



# Attentional bias and attentional control in Posttraumatic Stress Disorder



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## ABSTRACT

Extensive evidence exists for an association between attentional bias (AB; attentional vigilance or avoidance) and anxiety. Recent studies in healthy participants suggest that attentional control (AC) may facilitate inhibition of automatic attentional processes associated with anxiety.

To investigate relationships among AC, trauma-related AB, symptom severity and trait anxiety in patients with Posttraumatic Stress Disorder (PTSD), participants ( $N=91$ ) completed self-report measures of AC, posttraumatic stress symptoms (PTSS) and trait anxiety. AB was measured with a pictorial version of the Dot Probe Test.

AC moderated the relationship between PTSS and AB (threat avoidance). Patients high in PTSS and low in AC showed attentional avoidance. No association between PTSS and AB in patients with medium or high levels of AC was found. A similar pattern of results was observed for the relationship between trait anxiety, AC and AB. These results suggest that a low ability to control attention is a risk factor for AB in PTSD. This first clinical study corroborates the accumulating evidence from analog studies that individual differences in top-down attentional control are of considerable importance in the expression of AB in anxious psychopathology.

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## 1. Introduction

Problems with attention and concentration are important characteristics of anxiety disorders. In Posttraumatic Stress Disorder (PTSD), these problems are in fact part of the diagnostic criteria (American Psychiatric Association [DSM-IV-TR], 2000). A well known anxiety-related phenomenon is attentional bias (AB), which operates automatically to favor the processing of emotionally negative information in early stages of information processing (Williams, Mathews, & MacLeod, 1996). Attentional bias has been demonstrated in all anxiety disorders, including PTSD, with medium to large effect sizes (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007).

### 1.1. Attentional bias

The adapted Dot Probe Task (DPT; MacLeod, Mathews, & Tata, 1986; Posner, Snyder, & Davidson, 1980) is often used as a measure

of selective attention in psychological disorders (Harvey, Watkins, Mansell, & Shafran, 2004). In the DPT, a neutral and a threatening stimulus are presented simultaneously on a computer screen, in two separated locations. After a cue-target interval (e.g., 500 ms), a probe appears in one of the two locations. Participants are instructed to respond to the probe as fast as possible. If attention is selectively allocated to threatening information, RTs will be shorter in trials where the target replaces the threatening picture (a so-called congruent trial) than in trials where it replaces the neutral picture (an incongruent trial). Therefore, attentional bias in the DPT is defined as the congruency effect (RT incongruent minus RT congruent). Positive congruency scores reflect vigilant attentional bias toward threat and negative congruency scores reflect attentional avoidance of threat.

AB seems specific, in the sense that patients with PTSD selectively attend to trauma-related words (Kaspi, McNally, & Amir, 1995), whereas patients with social anxiety disorder respond strongest to words related to social judgment (Musa, Lépine, Clark, Mansell, & Ehlers, 2003), for instance. Although the majority of studies reports a relationship between vigilance and anxiety, selective attention away from threatening information has also often been reported, which is thought to reflect maladaptive avoidance of threat in later stages of processing (Cisler & Koster, 2010;

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Mathews, 1990; Mogg, Mathews, & Weinman, 1987). For instance, high trait anxious participants demonstrated vigilance after a cue-target delay of 100 ms but avoidance after 200 and 500 ms in an exogenous cueing task (ECT) with neutral and threatening pictorial stimuli (Koster, Crombez, Verschuere, Vanvolsem, & De Houwer, 2007). In healthy participants, avoidance of threatening pictures was also observed with the ECT at 200 ms and was correlated with trait anxiety (Putman, Verkuil, Ruissen, & Hagens, 2013). Such anxiety-driven attentional avoidance effects are also found using the DPT. For example, participants with blood-injury fear demonstrated attentional avoidance of threat scenes at longer stimulus durations (i.e., 1500 ms) in a DPT (Mogg, Bradley, Miles, & Dixon, 2004). In healthy participants, greater attentional avoidance as measured with the DPT at 500 ms was also positively related to self-reported trait anxiety (Putman, 2011). More DPT studies using pictorial cues with 500 ms delays have demonstrated such anxiety-related avoidance (e.g., Chen, Ehlers, Clark, & Mansell, 2002; Mansell, Clark, Ehlers, & Chen, 1999; Monk et al., 2006; Musa et al., 2003; Pine et al., 2005).

