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Eye tracking and visual attention to threating stimuli in veterans of the Iraq war

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ABSTRACT

Theoretical and clinical characterizations of attention in PTSD acknowledge the possibility for both hypervigilance and avoidance of trauma-relevant stimuli. This study used eye tracking technology to investigate visual orientation and attention to traumatic and neutral stimuli in nineteen veterans of the Iraq war. Veterans saw slides in which half the screen had a negatively valenced image and half had a neutral image. Negatively valenced stimuli were further divided into stimuli that varied in trauma relevance (either Iraq war or civilian motor vehicle accidents). Veterans reporting relatively higher levels of PSTD symptoms had larger pupils to all negatively valenced pictures and spent more time looking at them than did veterans lower in PTSD symptoms. Veterans higher in PTSD symptoms also showed a trend towards looking first at Iraq images. The findings suggest that post-traumatic pathology is associated with vigilance rather than avoidance when visually processing negatively valenced and trauma-relevant stimuli.

Hypervigilance is an increase in attention to threatening, potentially threatening, or trauma-relevant stimuli and is a widely reported symptom in post-traumatic stress disorder (APA, 2000). This symptom may have numerous manifestations including constant visual scanning for suspicious behavior in pubic places, an alertness for unusual sounds, noting of entrances and exits in enclosed places, constant checking of locks inside the home, or investigation of circumstances that seem out of the ordinary. Hypervigilance is also critical to theoretical characterizations of the disorder in which attentional biases toward threat is thought to be a central organizing feature in post-traumatic thought and behavior (Chemtob, Roitblat, Hamada, Carlson, & Twentyman, 1988; Ehlers & Clark, 2000; Litz & Keane, 1989). Such models posit that increased attentional bias to threat might maintain or even initiate other symptoms in the disorder such as intrusive memories, flashbacks, concentration difficulties, and avoidance behaviors.

Understandably, there has been considerable effort dedicated to understanding the nature and extent of attentional biases in PTSD. The majority of this work has been accomplished through behavioral reaction time tasks such as the emotional Stroop and dot probe paradigm (Bryant & Harvey, 1995; Dalgleish, Moradi, Taghavi, Neshat-Doost, & Yule, 2001; Harvey, Bryant, & Rapee, 1996; McNally, Kaspi, Riemann, & Zeitlin, 1990; Vrana, Roodman, & Beckham, 1995). As a whole, these paradigms have produced some support for attentional biases in PTSD, although the reliability of the emotional Stroop effect in PTSD has recently been called into question (Kimble, Frueh, & Marks, 2009). Part of the variability in these tasks may be due to the fact that attention is measured using reaction time and is indirectly inferred through facilitation and/or interference effects. Factors such as motor speed, depression, and motivation may all confound the findings.

Other strategies, such as the use of event related potentials (ERPs), have been more productive in studying attentional biases in PTSD (Attias, Bleich, & Gilat, 1996; Kimble, Kaloupek, Kaufman, & Deldin, 2000; Kimble, Ruddy, Deldin, & Kaufman, 2004; Metzger, Orr, Lasko, & Pitman, 1997; Metzger et al., 2002). Using ERPs as an index of attention has distinct advantages, including the ability to link specific neurophysiological processes to discrete psychological states and events. In a recent review and metaanalysis of ERP studies in PTSD, Karl, Malta, and Maercker (2006) concluded that individuals with PTSD showed increased attention to stimuli when those stimuli were potentially threatening or occurred in a threatening context. This body of work is important in that it illustrates automatic responses to threatening stimuli. Still yet, ERPs do not directly measure the behavioral correlates of hypervigilance. While the work may indicate neural differences in response to threatening stimuli, it is not clear how these neural responses translate into hypervigilant behavior.

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Eye tracking is a tool that has remained entirely unexplored in PTSD. Eye tracking potentially fills an important niche in the PTSD literature as it can directly assess hypervigilant behavior without the overlay of facilitation, interference, or reaction time. Patterns in eye fixations, fixation durations, and eye movements provide continuous and non-invasive behavioral indices of attention to visual stimuli. Eye tracking has been widely used in cognitive psychology for decades to understand processes such as motivation (Isaacowitz, 2006), visual attention in reading (Radach, Inhoff, & Heller, 2002; Rayner, 1998), scene perception (Rayner, Smith, Malcolm, & Henderson, 2009), and attention to emotional material (Calvo & Lang, 2004).

