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Evidence against mood-congruent attentional bias in Major Depressive Disorder

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ABSTRACT

Depression is consistently associated with biased retrieval and interpretation of affective stimuli, but evidence for depressive bias in earlier cognitive processing, such as attention, is mixed. In five separate experiments, individuals with depression (three experiments with clinically diagnosed major depression, two experiments with dysphoria measured via the Beck Depression Inventory) completed three tasks designed to elicit depressive biases in attention, including selective attention, attentional switching, and attentional inhibition. Selective attention was measured using a modified emotional Stroop task, while attentional switching and inhibition was examined via an emotional task-switching paradigm and an emotional counter task. Results across five different experiments indicate that individuals with depression perform comparably with healthy controls, providing corroboration that depression is not characterized by biases in attentional processes.

1. Introduction

Biased attentional processing has been a popular consideration as a causal mechanism in Major Depressive Disorder (MDD) in the last few decades, as reflected both in the theoretical framework of the etiology and phenomenology of depression (Beck et al., 1987; Nolen-Hoeksema, 1991; Clark and Beck, 1999; Alloy et al., 2000), and in research pursuits (for overview, see Koster et al., 2009). Specifically, it has been purported that individuals with MDD might demonstrate biased deployment of attention towards negatively valenced information in the environment for additional cognitive processing. In turn, the cascade of cognitive events lead to better retrieval and recognition of negative information in memory storage (Bradley et al., 1995), constituting a cognitive vulnerability to the onset and maintenance of MDD.

The influence of biased attentional processing as a contributing mechanism in MDD is evident in current interventions. For example, Cognitive Behavioral Therapy identifies "mental filtering" as a cognitive distortion, commonly illustrated with the example of selectively attending to negative criticisms presented in an otherwise positive performance evaluation. Subsequently, interventions such as Attentional Bias Modification have been enacted to correct mental filtering via the practice of attending to more benign or positive stimuli in the environment (Papageorgiou and Wells, 2000). However, the specific cognitive processes that contribute to a depressive "mental filtering" is still unclear. Theoretically, disruptions to multiple components during information processing can lead to the same observed phenomenon. In the example above, possible cognitive biases include (1) enhanced detection of negative criticism during the performance review (i.e. selective attention), (2) enhanced rehearsal of the negative feedback following the review (i.e. rumination), or (3) discriminatory retrieval of the negative criticisms when recounting the review (i.e. recall bias). Delineation of the specific vulnerabilities in the information processing system is important because it enhances the precision of intervention targets, which could potentially increase response to cognitive therapy.

While rumination and biased recall of episodic memory in depression has been consistently established (Dalgleish and Werner-Seidler, 2014), the empirical evidence for attentional bias in MDD has been less consistent. While some studies have shown attentional bias in MDD, many of these have been conducted in non-clinical samples (e.g., Whitmer and Banich, 2007; Brailean et al., 2014; Cooper et al., 2014). Furthermore, a plethora of studies are unable to replicate any depression-related biased processing (Mogg et al., 1995; Mathews et al., 1996; Williams et al., 1997; Gotlib et al., 2004a, 2004b). Additionally, many studies showing attentional biases in depression have relied on the dot-probe task (e.g., McCabe and Gotlib, 1995; Gotlib et al., 2004a, 2004b; Leyman

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et al., 2007). The dot-probe paradigm arguably requires participants to engage in two different tasks serially: the first is to attend to the emotional stimuli, and the second to identify the location of the dot following the emotional stimuli. While the first half of the task may measure selective attention for mood-congruent stimuli, the second half of the task adds a component of attention switching. However, since the task only measures latency to identifying the dot, it disallows disentanglement of different components of attention switching, such as the processes of *orienting towards* and *disengaging from* emotional stimuli (Posner and Petersen, 1989). In order to distinguish these disparate cognitive processes, tasks specific to attention orienting and attentional flexibility may be used.

The goal of this study was to systematically delineate the role of attentional biases in MDD, particularly in examining three different components in attention. Three attentional tasks were employed in five experiments; two in dysphoric samples, and three in samples of individuals diagnosed with MDD. The first is an emotional Stroop task that measured selective attention to emotional stimuli, and was completed in three experiments; two were conducted using a larger dysphoric sample in order to maximize power, and one in a sample of individuals diagnosed with MDD. The second task was conducted in a sample of participants diagnosed with MDD, and employed a set-switching/inhibition task that examined attentional flexibility in engaging and disengaging from emotional stimuli. Finally, the third task was also conducted in a sample diagnosed with MDD, and examined attentional flexibility under a higher working memory load using a modified Garavan counting task.

