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Selective attention for masked and unmasked emotionally toned stimuli: Effects of trait anxiety, state anxiety, and test order

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Abstract

We investigated selective attention for masked and unmasked, threat and positively valenced words, in high trait anxious (HTA) and low trait anxious (LTA) individuals using the emotional Stroop colour naming task. State anxiety was varied within participants through the threat of electric shock. To investigate whether the sequencing of the state anxiety manipulation affected colour naming latencies, the ordering of the shock threat and shock safe conditions was counterbalanced across participants. The results indicated that the ordering of the state anxiety manipulation moderated masked and unmasked threat bias effects. Specifically, relative to LTA individuals, HTA individuals showed a threat interference effect, but this effect was limited to those who performed under the threat of shock in the later stages of the experiment. Irrespective of exposure mode and state anxiety status, all individuals showed interference for threat in the early stages of the experiment, relative to a threat facilitation effect in the later stages of the experiment. For the unmasked trials alone, the data also revealed a significant threat interference effect for the HTA group relative to the LTA group in the shock threat condition, and this effect was evident irrespective of shock threat order. The results are discussed with respect to the automatic nature of emotional processing in anxiety.

Keywords: selective attention, emotional Stroop, threat words, backward masking, anxiety.

Selective Attention for Masked and Unmasked Emotionally Toned Stimuli: Effects of Trait Anxiety, State Anxiety and Test Order

There is now an extensive body of data to suggest that anxious individuals selectively attend to threat related information (for reviews see Mogg & Bradley, 1998; Williams, Watts MacLeod & Mathews, 1997), and this bias for threat is considered to be an important factor in the aetiology and maintenance of anxiety disorders (e.g., Williams, Mathews & MacLeod, 1996; Williams et al., 1997). A commonly employed experimental procedure for demonstrating this effect has been the emotional Stroop (1935) colour naming task. In this task, anxious individuals and non-anxious controls are shown threat related (e.g., death) and neutral (e.g., chair) words in various colours, and they are asked to name the word colour as quickly as possible while ignoring the semantic content of the item. Attentional bias effects are inferred from longer colour naming latencies for the threat words compared to non-threat words. A large number of studies have demonstrated that relative to non-anxious individuals, anxious participants are less able to avoid attending to the semantic content of the item on threat word trials than on neutral word trials. This effect has been reported in clinical populations (Bradley, Mogg, Millar & White, 1995; Mogg, Bradley, Williams & Mathews, 1993; Lundh, Wikström, Westerlund & Öst, 1999; McNally, Riemann & Kim, 1990), and in non-clinical high trait anxious individuals (i.e., those with an anxious predisposition) experiencing elevations in state (i.e., current) anxiety (e.g., Edwards, Burt & Lipp, 2006; Miller & Patrick, 2000).

Selective attention for threat effects have also been demonstrated when words have been presented in backward masking procedures designed to prevent conscious access to the items. This methodology involves threat and neutral items being presented very briefly (e.g., 20 ms), and followed by a pattern mask consisting of random consonant strings or letter fragments. To assess awareness of the items preceding the mask, forced choice lexical discrimination tasks or word present/absent tasks have been employed. Despite participants performing at chance on these awareness checking tasks, a number of researchers have reported longer colour naming latencies on threat word trials, relative to neutral word trials, in clinically anxious (e.g., Bradley et al., 1995; Foa, Feske, Murdock, Kozak & McCarthy, 1991; Harvey, Bryant & Rapee, 1993; Lundh et al., 1999) and HTA participants experiencing high levels of state anxiety (e.g., MacLeod & Rutherford, 1992).

On the basis of the available data, recent cognitive theories of emotional processing have suggested that, in anxiety, attentional biases for threat operate automatically, in that they occur both without volition and without awareness (e.g., Mogg & Bradley, 1998; Williams et al., 1997). Despite similarities with respect to the automatic nature of these attentional biases, the models of Mogg and Bradley and Williams et al. make different predictions concerning the direction of attention in high trait anxious (HTA) and low trait anxious (LTA) individuals who experience elevated state anxiety. That is, whereas both models predict that high state anxiety (or high threat value) will produce selective threat effects in HTA individuals, they differ in the predicted direction of attention for LTA individuals. Specifically, Williams et al. suggest that for LTA individuals, elevated state anxiety is associated with selective avoidance of threat, whereas Mogg and Bradley suggest that this attentional pattern is limited to mildly threatening stimuli, with stimuli having a high subjective threat value being capable of attentional capture regardless of trait anxiety status.

A further central feature of these models is that stimuli undergo a crude, global, valence-based appraisal prior to awareness, and that this appraisal process determines attentional allocation (cf. Mogg & Bradley, 1998). This feature has been incorporated to explain a number of reports demonstrating differential colour naming latencies for threat versus neutral words during masked exposure trials, and a number of observations that, unlike unmasked trials, threat specificity effects (i.e., differential selective attention effects for concern relevant and general threat material) are rarely observed when stimuli are backward masked (e.g., Bradley et al., 1995; Edwards et al., 2006; MacLeod & Rutherford, 1992; Mogg et al., 1993; Mogg, Bradley & Williams, 1995). The assumption, however, that stimuli are classified along a positive to negative continuum prior to awareness requires further validation because there have been a number of studies that employed the emotional Stroop and *positive* words as control items and failed to find masked threat bias effects (e.g., Kyrios & Iob, 1998; McNally, Amir & Lipke, 1996; Paunovic, Lundh & Öst, 2002). Since positive words have shown to be similar in rated emotionality to threat words (cf. Mogg et al., 1993; Rutherford, MacLeod & Campbell, 2004), these data bring to question whether subliminal stimuli are evaluated on a positive-to-negative continuum, or an emotional to non-emotional continuum.

There are however, two reports of preconscious threat bias effects operating specifically for negative information in experiments using the emotional Stroop. Mogg et al. (1993) presented anxious participants and non-anxious controls with masked and unmasked threat words (e.g., embarrassed, cancer), neutral words (e.g., carpet, domestic), and positive words (e.g., adorable, bliss). In a test of their claim that the preattentive bias was specific to threat, they carried out an ANOVA on subliminal interference scores for the positive and negative word types (positive and negative interference scores were calculated by subtracting the mean colour naming latencies for neutral words from those of positive words and negative words, respectively). For the masked trials, the results revealed reliable between group differences on the threat bias index, but not on the positive bias index. Although Mogg et al. interpreted these data as a specific threat bias effect in anxiety, the follow up tests performed do not permit full acceptance of this interpretation. That is, it was possible that the interference scores reported for the threat and positive information in the HTA group might not have been statistically separated, and that the interaction in the data was driven by the faster reaction times for negative than positive stimuli in the non-anxious controls. In addition, rather than the between stimulus comparison that were performed, a more stringent test of the interpretation that preconscious biases operate specifically on the basis of valence would be a direct comparison of positive word latencies to threat word latencies. In sum, the results of the Mogg et al. study remain equivocal as to whether preconscious information processing biases operate specifically for negatively valenced information.