It has only been in the last decade in which researchers have used eye tracking to study visual attention in anxiety disorders. Much of this work has been carried out by Karin Mogg and colleagues at the University of Southhampton and Kaye Horley from the University of Wollongong who have been looking at face perception in individuals with social anxiety disorders. In these tasks, participants are typically shown faces that vary in emotional content and differences in visual scanpath are analyzed based on psychiatric status. This body of work suggests that social phobics may have an initial bias for the processing of threat cues (Mogg, Philippot, & Bradley, 2004), an effect that is modified under stress and over time (Garner, Mogg, & Bradley, 2006). Horley, Williams, Gonsalvez, and Gordon (2003) found social phobics to have fewer fixations on the eyes of facial stimuli, an effect that is particularly evident for angry faces (Horley, Williams, Gonsalvez, & Gordon, 2004).

A number of studies have also investigated visual orientation and attention in individuals with phobia. In the majority of these tasks, slides that have a range of objects in them (including a picture of a spider) are shown to individuals who vary in spider fear (Gerdes, Alpers, & Pauli, 2008; Lange, Tierney, Reinhardt-Rutland, & Vivekananda-Schmidt, 2004; Pflugshaupt et al., 2005; Rinck & Becker, 2006). The data has suggested that spider phobics initially fixate faster on spider stimuli and then avoid them (Pflugshaupt et al., 2005; Rinck & Becker, 2006). Other work has shown that spider phobics may be distracted by spider pictures even when the spider pictures are irrelevant to the task (Gerdes et al., 2008).

Whether similar patterns of attention exist in individuals with PTSD is still an unanswered question. Individuals with PTSD may, for example, show evidence of initial hypervigilance only to be followed by avoidance of traumatic stimuli. This would be consistent with theories in the wider anxiety literature that indicate that both hypervigilant and avoidant behavior may co occur but are separated temporally—the hypervigilance is present to detect threat so that it can be subsequently avoided (Bradley et al., 1999; Mogg, Mathews, & Weinman, 1987; Mogg, Bradley, De Bono, & Painter, 1997). Given that PTSD is characterized by both hypervigilant and avoidant behaviors, a test of this hypervigilance-avoidance hypothesis is in order.

There has only been one study using eye tracking that has looked at visual attention in trauma survivors and it looked only at initial visual orientation. Bryant, Harvey, Gordon, and Barry (1995) presented four words in the parafoveal range of which one of the words was a threat word. Those motor vehicle accident survivors with PTSD demonstrated more initial eye movements towards the threat words than to neutral words as compared to motor vehicle accidents survivors without PTSD. The authors conclude that PTSD participants preferentially fixate on threat stimuli than do non-PTSD participants, particularly in the early stages of processing.

This study intends to expand our understanding of visual attention and vigilance in a traumatized sample. First, we investigated initial visual orienting to negatively valenced, neutral, and trauma-relevant stimuli. Preferential orientation to traumatic stimuli would be a relatively direct measure of hypervigilance and would have high ecological validity. Individuals with PTSD, and veterans in particular, often describe visual scanning after trauma in order to identify potential threats. When given a choice, do veterans with PTSD look first at trauma specific stimuli? We also investigated whether preferential orienting was specific to trauma-relevant stimuli or might include other negatively valenced stimuli. This level of control seemed important given that those with PTSD often describe being hypervigilant for a wide range of threats that exceed the content of their original trauma. Given this pattern, we hypothesized that veterans higher in PTSD symptoms would orient first to negatively valenced stimuli, regardless of whether they were combat or motor vehicle accidents.