Although PTSD is primarily associated with increased threat detection (Bar-Haim et al., 2007), understanding AB in PTSD is more complex than previously thought. For example, in a meta-analysis on the Emotional Stroop task (EST) in PTSD, it was found that trauma alone can generate AB (Cisler et al., 2011). However, in a review of dissertations and peer reviewed journal articles on the EST in PTSD it was reported that in 92% (dissertations) and 56% (journals) of the reviewed studies the effect was actually not demonstrated, despite general consensus in the literature (Kimble, Frueh, & Marks, 2009). Furthermore, attentional avoidance is also demonstrated in PTSD. In a study on distress reactions (PTSD, depression and anxiety) and acute real life proximal threat, participants who were exposed to the largest threat displayed attentional avoidance as measured with the DPT. Threat bias was inversely correlated with distress symptoms; when attentional avoidance increased, higher levels of distress were demonstrated. These outcomes suggest that attentional avoidance is associated with the development of pathological reactions on trauma (Bar-Haim et al., 2010). Attentional threat avoidance has also been observed in maltreated children with PTSD (Pine et al., 2005). In that study, traumatized children demonstrated avoidance of pictures of angry and threatening faces presented for 500 ms. The extent of this bias was associated with the severity of physical abuse and with the diagnosis of PTSD.

Over the past two decades, several theoretical models have been proposed to explain the underlying mechanisms of attentional bias in anxiety. According to the vigilance-avoidance hypothesis (Mathews, 1990; Mogg, Mathews, & Weinman, 1987) attentional bias follows a characteristic time-course; elevated anxiety levels will first lead to involuntary and fast attentional selection, followed by active attentional avoidance. This pattern is considered especially maladaptive, since threat-related stimuli are detected preferentially (prompting anxiety), but habituation is prevented, resulting in even more anxiety.

### 1.2. Attentional control

The central assumption of attentional control theory (Eysenck, Santos, Derakshan, & Calvo, 2007) is that anxiety affects the central executive cognitive function of attentional inhibition and attentional shift. Anxious individuals are more easily distracted by task-irrelevant internal (e.g., worrying thoughts) or external (threatening) stimuli (Hirsch & Mathews, 2012; Mogg & Bradley, 1998). Attentional control then is defined as the ability to use voluntary and effortful attention to constrain these cognitive responses to goal-irrelevant (emotional) stimuli (Derryberry & Rothbart, 1997). Weak attentional control may reflect a more general

cognitive deficit (trait) that might be of much importance in the regulation of attentional bias (Derakshan & Eysenck, 2009; Eysenck et al., 2007). Individuals with greater attentional control are less easily distracted by goal-irrelevant stimuli and should be better able to inhibit stimulus-driven attentional processes as probed by tests of attentional bias.

This has indeed been demonstrated several times now. Derryberry and Reed (2002) tested threat-selective attention in four groups of participants who scored high or low on trait anxiety and high or low on attentional control as measured with the Attentional Control Scale (ACS), a 20-item self-report questionnaire that measures the ability to focus and shift attention. Results of this study showed that a relationship between trait anxiety and threat bias was moderated by attentional control; high levels of attentional control enabled anxious participants to constrain the impact of threatening information on their performance on a spatial attention task. Putman and colleagues (Putman et al., 2013) also found relationships between trait anxiety, attentional control and attentional avoidance of threat in healthy students using an emotional cueing task. However, only ACS was independently associated with avoidance (controlling for anxiety). This finding was recently replicated in a large student sample ( $N=80$ ) where attentional control was found to predict threat interference as measured with the EST (Putman, Arias-Garcia, Pantazi, & Van Schie, 2012). Furthermore, results of a recent analog study by Bardeen and Orcutt (2011) demonstrated a moderating effect of attentional control on the relationship between posttraumatic symptoms (PTSS) and attentional bias, in line with the results from the original Derryberry and Reed study. These findings suggest an important but hitherto much overlooked role for AC in attentional processes and affect regulation. However, since the participants in the discussed studies were all unselected students, the extent to which these results generalize to patients with anxious psychopathology needs to be further determined. Another reason to study relations between AC and AB is that individual differences in AC might explain some of the abovementioned variability in the literature on the relationship between AB and anxiety.

## 2. Present study

The goal of the present study was to investigate the association between attentional bias, attentional control, PTSS and trait anxiety in a large clinical sample of PTSD patients. Based on the extant literature and theory, we expected an association between PTSS and trait anxiety and attentional bias. However, it is very likely that the direction of the relationship between attentional bias as measured in the lab and anxious constructs depends strongly on various (small) methodological variables (e.g., stimulus-type, cue-target delay; see Koster et al., 2007). Anxiety-related attentional avoidance was demonstrated previously with a condition of the exact DPT version that was used in the present study (Putman, 2011), which leads to the prediction of a bias away from threatening stimuli in PTSD patients.

Our main interest however, was the association between attentional control and attentional threat-processing. We expected that attentional control should be related to attentional bias in an opposite manner than posttraumatic stress symptoms or trait anxiety (i.e., higher AC associated with less avoidance), reflecting the previously reported buffering effect of attentional control (c.f. Bardeen & Orcutt, 2011; Derryberry & Reed, 2002; Putman et al., 2012, 2013). Our focus was on the relationships between posttraumatic stress symptoms and attentional mechanisms, but for purposes of comparison between our results and the broader literature on the role of AC, we also included a widely used measure of trait anxiety (Spielberger's State-Trait Anxiety Inventory (Spielberger, 1983).

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