In a more recent study, Rutherford et al. (2004) presented HTA and LTA students with positive, neutral, and threat related words early in semester when state anxiety was low, and again in close temporal proximity to semester exams when state anxiety was elevated. In comparison to LTA participants, HTA participants demonstrated masked (and unmasked) threat interference in the high state anxiety condition alone. However, although these data imply that HTA individuals experiencing elevated state anxiety differentially process masked emotional material on the basis of its valence, ordering effects might have influenced the data. That is, all participants undertook the same testing order of the low state anxiety condition followed by the high state anxiety condition, and as such, it is not clear whether the same pattern of responding would be evident if the reverse testing order was employed (cf. Rutherford et al., 2004). Moreover, it is possible that participants engaged in conscious, post-testing, elaboration of the stimulus information following the low state anxiety condition, which could plausibly have affected responses to the masked threat material during the high state anxiety session. This interpretation is plausible given that previous research has shown preconscious threat effects to be influenced by post-conscious priming processes (Fox, 1996). It would seem that when taken together, the current evidence to suggest that masked stimulus information is evaluated on the basis of its valence is not strong.

A subsidiary aim of the present experiment was to replicate a recent finding from our laboratory in which we reported a masked threat facilitation effect in a sample of HTA individuals experiencing elevated state anxiety (Edwards et al., 2006). This response pattern was qualitatively different from previous reports that have typically shown threat interference effects when state anxiety is high (e.g., MacLeod & Rutherford, 1992; Rutherford et al., 2004; Fox, 1996). We reasoned that the discrepant data patterns between our study and other reports might be explained by the differential manipulation of state anxiety between the studies. That is, in our experiment we employed a state anxiety manipulation that reflects a current stressor (i.e., the threat of electric shock), whereas these earlier studies employed impending exams, which reflects a future oriented stressor. A limitation of our earlier work however, was that we contrasted response latencies for threat words to those of neutral words, and as such, it is not known whether the selective threat effects we observed would be evident when positively valenced words are used as controls. In the current study this issue is addressed.

The primary aim of the present study was to assess the selective processing of masked and unmasked threat words, relative to positive words, in HTA and LTA individuals. Participants were assigned to the high and low trait anxiety groups on the basis of a median split of scores on the trait version of State-Trait Anxiety Inventory – Form Y (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). In line with previous work (e.g., Edwards et al., 2006; MacLeod & Rutherford, 1992), those who scored 37 points or higher on this measure were assigned to the HTA group, whereas those who scored below 37 were assigned to the LTA group. State anxiety was manipulated through the threat of electric shock. The ordering of the shock threat and shock safe conditions was counterbalanced across participants such that half received the order of shock threat followed by shock safe, whereas the other half received the reverse. This procedure allowed for the investigation of whether the ordering of the state anxiety manipulation affected selective attention for threat.

In accord with the models of Mogg and Bradley (1998) and Williams et al. (1988, 1997), the following predictions were made. For the masked and unmasked trials it was predicted that, relative to LTA individuals, HTA participants would be slower to colour name threat words than positive words when performing under the threat of shock, but that this effect would not be evident in the shock safe condition. If, as suggested by Mogg and Bradley and Williams et al., threat bias effects are truly automatic, there should be no effect of shock threat order on colour naming latencies.

Method

Participants

One hundred and five undergraduate students from the University of Queensland participated. Only those who reported English as their native language, normal colour vision, and normal or corrected to normal vision, were invited for the initial screening. Because previous research had suggested that high levels of depression might obscure preconscious threat effects in anxiety (Bradley et al., 1995), only those who scored 16 points or below on the Beck Depression Inventory – Revised (BDI-R; Beck, 1993; Beck, Rush, Shaw & Emery, 1979; Beck & Steer, 1993) were retained. To reduce the effects of social desirability in differentiating the HTA and LTA groups (see Weinberger, Swartz & Davidson, 1979), only participants who scored 5 or fewer socially desirable responses on the Marlowe-Crowne Social Desirability Scale-Form XI (MCSDS; Crowne & Marlowe, 1960; Strahan & Gerbasi, 1972) participated. At the request of the local ethics committee, participants who scored above 65 on either form of the State-Trait Anxiety Inventory (Spielberger et al., 1983) were excluded to protect them from being exposed to potentially anxiety invoking stimuli (e.g., threat words and/or threat of electric shock). Of the 105 participants who were initially recruited, 2 were rejected because their scores on the STAI-T fell above the criterion for retention, 7 were discarded due to high depression, 14 due to high social desirability, and 1 due to both high depression and high social desirability. These participants were provided with a handout describing details of the study, thanked and released. Of those who met initial screening requirements, 1 female participant withdrew because she reported having a headache and 1 participant was lost due to experimenter error. The data from a further 14 participants was not retained for the final analyses due to above criterion performance on the final awareness check trials. In return for participation, all 105 individuals received experimental credit towards an introductory psychology course.

The final sample consisted of 64 participants (32 HTA; 32 LTA) aged between 17 and 39 years (M = 20.22 years). Five participants were male and 59 were female. The groups did not differ with respect to age, $t < 1$, and sex was proportionately represented in each of the trait anxiety groups (HTA = 2 males & 30 females; LTA = 3 males & 29 females).

Materials

The 80 threat-related words used by Edwards et al. (2006) were employed, however, no distinction was made on the basis of the threat specificity factor in the present experiment. The neutral control items employed by Edwards et al. were replaced with 80 words thought to reflect positive content (e.g., jolly, comedy), and these words were matched for average length (M = 6.66), F <1, and frequency (M = 22.26) with the threat related items (Ms = 6.63 and 21.80, respectively), $F < 1$. Frequency counts were taken from the British National Corpus of approximately 89 million words (BNC; Kilgarriff, 1998).

The threat and positive words were further divided into two, length- and frequency-matched 80-item Sets (A and B; see Appendix). The allocation of the word sets to the two levels of exposure (i.e., masked and unmasked), and to the shock threat and shock safe conditions, was fully counterbalanced across participants. That is, half of the participants received Set A masked and Set B unmasked, whereas the other half received the opposite, and within each of the item sets, half were shown Set A under threat of shock and Set B without the threat of shock, whereas the other half received the opposite.

Exposure mode and item valence was randomly intermixed during the 4 blocks of 40 colour naming trials. The sequencing was restricted such that not more than two items of the same valence, or two presentations of the same exposure mode, occurred in succession. Each colour was assigned to each word type an equal number of times across the first and second blocks of 80 trials, each colour was assigned to each word type an equal number of times, and the threat related items were always presented in the same colour and in the same block as their positive related controls. The presentation of the colours was quasi-randomised such that the same colour did not occur on more than two successive trials. In addition, within each colour naming block, there was an equal number of threat and positive related items. To eliminate the possibility of item specific repetition priming effects, each participant was exposed to each of the 160 items on one occasion.

For the masked threshold setting trials, a set of 200 uncategorized neutral words and 200 non-words between 4 and 11 characters was developed, and the words were matched for average length and frequency with the stimuli used in the colour-naming task. To ensure that threshold levels were conservative, word stimuli were presented in *lower case*, whereas the non-words consisted of random consonant strings presented in *uppercase*. Finally, a further set of 40 uncategorized words was developed for the practice trials. The stimulus sets not used in the threshold setting procedure were used for the final awareness check trials. All stimuli were presented in lettering approximately 1cm high.