Second, we used a paradigm designed to assess visual attention across time to assess patterns of vigilance/avoidance. Despite 25 years as an official diagnosis, the field still has very little understanding as to whether those with PTSD are avoidant of or vigilant for traumatic reminders and threat. Those who highlight avoidance/numbing responses to traumatic reminder emphasize cognitive and behavioral strategies designed to evade stimuli that might remind one of a trauma (Horowitz, Wilner, & Alverez, 1979). In a forced task paradigm such as this one, one might expect that those with PTSD might preferentially look away from traumatic reminders in order to minimize the onset of intrusive symptoms. On the other hand, an emphasis on the vigilant aspects of the disorder would suggest that those with PTSD would find the traumatic stimuli quicker and then continue to scan the stimulus for potential threat. In addition, theories that emphasize an inability to disengage from traumatic reminders would also suggest vigilance rather avoidance in a PTSD sample (Ellenbogen & Schwartzman, 2008; Pineles, Shipherd, Welch, & Yovel, 2007) Finally, it is possible, as some theories of attention in anxiety suggest, that attention may be dynamic—with vigilance dominating early stages of visual processing only to be followed by avoidance (Bradley, Mogg, White, Groom, & de Bono, 1999; Mogg, Mathews, et al., 1987; Mogg, Bradley, et al., 1997). In this study we hypothesized that veterans higher in PTSD symptoms would dwell longer the first time they saw a negatively valenced picture but then subsequently avoid it.

Third, we assessed pupil dilation to negatively valenced and neutral pictures to assess arousal and interest (Sturgeon, Cooper, & Howell, 1989). The study controlled for general arousal effects by having arousing, but non-trauma-relevant stimuli (motor vehicle accidents) in addition to neutral stimuli. The literature provides clearer guidance with respect to how individuals higher in PTSD would react to trauma-relevant pictures. Given that individuals with PTSD are known clinically and experimentally to show autonomic sympathetic activation to traumatic reminders, one would expect that those veterans with PTSD would have larger pupils to traumatic stimuli. Whether they would also show larger pupils to non-traumatic, negatively valenced stimuli (motor vehicle accidents) is an empirical question that would shed light on the specificity of post-traumatic arousal.

Method

1.1. Participants

Nineteen veterans of the war in Iraq were recruited through Norwich University (Northfield VT) and its affiliated Army Reserve and Army National Guard Units. Norwich University is a military university and has many returning veterans seeking their bachelor's degrees and also has close ties to Vermont Guard and Reserve units. Some veterans were attending Norwich as part of the Cadet Corp with the intention of graduating with a commission as an officer. Veterans were recruited through announcements

Table 1
Demographic and psychometric variables (N = 19).

Group	Mean	SD	N
Age			
PTSD−	31.7	9.41	10
PTSD+	26.56	6.75	9
ALL	29.26	8.54	19
CAPS			
PTSD−	10.00	6.28	10
PTSD+	36.33	18.37	9
ALL	23.94	19.22	19
PSS			
PTSD−	6.80	11.75	10
PTSD+	18.44	3.99	9
ALL	12.32	10.25	19
CES			
PTSD−	18.33	9.73	10
PTSD+	17.00	8.21	8
ALL	17.72	8.85	18

made in classes by the investigators (KF and CB) as well as announcements made by staff sergeants who were familiar with the research project. Because this study was part of a larger study involving the assessment of brain activity, veterans were excluded if they had a history of moderate head injury, a history of epilepsy or seizures, or had a current substance abuse diagnosis.

The average of the veterans was 29.3(8.5) years with a range from 23 to 54. Seventeen males and two females participated. Their average education corresponded with partial completion of college. The sample was predominantly white. Two veterans self-reported as Hispanic. The veterans' duties overseas varied from infantry, to combat support, to medical services. All veterans reported being exposed to life threatening circumstances. The mean score on the Combat Exposure Scale (CES: Keane et al., 1989) corresponded to "moderate" exposure to combat. Two of the nineteen veterans met criteria for current PTSD. Three achieved criteria for major depression, one for generalized anxiety disorder, two for panic disorder. None carried a diagnosis for psychosis, obsessive–compulsive disorder, or substance abuse. Psychometric characteristics for the sample are included in Table 1.

1.2. Measures

1.2.1. PTSD diagnosis

The Clinician Administered PTSD Scale (CAPS: Blake et al., 1995) was used to diagnose current PTSD. In the CAPS, separate frequency and intensity items are made for each symptom allowing for a continuous estimate of specific symptoms or overall PTSD severity. The CAPS has been used widely and has demonstrated high interrater reliability, internal consistency, and concurrent validity with other measures of PTSD (Blake et al., 1995).

1.2.2. Axis I diagnosis

We administered parts of the Structured Clinical Interview for DSM-IV (SCID-IV; Spitzer, Williams, Gibbons, & First, 1996) to diagnose current major depression, psychotic disorders, substance abuse, generalized anxiety disorder, obsessive–compulsive disorder, and panic disorder. The SCID has well established reliability and validity in clinical and non-clinical samples (Williams, Gibbon, First, & Spitzer, 1992).

