally neutral set was chosen, some pictures and categories were included to allow for further analysis of PTSD. One analysis tested if military veterans with

combat related PTSD would rate combat associated stimuli differently than military personnel without PTSD. In general, this held true, but there were some unexpected results. It is not immediately apparent why some pictures were significant while others failed to reach significance. In the flag category, the expected distractors were the flags of the mujahedeen, Afghanistan, the POW flag, and the U.S. Army. All but the Army flag was significant for arousal but none were significant for valence. Instead, the flags of Sweden, Greece, South Carolina, Spain, and Arizona were significant for both valence and arousal. Why these flags rated as significant is unknown. The art category is possibly the easiest to understand. Paintings that depicted the last supper, an 18th century army marching into a city, Michael slaying the dragon, the battle of Little Roundtop, and a battle from WWII were all significant. The military centric paintings were anticipated to be significant, but the others all have a religious overtone and may point to some existential issues the PTSD participants are experiencing. The oddest results came from the objects category where several of the anticipated distractors were significant, but other items being significant came as a complete surprise. In the objects category, the items are displayed on a white background so no context is available. Nevertheless, pictures of a table, a pile of buttons, a cup, hand weights, and a potted plant were all significant. The vehicle category was the only category whose results were as expected with the military vehicles being significant but no others.

A second aim was to see if certain PTSD criteria could be detected within the data by testing patterns of responses between samples. To that end, there were mixed results. I found support for differential responding, which may reflect some PTSD criteria. Psychological distress (B4) could not be directly measured, but in looking at the data for psychological distress there were some interesting results. Within the animal category the pictures of a rattlesnake,

brown recluse spider, barking dog, and a wasp were included hoping to capture the effects of generalized fear conditioning thought to be a major part of PTSD (Dunsmoor et al., 2009) as a marker for psychological distress. Contrary to expectations, these pictures were not rated more negative by the Military PTSD group versus the Military without PTSD group. The rattlesnake picture was significant ($t(72)=2.27$; $p=0.03$) but the direction of significance was that the Military with PTSD group rated the image higher on valence (in this case more neutral) than Military without PTSD with average ratings of -0.42 and -1.31 respectively. Three pictures in the face category had similar results. The three pictures were pictures of models with a neutral expression. All three pictures were given negative valence ratings by the Military without PTSD group (-0.72, -0.70, and -0.63) but the PTSD group rated the same pictures either closer to neutral or even a slightly positive valence rating (0.13, -0.08, and 0.08). Emotional numbing could explain these results, but another alternative explanation may also be viable. It is possible that after prolonged exposure to mortal danger as one experiences in combat, that some things simply don't seem as threatening anymore.

The other three criteria examined were diminished interest in activities (D5), inability to experience positive emotions (D7), and hypervigilance (E3). The results suggested evidence for a decrease in interest in activities for those with PTSD in the areas of weapons and aircraft. Obviously not every service member has an interest in weapons or aircraft, but these areas are steeped in the military culture. Using this approach in PTSD from other trauma events might not be possible as those populations are not as homogenous in experiences within a shared culture. My results suggest that the detected inability to experience positive emotions was more likely the influence of military and combat experience than solely the effects of PTSD. The data clearly showed hypervigilance but there remains some questions. The survey results do not indicate the

order of presentation of the stimuli to the participants so it is impossible to tell if our PTSD group started the survey in a hyper-vigilant state or if they quickly entered one after seeing a picture they deemed negative and then remained in that state or the novelty of the stimuli was enough to induce hypervigilance. The title of the survey indicating that it contained visual stimuli for PTSD research might also have had a priming effect leading the PTSD group to anticipate negative pictures and thus they start the survey already in a hyperaroused state. Either way, the data does indicate the presence of hypervigilance for the PTSD participants.