Apparatus

Experimental hardware. All stimuli were presented by a Dell OptiPlex GX110 Pentium 3 computer running at 866 MHz using a Video Stimulus Generator video card (VSG; 2-3 issue 4a) capable of refresh rates up to 500 Hz (2 ms). The stimuli were presented on a Hitachi Superscan 813 21-inch colour monitor with a vertical refresh rate of 200 Hz (5 ms). A custom-built two-button response box was attached to the computer for use in the threshold setting and awareness check trials, and this box was labelled WORD (left button) and NON-WORD (right button). Participants wore a headset microphone and colour naming response latencies were detected by a voice-activated relay connected to the computer.

Experimental software. The VSG software controlled the presentation of stimuli for the threshold setting trials, practice trials, awareness check trials, and colour naming trials. The software also recorded reaction latencies and errors.

Electric stimulus. A Grass SD9 stimulator (0-90V) delivered the 200ms electric stimulus through a 35mm diameter concentric stainless steel electrode. Electrode-skin contact was made through a sponge soaked in saline.

Procedure

Participants were tested individually on all tasks and measures. After providing voluntary informed consent, they completed the STAI-T, STAI-S, MCSDS, and the BDI-R. They also completed a shortened, self-report, Arousal Rating Questionnaire, that was used to evaluate current fearfulness, nervousness and anxiousness. Ratings on these dimensions have shown to correlate with total scores on the STAI-S (Edwards et al., 2006). For this instrument, the statement ‘Right now, at this moment I feel’ precedes the scales, and participants rated their current responses for the dimensions of nervous to calm, fearful to not-at-all fearful, and anxious to not-at-all anxious, using a seven-point scale with the range 3-2-1-0-1-2-3. For example, on the nervousness scale a score of 3 indicated that the participant reported feeling *very* nervous, a score of 2 *quite* nervous, and a score of 1 *slightly* nervous. The same numerical ratings held true for the calm end of the scale. A rating of 0 indicated that the participant was *neither* nervous *nor* calm. Following the completion of these measures participants underwent the exposure threshold and shock setting procedures, the colour naming practice and experimental trials, and a final series of awareness checks.

Exposure threshold setting. Individual masking thresholds were set, and this procedure was identical to that reported by Edwards et al. (2006). Briefly, participants began with a block of 10 lexical decision trials in which 5 words and 5 non-words were each randomly presented for 80 ms, in red, blue, yellow or green lettering. Immediately following the offset of the target, a pattern mask consisting of a random string of 11 uppercase consonants was presented in the same location, and in the same colouring. The colour of the items was fully randomised within and across trial blocks. Participants were informed that during each block, half the items before the mask would be words, and half would be non-words. The items were presented in a quasi- randomised sequence, governed by the restriction that stimuli of the same lexical status would not occur on more than three consecutive trials. Following each trial, participants were instructed to indicate whether a word or non-word had preceded the mask by pressing the corresponding button on the button box. If unsure they were encouraged to guess, and any participant who reported seeing all words or non-words during a block of trials was reminded of the experimental parameters. Following each block of trials they were given feedback on their performance.

On each lexical decision trial, a fixation cue consisting of a row of three white crosses was presented for 1 s in the centre of the screen, the screen was blanked for 250 ms, and then either a word + pattern mask, or non-word + pattern mask was presented in the location formerly occupied by the crosses. On any block of 10 trials in which the participant made 5 or more correct identifications, the exposure time of the target was systematically shortened to 60, 40, 35, 30, 25, 20, 15, 10, and 5 ms. At the conclusion of any block of trials in which the participant made fewer than 5 correct identifications, a block of 20 trials was administered using the same procedures. On any block of 20 trials that the participant made 12 or more correct responses, the exposure time of the target was shortened to the next level, and a block of 10 trials was undertaken. On any block of 20 trials in which 11 or fewer correct identifications were made, the exposure duration of the target was considered to be below the participant's lexical awareness threshold. The procedure was adapted from Dagenbach, Carr, and Wilhelmsen (1989).

Shock intensity setting. The shock intensity was determined individually for each participant. The electrode was attached to the volar surface of the participant's right forearm, and commencing from a baseline of zero volts, the intensity of the 200 ms shocks was increased until the participant reported that the shock was 'uncomfortable but not painful'. At the completion of this procedure the electrode was removed.

Colour naming trials. Participants completed four blocks of 40 colour naming trials. On each trial a fixation cue consisting of a row of three white crosses was presented for 1 s in the centre of the screen, the screen was blanked for 250 ms, and then either a stimulus word, or stimulus word + pattern mask, was presented in the location formerly occupied by the cue in red, blue, yellow or green lettering. They were instructed to ignore the semantic nature of the items, and to name the colour of the lettering as quickly and accurately as possible. For the unmasked trials, the word remained on the screen until the software detected the participant's first vocal response, and the screen was then blanked. For the masked trials, the target word was presented for the duration of each participant's lexical decision threshold, and at its offset a pattern mask of the same colour replaced it. The mask remained visible until the software detected the participant's first vocal response, at which time the screen was blanked. Responses were coded as correct if the participant's first utterance reflected the name of stimulus colouring, and incorrect if it did not (e.g., saying the wrong colour, naming the word, stuttering). Response coding initiated the next trial, and the inter-trial interval was approximately 2 s.

At the completion of the practice trials a brief rest period followed. At this time, half of the HTA and half of the LTA participants had the shock electrode reattached. Assignment to the initial shock safe and shock threat groups was contingent upon participant's order of arrival at the laboratory. Those in the shock threat group were informed that the computer would deliver between 3 and 5 shocks at any time over the course of the following two blocks of 40 trials, and that the shocks were not contingent on colour naming performance. Approximately 15 s before the first colour naming trial, participants in the shock threat condition received one shock at the intensity determined earlier, and approximately 1 s after the final trial in block 1, they received a second shock to ensure that they believed the instruction given earlier (in reality this was the final shock delivered). To confirm that the threat of shock was successful in elevating state anxiety, participants completed the Arousal Rating Questionnaire a second time in the rest period between block 1 and 2, while the electrode was still attached. Following completion of the second block of 40 colour naming trials, the shock threat and shock safe conditions were reversed. Participants now in the shock threat condition received 1 shock approximately 15 s before the first trial in block 3, and a second shock approximately 1 s following the final trial in that block. These participants completed the Arousal Rating Questionnaire for a second time during the rest period between blocks 3 and 4. At the conclusion of the colour naming trials the electrode was removed.

Awareness check trials. To verify that awareness thresholds had remained unchanged throughout the experiment, participants underwent a series of 40 awareness checking trials governed by the same parameters as those employed in the exposure threshold setting procedure. The data from any participant who scored more than 23 correct responses on these trials was excluded from the final analyses. Following these trials participants were thanked, debriefed, and released.

Results

Manipulation Checks

Validity of trait anxiety status. As expected, an independent samples *t* test substantiated that the HTA (*M* = 45.09; *SD* = 4.09) and LTA (*M* = 29.78; *SD* = 4.41) groups were significantly differentiated on the trait anxiety measure, $t(62) = 10.12$, $p < .001$. The HTA group also reported higher levels of state anxiety (*M* = 38.84; *SD* = 8.09), $t(62) = 5.37$, $p < .001$, and depression (*M* = 9.13; *SD* = 3.78), $t(62) = 5.75$, $p < .001$, than the LTA group (*M*s = 28.78, 4.19; *SD*s = 6.84, 1.33, respectively). The groups did not differ on social desirability, $t < 1$.

