



## The emotional Stroop interference effect in anxiety: attentional bias or cognitive avoidance?

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**Summary**—Interference effects on threat words in anxious subjects on the emotional Stroop task have generally been interpreted as evidence for mood-congruent attentional bias in anxiety states. However, several recent studies have yielded results that run contrary to this attentional bias explanation. The most important of these conflicting findings show that: (1) panic disorder patients displayed interference on threat words, but also on other emotional words, including positively valenced words, and (2) 'repressors' showed even greater interference than high trait anxious subjects. We propose an alternative explanation for these findings, in which both attentional bias and cognitive avoidance are assumed to operate in the emotional Stroop task, but in which cognitive avoidance is hypothesized to be chiefly responsible for the greater interference effects found in anxious subjects and 'repressors'. We suggest that future research into cognitive processes associated with anxiety states should employ a variety of experimental paradigms on the same subjects and include measures of 'defensiveness'.

### INTRODUCTION

In the past decade there has been an upsurge of research into cognitive biases in emotional disorders, particularly anxiety and depressive disorders. Among the cognitive biases most frequently studied are attentional bias and memory bias. This research has been inspired by Beck's schema theory (Beck, 1976; Beck, Emery & Greenberg, 1986) and Bower's (1981, 1987) network theory of the relationship between emotion and cognition. Beck *et al.* propose that existing memory representations termed 'schemata' filter stimulus input in such a way that attention is selectively directed to schema-congruent information, that schema-congruent interpretations are imposed on ambiguous information, and that access to schema-consistent memories is facilitated. Bower's theory suggests that emotion nodes in semantic memory may be activated by environmental stimuli, resulting in increased activation of associated nodes. This theory predicts that entering any particular emotional state will enhance the salience of information congruent with that emotion through the spreading activation phenomenon. Thus, perception, attention, interpretation and retrieval of emotion-congruent stimuli will be facilitated. Notwithstanding important conceptual differences between these two theories (see MacLeod & Mathews, 1991 for a review), they both share the premise that an individual's affective status is associated with cognitive biases which favor the processing of information congruent with the affective state. These congruency effects are expected to occur at all levels and stages of information processing. However, this has not been supported by empirical research. Anxiety seems to be related to attentional bias for threatening stimuli, and depression seems to be related to memory bias for negative self-referential material (Williams, Watts, MacLeod & Mathews, 1988; Mineka & Sutton, 1992; MacLeod & Mathews, 1991). In this article we will focus on attentional bias in anxiety, which has been documented employing a number of experimental paradigms: the dichotic listening task (Burgess, Jones, Robertson, Radcliffe, Emerson, Lawler & Crow, 1981; Foa & McNally, 1986), the attention deployment task (MacLeod, Mathews & Tata, 1986), and the emotional Stroop task. The emotional Stroop task is by far the most frequently used of these paradigms, and the results it has yielded have generally been interpreted as providing evidence for attentional bias in anxiety states. However, in this paper we will review some conflicting research evidence which casts doubt on the interpretation of the emotional Stroop effect as an effect solely due to attentional bias. First, we will summarize the 'traditional' attentional bias interpretation of the emotional Stroop effect, then we will present conflicting evidence. Finally, we will propose an additional cognitive process which could account for the conflicting findings.

### THE EMOTIONAL STROOP TASK: AN ATTENTIONAL BIAS INTERPRETATION

The Stroop color-word task was created by John Ridley Stroop (1935) and has been a valuable tool in cognitive psychology (MacLeod, 1991a). In the classic Stroop task, the *S* is asked to name the color of ink in which an incompatible color word is printed (e.g. the word green is printed in red ink). Subjects take longer to name the ink color in this case than in a control condition in which the word red is printed in red or in which a string of XX's is printed in red ink. This phenomenon is referred to as Stroop interference. The emotional Stroop task is a modified version of this classic paradigm.

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It involves the presentation of differentially emotionally valenced words in different colored inks and the S's task is to name the color of the words as quickly as possible whilst ignoring their semantic content. For example, an emotional word such as 'heart attack' may be presented in blue, and the S's task is to say 'blue'.

More than half a century after the creation of the Stroop task, the explanation of the classic Stroop interference effect continues to pose challenges to cognitive psychologists, since the task itself cannot determine the locus of interference. In a recent review article, MacLeod (1991b) summarizes the theoretical accounts of the Stroop effect and concludes that a recently developed model by Cohen, Dunbar and McClelland (1990) that incorporates attentional and response processes can best account for the existing body of empirical findings with the task. Several studies have confirmed that both early and late stages of processing are involved (Duncan-Johnson & Kopell, 1981; Stirling, 1979). It seems likely that this would also apply to the interference effect observed on the emotional Stroop task.