Conclusion

Combat-related PTSD is a complex disorder that combines the sequelae of PTSD with the cultural influences of military service. As such, it seems that any study into combat-related PTSD must account for the nuances and influences of the military culture. Nevertheless, this study does show that aspects of PTSD can be studied using general or neutral stimuli without the need for overtly traumatic images. Additionally, it highlights the potential for PTSD criteria to be identified without specifically asking about diagnostic criteria. These findings open the door for new and innovative research designs that incorporate neutral stimuli.

References

Veterans Health Administration. (2014). *Report on VA Facility Specific Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and Operation New Dawn (OND) Veterans Diagnosed with Potential or Provisional PTSD*.

Andrade, J., Kavanagh, D., & Baddeley, A. (1997). Eye-movements and visual imagery: A working memory approach to the treatment of post-traumatic stress disorder. *British Journal of Clinical Psychology, 36*(2), 209-223. doi:10.1111/j.2044-8260.1997.tb01408.x

Bishop, S., Duncan, J., Brett, M., & Lawrence, A. D. (2004). Prefrontal cortical function and anxiety: controlling attention to threat-related stimuli. *Nature Neuroscience, 7*(2), 184-188. doi:10.1038/nn1173

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: Defensive and appetitive reactions in picture processing. *Emotion, 1*(3), 276-298. doi:10.1037/1528-3542.1.3.276

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The self-assessment manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry, 25*(1), 49-59. doi:http://dx.doi.org/10.1016/0005-7916(94)90063-9

Brockman, C., Snyder, J., Gewirtz, A., Gird, S. R., Quattlebaum, J., Schmidt, N., . . . DeGarmo, D. (2016). Relationship of service members' deployment trauma, PTSD symptoms, and experiential avoidance to postdeployment family reengagement. *Journal of Family Psychology, 30*(1), 52-62. doi:10.1037/fam0000152

Bryant, R. A., Marosszeky, J. E., Crooks, J., Baguley, I. J., & Gurka, J. A. (2001). Posttraumatic stress disorder and psychosocial functioning after severe traumatic brain injury. *Journal*

of Nervous and Mental Disease, 189(2), 109-113. doi:10.1097/00005053-200102000-00006

Chemtob, C., Roitblat, H., Hamada, R., Muraoka, M., Carlson, J., & Bauer, G. (1999). Compelled Attention: The Effects of Viewing Trauma-Related Stimuli on Concurrent Task Performance in Posttraumatic Stress Disorder. *Journal of Traumatic Stress, 12*(2), 309-326. doi:10.1023/A:1024728626505

Constans, J. I. (2005). Information Processing Biases in PTSD. In J. J. Vasterling & C. R. Brewin (Eds.), *Neuropsychology of PTSD: Biological, Cognitive, and Clinical Perspectives* (pp. 105-130). New York: Guilford Press.

Dunsmoor, J. E., Mitroff, S. R., & LaBar, K. S. (2009). Generalization of Conditioned Fear along a Dimension of Increasing Fear Intensity. *Learning and Memory, 16*, 460-469.

Fani, N., Tone, E. B., Phifer, J., Norrholm, S. D., Bradley, B., Ressler, K. J., . . . Jovanovic, T. (2012). Attention bias toward threat is associated with exaggerated fear expression and impaired extinction in PTSD. *Psychological Medicine, 42*(03), 533-543. doi:doi:10.1017/S0033291711001565

Field, A. P. (2006). Is conditioning a useful framework for understanding the development and treatment of phobias? *Clinical Psychology Review, 26*(7), 857-875. doi:http://dx.doi.org/10.1016/j.cpr.2005.05.010

Foa, E., & Cahill, S. (2001). Psychological therapies: Emotional processing.

Friedman, M. J., Keane, T. M., & Resick, P. A. (Eds.). (2014). *Handbook of PTSD: Science and Practice* (2nd ed.). New York, NY: The Guilford Press.

IBM Corporation. (2015). IBM SPSS Statistics for Windows (Version 23.0). Armonk, NY: IBM Corp.

