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Impact of the temporal stability of preexistent attentional bias for threat on its alteration through attention bias modification

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ABSTRACT

Background: Attention bias modification (ABM) aims to reduce attentional bias for threat (AB), thereby diminishing anxiety symptoms. However, recent meta-analyses indicated mixed effects. Recent works suggest that the presence of AB prior to ABM can be considered as a critical moderating factor that may account for these mixed results.
Methods: We assessed AB among highly trait-anxious individuals ($n = 77$) using both a face-version and a word-version of the dot-probe task at multiple time points: two weeks before ABM (t_1), just prior to ABM (t_2), and after ABM (t_3). All participants were submitted to an ABM procedure including facial expressions. Analyses focused on 2 components of AB prior to ABM: a stable component, representing variance shared between the two baseline points (t_1 and t_2), and a dynamic component, representing variance that is specific to that point (t_1 or t_2).
Results: The stable component of AB at baseline predicted the intensity of AB after ABM (t_3) while the dynamic component did not. The dynamic component of AB at baseline positively predicts performance improvement during ABM procedure, while the stable component negatively predicted it.
Limitations: The findings depicted above only appear with the face-version of the dot-probe task.
Conclusions: The present results highlight the contribution of both the stable individual differences and dynamic components of preexistent AB. They also show the importance of moving the conceptualization of AB beyond the group-based analysis by integrating the notion and the assessment of within-person variability.

1. Introduction

The ability to rapidly orient attention towards threat in the environment is crucial for survival. However, this essentially adaptive process is oftentimes exaggerated in anxious individuals. Evidence has accumulated that anxious individuals, regardless of the type of anxiety disorders, are prone to exhibit an attentional bias (AB) for threatening stimuli, such as threatening facial expressions (for a meta-analysis, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). Over the last fifteen years, researchers have started to investigate the causal nature of these biases in the *maintenance* of anxiety disorders, by directly manipulating AB. A growing body of research has accumulated on a new therapeutic intervention, called attention bias modification (ABM). ABM builds upon cognitive theories of psychopathology that implicate AB in the maintenance, and perhaps the etiology, of anxiety disorders (for a recent review, see Van Bockstaele et al., 2014). The clinical purpose of ABM is to reduce excessive AB, thereby diminishing anxiety symptoms (MacLeod & Mathews, 2012).

The most common ABM procedure is a modification of visual dot-probe task (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002) based on the classic work of MacLeod, Mathews, and Tata (1986). In the original dot-probe task (MacLeod et al., 1986), participants view two stimuli (e.g., a threatening word/photograph and a neutral word/photograph) presented in two distinct locations (left/right or up/down) of a computer screen for a brief duration (usually 500 ms). Immediately thereafter, a probe appears at the location previously occupied by one of the two stimuli. Participants have to indicate the location of the probe (right/left or up/down) or to discriminate the nature of the probe (e.g., "E" or "F") as quickly and accurately as possible. An AB is

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demonstrated when participants respond faster to the probe when it replaces a threatening stimulus than when it replaces a nonthreatening stimulus, indicating that their attention was directed to the location occupied by the threatening stimulus. In ABM, researchers typically modify the original task such as the probe nearly always (e.g., 95% of the trials) replaces the neutral or positive stimulus, thereby redirecting subjects' attention to nonthreatening cues. This work has led to several randomized controlled trials among anxious individuals reporting that, relative to control training (i.e., a sham training), this procedure reduces AB, thereby diminishing anxiety symptoms (for meta-analyses, see Hakamata et al., 2010; Mogoase et al., in press). By most standards, these results raised promising clinical avenues for ABM as it entails a very simple protocol, little contact with a mental health professional, and a potential for easy dissemination (e.g., Amir, Taylor, & Donohue, 2011; Clarke, Notebaert, & MacLeod, 2014; Heeren, Maurage, & Philippot, 2013).

However, despite these promising initial results, recent evidence suggests that the picture may be more complicated than initially thought as several studies with inconsistent findings have been published recently. More specifically, some studies have shown that ABM and the control condition did not significantly differ at post-training, neither for AB, nor for anxiety symptoms (e.g., Julian, Beard, Schmidt, Powers, & Smits, 2012; McNally, Enock, Tsai, & Tousian, 2013). These failures to replicate have led some to raise doubt about the clinical potential of ABM (Emmelkamp, 2012). However, it has inspired others to examine whether there are variables that moderate the malleability of AB (e.g., MacLeod, Koster, & Fox, 2009). Indeed, recent research suggests that several important moderating factors may account for these inconsistent findings. Given the rational of ABM, the presence of an AB before ABM has been considered as a critical one. Accordingly, Amir et al. (2011) reported that the initial level of AB significantly moderated the relationship between assigned training condition (ABM versus sham training) and improvement in anxiety symptoms. In the same vein, Kuckertz et al. (2014) reported that higher preexistent AB predicted greater symptom reduction for participants who completed ABM, but not for those who were in the sham group. More recently, Mogoase et al. (in press) demonstrated that, in the overall dataset of their meta-analysis, preexistent AB was significantly related to the change in AB from baseline to post-training and that this change correlated significantly with the change in symptoms.