Validity of state anxiety manipulation. There was no significant difference in intensity of the electric stimulus between the HTA (*M* = 39.84 V) and LTA (*M* = 40.94 V) groups, $t < 1$. The patterns of responses on the arousal-rating questionnaire for HTA and LTA groups in the shock safe and shock threat conditions are shown in Table 1. To confirm that the threat of shock was effective in elevating state anxiety, a series of repeated measures t-tests were performed on each dimension of the Arousal Rating Questionnaire in the shock threat and shock safe conditions, for the HTA and LTA groups. The results of these tests confirmed that the threat of shock was successful in elevating state anxiety on all dimensions in both groups, all $t(31) > 4.70$, all $p < .001$.

Insert table 1 about here

Validity of masking procedure in preventing awareness. The exposure duration of the masked items for the HTA (17 ms) and LTA (18 ms) groups did not differ, $t < 1$. For the final awareness check trials there was no significant difference in mean performance between HTA (*M* = 49.93%) and LTA (*M* = 48.60%) groups, $t < 1$, and the performance of both groups (*M* = 19.70%, *SD* = 2.84) in correctly identifying the status of the masked items did not differ from that expected by chance, $z = .11$, *n.s*. These results therefore verified that participants were unaware of the lexical status of the stimulus items.

Data Reduction

Prior to analysis, the colour-naming latency data were reduced in four stages. Trials involving (a) microphone failures (0.33% of trials), (b) colour naming errors (2.17%), (c) response latencies less than 300 ms or greater than 3000 ms were excluded (0.12% of trials), (d) and trials more than two standard deviations from each individual's cell means (4.42% of trials) were eliminated.

Colour Naming Latency Data

The mean colour naming response latency in each experimental condition was calculated for each participant, and these data are summarised below in Table 2. The data were entered into a 2 X 2 X 2 X 2 X 2 mixed factorial ANOVA that considered Valence (threat words vs. positive words), Exposure Mode (masked vs. unmasked), and Shock Condition (shock threat vs. shock safe) as within subjects factors, and Trait Anxiety (high vs. low) and Shock Condition Order (threat of shock in blocks 1 and 2 vs. threat of shock in blocks 3 and 4) as between subjects factors. The analysis yielded significant main effects for Exposure Mode, $F(1, 60) = 160.17$, $MSE = 1136.06$, $p <.001$, $\eta^2 = .73$, and Trait Anxiety, $F(1, 60) = 7.81$, $MSE = 2717.71$, $p = .007$, $\eta^2 = .12$. Inspection of the marginal means suggested that colour naming latencies were shorter on masked trials (*M* = 573 ms) than on unmasked trials (*M* = 610 ms), and that the LTA group (*M* = 573 ms) were faster at colour naming all word types than the HTA group (*M* = 610 ms).

Insert Table 2 about here

A significant interaction between Trait Anxiety X Valence X Shock Condition Order, $F(1, 60) = 4.47$, $MSE = 444.13$, $p = .039$, $\eta^2 = .07$ was also noted. To illustrate the nature of this interaction a single index of threat processing bias was calculated by subtracting the mean colour naming latencies for the positive words from the mean latencies for the threat related words, after averaging the data over Shock Condition and Exposure Mode. This procedure produced a differential threat-processing index such that negative scores reflected facilitated colour naming of threat, whereas positive scores reflected interference for threat. The pattern of the interaction is shown below in Figure 1. As can be seen, there was no difference in the processing of threat between HTA (*M* = -1 ms) and LTA (*M* = 1 ms) individuals when performing under the threat of shock in blocks 1 and 2, $t < 1$. However, when under the threat of shock in blocks 3 and 4, the HTA group was slower on threat word trials compared to positive word trials (*M* = 7 ms), relative to the LTA group who tended to show the opposite pattern (*M* = -7 ms), $t(60) = 2.55$, $p = .013$.

Insert Figure 1 about here

The analysis also yielded a significant Shock Condition X Valence X Shock Condition Order interaction, $F(1, 60) = 9.91$, $MSE = 485.26$, $p = .003$, $\eta^2 = .14$. To pursue the nature of this interaction a separate threat bias index was calculated by subtracting the mean colour naming latencies of the positive related words from the mean latencies from the threat related words, after averaging the data over Trait Anxiety and Exposure Mode. Positive scores reflected interference in threat word colour naming and negative scores reflected facilitation. Follow up *t* tests indicated that participants who performed first under threat of shock displayed a larger threat index in blocks 1 and 2 (*M* = 5 ms) than during blocks 3 and 4 (*M* = -6 ms), *t*(60) = 2.05, *p* = .043. A similar pattern emerged for those who performed the task under the safe condition first. The threat bias index was larger in blocks 1 and 2 (*M* = 7 ms) than in blocks 3 and 4 (*M* = -6 ms), *t*(60) = 2.41, *p* = .014. Hence, as illustrated in Figure 2, the interaction between shock condition and shock condition order is best understood as reflecting a main effect of block, with threat interference during the early blocks and threat facilitation during the later blocks, irrespective of shock condition or trait anxiety status.

Insert Figure 2 about here

A Trait Anxiety X Shock Condition interaction, *F*(1, 60) = 4.06, *MSE* = 2265.57, *p* = .048, η^2 = .06, was also found, which was further qualified by a higher order interaction involving Trait Anxiety X Shock Condition X Valence X Exposure Mode, *F*(1, 60) = 4.45, *MSE* = 544.40, *p* = .039, η^2 = .07. This finding indicated that the patterns of colour naming data for the positive and threat related words differed in the masked and unmasked exposure modes, and that this pattern was further influenced by both the threat of shock and trait anxiety status. As with the above analyses, a threat processing index was calculated by subtracting the mean colour naming latencies of the positive related words from the mean latencies for the threat related words, after collapsing the data over Shock Condition Order. Again, negative scores reflected facilitated colour naming of threat, whereas positive scores reflected interference. To further follow up the interaction, separate analyses were performed on the threat-processing index for the unmasked and masked trials.

Inset Figure 3 about here

Unmasked trials. The left panel of Figure 3 represents the differential patterns of threat processing for the HTA and LTA groups in the shock threat and shock safe conditions, for the unmasked trials. As the figure shows, there appeared to be little difference in responding between the HTA (M = 1 ms) and LTA (M = 7 ms) groups in the shock safe condition, and a tendency for the HTA group (M = 7 ms) to be slower than the LTA group (M = -8ms) at colour naming threat when performing under the threat of shock. When the threat processing indices were entered into a Shock Condition X Trait Anxiety ANOVA, the only effect to emerge was a marginally significant interaction involving both factors, $F(1, 62) = 3.21$, $MSE = 1161.26$, $p = .070$, $\eta^2 = .05$. A series of Bonferroni t-tests were carried out to test specific predictions concerning the effects of the state anxiety manipulation on threat processing for the HTA and LTA groups. In the shock safe condition, there was no difference in responding to threat between the HTA and LTA groups, $t < 1$, however when under the threat of shock, the HTA group were marginally slower on threat trials compared to positive trials, relative to the LTA group who tended to show the reverse pattern, $t(62) = 1.90$, $p = .060$. For the unmasked trials, the threat processing index was not significantly different from zero for either group in any condition, all $t < 1.60$, $p > .120$, *n.s.*

Masked trials. The right panel of Figure 3 depicts the pattern of threat processing in the masked exposure mode for the HTA and LTA groups in the shock threat and shock safe conditions. As can be seen, in the shock safe condition there appeared to be a tendency for the LTA group to be faster on threat word trials compared to positive word trials (M = -10 ms), relative to the HTA group (M = 3 ms). In the shock threat condition there was no difference in responding between the HTA (M = 0 ms) and LTA groups (M = 0 ms). When the data for the masked threat processing indices were entered into a Shock Condition X Trait Anxiety ANOVA, there were no significant main effects, all $F < 2.50$, $p > .12$, and the interaction involving both factors did not approach significance $F(1, 62) = 1.35$, $p = .25$, n.s.

