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A naturalistic visual scanning approach to assess selective attention in major depressive disorder

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Abstract

Cognitive biases in information processing play an important role in the etiology and maintenance of emotional disorders. A new methodology to measure attentional biases is presented; this approach encourages subjects to scan and re-scan images with different thematic content, while the pattern of their attentional deployment is continuously monitored by an eye-tracking system. Measures of attentional bias are the total fixation time and the average glance duration on images belonging to a particular theme. Results showed that subjects with depressive disorder ($n=8$; Beck Depression Inventory Score$\geqslant$16) spent significantly more time looking at images with dysphoric themes than subjects in the control group ($n=9$). Correlation analysis revealed that the differences between the fixation times of the two groups are significantly correlated with the valence ratings, but not with the arousal ratings of the images. The average glance duration on images with social, neutral and threatening themes were similar for both groups, while the average glance duration on images with dysphoric themes was significantly larger for subjects with depressive disorder. The above results suggest that subjects with depressive disorder selectively attend to mood-congruent material and that depression appears to influence the elaborative stages of processing when dysphoric images are viewed.

Keywords: Cognitive biases; Eye tracking; Eye movements; Major depression; Pathophysiology; Cognition

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1. Introduction

Understanding the vulnerability factors that promote mood disorders over the life span is a high priority for psychiatric research. One area of growing interest is the relationship between selective attention and mood-related psychopathology (Mogg and Bradley, 1998; McNally, 1998). With selective attention, some stimuli are given priority and amplified, while others are inhibited (Posner and Dehaene, 1994; Hillyard et al., 1999). Selective attention to negatively valenced information supports and sustains the maladaptive patterns of information processing that are characteristic of depressive states (Dalgleish and Watts, 1990; Mogg and Bradley, 1998). Further, recent evidence suggests that attentional biases causally alter emotional reactivity to stress (MacLeod et al., 2002). In this way, individual differences in selective attention may constitute an important vulnerability factor for depressed individuals.

Attentional biases in clinical populations have been observed primarily in cognitive reaction-time tasks (such as modified Stroop and probe-detection tasks) that measure selective attention indirectly. The modified Stroop task requires participants to name the ink colors of emotionally toned and neutral words. An increase in the response latency to the emotional words relative to neutral words is thought to indicate greater attentional allocation to the emotional content of the word (MacLeod, 1991). The probe-detection task presents pairs of emotionally toned and neutral words for a brief period of time. Participants are asked to respond as quickly as possible to a dot probe that appears in one of the two locations that the words formerly occupied. Shorter response latencies indicate that the dot probe appears in the attended region of the visual field (Posner et al., 1980). A modified visual dot probe task that features pictures instead of words has been used in several studies of attentional bias in anxiety (Mansell et al., 1999; Bradley et al., 2000; Mogg et al., 2000). In the modified test, following a brief (500 ms) presentation of a pair of pictures, a probe is presented for approximately 1 s in the location that one of the pictures formerly occupied. Participants are asked to press one of two response buttons as quickly as possible to indicate where the probe appears. Reaction times for correct responses are used as a measure of attentional bias. Bradley et al. (2000) further modified the visual dot probe test by using the initial direction of eye movements to emotional faces to determine attentional bias in anxiety.

Using the response latency tasks, however, it is difficult to distinguish attentional effects from other non-attentional factors such as deficits in motor response and response selection, both of which are common in depressed individuals. In addition, the dot probe task does not provide complete information about the pattern of attentional deployment before or after the moment of measurement. It only provides a snapshot of the state of affairs some 500 ms after the onset of the word or image pair. To rectify this problem, Hermans et al. (1999) suggested a new paradigm in which eye movements provide a continuous index of attentional deployment. In this paradigm, the proportion of viewing time spent on pictures relating to the emotional concerns of the experimental group is used as a measure of attentional bias.

Using the methods described above, attentional biases for threatening information have been found in various clinical anxiety disorders (MacLeod, 1986; Mogg et al., 2000). In contrast, evidence of attentional biases for negatively valenced information in depressive disorders is inconclusive. Mathews et al. (1996) and Mogg et al. (1995) found supportive evidence for attentional biases in subjects with clinical depressive disorders, while McCabe and Gotlib (1995) and Bradley et al. (1995) did not find such biases. This inconsistency may be partially due to limitations in the experimental techniques used to measure selective attention.

The current study set out to *directly* examine visual selective attention in normal and depressed subjects using an eye-tracking technology specifically adapted to allow continuous monitoring of the point-of-gaze. The paradigm suggested by Hermans et al. (1999) is extended by displaying multiple (more than two) complex visual stimuli that compete for the subject's attention. In addition, the visual stimuli are presented for a relatively long period of time, so that the participant has the