Joseph, S. (2011). *What doesn't kill Us: the new psychology of posttraumatic growth*: Basic Books.

Kendall-Tackett, K. A. (2000). Physiological correlates of childhood abuse: chronic hyperarousal in PTSD, depression, and irritable bowel syndrome. *Child Abuse & Neglect, 24*(6), 799-810. doi:http://dx.doi.org/10.1016/S0145-2134(00)00136-8

Kimble, M., Boxwala, M., Bean, W., Maletsky, K., Halper, J., Spollen, K., & Fleming, K. (2014). The impact of hypervigilance: Evidence for a forward feedback loop. *Journal of Anxiety Disorders, 28*(2), 241-245. doi:http://dx.doi.org/10.1016/j.janxdis.2013.12.006

Kimble, M., Kaloupek, D., Kaufman, M., & Deldin, P. (2000). Stimulus novelty differentially affects attentional allocation in PTSD. *Biological Psychiatry, 47*(10), 880-890. doi:http://dx.doi.org/10.1016/S0006-3223(99)00258-9

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual*. Retrieved from

Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & Knippenberg, A. V. (2010). Presentation and Validation of the Radboud Faces Database. *Cognition & Emotion, 24*(8), 1377-1388.

Lissek, S., Powers, A. S., McClure, E. B., Phelps, E. A., Woldehawariat, G., Grillon, C., & Pine, D. S. (2005). Classical fear conditioning in the anxiety disorders: a meta-analysis. *Behaviour Research and Therapy, 43*(11), 1391-1424. doi:http://dx.doi.org/10.1016/j.brat.2004.10.007

McFarlane, A. C. (2000). Posttraumatic Stress Disorder: A Model of the Longitudinal Course and the Role of Risk Factors. *Journal of Clinical Psychiatry, 61*(supplement 5), 15-20.

Monk, C. S., Telzer, E. H., Mogg, K., Bradley, B. P., Mai, X., Hugo, m. c. L., . . . Pine, D. S. (2008). Amygdala and Ventrolateral Prefrontal Cortex Activation to Masked Angry Faces in Childres and Adolescents with Generalized Anxiety Disorder. *Archives of General Psychiatry, 65*(5), 568-576.

Pappens, M., Van den Bergh, O., De Peuter, S., Bresseleers, J., Vansteenwegen, D., & Van Diest, I. (2010). Defense reactions to interoceptive threats: A comparison between loaded breathing and aversive picture viewing. *Biological Psychology, 84*(1), 98-103. doi:http://dx.doi.org/10.1016/j.biopsycho.2010.02.006

Pergamin-Hight, L., Naim, R., Bakermans-Kranenburg, M. J., van Ijzendoorn, M. H., & Bar-Haim, Y. (2015). Content specificity of attention bias to threat in anxiety disorders: A meta-analysis. *Clinical Psychology Review, 35*(0), 10-18. doi:http://dx.doi.org/10.1016/j.cpr.2014.10.005

Sipos, M. L., Bar-Haim, Y., Abend, R., Adler, A. B., & Bliese, P. D. (2014). POSTDEPLOYMENT THREAT-RELATED ATTENTION BIAS INTERACTS WITH COMBAT EXPOSURE TO ACCOUNT FOR PTSD AND ANXIETY SYMPTOMS IN SOLDIERS. *Depression & Anxiety (1091-4269), 31*(2), 124-129. doi:10.1002/da.22157

Stam, R. (2007). PTSD and stress sensitisation: A tale of brain and body: Part 1: Human studies. *Neuroscience & Biobehavioral Reviews, 31*(4), 530-557. doi:http://dx.doi.org/10.1016/j.neubiorev.2006.11.010

Wald, I., Shechner, T., Bitton, S., Holoshitz, Y., Charney, D. S., Muller, D., . . . Bar-Haim, Y. (2011). Attention bias away from threat during life threatening danger predicts PTSD symptoms at one-year follow-up. *Depress Anxiety, 28*(5), 406-411. doi:10.1002/da.20808