1.2.3. PTSD symptoms scale (Foa, Riggs, Dancu, & Rothbaum, 1993)

This 17-item questionnaire corresponds directly to the DSM-IV criteria for PTSD. Symptoms are rated on a four-point scale. The measure has well-established reliability and validity.

1.2.4. Combat exposure scale (Keane et al., 1989)

This 7-item scale was given to assess the veterans' exposure to combat.

1.3. Split screen task

The split screen task involved the presentation of twenty slides presented on a computer screen. Each slide had two pictures, one on the right side of the slide and one on the left side. On combat slides (N = 10), one picture was a war related image and the other was not (a neutral picture). Attempts were made to match war and neutral images on figure posture, number of individuals, and overall complexity. For example, an image of forward facing Iraqi soldiers in formation might be matched with a picture of forward facing athletes standing in line during a national anthem. On MVA slides (N = 10), one picture was an image of a MVA and the other was a neutral picture involving a vehicle but no accident. Again, attempts were made to match image qualities. For example, an MVA involving a tree was matched with a neutral picture of a car parked next to a tree.

Neutral and trauma images were counterbalanced by side such that half the slides had the trauma images on the left and half had them on the right. The order of slide presentation was random for each participant. Each slide was presented for a total of ten seconds. The inter trial interval varied depending on how long it took to calibrate before each trial, but typically the intervals were between two and five seconds.

2. Procedures

Participants started the study session by completing a written informed consent procedure. All participants were then interviewed by a trained clinical psychologist who has been trained specifically in CAPS and SCID administration (MK). A median split was used to create PTSD-High and PTSD-Low groups, the "High" and the "Low" indicating more or less PTSD pathology respectively, not the presence of absence of PTSD. The participant also filled out the Combat Exposure Scale (Keane et al., 1989) and Post-traumatic Stress Scale (Foa et al., 1993). After completing these procedures, the participant placed their head in a chin rest with their forehead touching a crossbar. After positioning themselves in the chinrest, the eyes were 57 cm away from a 19 in. flat screen monitor (Dell: Model No. 1907FPt). Slides were prepared in Adobe Illustrator® and presented using Experiment Builder® software (Ottowa, Canada). Slides took up the entirety of the screen and had a black background. The pictures within each slide were the same size but the size of the images varied across slides. Both pictures on a given slide were centered 10 degrees visual angle away from the horizontal center and on average were 11.5 degrees tall and 14 degrees wide. All pictures were color pictures with a white border approximately 1 cm wide (see Fig. 1). Eye tracking and pupil diameters were measures using Eyelink 1000®, a desktop mounted, mirrorless, high resolution eye tracker (SR Research: Ottowa). Movement was detected using corneal reflection and an elliptical pupil detection algorithm standard in the Eyelink 1000® system. Pupil size resolution was within .2% of pupil diameter. Data was sampled at 2000 Hz. Data Viewer® software was used to overlay fixations and pupil size on the stimuli for later offline analyses (SR Research, Ottowa).

The eye tracking procedure started with a calibration/validation sequence in which participants had to follow a dot presented randomly at nine different locations on the screen. The system was calibrated on a per subject basis at the beginning of the experiment to a spatial accuracy that was on average below 0.5°. The accuracy of the calibration was checked between each trial and the participant was recalibrated if their error at the central fixation point was greater than 1°. Once the calibration was completed, the

Fig. 1. Iraq war slide with neutral picture on the left and Iraq war picture on the right. Veterans looked at the slide for 10 s.

first of the twenty stimuli was presented. A brief calibration check occurred between each slide. The entire task took approximately four minutes. When the task was complete, the participants were debriefed and then paid for their time.

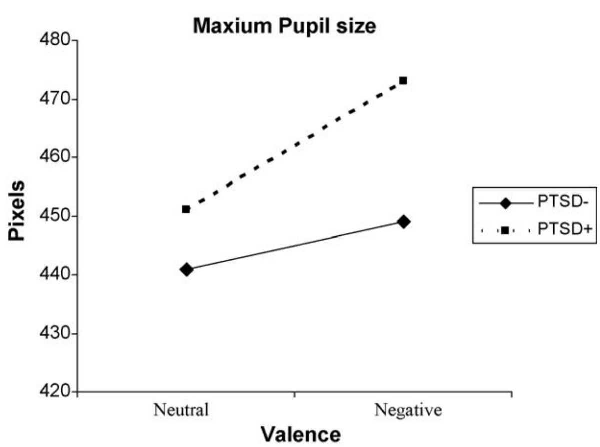

Fig. 2. Maximum pupil size as a function and valence and PTSD status.

