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Are attentional bias and memory bias for negative words causally related?

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ABSTRACT

Background and objectives: In cognitive theories of depression, processing biases are assumed to be partly responsible for the onset and maintenance of mood disorders. Despite a wealth of studies examining the relation between depression and individual biases (at the level of attention, interpretation, and memory), little is known about relationships between different biases. The purpose of the present study was to assess if attentional bias is causally related to memory bias.
Methods: 71 participants were randomly assigned to a control ($n = 37$) or attentional training group ($n = 34$). The attentional manipulation was followed by an explicit, intentional memory task during which novel neutral, negative, and positive words were presented.
Results: It was found that individuals with elevated depression score trained to orient away from negative words did not display a memory bias for negative words (adjectives) whereas similar individuals displayed this memory bias in the control condition.
Limitation: Generalization of the findings is limited because of the short study time frame and specific nature of the memory task.
Conclusions: These results indicate that altering attentional bias can influence elaborative processing of emotional material and that this bias could be one of the causes of mood congruent memory in depression.

Cognitive theories of depression and anxiety postulate that processing biases are vulnerability and maintenance factors for these disorders (Beck, 1976; Clark, Beck, & Alford, 1999; Mathews & MacLeod, 2005; Williams, Watts, MacLeod, & Mathews, 1997). That is, certain types of processing strategies are thought to result in selection and interpretation of endogenous and exogenous sources of information in a way that both reflects and serves to induce, maintain or exaggerate a maladaptive view of self and the world. For both disorders there is extensive research on biased attention, interpretation, and memory. Only recently theorists have begun to consider the question whether these biases are related (Everaert, Koster, & Derakshan, 2012; Hertel, 2002; Hirsch, Clark, & Mathews, 2006). The current paper is aimed to examine the causal relation between attentional bias and memory bias for negative words in the context of depression, as depression is characterized by both types of biases. We will first discuss attentional bias and memory bias to then consider how the relationship between these biases can be studied.

Despite initial debate (Williams et al., 1997), recent research has shown that depression is characterized by an attentional bias for negative, self-relevant information (for reviews, see De Raedt & Koster, 2010; Disner, Beevers, Haigh, & Beck, 2011; Gotlib & Joormann, 2010; Peckham, McHugh, & Otto, 2010). The reason why initial attempts at discovering attentional bias in depression were not successful could be related to the presentation duration of emotional stimuli. Although little is known about the time threshold at which this phenomenon can be reliably observed it should be noted that at present there is hardly any support for the existence of attentional bias effect in depression when presentation times are very short, e.g., subliminal (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Mogg, Bradley, & Williams, 1995). Of particular importance in this context are the results of eye-tracking studies indicating that depression is not associated with mood

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congruent initial shifts of attention but with longer gaze duration (Caseras, Garner, Bradley, & Mogg, 2007) or difficulty in disengagement from negative stimuli (Sears, Thomas, LeHuquet, & Johnson, 2010). At longer stimulus presentation times attentional bias is usually interpreted as reflecting sustained attention, difficulty in disengagement or other forms of interference occurring at later, more elaborative stages of processing (Gotlib et al., 2004; Koster et al., 2005).

Empirical research has also indicated that depression is associated with memory bias. In an influential narrative review of memory bias in depression Blaney (1986) concluded that mood congruent explicit memory bias is a robust phenomenon only in clinically depressed participants asked to self-referentially encode emotional material. Under such conditions clinical depression is associated with improved recall of negative information. To our knowledge, only one quantitative review of memory bias in depression has been published (Matt, Vázquez, & Campbell, 1992). Their results indicate that subclinical depression is associated with lack of positive recall asymmetry: non-depressed individuals recall positive material better than negative material and this effect seems to be absent in the subclinically depressed. Since then, memory bias is considered a hallmark feature in cognitive models of depression (Williams et al., 1997).

Despite decades of research on the presence and role of individual biases in depression, there has been very little consideration of influences among different processing biases. This is remarkable since cognitive models of depression propose that cognitive schemas influence processing at the attentional as well as the memory level (Beck, 1976). In the basic experimental literature there is ample evidence that attention influences memory processes (e.g., Cowan, 1995), however this has received little study in the context of emotional processing biases. Studying the interplay between biases is considered important as – according to the combined bias hypothesis (Everaert et al., 2012; Hirsch et al., 2006) – single biases (for instance at the level of attention) may act as a gateway to influence other levels of information processing (memory and interpretation), which in concert can maintain and exaggerate negative beliefs.