To determine whether the groups were significantly different in their responses between the shock safe and shock threat conditions, further Bonferroni t-tests were conducted. In the shock safe condition, there was a non-significant trend for the LTA group to show facilitated threat processing relative to the HTA group, $t(62) = 1.79$, $p = .080$, but there was no difference between the groups in the shock threat condition, $t < 1$. When considered together, these data suggest that the HTA and LTA groups processed masked threat and positively valenced emotional information in an equivalent manner.

Error Data

Despite only 2.17% of trials being associated with colour naming errors the effects reported for the reaction time data were relatively small, and as such, we considered the possibility of a speed vs. accuracy trade off. The percentage of errors in each experimental condition was calculated for each participant, and these data were entered into an ANOVA equivalent to that used for the colour naming data. The results failed to reveal evidence of a speed vs. accuracy trade off.

Depression Analyses

Given that HTA and LTA groups were significantly different on self reported depression, an ANOVA equivalent to that conducted for Trait Anxiety status was performed on the colour naming data after reassigning participants to high and low depression groups on the basis of a median split of scores on the BDI-R. The results failed to produce any significant main effects or interactions involving Depression Group as a between subjects factor, all $F < 1.88$, $p > .177$, n.s., and the interactions involving all factors failed to near significance, $F < 1$.

Discussion

The primary aim of the present study was to assess the effects of state anxiety, trait anxiety, and ordering of the state anxiety manipulation, on selective attention for masked and unmasked threat and positively valenced words. In line with the theoretical views adopted by Mogg and Bradley (1998) and Williams et al. (1988, 1997), it was hypothesised that relative to LTA individuals, HTA participants would show selective interference for threat when performing under the threat of shock, and that this effect would be evident during both the masked and unmasked trials. The data found partial support for this prediction. To investigate whether selective threat effects were affected by the ordering of the state anxiety manipulation we incorporated this factor into our design. Following the views of Mogg and Bradley and Williams et al. that threat bias effects operate automatically within the attentional system, we predicted that there would not be an effect of shock condition order on colour naming latencies. This prediction was not supported.

The nature of the significant Trait Anxiety X Shock Condition X Valence X Exposure interaction provided some evidence to suggest that on unmasked trials, HTA individuals were slower on threat word trials than positive word trials under conditions in which state anxiety was elevated, relative to LTA individuals who tended to show the reverse pattern (i.e., a selective vigilance for positive material). Despite the fact that in the present experiment this effect was marginal, the general pattern of data is in agreement with a number of previous reports that have shown non-clinical HTA individuals to be less able than LTA participants to avoid attending to threat during periods in which state anxiety is currently elevated (e.g., Edwards et al., 2006; Miller & Patrick, 2000). If it is accepted that interference for threat reflects selective attentional capture, then these data are in accord with the models of Mogg and Bradley (1998) and Williams et al. (1997). Moreover, because participants were instructed to name the letter colouring and ignore the content of the items, the evidence adds support to the idea that post-conscious valence-based threat effects operate without volition within the attentional system.

The pattern of the 4-way Trait Anxiety X Shock Condition X Valence X Exposure Mode interaction failed to provide evidence for subliminal threat effects in either group irrespective of state anxiety status. Although the data for the masked trials are in accord with previous reports that failed to find a selective threat bias when positive items were employed as control words (e.g., Kyrios & Iob, 1998; McNally et al., 1996; Paunovic et al., 2002), they are in contrast to the results of Mogg et al. (1993) and Rutherford et al. (2004) who did report valence-based threat effects. For example, in the Rutherford et al. experiment there was some evidence to suggest that in the high state anxiety condition, HTA participants were slower to colour name masked threat words compared to positively valenced words, relative to LTA individuals. One explanation for the discordant patterns of data between their study and ours might have been that in their experiment the low state anxiety condition always preceded the high state anxiety condition, whereas in the present study these conditions were counterbalanced.

In fact, the significant Trait Anxiety X Valence X Shock Condition Order interaction yielded some evidence to support the possibility that the sequencing of the state anxiety manipulation might play a critical role in revealing preconscious valenced-based threat effects. The nature of this interaction suggested that for the masked (and unmasked) trials, there was no difference in responses to threat between HTA and LTA participants when presented with the threat of shock in blocks 1 and 2. However, the HTA participants who performed under the threat of shock in blocks 3 and 4 showed significantly more interference for threat relative to the LTA group, who tended to show a bias for the positive material. The data reported here are therefore conceptually similar to those reported by Rutherford et al. (2004), and when considered together, the evidence suggests that masked valenced-based threat effects might only become apparent when the high state anxiety condition follows the low state anxiety condition. One explanation for this finding is that individuals with an anxious predisposition may engage in post-conscious elaboration of potentially threatening material across or following periods of low state anxiety, and that this rumination may lead to threat processing biases during subsequent periods of higher state anxiety. Threat processing biases were not evident for HTA individuals exposed to the threat of shock in blocks 1 and 2, potentially because there was insufficient time during the early stages of testing for these rumination effects to build. In the present experiment the masked and unmasked trials were presented in an intermixed sequence, and as such, participants would have become aware that they were being exposed to threat material on some trials. The intermixing of exposure mode would therefore have permitted elaboration of the materials over the time course of the experiment, which in turn may have affected responses on the masked (and unmasked) threat trials. This interpretation seems plausible given Fox's (1996) previous demonstration that post-conscious priming processes influence threat processing at the preconscious level.

Although these data provide some support for the idea that selective valence-based threat effects operate as predicted by the models of Mogg and Bradley (1998) and Williams et al. (1988, 1997), it would appear that their occurrence might be heavily influenced by subtle procedural factors such as the opportunity for elaboration and the ordering of the high and low state anxiety conditions. In addition, it should be noted that the observed valenced-based threat effects involving shock condition order were not further modified by shock condition (i.e., not restricted to the high state anxiety condition). As such, it would seem that unlike when neutral stimuli are employed as controls (e.g., Edwards et al., 2006), the use of positive controls might reveal selective threat effects that are not as reliant on state anxiety status as the models of Mogg and Bradley and Williams et al. would predict.

