



Attentional control as a moderator of the relationship between posttraumatic stress symptoms and attentional threat bias

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ABSTRACT

Attentional threat bias (ATB) has been suggested as one factor leading to maintenance and exacerbation of posttraumatic stress symptoms (PTSS). In the present study, attentional processes (i.e., facilitated engagement, difficulty disengaging) underlying the association between ATB and PTSS were examined. Additionally, attentional control (AC) was examined as a moderator of this relationship. Participants ($N=97$) completed a dot-probe task with two levels of stimulus-onset asynchrony (SOA: 150 and 500 ms). Higher PTSS were associated with ATB when SOA was longer (i.e., 500 ms), suggesting difficulty disengaging from threat stimuli. AC moderated the relationship between PTSS and ATB when SOA was shorter (i.e., 150 ms), with participants high in PTSS and high in AC having disengaged and shifted attention from threat stimuli using top-down AC when the emotional valence of threat stimuli was less salient (i.e., shorter presentation duration). Findings implicate AC as a buffering mechanism against prolonged attentional engagement with threat-related stimuli among those with high PTSS. Current PTSD interventions may benefit from incorporating attention-based components.

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1. Introduction

Hypervigilance toward threatening information, a symptom of posttraumatic stress disorder (PTSD; *Diagnostic and Statistical Manual for Psychiatric Disorders-Fourth Edition-Text Revision [DSM-IV-TR]*; American Psychiatric Association [APA], 2000), has been implicated as one factor leading to the maintenance and exacerbation of PTSD symptoms (e.g., intrusive thoughts, flashbacks, physiological reactivity, avoidance behaviors, heightened arousal; Constans, 2005; Elzinga & Bremner, 2002). Therefore, among trauma and PTSD researchers, there has been an emphasis on understanding the attentional processing of threat- and trauma-related information among those with PTSD, with the idea that facilitated threat detection (i.e., hypervigilance) is synonymous with PTSD-related attentional threat biases.

Consistent with this conceptualization, a plethora of published journal articles has reported that individuals with PTSD exhibit a bias for attending to trauma-specific stimuli (e.g., Beck, Freeman, Shipherd, Hamblen, & Lackner, 2001; Bryant & Harvey, 1997; McNally, Amir, & Lipke, 1996; McNally, Kaspi, Riemann, & Zeitlin, 1990) and to a lesser degree, general threat stimuli (e.g., Litz et al., 1996). Thus, there has been a general consensus among researchers that an attentional bias to threat information in PTSD is a phe-

nomenon with an overabundance of support in the extant literature (Buckley, Galovski, Blanchard, & Hickling, 2003; Constans, 2005; McNally, 1998). However, a recent examination of peer-reviewed literature and dissertation abstracts has called robustness of this phenomenon into question (Kimble, Frueh, & Marks, 2009).

1.1. Measuring attentional bias

Attentional threat bias is most often conceptualized as being reflexive, automatic, and occurring outside of conscious awareness (Constans, 2005; Yiend, 2010). The modified Stroop task has been used as the primary experimental task to examine attentional biases in PTSD (Constans, 2005). In the traditional Stroop task, participants are asked to name the colors in which words are printed as quickly as possible while ignoring the meaning of the word, a task which becomes more difficult when the color of the ink differs from the meaning of the word (e.g., the word “green” written in red ink). Similarly, in the modified Stroop task, participants are presented with a series of one-word stimuli, each from a specific word category (e.g., trauma, positive, neutral, etc.), and asked to name the color of the word while paying no attention to the word’s meaning. Slower responding to specific word stimuli is thought to occur when attention is briefly captured by the potency of word meaning, thus disrupting the processing of color information.

Kimble et al. (2009) conducted a review of peer-reviewed journal articles and dissertation abstracts for studies using the modified Stroop task to examine attentional bias for threat information

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in individuals with PTSD versus individuals without PTSD; both groups had experienced a traumatic event. Contrary to predictions, only 8% of dissertation abstracts and 44% of peer-reviewed journal articles showed slowed responding to threat words among individuals with PTSD. Kimble et al. (2009) suggest that a lack of empirical support for the modified Stroop effect in PTSD may indicate absence of attentional threat bias in PTSD. However, considerable debate exists about the nature of the modified Stroop task, with some suggesting that the task is inappropriate for use in determining information-processing biases (McKenna & Sharma, 2004; Phaf & Kan, 2007; Weierich, Treat, & Hollingworth, 2008).

There are two primary presentation formats of the modified Stroop task: (a) a blocked format which provides a measure of the combined effect of the slow and fast components of attention and (b) a random format which provides a measure of the fast component of attention (McKenna & Sharma, 2004). Contrary to the expectation of automaticity that the traditional Stroop task is founded on, McKenna and Sharma (2004) found no evidence for fast, automatic effects in the modified Stroop task. Furthermore, in a recent meta-analysis of 172 studies that used the modified Stroop task to examine threat-related attentional biases in anxiety, Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van Ijzendoorn (2007) found evidence of the modified Stroop effect, but only when a blocked presentation format was used. Thus, observed effects are likely the result of slower, higher order regulatory processing; therefore, the modified Stroop task, which does not provide an independent measure of these effects, may not be an appropriate experimental task for examining the processing of threat information in PTSD. The findings of Kimble et al. (2009) are important in advancing research in the area of information processing in PTSD. However, instead of providing contradictory evidence of an association between PTSD and attentional threat bias, Kimble et al.'s (2009) findings suggest that it is necessary to examine attentional threat bias in PTSD using more appropriate experimental tasks.

