



Attention bias towards negative emotional information and its relationship with daily worry in the context of acute stress: An eye-tracking study



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ABSTRACT

Cognitive theories of anxiety psychopathology cite biased attention towards threat as a central vulnerability and maintaining factor. However, many studies have found threat bias indices to have poor reliability and have failed to observe the theorized relationship between threat bias and anxiety symptoms; this may be due to the non-unitary nature of threat bias and the influence of state-level variables on its expression. Accumulating data suggests that state anxious mood is important for the robust expression of threat bias and for relations to emerge between threat bias and symptoms, though this possibility has not been experimentally tested. Eye-tracking was used to assess multiple forms of threat bias (i.e., early vigilance, sustained attention, facilitated engagement, delayed disengagement) thought to be related to anxiety. A non-clinical sample ($N = 165$) was recruited to test the hypothesis that biased attention towards threat, but not dysphoric or positive emotional stimuli, during an anxious mood induction, but not at a pre-stress baseline, would prospectively predict greater worry symptoms on days in which more naturalistic stressors occurred. Results revealed the hypothesized moderation effect for sustained attention towards threat after the mood induction but not at baseline, though sustained attention towards dysphoric stimuli also moderated the effect of stressors on worry. Worry-relevant sustained attention towards negative emotional stimuli may be a partially mood-context dependent phenomenon.

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1. Introduction

Anxiety disorders comprise one of the most prevalent classes of psychiatric diagnoses (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012; Kessler et al., 2005). Despite improvements in treatment efficacy and utilization, the staggering personal and economic burden of these disorders has persisted (Greenberg et al., 2003; Kessler & Greenberg, 2002; Whiteford et al., 2013). This underscores the urgent need to better understand mechanisms contributing to anxiety pathology that may inform more targeted treatments. Cognitive theories of anxiety disorders posit that information processing abnormalities are central to their etiology and maintenance (e.g., Dalglish & Watts, 1990; Eysenck, Derakshan, Santos, & Calvo, 2007). One well-researched aberration of

information processing that has been tied to anxiety psychopathology is attention bias towards threat (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Van Bockstaele et al., 2014).

1.1. Attention biases towards threat in anxiety

Attention bias towards threat can be defined as selective attentional allocation to threatening relative to neutral stimuli (Cisler & Koster, 2010). Although meta-analytic evidence suggests that manual reaction time (RT) and eye-tracking assessed threat bias is significantly associated with clinical and non-clinical anxiety (Armstrong & Olatunji, 2012; Bar-Haim et al., 2007), attention bias towards threat is not a unitary phenomenon (Cisler & Koster, 2010; Cisler, Bacon, & Williams, 2009). Sustained attention towards/delayed disengagement from threat as well as facilitated engagement with threat have all been linked with anxiety symptomatology (Armstrong & Olatunji, 2012; Cisler & Koster, 2010; Cisler et al., 2009). Sustained attention towards threat and delayed

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disengagement of attention from threat refers to the degree to which threatening stimuli capture and hold attention, whereas facilitated engagement refers to the speed at which attention orients towards threat (Cisler & Koster, 2010). According to Cisler and Koster's (2010) review, delayed disengagement from threat has been consistently linked with anxiety across reaction time (RT) and eye-tracking assessment methods, whereas facilitated engagement with threat has been associated with anxiety in some studies but not others. Further, among studies that employed bias assessments capable of distinguishing facilitated engagement with threat from delayed disengagement from threat, anxiety was generally found to be specifically related to delayed disengagement. In contrast, the relationship between anxiety and facilitated engagement with threat is less consistently found and possibly moderated by assessment method (RT vs. eye-tracking), attention bias task (visual search/free-viewing vs. dot-probe/spatial cueing), stimulus threat intensity (high vs. low), and/or stimulus presentation duration (i.e., short/subliminal vs. long/supraliminal) (Cisler & Koster, 2010).

In addition to attention bias towards threat, numerous studies have also documented a relationship between anxiety and attention bias away from threat (see Cisler & Koster, 2010 for a review). Given accumulating data demonstrating a relationship between anxiety and attentional bias towards as well as away from threat, some authors have suggested that these seemingly contradictory findings are indicative of a vigilance-avoidance pattern of attention in anxious individuals (e.g., Mogg, Bradley, Miles, & Dixon, 2004; Wieser, Pauli, Weyers, Alpers, & Muhlberger, 2009). Overall, extant data suggest that threat bias is not a unitary phenomenon and may vary over time, underscoring the need to use methods (e.g., eye-tracking) and tasks capable of parsing multiple forms of threat bias across time (e.g., Sanchez, Vazquez, Marker, LeMoult, & Joormann, 2013). However, despite progress in our understanding of the various forms of anxiety-related threat bias, a recent review of the literature highlighted the significant heterogeneity in effect sizes across studies measuring the relationship between manual RT-assessed threat bias and anxiety psychopathology (Van Bockstaele et al., 2014), suggesting that moderator variables may affect the extent to which threat bias indexes anxiety vulnerability. Indeed, a number of studies, including those using eye-tracking indices of threat bias, have failed to find a relationship between threat bias and anxiety (e.g., Mohlman, Price, & Vietri, 2013; Price et al., 2013; Waters, Lipp, & Spence, 2004). Relatedly, accumulating evidence suggests that most manual RT and eye-tracking attention bias assessments demonstrate poor internal and test-retest reliability, limiting their convergent validity (Price et al., 2015; Rodebaugh et al., 2016; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). Taken together, these data suggest that the role of threat bias in anxiety psychopathology may depend upon the specific form of threat bias (e.g., facilitated engagement vs. delayed disengagement) as well as the manner in which bias is assessed.