Weathers, Litz, Keane, Palmieri, Marx, & Schnurr. (2013). *Posttraumatic Stress Disorder Checklist 5 (PCL-5)*. Retrieved from

Wessa, M., & Flor, H. (2007). Failure of Extinction of Fear Responses in Posttraumatic Stress Disorder: Evidence From Second-Order Conditioning. *American Journal of Psychiatry, 164*(11), 1684-1692. doi:doi:10.1176/appi.ajp.2007.07030525

Table

Table 1

Dangerous Animal comparison

	Military with PTSD			Military W/O PTSD		
Picture	Valence	Arousal	t-test Valence	Valence	Arousal	t-test Arousal
Mean dog	-0.82±2.21	5.86±2.23	t(132)=-0.69, p=0.49	-0.56±2.01	4.15±2.48	t(120)=3.74, p<0.001**
Brown recluse	-1.32±2.47	5.86±2.59	t(139)=0.45, p=0.65	-1.5±2.16	4.28±2.91	t(121)=3.11, p<0.001**
Rattlesnake	-0.42±2.29	4.88±2.53	t(72)=2.27, p=0.03**	-1.31±1.78	4.82±2.64	t(112)=0.13, p=0.89
Wasp	-0.75±1.93	4.61±2.56	t(142)=0.53, p=0.60	-0.92±1.71	3.06±2.28	t(126)=3.53, p<0.001**

Note: M±SD reported for valence and arousal for the pictures listed for both the Military with PTSD group and the Military without PTSD group along with the corresponding t-test. The "**" denotes significance.

Figures

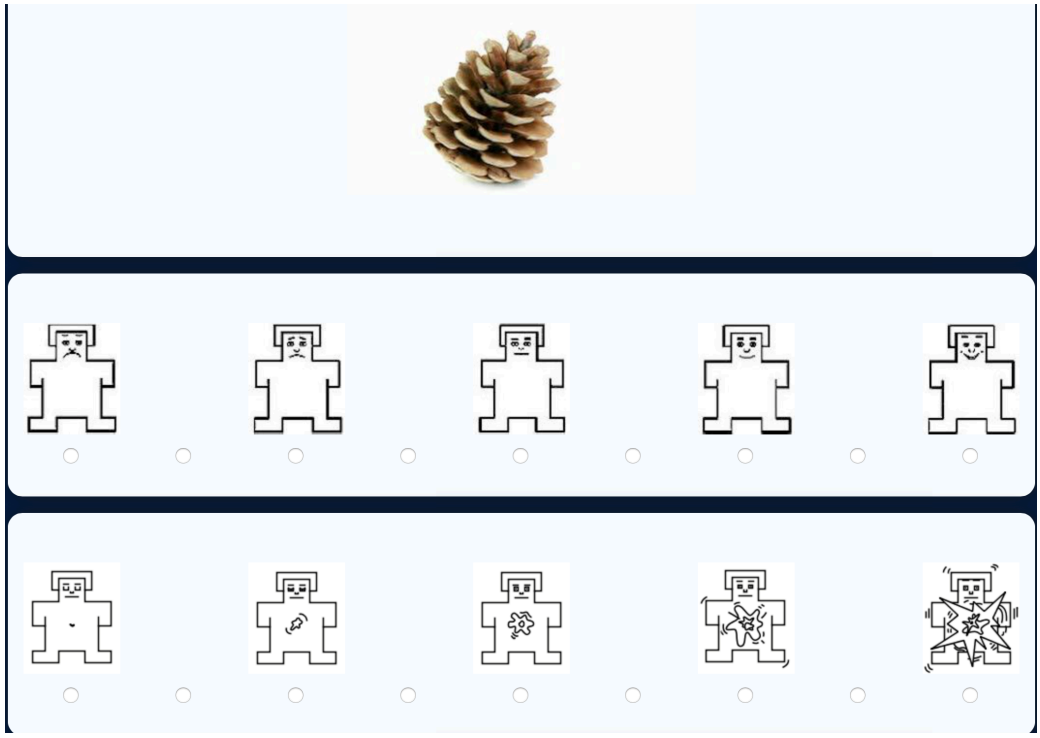

Figure 1: Survey example. The self assessment manikins for valence on top and arousal on the bottom placed over a 9-point Likert scale were presented to participants along with each image for them to record their valence and arousal data.