Our results also yielded a significant Valence X Shock Condition X Shock Condition Order interaction, which reflected the fact that threat interference effects tended to be evident early in the experiment (i.e., during blocks 1 and 2), and facilitation effects in the later stages of testing (i.e., during blocks 3 and 4). Although it is not known whether this effect was the result of a general slowing on positive word trials or a speeding of latencies on threat word trials across the course of testing, it is important to note that exposure mode, state anxiety status, and trait anxiety status did not modify this pattern. On the basis of these data it would appear that participants were less able to avoid attending to the semantic content of threat items during the early stages of the experiment, but as testing continued they became more practiced at this task. The exact reason for why this general pattern of data emerged is unclear. Perhaps because participants were aware that threat words were being presented on some trials, awareness of this material might systematically have affected responses to threat over the course of testing (cf. Fox, 1996). As suggested by Edwards et al. (2006), exposure to threat items (and/or the threat of shock) over the course of the experiment might have primed access to the semantic nature of these words, which in turn, allowed more cognitive resources to be dedicated to colour naming these items (see also Burt, 1999).

What is important however is that shock condition order moderated selective threat effects. Although the interactions involving this factor confirmed that threat and positively valenced stimuli are differentially processed at a preconscious level within the attentional system, the fact that the ordering of the state anxiety manipulation affected colour naming latencies for both the masked and unmasked trials raises questions as to whether threat bias effects in anxiety operate entirely automatically (cf. Mogg & Bradley, 1988; Williams et al., 1988, 1997). That is, the data suggest that differential threat effects might not operate in an equivalent manner at all times, but rather that they are systematically altered by subtle procedural factors that vary over the course of the experiment. Moreover, the fact that the observed effects were modified by the ordering of the state anxiety manipulation, rather than by state anxiety status, suggests that the models of Mogg and Bradley and Williams et al. might require some modification to account for the data reported here.

The final aim of the present experiment was to replicate a recent report from our laboratory of a reliable masked threat facilitation effect in a sample of HTA individuals whose state anxiety was elevated (Edwards et al., 2006). With the exception of the control stimuli (i.e., in our earlier study we used neutral words, whereas in the present experiment we used positively valenced items), there were minimal procedural differences between experiments (e.g., same threat words, state anxiety manipulation, controls over awareness), and as such, differences in the patterns of results between studies can most parsimoniously explained by the differences in the stimulus sets employed.

One potential limitation of the present study was the use of the emotional Stroop. Some researchers have suggested that interference effects produced by this task could arise not only from the processes involved in selective attention but from several other mechanisms including competition for resources arising from task irrelevant processes, and/or from competition arising at the response selection stage (e.g., Mogg, Bradley, Field & De Houwer, 2003; Williams et al., 1996). Despite these criticisms, the emotional Stroop has shown to have good predictive utility (Cox, Pothos & Hosier, 2007; MacLeod & Hagan, 1992), and importantly, it has been used to assess emotional processing across a range of clinical and non-clinical anxiety states. In a field that has used multiple paradigms (dichotic listening, dot-probe task, emotional Stroop) across various clinical and non-clinical samples, it is difficult to determine whether the differential data patterns reported in the literature emerge on the basis of the populations sampled or the methodologies employed (cf. Williams et al., 1996). Given its extensive use, the emotional Stroop task has contributed to the development of a growing base of knowledge into the relationship between anxiety and cognition.

In summary, the results from the present experiment add further support to the idea that when conscious access is permitted, HTA individuals, relative to LTA individuals, show a selective bias for threat when their state anxiety is elevated. These data are therefore in accord with the models of Mogg and Bradley (1998), and Williams et al. (1988, 1997). However, when conscious access to this material was restricted, there was less evidence for a selective threat effect. With the ordering of the state anxiety manipulation included as a factor, the results confirmed that masked emotional material was differentially processed on the basis of its valence, and that the direction of this bias for HTA and LTA individuals was exactly as specified by the models of Mogg and Bradley, and Williams et al. However, these models predict that threat biases should be most evident under conditions in which state anxiety is elevated, whereas the present data indicate they might operate independent of state anxiety status. Our results suggest that biases for threat might not be moderated by state anxiety and trait anxiety alone, but rather that they seem to be heavily influenced by subtle procedural factors such as the ordering of the state anxiety manipulation, the opportunity for elaboration, and the nature of the comparison stimuli employed.

References

Beck, A. T. (1993). *Beck Depression Inventory Manual.* San Antonio: The Psychological Corporation.

Beck, A. T., Rush, A. J., Shaw, B. F., & Emery, G. (1979). *Cognitive therapy of depression.* New York: Guilford Press.

Beck, A. T., & Steer, R. A. (1993). *Beck Depression Inventory Manual*. San Antonio, California: Harcourt Brace.

Bradley, B. P., Mogg, K., Millar, N., & White, J. (1995). Selective Processing of negative information: Effects of clinical anxiety, concurrent depression, and awareness. *Journal of Abnormal Psychology, 104,* 532-536.

Burt, J. S. (1999). Associative priming in colour naming: Interference and facilitation. *Memory and Cognition, 27,* 454-464.

Cox, W.M., Pothos, E.M., & Hosier, S.G. (2007). Cognitive-motivational predictors of excessive drinkers' success in changing. Psychopharmacology, 192, 499-510.

Crowne, D. P. & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology, 24*, 349-354.

Dagenbach, D., Carr, T. H., & Wilhelmsen, A. (1989). Task-induced strategies and near-threshold priming: Conscious influences on unconscious perception. *Journal of Memory and Language, 28,* 412-443.

Edwards, M. S., Burt, J. S., & Lipp, O. V. (2006). Selective processing of masked and unmasked verbal threat material in anxiety: Influence of an immediate acute stressor. *Cognition and Emotion, 20,* 812-835.

Foa, E. B., Feske, U., Murdock, T. B., Kozak, M. J., & McCarthy, P. R. (1991). Processing of threat related information in rape victims. *Journal of Abnormal Psychology, 100,* 156-162.

Fox, E. (1996). Selective processing of threat words in anxiety: The role of awareness. *Cognition and Emotion, 10,* 449-480.

Fox, E. (1994). Attentional bias in anxiety: A defective inhibition hypothesis. *Cognition and Emotion, 8,* 165-195.

Harvey, A. G., Bryant, R. A., & Rapee, R. M. (1996). Preconscious processing of threat in posttraumatic stress disorder. *Cognitive Therapy and Research, 20,* 613-623.

Kilgarriff, A. (1995, November 3, 1998). BNC database and word frequency lists. Available: *http://www.itri.brighton.ac.uk/~Adam.Kilgarriff/bnc-readme.html* [2001, April 10].

Kyrios, M., & Iob, M. A. (1998). Automatic and strategic processing in obsessive-compulsive disorder: Attentional bias, cognitive avoidance or more complex phenomena? *Journal of Anxiety Disorders, 12,* 271-292.

Lundh, L. -G., Wikström, J., Westerlund, J., & Öst, L. -G. (1999) Preattentive bias for emotional information in panic disorder with agoraphobia. *Journal of Abnormal Psychology, 108,* 222-232.

MacLeod, C., & Hagan, R., (1992). Individual differences in the selective processing of threatening information, and emotional responses to a stressful life event. Behaviour Research and Therapy, 30, 151-161.

MacLeod, C., & Rutherford, E. M. (1992). Anxiety and the selective processing of emotional information: mediating roles of awareness, state and trait variables, and personal relevance of stimulus materials. *Behaviour Research and Therapy, 30,* 479-491.

McNally, R. J., Amir, N., & Lipke, H. J. (1996). Subliminal processing of threat cues in posttraumatic stress disorder? *Journal of Anxiety Disorders, 10,* 115-128.