The dot-probe task is another stimulus-response task used to examine the association between attentional threat bias and anxiety (Saleminck, van den Hout, & Kindt, 2007). In the traditional dot-probe task, two stimuli are presented side by side on a computer screen. The stimuli remain on the screen for a specified duration of time, after which a dot appears on the screen, replacing one of the two pictures. The participant presses a button that corresponds to the relative position of the dot on the screen, thus providing the researcher with a snapshot of the participant's attention allocation at that point and time. If the participant has a bias for attending to threat stimuli, s/he should respond faster when the dot appears in the spatial position previously held by the threat stimuli. Additionally, if the time interval of stimulus presentation varies (e.g., 150 milliseconds [ms], 500 ms), the dot-probe task can provide a temporal examination of attention allocation. However, the majority of research incorporating the dot-probe task has used only one stimulus duration (i.e., 500 ms; Yiend, 2010), a duration of time which likely allows the participant to make multiple shifts in attention.

The only published study related to attentional bias in PTSD to incorporate a dot-probe task found that participants with PTSD showed a bias for attending to mild threat words when compared to participants with subclinical PTSD and participants with low anxiety (Bryant & Harvey, 1997). Interestingly, no attentional bias was observed for strong threat words. These findings may be the consequence of (a) using a modified version of the dot-probe task in which stimulus words were presented simultaneously with a word indicating the direction of the button that the participant was instructed to press (i.e., "left" or "right") and (b) no variation in stimulus-onset asynchrony (SOA; i.e., the duration of time between the initial stimulus presentation and response option).

As previously mentioned, the dot-probe task can provide a temporal examination of attention allocation when multiple stimulus presentation intervals are used, and thus, would be helpful in identifying specific attentional processes (i.e., fast [bottom-up], slow [top-down]) that may account for information-processing biases in PTSD.

1.2. Theories of attentional bias: facilitated engagement or difficulty disengaging?

The vigilance-avoidance model of anxiety-associated attentional threat bias presupposes facilitated threat engagement, or orienting of attention toward threat stimuli, which is followed by the subsequent avoidance of such stimuli (Weierich et al., 2008). In contrast, the attention-maintenance model is not based on the premise that there is faster orienting toward threat stimuli; instead, once threat stimuli are attended to, it is more difficult to disengage from such stimuli, especially at higher levels of anxiety (Weierich et al., 2008).

Related theories of attention (i.e., Corbetta & Shulman, 2002; Eysenck, Derakshan, Santos, & Calvo, 2007; Metcalfe & Mischel, 1999) describe attentional threat bias in anxiety in terms of a bottom-up, sensory driven attentional system and a top-down attentional control (AC) system. AC has been described as one's ability to use higher level executive functioning to regulate, or override, automatic emotional responses (Derryberry & Reed, 2002). In Metcalfe and Mischel's (1999) conceptualization, the "hot" system (bottom-up) is specialized for immediate responding and emotional processing, whereas the "cool" system (top-down) is specialized for reflective emotion regulation and control of impulsive tendencies.

The balance between these two attentional systems is thought to be disrupted when high levels of stress/anxiety impair the cool system and potentiate the hot system (Eysenck et al., 2007; Metcalfe & Mischel, 1999). The top-down attentional system, controlled by the central executive, is seen as being responsible for three main functions of AC: (a) the inhibition of dominant, automatic responses, (b) shifting back and forth between multiple task demands, and (c) updating working memory. Research has consistently shown that anxiety impairs two of these three functions: the inhibition of dominant, automatic responses and shifting back and forth between multiple task demands (Graydon & Eysenck, 1989; Lavie, Hirst, de Fockert, & Viding, 2004). Therefore, individuals in a heightened state of anxiety will be less successful at tasks in which the executive attentional mechanisms of inhibition and shifting are needed. Furthermore, when task-irrelevant stimuli increase participant distress, these stimuli will be attended to for a greater length of time as a result of anxiety's detrimental influence on inhibition and switching functions. However, at low levels of stress, the cool system allows for the inhibition of hot system dominant response tendencies (Metcalfe & Mischel, 1999). Additionally, Metcalfe and Mischel (1999) proposed that hot system activity is more likely to trigger cool system activation in individuals with better developed, more complex cool systems, with cool control eventually becoming an almost automatic response to hot system activation. Thus, individuals with high levels of PTSD who report experiencing high levels of anxiety and persistent arousal (i.e., hot system activation) may have greater difficulty disengaging from threat-relevant information due to impairment of the cool system (i.e., AC).

Research has provided support for the hypothesis that anxious individuals are slower to disengage attention from threat stimuli. Amir, Elias, Klumpp, and Przeworski (2003) found that individuals with social phobia had difficulty disengaging attention from social threat words (e.g., embarrassed, humiliated) when compared with a control group. Fox, Russo, and Dutton (2002) found that individuals with high trait anxiety, in comparison to individuals

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