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Attention to threat images in individuals with clinical and subthreshold symptoms of post-traumatic stress disorder

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ABSTRACT

Attention to general and trauma-relevant threat was examined in individuals with clinical and subthreshold symptoms of post-traumatic stress disorder (PTSD). Participants' eye gaze was tracked and recorded while they viewed sets of four images over a 6-s presentation (one negative, positive, and neutral image, and either a general threat image or a trauma-relevant threat image). Two trauma-exposed groups (a clinical and a subthreshold PTSD symptom group) were compared to a non-trauma-exposed group. Both the clinical and subthreshold PTSD symptom groups attended to trauma-relevant threat images more than the no-trauma-exposure group, whereas there were no group differences for general threat images. A time course analysis of attention to trauma-relevant threat images revealed different attentional profiles for the trauma-exposed groups. Participants with clinical PTSD symptoms exhibited immediate heightened attention to the images relative to participants with no-trauma-exposure, whereas participants with subthreshold PTSD symptoms did not. In addition, participants with subthreshold PTSD symptoms attended to trauma-relevant threat images throughout the 6-s presentation, whereas participants with clinical symptoms of PTSD exhibited evidence of avoidance. The theoretical and clinical implications of these distinct attentional profiles are discussed.

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1. Introduction

Post-traumatic stress disorder (PTSD) is a complex clinical syndrome that can develop in response to experiencing, witnessing, or being confronted with actual or threatened death or serious injury. Recent estimates of PTSD in the general population indicate that approximately 3.6% of men and 9.7% of women are affected (Kessler, Berglund, Demler, Jin, & Walters, 2005). The magnitude of distress, functional impairment, comorbidity, and economic costs associated with PTSD is well established (e.g. Keane, Marshall Am, & Taft, 2006). Researchers have also documented the prevalence and disability experienced by those who meet some, but not all criteria for this disorder. Rates of subthreshold PTSD have been cited to range from 3.4% in a community sample (Stein, Walker, Hazen, & Forde, 1997) and 4.6% in a large epidemiological study of veterans (Grubach et al., 2005), to as high as 44% in trauma-specific samples (e.g. Blanchard, Hickling, Taylor, Loos, & Gerardi, 1994). The associated impairments are significant and pervasive, and include increased rates of suicidal ideation, substance use, impaired occupational and social functioning, and other Axis I disorders (e.g.

Cukor, Wyka, Jayasinghe, & Difede, 2010; Marshall et al., 2001; Mylle & Mae, 2004; Zlotnick, Franklin, & Zimmerman, 2002).

In addition to the impairments associated with clinical and subthreshold PTSD, researchers have found that this disorder affects how people attend to the world around them. Many studies have shown that PTSD is associated with a heightened vigilance for threat-related stimuli and increased attention to threat-related information, collectively referred to as a threat-related attentional bias (e.g. Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007; Buckley, Blanchard, & Neill, 2000; Cisler & Koster, 2009). Researchers have identified three possible manifestations of biased attention in PTSD: facilitated attention to threat (attending first to threat stimuli more frequently than to other types of stimuli), delayed disengagement from threat (difficulty moving one's attention away from threat stimuli once detected), and attentional avoidance of threat (avoiding threat stimuli once detected). Understanding the attentional profile of PTSD has become a major focus of research due to its clinical and theoretical implications. For example, the vigilance-avoidance model proposes that facilitated attention (vigilance) to threat stimuli, followed by its subsequent avoidance, are two key processes driving attentional biases in anxiety disorders. Applied to PTSD, this model suggests that people with PTSD are primed to detect threat more quickly in order to facilitate its subsequent avoidance (Mogg, Bradley, Miles, & Dixon, 2004;

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Rinck & Becker, 2006). Threat avoidance then enables individuals to evade attentional engagement with reminders of the traumatic event, to avert the emotional distress that trauma-related memories evoke. Confirmation of this attentional profile would have clinical relevance: habituation to trauma-related stimuli is thought to be a key factor in the reduction of PTSD symptoms, but in order to habituate, one must attentionally engage with, rather than avoid, trauma-related stimuli (e.g. Foa & Kozak, 1986; Wells & Mathews, 1994).

Delineating the attentional profile of those with symptoms of PTSD has been difficult due to the limitations of response latency-based measures of attention. Most studies have used the dot probe or the emotional Stroop task (for a review, see Bar-Haim et al., 2007) to evaluate attentional processing in PTSD. These tasks measure the focus of attention only at a single moment in time, however, making it difficult to assess temporal changes in the allocation of attention. This is a crucial limitation given that attention to threat in PTSD and other anxiety disorders is likely a complex, dynamic process that changes over time (Bar-Haim et al., 2007). Another limitation is that response latency-based tasks use facilitation and interference effects to infer attentional engagement; they do not measure attentional engagement directly. Moreover, a variety of factors such as emotional arousal, motivation, and slowed motor response due to comorbid disorders (e.g. depression) can affect participants' verbal and manual responses to threat-related stimuli and complicate the interpretation of response latency data (e.g. Bar-Haim et al., 2007; De Ruiter & Brosschot, 1994; Markela-Lerenc, Kaiser, Fiedler, Weisbrod, & Mundt, 2006).