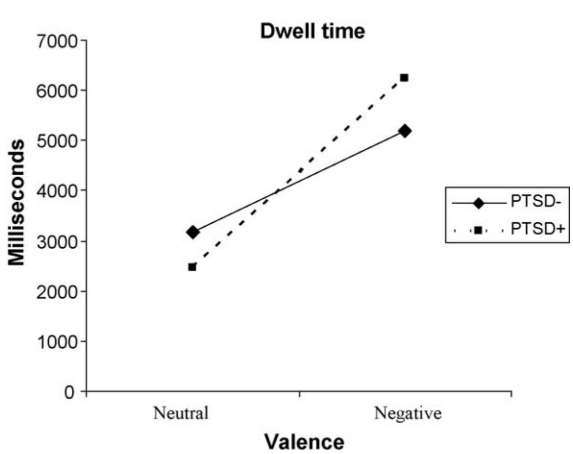

Fig. 3. Dwell time as a function of valence and PTSD symptom reports.

Data Viewer® software was used to extract first fixations, dwell times, and pupil size data for offline analyses. Dependent variables were analyzed using a 2 (Group: PTSD-High vs. PTSD-Low) × 2 (Slide Type: Iraq vs. MVA) × 2 (Valence: Negative vs. Neutral) analysis of variance. Therefore, a Type × Valence interaction would represent differential response to one of the four types of pictures [(1) Iraq picture: negative valence, combat slide; (2) MVA picture: negative valence, MVA slide; (3) Neutral 1 picture: Neutral valence, combat slide; (4) Neutral 2 picture: neutral valence, MVA slide]. In particular, we were most interested in the amount of time spent looking at a particular type of image (Dwell Time), the location of the first fixation (first fixation), and the pupil size of fixations (maximum pupil sizes). Dwell time was measured in seconds and pupil size in pixels. In order to assess possible avoidance of the MVA or Iraq pictures, we further broke Dwell Time into First Run Dwell Time (how long they looked at a picture the first time they looked at it) and Second Run Dwell Time (how long they looked at a picture the second time they looked at it). This allowed for the assessment of possible avoidance of MVA or Combat pictures (during the 2nd run) after the participants are aware of the content of all the pictures. First fixation was measured in the amount of time, in seconds, it took an individual to first fixate on a given picture.

3. Results

3.1. Pupil size

The 2 × 2 × 2 ANOVA indicated a Group × Valence interaction with veterans higher in PTSD showing larger pupil size to the negatively valenced (both Iraq and MVA) pictures [$F(1,17) = 4.77$, $p < .05$]. There was no significant Group × Slide × Valence interaction which would indicate larger pupils to combat pictures only. See Table 2 and Fig. 2.

3.2. First fixation

The 2 × 2 × 2 ANOVA indicated a statistical trend in the Group × Valence interaction indicating that veterans higher in PTSD symptoms reports looked first to MVA and Iraq pictures [$F(1,17) = 4.10$, $p < .10$]. There was also a trend in the

Table 2
Maximum pupil size by group and condition.

Group	Mean	SD	*N*
Neutral (Iraq)			
PTSD−	447.5	109.2	10
PTSD+	453.6	100.1	9
Iraq war			
PTSD−	450.4	102.1	10
PTSD+	475.7	103.6	9
Neutral (MVA)			
PTSD−	434.7	104.0	10
PTSD+	448.9	102.6	9
MVA			
PTSD−	442.0	106.7	10
PTSD+	470.7	100.7	9

Table 3
First fixation by group and condition.

Stimulus	Group	Mean	SD	*N*
Neutral (Iraq)	PTSD−	1419.3	780.2	10
	PTSD+	2261.4	1422.9	9
Iraq war	PTSD−	809.7	468.2	10
	PTSD+	527.8	138.0	9
Neutral (MVA)	PTSD−	1115.7	322.6	10
	PTSD+	1323.3	639.1	9
MVA	PTSD−	904.4	418.8	10
	PTSD+	731.0	274.2	9

Group × Valence × Slide interaction [$F(1,17) = 3.3$, $p < .10$] in which veterans higher in PTSD scores were quicker to look at and Iraq pictures in particular (see Table 3).