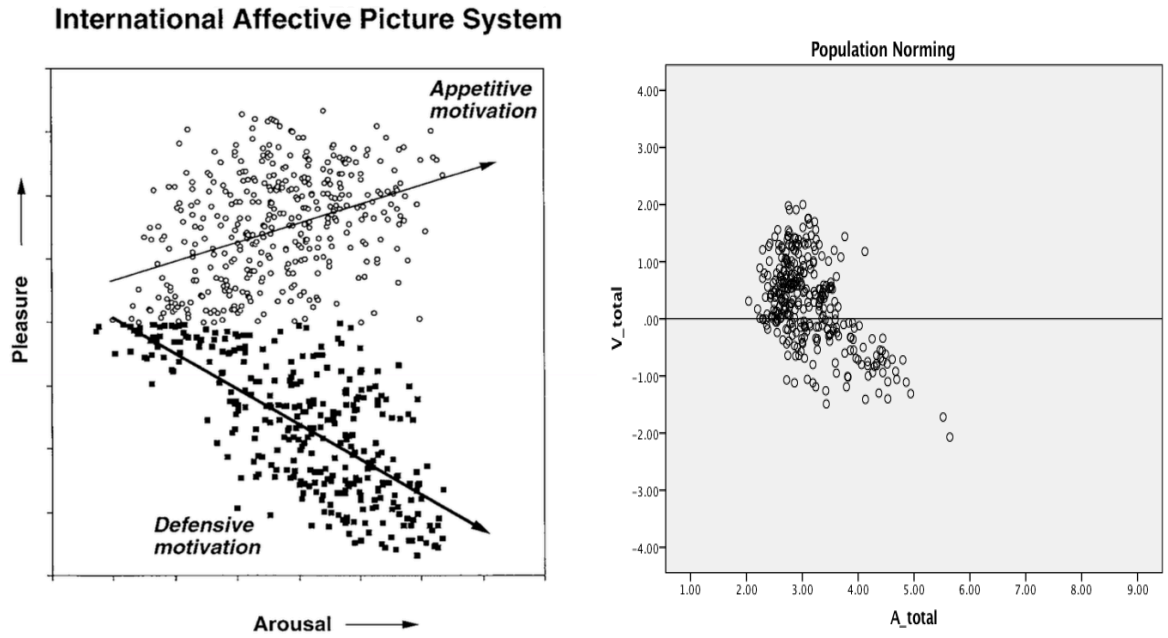

Figure 2: Affective space for stimuli. The affective space of the International Affective Picture System (Bradley et al., 2001) on the right is compared to the affective space for the picture set used in this study, which is on the left. The Y-axis on both affective spaces represents valence scores for each picture with a neutral valence score located in the middle of the scale. The X-axis of both affective spaces records the arousal ratings for each picture going from calm on the left to high arousal toward the right.

Figure 3: High and low valence images. Valence is the measure of how positive or negative an image is. The two highest rated and two lowest rated pictures in valence are shown here. The picture of the path (2.0±1.78) and bunny (1.98±1.7) were the highest with the brown recluse (-2.07±2.1) and rattlesnake (-1.72±2.1) being the lowest valence in the stimulus set.