Recently studies have started to consider relations among attention and memory bias. In a seminal study, Gotlib et al. (2004) used emotional face dot-probe, emotional Stroop, and incidental recall tasks with self-referential encoding to investigate correlations between processing biases. No significant correlations were found between attentional and memory bias indices for sad, socially threatening, physically threatening or positive stimuli in participants diagnosed with major depression or social phobia. Alternatively, in a recent study (Koster, De Raedt, Leyman, & De Lissnyder, 2010) dysphoric participants showed an attentional bias for negative words in a spatial cueing task at conditions that allowed elaboration but did not show memory bias in an incidental recall task testing memory for the words presented during the attentional task. However, in this study attentional bias indices correlated with the number of words recalled within *each* emotional valence category (both negative and positive) in the dysphoric group. Moreover, Wells and Beevers (2009) conducted a study presenting happy, sad, angry, and neutral facial expressions for 12 s to dysphoric and non-dysphoric individuals. After viewing the faces participants performed a surprise recognition task. Dysphoric individuals showed better recognition accuracy for angry faces and this effect was mediated by average distance between fixations ("breadth of attentional focus" in the authors' terminology), but no differences in fixation durations, number of fixations or memory for sad, happy or neutral faces were observed. Finally, in an eye tracking task depicting slides containing depression-relevant, aversive, neutral, and positive words, subclinically depressed individuals exhibited an absence of attention bias for positive words, which predicted less accurate recognition of these stimuli (Ellis, Beevers, & Wells, 2011).

It is important to note that the data in the preceding studies cannot determine whether there is a causal relation between attentional and memory bias as the design is correlational in each case. Experimental manipulation of attentional bias would allow to directly examine whether attentional bias influences memory bias. Cognitive Bias Modification (CBM) methodology has been specifically developed to experimentally manipulate information processing bias to investigate its causal effects on symptoms and processes associated with psychopathology (Koster, Fox, & MacLeod, 2009; MacLeod, Koster, & Fox, 2009). The typical way to manipulate attention is a modified dot-probe task (MacLeod, Matthews, & Tata, 1986). When used to measure attentional bias it consists of a series of trials during which simultaneously presented emotional and neutral cues are replaced by the probe appearing with equal probability in place of the preceding emotional (congruent trial) or neutral (incongruent trial) stimulus. If the number of congruent trials is much smaller than the number of incongruent trials, directing attention away from emotional or toward neutral stimuli is beneficial to task performance. It has been demonstrated that participants engaging in the training version of the dot-probe task learn to direct their attention in accordance with the imposed contingency (MacLeod, Rutherford, Campbell, Ebsworhty, & Holker, 2002).

The purpose of the present study was to assess the causal relation between attentional and memory biases in relation to subclinical depression levels by observing the effects of attentional bias training on performance on a subsequent intentional memory task. To the best of our knowledge this experiment is the first attempt at examining whether attentional training alters the results of an intentional memory test for *novel* emotional information. To this end we allocated individuals to either a condition where attention was trained away from negative words or a non-training control condition and subsequently investigated whether this manipulation influenced explicit memory for novel emotional words. If there is a causal relationship between attention and memory bias, we hypothesized that individuals in the attentional training condition would be worse at recalling negative words. As this study was conducted in non-selected individuals we also examined whether this effect was moderated by depression level.

1. Method

1.1. Overview

An overview of the design is depicted in Fig. 1. The whole experiment can be divided into an attentional and memory part. Experimental manipulation occurred only in the attentional part, during which participants in the attentional training group completed a modified version of the dot-probe task designed to *reduce* attentional bias to negative words. Verbal stimuli were used both in the attentional and the memory tasks because a recent meta-analysis (Hakamata et al., 2010) indicates that attentional training is more effective with verbal than pictorial stimuli. An explicit memory task was used, as it was found in the pilot study that repeated exposure to emotional words in the dot-probe task resulted in a large number of intrusions when recall was incidental.

1.2. Participants characteristics

Participants were 71 undergraduate Jagiellonian University students (57 female and 14 male, mean age = 22, $SD = 2.5$) who completed the study in exchange for course credit. They were assigned either to the attentional training ($n = 34$) or to the control condition ($n = 37$). Assignment to groups was random and the experimenter