3.3. Dwell time

Dwell time included a fourth factor called "Time". The Time factor compared the amount of time they looked at a particular picture the first time they looked at it as compared to when they returned to the picture and looked at it a second time. This allowed for an assessment of how their dwell time to the picture types changed over the course of the ten-second interval. The 2 (Group) × 2 (Slide Type) × 2 (Valence) × 2 (Time) ANOVA was not significant [$F(1,17) = 0.94$, $p > .05$] indicating that the two groups did not differ over time in how they looked at the pictures. There was a significant Group × Valence interaction [$F(1,17) = 9.1$ $p < .01$] however. Veterans higher in PTSD scores spent more time looking at negatively valenced pictures. This was not modified by a Group × Valence × Slide interaction which would indicate combat specific vigilance (see Fig. 3 and Table 4).

Table 4
Dwell time by group and condition.

Stimulus	Group	Mean	SD	*N*
Neutral (Iraq)	PTSD−	3037.4	911.6	10
	PTSD+	2266.1	658.1	9
Iraq war	PTSD−	5264.7	783.8	10
	PTSD+	6493.7	648.2	9
Neutral (MVA)	PTSD−	3315.5	957.4	10
	PTSD+	2665.2	1160.8	9
MVA	PTSD−	5105.1	860.7	10
	PTSD+	5989.0	1181.9	9

4. Discussion

In this study combat veterans higher in PTSD symptom reports had larger pupils and looked longer at negatively valenced material. There was also a trend for those higher in PTSD scores to look first to negative pictures in general and combat pictures in particular. There was no data that would support avoidance of traumatic visual material either in early or late stage processing. This last conclusion is supported both by the first fixation data as well as the dwell time data which show no avoidance of traumatic stimuli in veterans with PTSD. Rather, the data is consistent with attentional bias and hypervigilance for potentially threatening stimuli.

The initial trend in first fixations was followed by continued processing of negatively valenced stimuli in those higher in PTSD scores. This indicates that the PTSD-High group did not employ any behavioral strategies (i.e., closing their eyes, blinking, looking at neutral pictures, looking off screen) to avoid threatening material. There was also no change in dwell time over the ten-second period. Even when PTSD-High veterans were sure of the exact content of the pictures (they had visited each picture at least once), these veterans still spent more time on negatively valenced pictures.

Rather than avoidance, this pattern suggests an inability to disengage from threatening material in those higher in PTSD symptoms and highlights the ruminative quality of PTSD symptoms. In recent years, there has been increasing evidence to suggest that rumination plays an important role in predicting and maintaining PTSD symptoms (Ehring, Frank, & Ehlers, 2008; Michael, Halligan, Clark, & Ehlers, 2007; Steil & Ehlers, 2000). It has been suggested, for example, that ongoing intrusive memories and the playing out of unproductive "what if" scenarios are all associated with ongoing PTSD pathology. It is also suggested in this work that these ruminative symptoms are the targets of patient-initiated avoidance strategies that become dysfunctional in and of themselves. The fact that veterans higher in PTSD scores spent more time rather than less looking at negatively valenced pictures suggests that they could not disengage in a way that might minimize threatening input.

In this way, individuals with PTSD might differ from other anxiety disorders in which eye tracking has been done. There has been general support for a hypervigilance/avoidance model in phobias (Mogg et al., 1997; Pflugshaupt et al., 2005; Rinck & Becker, 2006). Social phobics seem to avoid anxiety provoking stimuli such as eyes and angry faces (Horley et al., 2004). If the data from the PTSD-High group can be generalized, it suggests that attention in PTSD may have more in common with depression and obsessive–compulsive disorder where rumination is thought to be prominent rather than anxiety disorders in which avoidance is prominent.

