Selective attention for masked and unmasked threatening words in anxiety: Effects of trait anxiety, state anxiety and awareness

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ABSTRACT

We investigated the effects of awareness on selective attention for masked and unmasked verbal threat material using a computerised version of the emotional Stroop. Participants were assigned to the high trait anxious (HTA) and low trait anxious (LTA) groups on the basis of questionnaire scores, and state anxiety was manipulated within participants through the threat of electric shock. To investigate the effects of awareness on responses to threat, the mode of exposure was blocked such that half the participants received masked trials before the unmasked trials, whereas the other half received the reverse order. The results revealed that there was no difference between the HTA and LTA groups in responses to threat for those who received the masked trials before the unmasked trials. However, when unmasked trials were presented before the masked trials HTA individuals were significantly slower to respond to both masked and unmasked threat words compared to the LTA group, and these effects were not further modified by participants' state anxiety status. The results are discussed in terms of the automatic nature of threat processing in anxiety.

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Prominent cognitive theories of emotional processing propose that anxiety is characterised by a bias to attend to threat-related information, and that this bias is likely to proceed without volition and without awareness within the attentional system (e.g., Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1988, 1997). These models also suggest that biases for threat are not limited to individuals with clinical anxiety diagnoses in that they are thought to operate in a similar fashion for non-clinically high trait anxious individuals who experience high levels of state anxiety. Because threat-related processing biases are thought to be an important causal and maintaining factor for anxiety disorders (e.g., Williams, Mathews, & MacLeod, 1996; Williams et al., 1997) research into the conditions that elicit them has considerable clinical implications.

Interference paradigms have been the most extensively used procedures for investigating threat-related processing biases in anxiety. For example, in the emotional Stroop paradigm, anxious participants and non-anxious controls are presented with threat words (e.g., panic, danger) and neutral words (e.g., table, chair) in letter strings of one colour (e.g., red, green, blue, yellow), and the participants' primary task is to name the colour of the lettering as quickly as possible while ignoring the semantic content of the items. The extent to which colour-naming latencies for threat words differ from those of non-threat words is taken as a measure of selective attention for threat. The results from a number of studies using the emotional Stroop procedure have shown that relative to non-anxious controls, anxious participants are slower to name the colour of threat words than neutral words, presumably because the content of the item interferes with performance on the colour-naming task. Threat-related biases have shown to be associated with a variety of clinical anxiety disorders including PTSD (e.g., Harvey, Bryant, & Rapee, 1996), panic disorder (e.g., Lundh, Wikström, Westerlund, & Öst, 1999; McNally, Riemann, & Kim, 1990), GAD (e.g., Bradley, Mogg, Millar, & White, 1995; Mogg, Bradley, Williams, & Mathews, 1993), OCD (e.g., Cohen, Lachenmeyer, & Springer, 2003), and generalised social phobia (Amir, Freshman, & Foa, 2002), and in non-clinical high trait anxious individuals who experience elevations in state anxiety (e.g., Edwards, Burt, & Lipp, 2006; Miller & Patrick, 2000). Importantly, because participants are instructed to ignore the meaning of the item and to name the colour as quickly as possible, these data suggest that selective threat bias effects might operate automatically, at least in the sense that they occur without volition.

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There is also a large body of data that suggests threat-processing biases might proceed without awareness. The most convincing evidence for this interpretation has come from studies employing backward masking procedures. This protocol involves presenting participants with neutral and threat-related words for a brief period (e.g., 14 ms), and at their offset a pattern mask consisting of letter fragments or random consonant strings is presented in the location previously occupied by the item. Awareness assessments are carried out using forced-choice lexical decision tasks in which participants are asked to choose whether a true word or non-word was presented before the mask. Despite chance performance in determining the lexical status of the item before the mask, a number of studies have reported data showing that relative to non-anxious controls, anxious individuals are slower to name the colour of masked threat words compared to masked non-threat control words. These effects have been reported in clinically anxious samples (e.g., Bradley et al., 1995; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; Harvey et al., 1996; Lundh et al., 1999) and in HTA participants experiencing high levels of state anxiety (e.g., MacLeod & Hagan, 1992; MacLeod & Rutherford, 1992; Rutherford, MacLeod, & Campbell, 2004).

Despite the large number of studies that have reported selective attention for masked threat words in anxiety, there are at least three lines of evidence that question whether the effects operate completely independent of awareness. First, all studies that have reported masked threat effects have presented masked and unmasked trials in an intermixed sequence, which does not preclude the possibility that awareness of threat on the unmasked trials might prime the mechanisms responsible for processing subliminal threat information (cf. Matthews & Wells, 2000). Support for the possibility that the intermixing of masked and unmasked trials might be a necessary condition to establish masked threat bias effects comes from a report using the emotional Stroop procedure that blocked on the mode of presentation (i.e., masked and unmasked trials) and failed to find selective attention for threat during the masked trials (Kampman, Keijsers, Verbraak, Näring, & Hoogduin, 2002).