The results of these studies clearly implicate preexistent AB as a critical variable in moderating ABM efficacy. Nevertheless, it is important to consider such findings within the context of the broader AB literature. Indeed, most of the cognitive models of AB have argued that such a bias is guided by both situational (e.g., state anxiety, threat-value of the stimulus, environmental factors) and stable (e.g., trait-anxiety, genes) components of the individuals (e.g., Bar-Haim et al., 2007; Eysenck, Derakshan, Santos, & Calvo, 2007; Heeren, De Raedt, Koster, & Philippot, 2013; Mogg & Bradley, 1998). For instance, while some studies suggest that context-dependent variables such as being under conditions of threat (e.g., an upcoming speech-task following the AB assessment) impact on AB (e.g., Garner, Mogg, & Bradley, 2006; Mansell, Ehlers, Clark, & Chen, 2002; Sposari & Rapee, 2007), other reported that stable individual component such as allelic variation in the promoter region of the serotonin transporter gene also modulate the sensitivity to acquire AB (e.g., Fox, Zougkou, Ridgewell, & Garner, 2011). In the same vein, Clarke and his collaborators also reported that the ease to modify AB predicts change in stable individual component such as trait-anxiety (Clarke, MacLeod, & Shirazee, 2008) and the tendency to respond to positive experiential conditions, such as group therapy (Clarke, Nigel, & Guastella, 2012). As a consequence, it seem unfortunate to only use a single time-point to examine the moderating influence of preexistent AB on ABM since such a design does not allow to properly disentangle stable from situational components of AB.

Beyond AB studies, such a distinction between stable and dynamic components is becoming widely used in the broader literature about the dynamic nature of emotional processes where the shifting nature of contextual demand across time demands flexibility (Aldao, 2013; Bonnano & Burton, 2013; Carver & Connor-Smith, 2010; Fleeson, 2004; Hoeksma, Oosterlaan, & Schipper, 2004). More specifically, it has been considered that the assessment of emotional processes at a single time-point mirrors both stable personal factors and dynamic responses to the current situational context (Bonanno, Papa, Lalande, Westphal, & Coifman, 2004; Hoeksma et al., 2004; Srivastava, Tamir, McGonigal, John, & Gross, 2009).

Despite the previous indications that preexistent AB may interact with ABM efficacy, up to now no study has been focused on the influence of dynamic fluctuation of AB magnitude on ABM. This knowledge is critical as previous findings indicate that AB is not only guided by stable individual differences but can also change dynamically in function of situational influences and demands. To overcome these limitations, the present study relied on the use of a panel design, which contains measures of the same variables from units observed repeatedly overtime (Finkel, 1995). The most important feature of panel data is that change is explicitly incorporated into the design so that individual-level changes in a set of variables are directly measured (Finkel, 1995). We focused on the assessment of the magnitude of AB in highly trait-anxious individuals at two time-points prior to ABM: two weeks before ABM (t_1), just prior to ABM (t_2). This enables us to distinguish between two components of preexistent AB: a stable component, representing variance shared between the two baseline points (t_1 and t_2), and a dynamic component, representing variance that is specific to that point (t_1 or t_2).

All participants were submitted to a face-version of a single-session ABM procedure. AB was assessed using both a face-version and a word-version of the dot-probe task. This allowed us to examine the specificity of training effects since we only used faces in the training. Our main question addresses how stable and dynamic components of AB prior to ABM relate to AB after ABM (t_3) and on performance improvement during ABM. Provided that this study is the first of its kind, several hypotheses can be formulated. One possibility is that individuals with higher level of AB dynamics exhibit more performance improvement during the ABM and have a more malleable AB in response to ABM. Alternatively, ABM may have more beneficial effects in individuals with a higher level of AB stability.

2. Method

2.1. Participants

Participants were 77 individuals (58% female) with elevated trait-anxiety scores, with a mean age of 26.85 ($SD = 11.54$, $Min = 18$, $Max = 60$). They were drawn from a pool of the Université Catholique de Louvain community (students and employees) based on their score on the trait-version of the State and Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Those who scored among the 30% of the highest scores (among a database of 607 participants) were invited to participate in the current study. Of those who were contacted, 80 accepted to participate. Additional inclusion criteria were that the participant: (a) was not currently following a psychotherapeutic treatment, (b) had no current psychotropic medications, (c) and had normal or

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