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Review

Generalized Anxiety Disorder, worry and attention to threat: A systematic review

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ABSTRACT

Among anxious populations, attention has been demonstrated to be preferentially biased to threatening material compared to neutral or other valenced material. Individuals who have high levels of trait worry, such as those with Generalized Anxiety Disorder (GAD), may be biased to threat but research has produced equivocal findings. This review aimed to systematically review the extant experimental literature to establish the current evidence of attentional bias to threat among trait worriers compared to healthy controls and other clinical populations. Twenty-nine published articles were included in the final review. There was strong evidence of a bias to threat among GAD patients compared to other groups and this was found across most experimental paradigms. Few studies had investigated this bias in non-clinical trait worriers. Among GAD patients this bias to threat was most strongly evidenced when visual threat material was in a verbal-linguistic format (i.e., words) rather than when in pictorial form (i.e., images or faces). The bias was also found across several domains of negative material, supporting the general nature of worry. Further research should look to examine the specific components of the threat bias in GAD, as well as investigating the bias to threat in trait worriers.

1. Introduction

The current review examines the extant literature on attentional bias to threatening stimuli among individuals with a diagnosis of Generalized Anxiety Disorder (GAD) or those with high levels of trait worry who do not have a diagnosis of GAD. The paper begins by highlighting the distinction between "bottom-up" and "top-down" processing before then defining worry itself. The paper also provides a discussion of the different mechanisms associated with attentional biases (i.e., engagement, disengagement, shifting) and then leads into a brief review of neurobiological evidence of threat biases and worry. The paper then discusses Hirsch and Mathews' (2012) cognitive model of pathological worry which focuses on information-processing biases (including attentional bias) and the role of attentional control in promoting uncontrollable worry, before reviewing in detail the literature on attentional bias to threat.

This paper is the first known review that systematically examines the empirical evidence of attentional bias to threat among individuals with GAD and/or pathological levels of trait worry. Although previous papers have examined trait anxiety more broadly, worry has not been specifically targeted for review. However, worry is an integral cognitive component of anxiety, which can interfere with information-processing directly (Hayes, Hirsch, & Mathews, 2008) and has been linked to attentional bias to threat stimuli (Mathews & MacLeod, 2005; Williams, Mathews, & Hirsch, 2014). It also represents a cardinal feature of GAD, an anxiety disorder with often difficult to treat symptoms. Therefore, this review will examine the evidence base for attentional bias to threat in individuals with high levels of worry in order to offer important insights into our understanding of attentional bias in those suffering from GAD or pathological worry, to highlight directions of future research and areas for potential treatment innovation. Given the lack of previous reviews targeting this specific characteristic of anxiety, the current paper will aim to focus on the association only between worry and attentional bias to threat, rather than trying to identify the specific direction of the relationship. Indeed, the role of attentional bias in the development of anxiety is rather complex and beyond the remit of this current paper, as Van Bockstaele et al. (2014) eloquently highlighted that "the relation between attentional bias and fear and anxiety is best described as a bidirectional, maintaining, or mutually reinforcing relation." (page 682).

Visual attention can be captured by salient or distinctive information in everyday environments, such as a smiling face, a growling dog, or a speeding car. At a basic level, selective attention can be defined as "any cognitive operation that results in the selection of some information over other information" (Weierich, Treat, & Hollingworth, 2008, p. 988). This selection can be stimulus-driven, such as changes in

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perceptual events which may capture attention automatically (Franconeri & Simons, 2003), or can be more strategically controlled, such as avoiding certain stimuli in order to regulate emotion (Calvo & Avero, 2005). The former is often regarded as being mediated by sub-cortical "bottom-up" pathways designed to rapidly detect salient stimuli in the environment (Davis & Whalen, 2001), whilst the latter is believed to be regulated by "top-down" pathways located in more prefrontal cortex regions, associated with attentional control, working memory, and goal-driven behaviour (Miller & Cohen, 2001). One factor that may influence the selection of attention is the level of threat attached to the stimulus, which may bias individuals to attend to it over neutrally valenced stimuli in the environment (e.g., MacLeod, Mathews, & Tata, 1986). This preferential processing of threat is regarded as being evolutionarily adaptive (to monitor danger in the environment) (Ohman, 1986) and is thus applicable to most individuals, but it is more pronounced in anxious individuals compared to non-anxious populations (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Beck, Emery, & Greenberg, 1985; Mathews & MacLeod, 1994). This 'attentional bias' to threat among anxious populations is well established and may be implicated in the maintenance of anxiety symptoms (Yiend, 2010). However, the attentional system comprises several components and is modulated by multiple mechanisms and so understanding the distinct processes involved within attentional bias to threat among anxious individuals is warranted to inform clinical treatments (Bar-Haim et al., 2007; Cisler, Bacon, & Williams, 2009; Cisler & Koster, 2010).