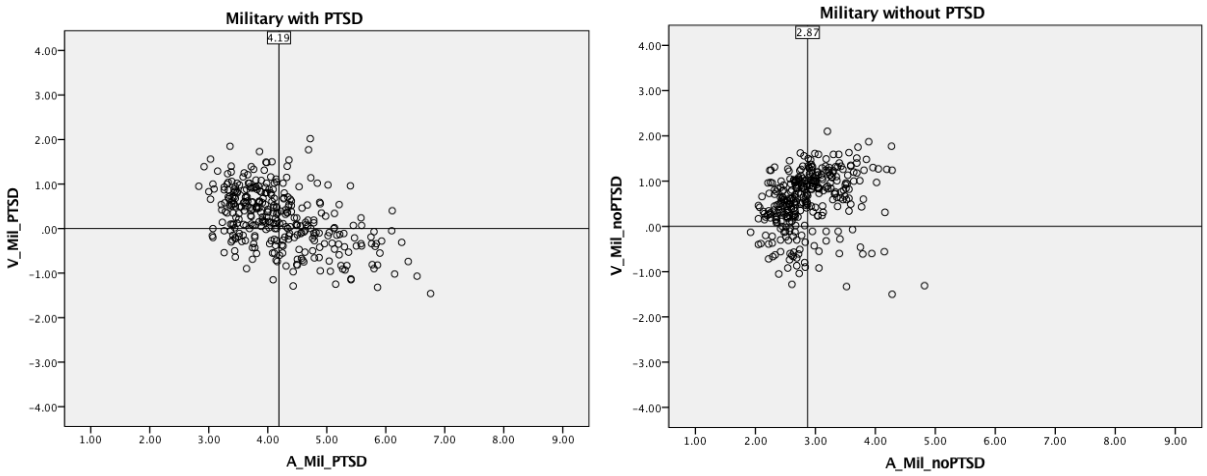

Figure 4: Military samples affective space. The affective space for both Military with PTSD and Military without PTSD is depicted. The horizontal line indicates a neutral valence (Y-axis). The vertical line indicates the mean arousal for that group.

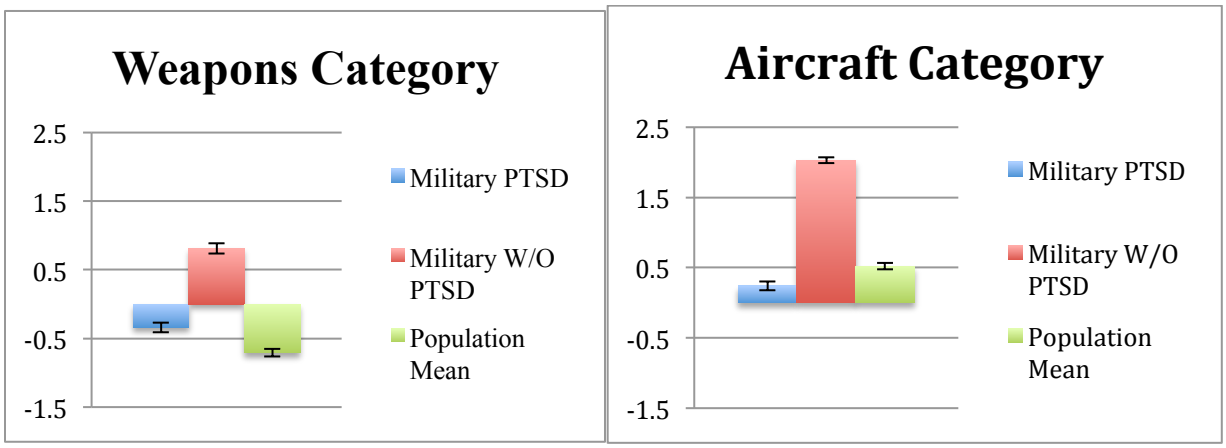

Figure 5: Categories with military interest. Bar charts depicting the categories of Weapons and Aircraft. Bars represent the mean valence ratings for each group for the 33 pictures within each category. Error bars depict Standard Error of the Mean.