McNally, R. J., Riemann, B. C., & Kim, E. (1990). Selective processing of threat cues in panic disorder. *Behaviour Research and Therapy, 28,* 407-412.

Miller, M. W., & Patrick, C. J. (2000). Trait differences in affective and Attentional responding to threat revealed by emotional Stroop interference and startle reflex modulation. *Behavior Therapy, 31,* 757-776.

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36,* 809-848.

Mogg, K., Bradley, B.P., Field, M., & De Houwer, J. (2003). Eye movements to smoking related pictures in smokers: Relationship between attentional biases and implicit and explicit measures of stimulus valence. *Addiction, 98*, 825-836.

Mogg, K., Bradley, B. P., & Williams, R. (1995). Attentional bias in anxiety and depression: The role of awareness. *British Journal of Clinical Psychology, 34,* 17-36.

Mogg, K., Bradley, B. P., Williams, R., & Mathews, A. (1993). Subliminal processing of emotional information in anxiety and depression. *Journal of Abnormal Psychology, 102,* 304-311.

Paunovic, N., Lundh, L.-G., & Öst, L.-G. (2002). Attentional and memory bias for emotional information in crime victims with acute posttraumatic stress disorder (PTSD). *Anxiety Disorders, 16,* 675-692.

Rutherford, E. M., MacLeod, C., & Campbell, L. W. (2004). Negative selectivity effects and emotional selectivity effects in anxiety: Differential attentional correlates of state and trait variables. *Cognition and Emotion, 18,* 711-720.

Spielberger, C. D., Gorsuch, R. L., Lushene, R. E., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory (Form Y).* Palo Alto: Consulting Psychologists Press.

Strahan, R. & Gerbasi, K. C. (1972). Short, homogenous versions of the Marlowe-Crown social desirability scale. *Journal of Clinical Psychology, 28*, 191-193.

Weinberger, D. A., Schwartz, G. E., & Davidson, J. R. (1979). Low-anxious, high-anxious, and repressive coping styles: Psychometric patterns and behavioural and physiological responses to stress. *Journal of Abnormal Psychology, 88*, 369-380.

Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 20*, 3-24.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders.* Chichester: Wiley.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). Chichester: Wiley.

Table 1.

Means and Standard Deviations of Responses for High Trait Anxious and Low Trait Anxious Participants on Arousal Rating Questionnaire Dimensions under Shock Threat and Shock Safe Conditions

	High Trait Anxious				Low Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	SD	M	SD	M	SD	M	SD
Nervous-Calm	-0.63	1.36	1.28	1.28	-1.78	1.10	0.81	1.62
Fearful-Not Fearful	-1.09	1.51	0.56	1.50	-2.31	1.06	-0.03	1.66
Anxious-Not Anxious	-0.28	1.71	1.53	0.95	-1.94	1.24	1.13	1.26

Note: Positive scores denote greater nervousness, fearfulness and anxiety whereas negative scores denote the opposite.

Table 2.

Means and Standard Deviations of Colour-Naming Latency Data in Milliseconds for High Trait Anxious and Low Trait Anxious Participants in Each Experimental Condition

	High Trait Anxious				Low Trait Anxious			
	Shock Safe		Shock Threat		Shock Safe		Shock Threat	
Variable	M	SD	M	SD	M	SD	M	SD
Shock Blocks 1 & 2								
Masked								
Threat Words	571	38	573	37	561	62	569	76
Positive Words	583	49	567	37	574	62	565	62
Unmasked								
Threat Words	603	50	610	51	605	82	604	72
Positive Words	610	46	602	46	596	64	602	66
Shock Blocks 3 & 4								
Masked								
Threat Words	626	84	598	46	530	43	546	47
Positive Words	607	69	604	52	537	53	551	41
Unmasked								
Threat Words	660	66	649	63	576	66	583	55
Positive Words	650	76	644	55	570	52	602	57

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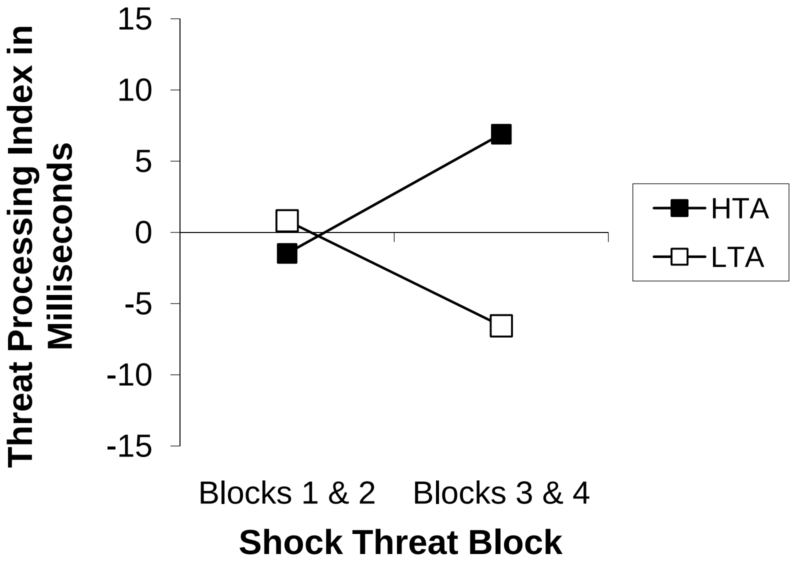
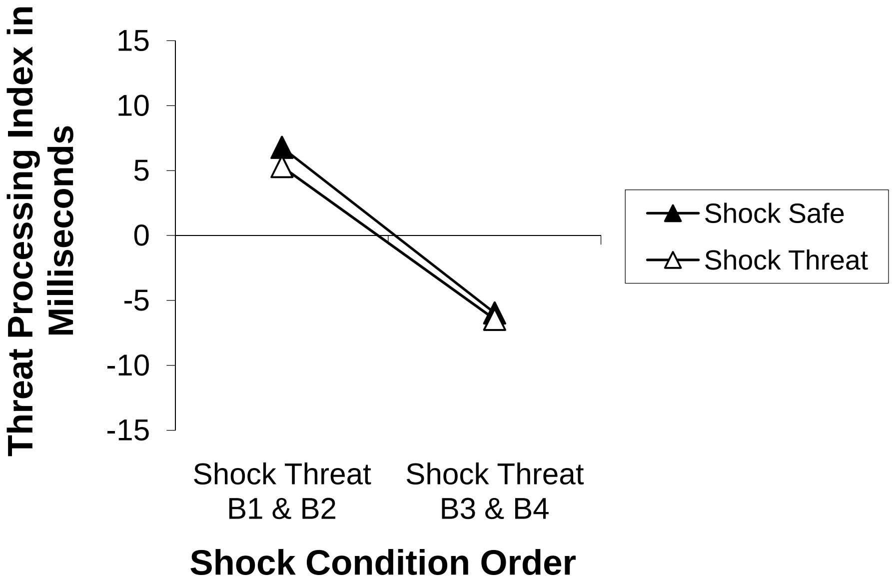
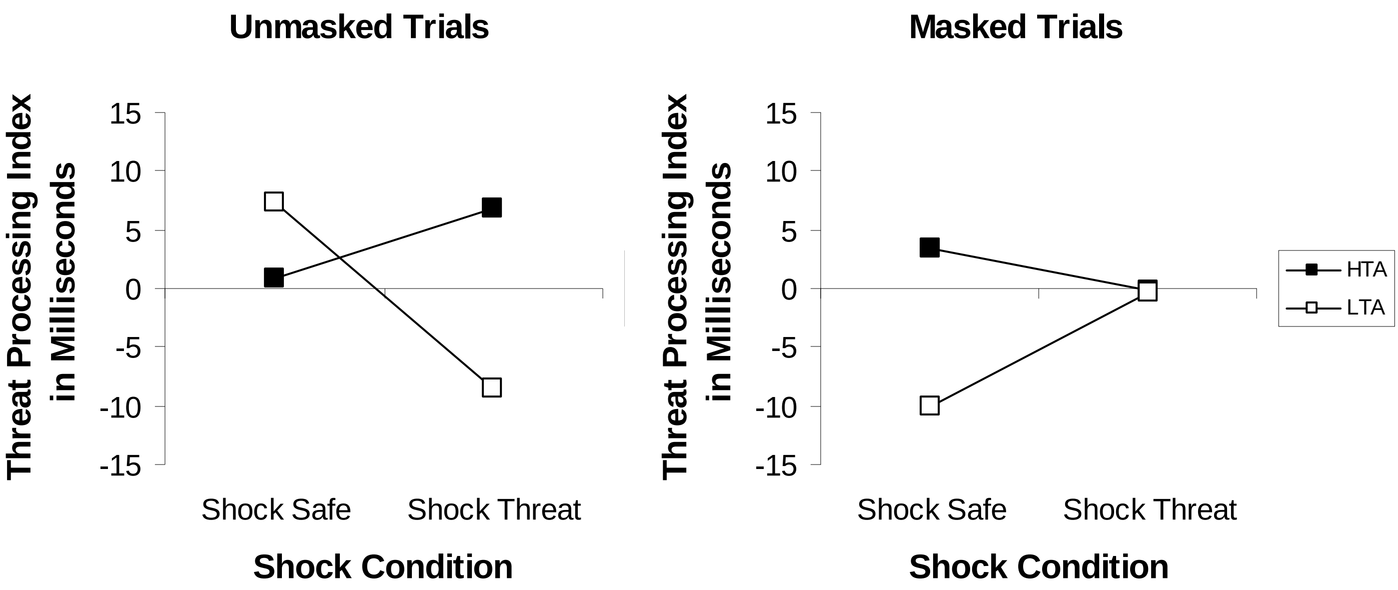
Figure 1. Threat processing index in milliseconds for HTA and LTA individuals collapsed over state anxiety as a function of shock threat block. (NOTE: Positive scores show interference for threat words, whereas negative scores show facilitation for threat words).