Worry is a feature of most anxiety disorders (Beck & Clark, 1997), but in particular is the core criterion of Generalized Anxiety Disorder (GAD; Diagnostic and Statistical Manual 5th Edition, DSM-V; American Psychiatric Association, 2013). Worry is often associated with elevated feelings of anxiety, but is conceptually distinct, as anxiety is more broadly defined as including feelings of tension and autonomic arousal (Borkovec, Robinson, Pruzinsky, & DePree, 1983). Thus high worriers represent a subset of anxious individuals, for whom repetitive negative thoughts (typically in quasi-verbal form) are particularly prominent. Those with high levels of trait worry may experience negative health outcomes, regardless of whether or not they currently qualify for a GAD diagnosis (Brosschot & van der Doef, 2006). Consequently, it is important to identify factors that cause and maintain excessive worry, with attentional biases providing a possible avenue of research (e.g., Oathes, Siegle, & Ray, 2011). Although studies have found attentional bias to threat in GAD patients (e.g., Mogg & Bradley, 2005) and in high trait anxious groups (see Bar-Haim et al., 2007), less research has examined threat bias in non-clinical worriers, who represent an at-risk group for the development of GAD. Importantly, as will be discussed briefly later, investigations of emotional processing have revealed certain neural characteristics that seem to distinguish high worriers from non-worrying high trait anxious individuals (e.g. Engels et al., 2007; Paulesu et al., 2010).

Posner (1980) postulated three components of attention: engagement, disengagement, and shifting. Engagement refers to the orienting of the attentional resources on a particular stimulus, whilst shifting refers to the process of switching from one stimulus to another (Clarke, MacLeod, & Guastella, 2013). In order for shifting to occur though, the individual has to first disengage their attention from the current attended to stimulus. Clarke and colleagues defined biased engagement as "the rapid orientation of attention to a threat stimulus due to its enhanced ability to "capture" or "draw" attention" (2013, p. 3), whilst they defined biased disengagement as the "delayed withdrawal of attention from a threat stimulus due to its ability to "hold" attention" (2013, p. 3). Different methods have been used to assess attentional bias to threat in the anxiety literature, with each having advantages and disadvantages. Posner (1980) developed the spatial cueing task, which involves participants attending to a cue which is located in the same location as a to-be-identified target in the majority of trials and then in the remaining trials the target is in the opposite location (opposite to an original fixation cross). This task was modified by Yiend and Mathews (2001) and Fox, Russo, Bowles, and Dutton (2001) who used different emotional cues (threat/neutral) to identify preferential processing of different emotional stimuli. This task is thought to detect biased engagement and delayed disengagement as inferred by speeded reactions to targets in valid trials (emotional cue and target in same location) and by delayed reactions to invalid trials (target in opposite location to emotional cue), respectively. Fox et al. (2001), Fox, Russo, and Dutton (2002) and Yiend and Mathews (2001) concluded from their use of this paradigm that attentional bias is primarily due to delayed disengagement from threat rather than facilitated engagement to threat. However, some believe that the task measures disengagement better than engagement (Cisler & Koster, 2010; Clarke et al., 2013) and has been criticised for not distinguishing between disengagement and a general behavioural slowing that occurs in the presence of threat (Mogg, Holmes, Garner, & Bradley, 2008; although see Yiend, 2010 for a critique of this). The affective Stroop task (Mathews & MacLeod, 1985) and the attentional probe task (MacLeod et al., 1986) have been commonly used, although other paradigms have also included the visual search task, which typically involves participants having to decide if a target stimulus is present or absent in the presence of distractor stimuli (Müller & Krummenacher, 2006); or the attentional blink task, where a stream of stimuli are displayed and respondents are required to identify a target presented shortly after the first target has been presented (Raymond, Shapiro, & Arnell, 1992).

The results of studies using these different tasks points to attentional bias to threat among anxious individuals in general, but it is unclear whether the bias to threat is a result of facilitated engagement, delayed disengagement, or impaired or biased shifting. This uncertainty is due to a lack of studies that have specifically distinguished the components of attentional bias (Bar-Haim et al., 2007) and the lack of reliability in the methodological designs to confirm the contribution of each component on attentional bias (Clarke et al., 2013). Further, research looking at the neural mechanisms underpinning attentional bias point to different neural networks and locations involved in the bias, as described below.

The attentional system and the regulation of emotion are regarded as operating through an interaction of the amygdala and cortical regions (Bishop, 2007; Blair & Blair, 2012; Cisler & Koster, 2010), which has also been reported in the context of individual differences in anxiety (Mathews, Yiend, & Lawrence, 2004). The initial rapid orienting of attention to threat is regarded as being relatively automatic and has been shown to be coordinated by sub-cortical structures, such as the amygdala (Davis & Whalen, 2001). However, most of the research cited above has not investigated the specific role of worry, as opposed to elevated state or trait anxiety, and current evidence indicates that elevated worry is distinguished by involvement of the so-called "extended Amygdala"; and specifically, the Base Nucleus of the Stria Terminalis or BNST, which is particularly active under conditions of uncertain threat (Paulesu et al., 2010: Yassa, Hazlett, Stark, & Hoehn-Saric, 2012).

Biased engagement of attention with threat cues is often shown at short stimulus exposures in most experimental paradigms (Sagliano, Trojano, Amoriello, Migliozzi, & D'Olimpio, 2014) suggesting a degree of automaticity in the initial capture of attention by threat cues. When a stimulus is exposed for longer durations then it falls within conscious awareness (i.e. is 'supraliminal') and it is generally assumed that at these longer stimulus exposures there are more top-down strategic (or controlled) processes contributing towards the allocation of resources (Cisler & Koster, 2010). These top-down processes are believed to be governed by frontal brain structures, such as the prefrontal cortex (Blair et al., 2012), which are involved in disengaging and selectively shifting attention (Miller & Cohen, 2001). As a result, there may be more variation in experimental findings when using supraliminal exposures, as individuals may have different attentional goals. For example, several studies have found a bias towards threat at later exposure