A few studies have used eye gaze tracking paradigms to avoid these limitations and to provide a more complete picture of attentional processing in PTSD (Bryant, Harvey, Gordon, & Barry, 1995; Felminghman, Rennie, Manor, & Bryant, 2011; Kimble, Fleming, Bandy, Kim, & Zambetti, 2010). A major advantage of eye gaze tracking is that it can provide a direct and continuous record of the focus of attention over extended intervals, because the direction of an individual's gaze and the focus of their attention are tightly coupled (Wright & Ward, 2008). Bryant et al. (1995) looked for evidence of enhanced threat detection in PTSD by determining if trauma-relevant words were attended to before neutral words. The participants were motor vehicle accident (MVA) survivors with PTSD and control participants without PTSD. Each word set consisted of three filler words and either one MVA-relevant threat word or one neutral word. Bryant et al. found that, unlike control participants, PTSD participants were more likely to initially fixate on MVA-relevant threat words than neutral words, which was interpreted as evidence of enhanced threat detection in PTSD. In a similar study, Felminghman et al. (2011) compared physical assault survivors with and without a diagnosis of PTSD (there were no non-trauma exposed participants). Participants were presented with sets of four words for 1 s. Each word set consisted of three filler words and either one physical assault-relevant threat word or one neutral word. Felmingham et al. found that physical assault survivors with PTSD had significantly more initial fixations to assault-relevant threat words than neutral words, unlike the trauma-exposed participants without PTSD. Thus, like Bryant et al., Felmingham et al. found evidence of enhanced threat detection in individuals with PTSD. Felmingham et al. also analyzed participants' subsequent fixations to assault-relevant threat words following initial fixation and found no between-group differences. Taken together, their results suggest that individuals with PTSD are more likely to first attend to threat-relevant stimuli than trauma-exposed individuals without PTSD, but are no more likely to subsequently avoid threat.

Kimble et al. (2010) used eye gaze tracking to examine attention to threat-relevant images in a group of veterans of the Iraq war. Participants were assigned to either a high PTSD symptom group or a low PTSD symptom group (2 of the 19 participants met diagnostic criteria for PTSD; there were no non-trauma exposed participants). On each trial, participants were presented with a pair of images for 10 s: either a neutral image paired with a combat-themed image (i.e., a trauma-relevant threat image) or a neutral image paired with a motor vehicle accident-themed image (i.e., a general threat image). Three of Kimble et al.'s findings are especially relevant to the present research. First, unlike Bryant et al. (1995) and Felminghman et al. (2011), Kimble et al. did not find clear evidence of enhanced threat detection in PTSD: their results indicated that the participants in the high PTSD group were no more attentionally vigilant to general threat or trauma-relevant threat images than participants in the low PTSD symptom group. Second, Kimble et al. found a large difference between the high and low PTSD symptom groups in their total fixation time to general threat and trauma-relevant threat images: the high PTSD symptom participants had significantly longer total fixation times to both types of threat images relative to neutral images. This result indicates that the attentional bias for threat was not specific to trauma-relevant images. Finally, to look for evidence of threat avoidance, Kimble et al. compared the total amount of time an image was fixated the first time compared to the second time it was viewed during the same trial. Avoidance was defined as shorter total fixation times to an image the second time it was viewed relative to the first time it was viewed. The two groups did not differ in this respect, which indicated that participants with more severe symptoms of PTSD were no more likely to avoid threat images after they had been initially attended than were participants in the low PTSD symptom group.

2. The present research

Taken together, previous eye tracking research suggests that the attentional profile of individuals with PTSD is characterized by increased attention to general threat and trauma-relevant threat stimuli but no avoidance of these stimuli once attended. While there is some evidence of enhanced threat detection in PTSD (Bryant et al., 1995; Felminghman et al., 2011), the research to date is equivocal on this question (Kimble et al., 2010). Of course, the small number of eye tracking studies in the literature makes it difficult to reach any firm conclusions. In the present study, our goal was to build and expand on previous research by examining attention to threat-related stimuli in individuals with clinical and subthreshold levels of PTSD symptoms (hereafter referred to as the clinical PTSD symptom group and the subthreshold PTSD symptom group, respectively). Eye gaze tracking was used to measure participants' attention while they viewed sets of four images (a negative image, a positive image, a neutral image, and a general threat or trauma-relevant threat image) over a 6-s presentation time. Our study differed from previous eye tracking studies in several important respects. First, presenting multiple images with different valences on each trial allowed us to examine group differences in attention to both positive and negative images when multiple stimuli compete for attention. In addition, presenting four images gave participants more opportunity to avoid general threat and trauma-relevant threat images, an important consideration given that attentional avoidance is hypothesized to be important in PTSD. Second, by using both general threat and trauma-relevant threat images, we were able to examine whether attention to both trauma-relevant and general threat stimuli is affected in individuals with clinical and subthreshold levels of PTSD symptoms. Finally, unlike most studies on attention in PTSD, we included a control group of individuals never exposed to trauma (the no-trauma-exposure group). Assessing the attentional profile of individuals with no trauma exposure provided a baseline that allowed us to determine whether the attentional bias associated with clinical PTSD extends to those with subthreshold symptoms of the disorder,