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# Attentional bias in clinical depression and anxiety: The impact of emotional and non-emotional distracting information

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### ABSTRACT

Both anxiety and major depression disorder (MDD) were reported to involve a maladaptive selective attention mechanism, associated with bias toward negative stimuli. Previous studies investigated attentional bias using distractors that required processing as part of task settings, and therefore, in our view, these distractors should be regarded as task-relevant. Here, we applied a unique task that used peripheral distractors that presented emotional and spatial information simultaneously. Notably, the emotional information was not associated in any way to the task, and thus was task-irrelevant. The spatial information, however, was task-relevant as it corresponded with task instructions. Corroborating previous findings, anxious patients showed attentional bias toward negative information. MDD patients showed no indication of this bias. Spatial information influenced all groups similarly. These results indicate that anxiety, but not MDD, is associated with an inherent negative information bias, further illustrating that the two closely related disorders are characterized by different processing patterns.

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## 1. Introduction

In attempts to gain a better understanding regarding the factors influencing the onset and sustainment of anxiety and depression, studies have been relentlessly seeking measures and biomarkers that could document cognitive, biological and neurological abnormalities that characterize each disorder. These efforts have been strongly associated with the need to achieve better understanding regarding anxiety and depression nosology (e.g., LeMoult & Joormann, 2012).

Evidence suggests that anxiety and depression are associated with enhanced attention allocation towards negative stimuli relative to neutral ones (i.e., an attentional negativity bias; MacLeod, Mathews, & Tata, 1986; Eizenman et al., 2003). The attentional bias has been claimed to be a key factor in initiating and maintaining both disorders (Koster, Fox, & MacLeod, 2009), although evidence is less robust for depression (e.g., Dai & Feng, 2011; Dalgleish & Watts, 1990; for a review see Gotlib & Joormann, 2010) compared

to anxiety (for review see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Cisler & Koster, 2010).

Although the attentional bias phenomenon has been widely studied, several questions are yet to be answered. Here we ask whether attentional bias in anxiety and in depression depends on specific task settings. Specifically, most evidence demonstrating attentional bias in anxiety and depression is based on two tasks in which the distracting information consists of emotional content – the emotional Stroop task (e.g., Mathews & MacLeod, 1985) and the dot-probe task (e.g., Koster, Crombez, Verschuere, & De Houwer, 2006; MacLeod et al., 1986; for review and discussion of different tasks see Aue & Okon-Singer, 2015). The emotional Stroop task requires participants to name the print color of emotionally valenced words presented in the focus of attention, while disregarding their semantic content. Typically, individuals with anxiety and depression take longer to name the colors of negative words than to name the color of neutral words, compared to healthy individuals (e.g., Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989). Such results are usually interpreted in terms of the tendency of anxious and depressed individuals to preferentially allocate attention to negative content. However, since the distracting information is presented in the focus of attention, it is not clear whether this interference arises at the perceptual level,

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at the level of response selection, or whether it reflects cognitive effort in attempts to suppress the distracting emotional information (e.g., De Raedt, & Koster, 2010; Ruiter, & Brosschot, 1994; for review see Yiend, 2010).

The dot-probe task consists of an initial stage of presenting a fixation point, immediately followed by a pair of stimuli (usually words or faces) on both sides of fixation, with one stimulus being emotion-related while the other being neutral. After a relatively short presentation (e.g., 500–1000 ms), the stimuli disappear and a probe appears in one of the preceding stimulus positions. Participants are asked to respond as quickly as possible to the location of the probe (e.g., left or right side of the screen). The assumption is that reaction time (RT) to the probe will be faster if one's attention is already allocated to that side of the visual field (MacLeod et al., 1986). Notably, while the task has become a “gold standard” for examining attention to negative content in anxiety and depression (see Bar-Haim et al., 2007), it has nevertheless been criticized, as concerns regarding its reliability and lack of correlation with anxiety have been raised (Kappenman, Farrens, Luck, & Proudfit, 2014; Kappenman, MacNamara, & Proudfit, 2014; Schmukle, 2005; Staugaard, 2009). Taken together, while the emotional Stroop and the dot-probe tasks provide valuable data regarding attentional bias, there are several methodological concerns that highlight the need to develop new paradigms that enable fine tuning of the investigation of the processes underlying attentional bias in anxiety and in depression. The current study uses a sensitive task to explore abnormalities in specific attention processes among anxious, depressed and healthy individuals.