Results from studies with anxiety disorder patients suggest that these patients show greater Stroop interference when the words are emotionally threatening as opposed to neutral (see MacLeod, 1991c for a review). Anxiety patients tend to take longer to name the color of threat words such as 'tragedy' than neutral words such as 'corner', and this effect is not observed in normal control Ss. These interference effects have been demonstrated for spider phobics with spider-related words (Watts, McKenna, Sharrock & Trezise, 1986); for generalized anxiety disorder patients with words related to their particular domain of worry (Mogg, Mathews & Weinman, 1989); and for panic disorder patients with words related to physical threat, but not to social threat (Ehlers, Margraf, Davies & Roth, 1988; McNally, Riemann & Kim, 1990). Studies with normal Ss suggest that high trait anxious Ss, compared to low trait anxious Ss, show increased Stroop interference on threat words relative to neutral words (Dawkins & Furnham, 1989; Richards & Millwood, 1989; Richards, French, Johnson, Naparstek & Williams, 1992). On the basis of the findings from these studies with anxiety disorder patients and high trait anxious Ss, it is thought that a bias for selectively processing threatening information is associated with anxiety states. The presence of such a bias in an individual is expected to predispose to and exacerbate anxiety disorders.

At first glance, this interpretation of the findings with the emotional Stroop paradigm in anxiety states in terms of selective attention to threatening information seems relatively straightforward. It is considered evidence for Beck's schema theory and Bower's network theory, which propose that danger representations in long-term memory serve to favor selective encoding of danger-related information.

#### THE EMOTIONAL STROOP TASK: A COGNITIVE AVOIDANCE INTERPRETATION

A number of recent studies offer evidence contrary to the attentional bias interpretation of the emotional Stroop effect in anxiety. First, two recent studies found that the Stroop interference is not limited to threat-related words in panic disorder (PD) patients (Carter, Maddock & Magliozzi, 1992; McNally, Riemann, Louro, Lukach & Kim, 1992). Carter *et al.* (1992) found that PD patients showed significantly greater interference than normal controls on threat words, but also on depression words. McNally *et al.* (1992) showed that positive words (e.g. happiness, joy, elation, carefree), compared to neutral words, produced as much Stroop interference as threat words associated with fear and bodily sensations in PD patients. Second, Mogg and Marden (1990) found that high trait anxious Ss, compared to low trait anxious Ss, showed significantly more color naming interference on positive than neutral words, but there was only a trend for high anxious Ss to display more interference on threat than on neutral words. These findings are difficult to explain by either Beck's schema theory or Bower's network theory, since the information favored in processing is clearly not congruent with the danger schemata assumed to exist.

Third, in a normal sample, Dawkins and Furnham (1989) found that 'repressors' showed emotional Stroop interference effects even greater than those of high trait anxious Ss with anger, anxiety and grief words. Repressors were defined as those Ss scoring high on the Marlowe-Crowne Social Desirability Scale (M-C; Crowne & Marlowe, 1964) and low on the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983). High anxious Ss are defined as those scoring high on the STAI and low on the M-C; low anxious Ss score low on both scales. High scorers on both scales were not included in the Dawkins and Furnham study.

The 'repressor' coping style was first operationalized in the above-mentioned way by Weinberger, Schwartz and Davidson (1979). They found that 'repressors' reported the lowest level of subjective distress and the highest level of physiological arousal in a phrase association task that included phrases with sexual and aggressive content. This lack of congruence between subjective and physiological indices of arousal has subsequently been replicated (Asendorpf & Scherer, 1983; Davis & Schwartz, 1985; Gudjonsson, 1981). 'Repressors' have also been found to exhibit memory deficiencies for particular affect-laden memories. For instance, Davis (1987) showed that 'repressors' displayed a limited accessibility to personal, real-life affective memories, particularly to experiences that referred to the self. In a study that employed the dichotic listening paradigm, involving neutral and negative affective words presented in the unattended ear, the recognition level for negative words was at chance level for 'repressors', but not for the high anxious Ss, who scored well above chance levels (Bonanno, Davis, Singer & Schwartz, 1991). In response to a post-experiment questionnaire, 'repressors' indicated a significantly greater number of distracting thoughts during the experiment relative to the other Ss. The body of research on the 'repressor' coping style is generally interpreted as supporting the thesis that 'repressors' are skilful in avoidant information processing with regard to emotionally negative information.

As already mentioned above, Dawkins and Furnham (1989) found that 'repressors' showed *greater* interference than high trait anxious Ss on an emotional Stroop task. At first glance, this finding seems counter-intuitive in light of empirical research conducted on the 'repressor' style. One would expect that 'repressors' would be most likely to show the *least* degree of emotional Stroop interference, since they would tend to avoid directing their attention to the negatively valenced words. However, 'repressors' appeared to take longer to color-name emotional words, which seems to indicate that their avoidant tendency requires extra processing capacity that slows their performance on the primary color-naming task. The question of how avoidance might use additional processing capacity cannot be answered at this time, but looking away, as suggested by MacLeod and Mathews (1991) and distracting thoughts (see Bonanno *et al.*, 1991 above) are possible mechanisms.