Figure 2. Threat processing index in milliseconds for the shock threat and shock safe conditions collapsed over trait anxiety status as a function of block of the experiment. (NOTE: Positive scores show interference for threat words, whereas negative scores show facilitation for threat words).

Figure 3. Unmasked and masked threat processing indices for high trait anxious and low trait anxious participants in the shock threat and shock safe conditions. (NOTE: Positive scores show interference for threat words, whereas negative scores show facilitation for threat words).


Threat Processing Index in Milliseconds
15
10
5
0
-5
-10
-15
HTA
LTA
Blocks 1 & 2
Blocks 3 & 4
Shock Threat Block


Threat Processing Index in Milliseconds
15
10
5
0
-5
-10
-15
Shock Safe
Shock Threat
Shock Threat B1 & B2
Shock Threat B3 & B4
Shock Condition Order


Unmasked Trials
Masked Trials
Threat Processing Index in Milliseconds
15
10
5
0
-5
-10
-15
Shock Safe
Shock Threat
Shock Condition
HTA
LTA

Appendix

Stimulus Words with Frequencies Per Million X 89 in Parentheses

Set A		Set B	
Threat Words	Positive Words	Threat Words	Positive Words
Burn (1559)	Wins (1500)	Burnt (1100)	Jokes (1101)
Cable (1863)	Comic (1152)	Charge (9528)	Happy (9906)
Charred (185)	Loveable (146)	Circuit (2552)	Singing (2501)
Current (13599)	Success (12938)	Danger (5709)	Profit (5555)
Electrical (2136)	Excitement (2573)	Electricity (3476)	Achievement (3023)
Electrify (14)	Funnyman (12)	Electrocute (0)	Helpfulness (27)
Electrode (122)	Affluence (198)	Fear (8689)	Peace (8564)
Frightened (2408)	Enthusiasm (2864)	Generator (401)	Admirable (463)
Hazard (829)	Assure (857)	Hurt (4145)	Dance (4117)
Intense (2303)	Devoted (2492)	Lethal (626)	Heroic (602)
Lightening (480)	Comforting (493)	Pain (6928)	Rich (6435)
Painful (1823)	Happily (1704)	Polarity (116)	Affable (111)
Scar (411)	Skip (481)	Shocking (534)	Embraced (545)
Shocks (346)	Candy (352)	Singed (45)	Greets (70)
Sparks (418)	Thrill (468)	Spasm (184)	Joker (123)
Sting (552)	Merry (501)	Stinging (504)	Pleasing (597)
Voltage (837)	Blessed (824)	Volt (97)	Grins (139)
Wires (656)	Greet (570)	Watts (450)	Puppy (431)
Wound (2062)	Marry (2586)	Wiring (364)	Cheery (171)
Zapped (20)	Pizzazz (20)	Unpleasant (1255)	Positively (1281)
Amputate (11)	Nurturance (15)	Abuse (3389)	Laugh (3307)
Coffin (1317)	Loving (1396)	Cancer (4023)	Beauty (4055)
Deceit (205)	Caress (210)	Dead (11643)	Fine (11260)
Diseased (178)	Altruism (165)	Disgraced (178)	Comedians (156)
Dumb (667)	Cosy (674)	Embarrass (195)	Gleefully (122)
Evil (2745)	Gift (2769)	Fail (3238)	Glad (3542)
Grief (1315)	Loyal (1310)	Hate (2390)	Kiss (2394)
Hateful (105)	Restful (124)	Humiliate (112)	Birthdays (164)
Illness (3118)	Comfort (3323)	Inadequate (2263)	Friendship (1990)
Incompetent (350)	Pleasurable (261)	Infection (2654)	Brilliant (2742)
Kill (4375)	Loved (4668)	Lacking (1479)	Grinned (1758)
Lonely (1696)	Kissed (1756)	Massacre (621)	Greeting (601)
Murder (5781)	Welcome (5927)	Mutilation (92)	Soothingly (110)
Pathetic (625)	Applause (553)	Peril (289)	Cheery (171)
Punishment (2211)	Satisfying (965)	Sadness (754)	Ecstasy (602)
Satan (375)	Bliss (376)	Snake (718)	Jolly (731)
Stupid (2439)	Relaxed (2447)	Starve (247)	Gladly (286)
Tumour (879)	Admire (751)	Torture (863)	Happier (850)
Violence (5350)	Pleasure (5018)	Ugly (1252)	Fond (1132)
Worry (4516)	Faith (4881)	Spider (1272)	Comedy (1353)