When referring to attentional bias, it is important to consider the degree to which the distracting information is relevant to the task. While the attentional bias found in the emotional Stroop and dot-probe tasks was interpreted as susceptibility to *irrelevant* emotional information, according to the task-relevance theory (Gronau, Cohen, & Ben-Shakhar, 2003; Lichtenstein-Vidne, Henik, & Safadi, 2007; Lichtenstein-Vidne, Henik, Safadi, 2012), another interpretation can be suggested. According to the task-relevance hypothesis, any information that includes a stimulus that is associated in some fashion to the task at hand is task-relevant (Gronau et al., 2003). This view is based on studies documenting that even involuntary orienting of attention to salient stimuli such as onsets (e.g., Jonides & Yantis, 1988) or singletons (a stimulus that differs from all other stimuli in a specific characteristic; e.g., Theeuwes, 1992, 1994) is contingent on whether that event shares a feature that is significant to task performance (e.g., Folk, Remington, & Johnston, 1992). Accordingly, even specifically asked-to-be-ignored distracting stimuli (as, for instance, in the Stroop task) might nonetheless hold task-relevant characteristics.

The presentation location of the distracting information, inside vs. outside the main focus of attention, is another significant parameter according to the task-relevance hypothesis. Specifically, when distracting information appears at the center of attention, it simply cannot be disregarded or stopped from being processed, subsequently affecting performance (Eriksen & Eriksen, 1974).<sup>1</sup> Hence, when positioned at the center of attention, all of the distractor's features should be regarded as relevant for task performance (Fox, 1993; Gronau et al., 2003).

<sup>1</sup> Notably, previous findings showed that only task-relevant factors affected performance when positioned outside the main focus of attention (Lichtenstein-Vidne et al., 2007, 2012). For instance, Gronau et al. (2003) showed that even personally significant information was not processed when presented outside the main focus of attention under conditions of irrelevance for task-performance. However, when the information appeared in the focus of attention, it created a significant interference effect.

In both the emotional Stroop and the dot-probe tasks, the emotional distractors are presented inside the focus of attention. In the emotional Stroop task, the emotional content is part of the central target; in the dot-probe task, it is centrally presented just before the target without any concurrent task requirements (e.g., Bradley, Keil, & Lang, 2012; Carretié, 2014; Domínguez-Borrás & Vuilleumier, 2013; Pessoa, Oliveira, & Pereira, 2013). Therefore, while the two tasks provide evidence for attentional bias in anxiety and depression towards distracting emotional content that is presented inside the focus of attention, under these circumstances it is not clear whether depressed and anxious individuals would exhibit a bias to *task-irrelevant* emotional content, even when task settings do not encourage its processing. This is more pronounced in view of the fact that in everyday life, only a small portion of the visual stimuli in natural environments and social settings appear at the retina's foveal boundaries (Wandell, 1995).

The first question of the present study is whether attentional bias would be documented in anxiety and depression even when the emotional content is presented outside the focus of attention and does not coincide with the task, and therefore is irrelevant to the task-at-hand. Considering the important role attributed to attentional bias in the etiology of anxiety and depression, it is of importance to further understand the circumstances modulating this bias in each of the disorders.

In this context, another important question is whether anxiety and depression are associated with a general susceptibility for distracting non-emotional stimuli that are relevant to the task-at-hand. In other words, whether attention modulates the processing of non-emotional distractors in those with anxiety and depression dissimilarly than in a healthy population. Indeed, anxiety has been characterized by enhanced attention toward distracting stimuli and by an overall decline in the ability to inhibit the influence of distractors on performance (e.g., Eysenck, Derakshan, Santos, & Calvo, 2007; Fox, 1993; Friedman & Miyake, 2004; Hochman, 1967, 1969). For instance, in a study conducted by Janelle, Singer and Williams (1999), participants were asked to simulate driving a car as their central task. Under conditions of presenting distracting peripheral stimuli, anxious participants had significantly more eye movements toward peripheral locations compared to control participants. This claim is in accord with behavioral (Moriya & Tanno, 2009a) as well as with ERP findings indicating a general hypervigilance to visual stimuli in anxiety disorders, which extends to various categories of stimuli rather than simply emotional ones (Rossignol-Philippot, Bissot, Rigoulot, & Campanella, 2012). A similar claim has been suggested regarding depression. Cognitive impairments in depression are accounted for by distractor inhibition disturbance (Benoit et al., 1992; Ellis & Ashbrook, 1988; Ellis, 1991; Trichard et al., 1995), in line with dysfunction of the anterior cingulate cortex (ACC), involved in the cognitive control of distractor processing (Aron, 2007). However, other findings show no difference in the processing of non-emotional distractors between participants with anxiety and/or depression and healthy participants (e.g., Moriya & Tanno, 2009b).

Taken together, findings from the emotional Stroop and the dot-probe tasks show that anxious individuals have an attentional bias toward negative information (for review see Cisler & Koster, 2010). Depressed individuals, however, show inconsistent findings regarding the presence of such a bias (e.g., Dai & Feng, 2011; Dalgleish & Watts, 1990; for a review see Gotlib & Joormann, 2010). In addition, there is evidence of a general susceptibility for distracting information among depressed and anxious patients. It is yet unknown whether these aforementioned effects resulted from specific task characteristics (i.e., the emotional stimuli were presented in the focus of attention and were task-relevant). The current study explores this question by using a task that distinguishes between attentional bias to task-irrelevant emotional distractors

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