The Carter *et al.* (1992), McNally *et al.* (1992), the Mogg and Marden (1990), and the Dawkins & Furnham (1989) findings

reviewed above question the interpretation of the emotional Stroop interference effect as an attentional bias to threat effect. Previously, MacLeod & Mathews (1991, p. 136) pointed to the fact that the Stroop paradigm is "only an indirect test of this possibility". The increased Stroop interference might also be the result of an attempt to *avoid* processing the stimulus because it contains emotionally valenced information. This cognitive avoidance interpretation would explain why 'repressors' showed the largest Stroop interference effect: the effort or time needed to avoid cognitively processing threatening information increases response latencies. It would also explain why the panic disorder patients in the McNally *et al.* and Carter *et al.* studies showed Stroop interference in response to the positively valenced and the depressively valenced words, respectively. The long duration of their response latencies might reflect a general style of cognitive avoidance of emotionally loaded information, whether positive or negative. Thus, a cognitive avoidance explanation fits these data better than an attentional bias explanation. This interpretation is in line with the view offered by Jones and Barlow (1990) who suggested that panic disorder (and perhaps all anxiety disorder) patients "avoid the experience of affect regardless of whether it is frightening, sad, or exciting" (p. 322).

In offering the alternative cognitive avoidance interpretation of the emotional Stroop effect in anxiety, we do not wish to suggest that an attentional bias for threat stimuli in anxiety does not exist. Direct evidence for attentional bias in anxiety comes from studies with the attention deployment task (MacLeod *et al.*, 1986). In this paradigm, generalized anxiety disorder (GAD) patients and non-patient Ss were presented with a series of word pairs on upper and lower locations on a video display for brief durations (500 msec). They were required to detect a small dot probe that appeared in either location on the display. MacLeod *et al.* (1986) found that the GAD patients were relatively faster in detecting probes that replaced threat rather than non-threat words. This finding has recently been replicated by Mogg, Mathews and Eysenck (1992). Asmundson, Sandler, Wilson and Walker (1992) employed the same paradigm and found that panic disorder patients, relative to normal controls, showed reduced detection latencies for stimuli related to physical threat, but not to social threat. Together, these studies suggest that anxiety disorders are associated with selective allocation of attention to threat stimuli.

In the emotional Stroop task, early and late stages of processing are involved. Attentional bias occurs in the early stages, and cognitive avoidance at later stages. Attentional bias might play a role in the emotional Stroop interference effect, but we have offered conflicting evidence suggesting that the effect cannot be attributed to attentional bias alone. Whether the effect is mediated by cognitive avoidance, or by still another process such as response inhibition, as recently suggested by Cl  tre, Heimberg, Holt and Liebowitz (1992), is still subject to debate.

#### FUTURE RESEARCH

In order to unravel the cognitive biases associated with anxiety states and the workings of the emotional Stroop task, several avenues for future research can be considered. First, studies in which the same Ss perform a number of cognitive tasks (e.g. Stroop task, dichotic listening task, attention deployment task) seem called for. For instance, a study employing the Stroop and attention deployment paradigms with positively and negatively (threat) valenced words in anxiety disorder patients could reveal whether or not the Stroop interference effect on the positive words is due to attentional bias. Second, it seems wise to include an independent measure of repression or defensiveness in studies using experimental cognitive paradigms. A number of studies have documented differences in information processing between defensively low anxious and truly low anxious Ss (Bonanno *et al.*, 1991; Dawkins & Furnham, 1989; Weinberger *et al.*, 1979). Incorporation of measures of defensiveness might help to explain findings which are difficult to interpret within the framework of schema and network theories, such as the finding that low trait anxious Ss show a reduction in color-naming interference on threat relative to neutral words during elevations of state anxiety (MacLeod & Mathews, 1988; MacLeod & Rutherford, 1992). It is conceivable that a majority of the low trait anxiety Ss in these studies scored low on defensiveness, which might cause them to be non-defensive (non-avoidant) when exposed to threat stimuli under elevated anxiety conditions. The reverse process is expected to operate in defensive individuals: increased anxiety levels are expected to trigger defensiveness and avoidance.

In general, it seems that research on the association between cognitive biases and emotional disorders has tended to focus chiefly on cognitive biases that favor the processing of information congruent with existing memory representations. We believe that the research could benefit from input from theoretical frameworks that emphasize the *dis*favoring of processing of schema-*incongruent* information (Bowlby, 1980; Horowitz, 1988).

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