All three paradigms in this study required participants to navigate goal-oriented tasks while simultaneously processing emotional faces, thereby enabling an index of how task-performance is influenced by competing emotional stimuli. The first three experiments examined selective attention via an emotional Stroop task (Preston and Stansfield, 2008). The emotional Stroop task examines whether task performance is influenced by deficits in inhibition of task-irrelevant mood-congruent stimuli. The fourth experiment uses a task-switching paradigm to examine if attentional flexibility (set-switching and set-inhibition) is impaired by mood-congruent stimuli. Finally, the fifth experiment further examines set-switching under a higher cognitive load, using a counter task that also requires an additional updating of working memory.

2. Emotional Stroop (experiments 1–3)

The emotional Stroop task is a variant of the classic color-naming Stroop task modified to examine emotional biases in selective attention. Previous research using the emotional Stroop task in depression typically replaces the content of the word stimuli from colors (e.g., red, blue, green) to emotional words (e.g., sad, down, tired). Use of this task has produced inconsistent depression related Stroop effects, and it has been suggested that effects are more likely to be detected if depressive schemas are activated prior to the task, or if self-relevant stimuli are used (Mogg and Bradley, 2005). The former appears to suggest that the attentional bias in depression might be state-dependent, and the latter may be confounded by the fact that self-relevant stimuli have likely been rehearsed and elaborated, and therefore may relate to components of information processing other than attention.

Alternatively, a different variation of the emotional Stroop task may be more robust in eliciting a depression-related Stroop effect without reliance on priming or self-relevant stimuli. This may be achieved through the use of facial images, as evidenced by the increased semantic accessibility of emotions via facial expressions compared to verbal stimuli (Glaser and Glaser, 1989). Facial expressions are also processed innately and automatically (Izard, 1994), as evinced by automatic facial mimicry and matching self-reported feelings in response to subliminal presentations of facial expressions (Sonnby-Borgström, 2002). This variant of the emotional Stroop task has been previously tested (Preston and Stansfield, 2008; Hofelich and Preston, 2012), with results demonstrating semantic interference at the level specific to the emotion. Together, this suggests that affective biases may be enhanced with the use emotional faces as stimuli.

In this variant of the emotional Stroop task, valenced word stimuli are superimposed onto emotional face stimuli, and participants are instructed to selectively attend to the valence of the word. In some trials, the valences of the word and face are congruent, whereas others are incongruent. Congruent trials should yield faster response times than incongruent trials. Furthermore, incongruent trials where the facial emotions (i.e. distracters) are mood-congruent with the participant should yield slower response times. For example, if depression is characterized by attentional bias to mood-congruent stimuli, depressed individuals should exhibit increased response times for incongruent trials with sad faces as distracters. This is because of the additional cognitive effort required to inhibit the negative distracter stimuli, which may be activating task irrelevant and self-preoccupying processes (Holmes, 1974; Dawkins and Furnham, 1989; De Ruiter and Brosschot, 1994). Alternatively, depressed individuals may also show decreased reaction on all trials with mood-congruent stimuli, including both sad words and faces.

Three different samples using the emotional Stroop task were examined in the following experiments. Experiment 1 was an archival study in a combined sample of two undergraduate populations (Preston and Stansfield, 2008; Hofelich and Preston, 2012). This non-clinical sample was used in order to maximize sample size, and to examine depression severity (as indexed by the Beck Depression Inventory; Beck et al., 1961) as a continuous variable in a general sample of college students. Data from experiment 2 was from an unpublished archival dataset also completed in a sample of undergraduates, and differs from experiment 1 in the use of varying stimulus presentation times from subliminal to supraliminal. Data from experiments 1 and 2 were collected for the purpose of investigating trait emotionality (empathy, alexithymia) and facial mimicry, and no analyses involving depression were previously published. Finally, experiment 3 was conducted in a sample of individuals diagnosed with MDD using the Structured Clinical Interview for the DSM-IV. In all three experiments, it was hypothesized that if depression is related to mood-congruent attentional biases, results should demonstrate that dysphoric or depressed individuals show increased response times to incongruent trials with sad faces as distracters. Alternatively, depressed or dysphoric participants may also demonstrate a generalized affective bias as indexed by longer reaction times to emotional stimuli (word or face).

2.1. Experiment 1

2.1.1. Methods

2.1.1.1. Participants. One hundred and six undergraduate students from a large midwestern university (54 female; mean age 19.18, range 18–27) participated in the study for course credit or $10. Sample mean on the BDI (mean=9.5, SD=7.3) fell in the range of normal mood fluctuation, with 10 participants scoring in the moderate to severe range of symptom severity. Participants did not differ by sex or age between the two groups (see Table 1).

2.1.1.2. Materials and procedure. Stimuli in this experiment consisted of emotional adjectives superimposed onto pictures of emotional faces. Stimuli were produced using Adobe Photoshop (Adobe Systems Inc., San Jose, CA), and delivered using E-Prime