In a review of the extant evidence for a causal role of threat bias in anxiety psychopathology, Van Bockstaele et al. (2014) propose that the relationship between anxious mood and threat bias is a bidirectional, mutually-maintaining one, suggesting that threat biases relevant to anxiety psychopathology are sensitive to fluctuations in anxious mood state. Indeed, measures of threat bias derived from manual RT and eye-tracking paradigms have demonstrated poor test-retest reliability (e.g., Price et al., 2015), which may partially be attributable to the influence of state-level factors (e.g., acute stress/anxious mood) on the expression of threat bias during a particular assessment session. Thus, as with other forms of learned behavior (Bower, 1981), threat bias may be a partially mood context-dependent as opposed to a trait-like phenomenon. It is conceivable that selectively attending to threatening relative to neutral stimuli under acute stress specifically confers

vulnerability to anxiety symptomatology, possibly via maintenance of anxious responding to stressors as suggested by Van Bockstaele et al. (2014). In summary, the degree to which biased attention towards threat emerges under conditions of acute stress may be a superior predictor of anxiety symptoms, particularly in response to stressors, relative to threat bias under baseline conditions, which may or may not reflect attentional behavior in an anxious mood state.

1.2. Attention biases towards threat under baseline vs. acute stress conditions

A number of studies have investigated the effect of mood state on threat bias (Ellenbogen, Schwartzman, Stewart, & Walker, 2002; Ford et al., 2010; Isaacowitz, Toner, Goren, & Wilson, 2008; Nelson, Purdon, Quigley, Carriere, & Smilek, 2015; Quigley, Nelson, Carriere, Smilek, & Purdon, 2012; Sanchez, Vazquez, Gomez, & Joormann, 2014). For instance, Quigley et al. (2012) utilized eye-tracking methodology and found that an overall attentional bias towards threat, but not positive stimuli, was observed after an anxious mood induction, but not under baseline conditions. Further, elevated state but not trait anxiety was associated with increased attention to threatening stimuli, consistent with the notion that acute anxious mood affects threat bias. Nelson et al. (2015) replicated these findings and demonstrated that the relationship between state anxiety and threat bias is specific to sustained attention towards threat, but unrelated to initial engagement with threat. Isaacowitz et al. (2008) subjected participants to neutral, positive, and negative mood inductions prior to an eye-tracking assessment of attention bias and, at least in young adults, generally found mood-congruent effects such that a significant negative attention bias emerged following a negative mood induction and an attention bias towards positive information was found after neutral and positive mood inductions. Likewise, Ford et al. (2010) utilized eye-tracking methodology and found that participants displayed greater attention bias towards threat following an anxious mood induction and greater attention bias towards rewarding stimuli following excitement and anger mood inductions.

Although multiple studies have demonstrated mood-congruent effects on attention bias, two studies known to the authors have found mood-incongruent effects (Ellenbogen et al., 2002; Sanchez et al., 2014). Ellenbogen et al. (2002) employed a spatial cueing task to examine the effects of a stress induction on attentional biases towards negatively-valenced stimuli. The authors found that participants who underwent the stress induction, but not participants in the control conditions, shifted their attention away more rapidly from negative relative to positive and neutral stimuli. Further, they found that greater increases in negative mood was related to faster shifting of attention away from negative relative to positive and neutral stimuli, suggesting that attentional avoidance of negative stimuli during acute stress may reflect an emotion regulation strategy. In line with this suggestion, Sanchez et al. (2014) found that participants who experienced greater reductions in positive mood after a negative mood induction demonstrated greater subsequent attention bias towards positive emotional stimuli (assessed via eye-tracking). Further, greater attention bias towards positive emotional stimuli after the negative mood induction predicted greater improvement in positive mood at the end of the experiment, consistent with the notion that attention bias during acute mood states is partially reflective of emotion regulatory behavior.

To summarize, the experimental literature on acute mood state and attention bias suggests that induced mood can causally affect the expression of attention bias towards emotional stimuli. Although these data are suggestive of the moderating role of acute

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