The second line of evidence comes from in a recent study from our laboratory in which we reported data to suggest that the direction of attention for masked threat information changed over the course of testing (Edwards, Burt & Lipp, in press). In that study, participants tended to show masked threat interference effects in the early stages of the experiment (i.e., blocks 1 & 2) and facilitation during the latter part of the experiment (i.e., blocks 3 & 4). Because the mode of exposure in that experiment was intermixed, and participants were undoubtedly aware that they were being presented with threat words on some trials, it might therefore have been that the direction of responding to the masked threat material was affected over the course of the experiment by the presence of threat words on the unmasked exposure trials.

The third line of evidence to suggest that post-conscious awareness of threat might affect responses to masked threat material comes from a series of three experiments reported by Fox (1996). Fox employed an interference paradigm in which participants were presented with a digit in the centre of a computer screen, and their primary task was to identify the status of the digit as odd or even as quickly as possible without making mistakes. At the same time the digit was presented, a pair of threat words or a pair of neutral words was presented above and below the digit. On half the trials the word pair was presented so that participants had conscious access to the words, whereas on the other half of the trials the words were presented using a backward pattern masking procedure. Fox reasoned that the time to identify the status of the digit might be influenced by the valence of the distracting information, such that longer digit identification latencies on threat

trials would indicate selective attention towards the threat information.

In Experiment 1, Fox (1996) presented the masked and unmasked trials in an intermixed sequence and the reaction time data revealed that HTA participants were significantly slower at identifying the status of the digit during masked threat word trials compared with masked neutral word trials. The data were therefore consistent with previous reports employing the emotional Stroop that have demonstrated masked threat effects in non-clinical participants (e.g., MacLeod & Rutherford, 1992; Rutherford et al., 2004). In Experiment 2, Fox blocked on the mode of exposure such that all participants received the masked block of trials before the unmasked block of trials. The results of Experiment 2 revealed a non-significant trend for HTA participants to be slowed on the digit classification task on masked threat word trials. In Experiment 3 Fox again presented the masked and unmasked trials in blocked format, but the design included the order of presentation (masked first vs. unmasked first) as a between participants factor. For the masked trials the results failed to reveal significant word type difference when participants received the masked trial block before the unmasked block. However when the unmasked block was presented first, HTA participants were significantly slowed on the number classification task during masked threat trials compared to masked neutral trials. Because the masked threat bias was only evident when participants had been presented with an intermixed sequence of masked and unmasked trials (Experiment 1), or when unmasked exposures were presented before masked exposures (Experiment 3), Fox suggested that some awareness of threat might be needed to elicit selective attention for subliminal threat material.

Despite the possibility that post-conscious awareness of threat might be needed to establish masked threat bias effects, there is at least one difficulty with Fox's procedure that requires resolving before this explanation can be accepted. In Experiments 1 and 2, Fox employed experimental procedures designed to elevate state anxiety, whereas in Experiment 3 there was no mention of a state anxiety manipulation. In non-clinical samples masked threat-processing biases have typically been restricted to testing sessions involving elevated state anxiety (see e.g., Edwards et al., 2006; MacLeod & Rutherford, 1992; Rutherford et al., 2004) and therefore it is plausible that the absence of a masked threat effect in the masked exposure first condition of Fox's third experiment can be accounted for by the lack of a state anxiety manipulation. One of the aims of the present study was to investigate this possibility.

A secondary aim of the present experiment was to investigate further the lack of threat-processing effects during the unmasked trials in a number of experiments (e.g., Fox, 1996; MacLeod & Rutherford, 1992). For example, although Fox interpreted the lack of unmasked threat effects for the HTA group in terms of a strategic inhibitory mechanism, it might also have been that the state anxiety manipulations reflecting a past stressor (Experiment 1) and future stressor (Experiment 2) were not sufficiently sensitive to produce threat-processing biases on these trials. In a recent paper we reported unmasked threat bias effects in a sample of HTA participants who were *currently* under stress using the emotional Stroop (Edwards et al., 2006). Perhaps the differential data patterns between our study and previous experiments that have failed to report unmasked threat-processing biases in non-clinical samples (e.g., Fox, 1996; MacLeod & Rutherford, 1992) might be accounted for on the basis of the immediacy of the state anxiety manipulation. In the present paper we readdress that issue.

To investigate whether post-conscious awareness of threat is necessary to produce masked threat bias effects, the present experiment employed masked and unmasked exposure trials, but blocked on the mode of exposure. Half the participants received