In this study, veterans higher in PTSD reports also showed significantly larger pupils to threatening pictures. In the broader literature, studies have found increased pupil size to arousing pictures and emotional auditory stimuli (Bradley, Miccoli, Escrig, & Lang, 2008; Bradshaw, 1967; Partala & Surakka, 2003; Partala, Jokiniemi, & Surakka, 2000). The longstanding notion that pupil dilation measure of autonomic sympathetic arousal has been further supported by recent data that shows that aymgdala activation causes pupil dilation but is also responsive to pupil dilation in others (Demos, Kelley, Ryan, Davis, & Whalen, 2008; Granholm & Steinhauer, 2004). The data from this study suggest increased autonomic arousal in those with higher PTSD symptoms when exposed to threatening stimuli. This is consistent with the clinical presentation of PTSD and a body of empirical work that has shown increases in heart rate and skin conductance in veterans with PTSD when exposed to trauma reminders. This study suggests that pupillometry can be a valuable addition to the study of dysregulated autonomic arousal after trauma.

5. Limitations

In this study, only two of the nineteen veterans achieved criteria for PTSD using the Clinician Administered PTSD scale (Blake et al., 1995). Therefore, using the median split included many veterans in the "PTSD-High" group that did not have PTSD. However, the "PTSD-High" group did have an average of 18.4 on the PSS-SR (Foa et al., 1993) which exceeds the recommended cut-off of 14 or 15 which has been suggested in a number of papers (Coffey, Gudmunsdottir, Beck, Palyo, & Miller, 2006; Stieglitz, Frommberger, Foa, & Berger, 2001; Wohlfarth, van den Brink, Winkel, & ter Smitten, 2003). Using this same cut-off, six of the nine in the PTSD-High group achieve a "probable" PTSD diagnosis on the PSS-SR. In this sample, the total CAPS score correlated with the PSS at $r = .86$ indicating very high reliability between the interview and the self-report measures. The discrepancy between the "probable" diagnosis and the actual diagnosis on the CAPS was almost certainly due to a selection bias. These veterans were recruited out of active Guard units and active college enrollments, therefore, were veterans who were continuing to function at a relatively high level. While some of the veterans may have had high symptom reports, they did not have significant functional impairments that would lead to a clinical diagnosis. It is also possible that, given their active duty service or enrollment in school, they may have downplayed the extent to which any symptoms impacted on their functional abilities. Future work might benefit from a large, clinically diagnosed PTSD sample to see if the effects present in this sample are exacerbated. It is also possible that those clinically diagnosed with PTSD might show avoidance patterns not present in this higher functioning sample.

It could also be argued that motor vehicle accidents could also be considered "trauma relevant" to Iraq veterans. Many veterans reported previous motor vehicle accidents and many would have seen vehicles destroyed while on deployment. However, none of the nineteen veterans reported any ongoing symptoms associated with motor vehicle accidents and none considered their past MVAs "traumatic". In addition, other negatively valenced pictures designed to be used as "controls" could also have potentially traumatic connotations. For example, the IAPS negatively valenced and arousing pictures are primarily of assaults and mutilations, both of which are likely to be even more "trauma-relevant" to combat veterans than are MVAs.

6. Implications

In this study, veterans higher in PTSD were biased towards all negatively valenced stimuli, not just Iraq specific stimuli. Group - × Valence interactions were present for dwell time and pupil size, and a trend was present for first fixations. Only in first fixations was there an additional trend towards an Iraq specific attentional bias. This finding is in agreement with some studies but in disagreement with others regarding the specificity of attentional bias in PTSD. However, this general vigilance for threat seems most consistent with the clinical presentation of returning veterans. Returning veterans report being on guard for a wide range of circumstances that go beyond the specifics of their trauma. While at times they report scanning the environment for individuals who might be concealing weapons or bombs, just as often they are alert for any signs of potential danger such as obstructions, deteriorating driving conditions, signs of fire, uncharacteristic noises, and objects that appear out of place.

There was no evidence that veterans higher in PTSD scores try to avoid stimuli that might specifically remind them of their trauma. In fact veterans with higher symptoms reports spent more than twice the time looking at negatively valenced pictures in comparison to neutral pictures. For the most part, this is consistent with the larger literature that has empirically demonstrated attentional biases toward rather than away from traumatic material. However, it stands in contrast to the weight of clinical evidence which reports both cognitive (numbing, dissociation) and behavioral (avoidance) strategies intended to minimize potential reminders of the trauma. The field would benefit from designing paradigms that could investigate when PTSD participants use hypervigilance and when they use avoidance to cope with negatively valenced emotional material.

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