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Attentional Bias for Threat: Evidence for Delayed Disengagement from Emotional Faces

Elaine Fox, **Riccardo Russo**, and **Kevin Dutton**
University of Essex, Colchester, UK

Abstract

The present paper reports three new experiments suggesting that the valence of a face cue can influence attentional effects in a cueing paradigm. Moreover, heightened trait anxiety resulted in increased attentional dwell-time on emotional facial stimuli, relative to neutral faces. Experiment 1 presented a cueing task, in which the cue was either an "angry", "happy", or "neutral" facial expression. Targets could appear either in the same location as the face (valid trials) or in a different location to the face (invalid trials). Participants did not show significant variations across the different cue types (angry, happy, neutral) in responding to a target on *valid* trials. However, the valence of the face did affect response times on *invalid* trials. Specifically, participants took longer to respond to a target when the face cue was "angry" or "happy" relative to neutral. In Experiment 2, the cue-target stimulus onset asynchrony (SOA) was increased and an overall *inhibition of return* (IOR) effect was found (i.e., *slower* responses on valid trials). However, the "angry" face cue eliminated the IOR effect for both high and low trait anxious groups. In Experiment 3, threat-related and jumbled facial stimuli reduced the magnitude of IOR for high, but not for low, trait-anxious participants.These results suggest that: (i) attentional bias in anxiety may reflect a difficulty in disengaging from threat-related and emotional stimuli, and (ii) threat-related and ambiguous cues can influence the magnitude of the IOR effect.

Many theories of attention assume that one of the primary functions of attentional mechanisms is to facilitate fast and accurate perception of objects appearing in the visual scene (e.g., Yantis, 1996). Likewise, a primary function of the basic emotion of *fear* is considered to be the facilitation of the detection of danger in the environment (e.g., LeDoux, 1996). It should not, therefore, be too surprising to find a close association between the brain mechanisms underlying attention and those underlying fear. Many psychological theories have examined attentional processing in people with disorders of the fear system (i.e., anxiety disorders) and concluded that attentional biases do play an important role in the etiology and maintenance of anxiety disorders (e.g., Eysenck, 1992; Mathews & MacLeod, 1994; Williams, Watts, MacLeod, & Matthews, 1988, 1997). Moreover, psychobiological research has shown that fear responses may well be driven by the pre-attentive analysis of stimuli as being threat-related (e.g., snakes, angry facial expressions), and that these mechanisms may then result in an automatic shift of attentional resources to the location of the threatening object (Öhman, 1993; Öhman & Soares, 1993).

Experimental psychological research has added to the evidence that anxious individuals may be especially sensitive to the presence of threat-related objects in their environment.

Correspondence should be addressed to Dr Elaine Fox, Department of Psychology, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, UK; email: efox@essex.ac.uk.

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Findings characteristic of such research are those which have emanated from modifications of the probe detection task. This task was designed to measure the allocation of spatial attention, and typically shows that participants tend to be faster in detecting a probe if it occurs in an attended, rather than an unattended, location on a computer screen (Navon & Margalit, 1983). MacLeod, Mathews, and Tata (1986) modified this paradigm by presenting a pair of words 5 cm apart for 500 ms, followed by a probe to be detected in either the upper or lower location on a subset of trials. The interesting trials were those in which one of the words was threat-related and the other neutral. The results showed that patients with generalised anxiety disorder (GAD) were faster to detect a probe when it occurred in the location recently occupied by a threat-related word, in comparison with normal control participants. Subsequent research has used a target categorisation task with the probe paradigm such that participants were required to determine whether two dots were vertically (:) or horizontally (..) aligned. As before, the dots could appear either to the left or the right of fixation. However, unlike the traditional dot-detection task in which a number of trials with no target probe (catch trials) were necessary, this method allows all trials to be used giving a greater degree of statistical power. Using photographs of neutral, happy, and angry facial expressions previous research has found that participants with high levels of self-reported trait anxiety were faster when the probe was preceded by an angry, relative to a neutral, facial expression, and this pattern did not occur in participants' with low levels of self-reported trait anxiety (Bradley, Mogg, Falla, & Hamilton, 1998). Similar findings have also been found with photographs of fearful, relative to neutral, facial expressions (Fox, 2001). Thus, a growing literature using the dot-probe task with both words (e.g., Fox, 1993; MacLeod & Mathews, 1988; Mogg, Bradley, & Hallowel, 1994), and faces (Bradley et al., 1998; Fox, 2001) has led to the assumption that anxious people are biased in the initial orientation of attentive resources towards threat-related stimuli.

However, this interpretation of the pattern of results observed in the probe detection task has recently been challenged. Fox, Russo, Bowles, and Dutton (in press) have argued that the presence of threat-related stimuli may affect the *attentional dwell-time* or the ability to *disengage* attentional resources from threatening stimuli in anxious people. They pointed out that in the probe-detection task, because both locations are task-relevant, and presentation times are relatively long (*c*. 500 ms), participants may attend alternately to both locations and then continue to dwell on threat-related stimuli once they have been detected. If this indeed were the case, it would become virtually impossible to distinguish between differences in initial orienting and differences in attentional dwell time using the traditional probe detection task. A task more conducive to investigating disengage mechanisms is one in which a threat-related or neutral cue is presented alone for a very *brief* period in one of two possible locations. A target can then appear in either validly cued locations (i.e., cue and target appear in the same location) or invalidly cued locations (i.e., cue and target appear in different locations). It should be noted, however, that this task cannot measure enhanced attentional *orienting* towards a threat stimulus. Because only one stimulus is presented prior to the probe on each trial, any individual difference in the tendency to initially prioritise the assignment of attention to an emotional class of stimuli relative to another class of stimuli will not manifest itself on this task. Only effects that reflect differential disengagement of attention from alternative emotional stimulus classes will be revealed. Thus, the aim of the present research is to investigate differences in attentional disengagement from different emotional stimuli. The *invalid* trials are critical since reaction times can be compared following neutral, positive, and threat-related cues, giving a fairly direct measure of disengagement from threatening stimuli. If attentional dwell time increases in anxious people for threat-related stimuli then anxious people should be *slower* in detecting a target on *invalid* trials following a threat-related cue, relative to a positive or neutral cue. In a series of experiments using both schematic facial expressions, and photographs of real facial expressions, this predicted pattern of results was observed. Individuals with high levels of self-reported state anxiety took longer to respond to a target on invalid trials when the cue had been an angry facial expression. This pattern was not apparent in those with low levels of state anxiety (Fox et al., in press). Such results support the possibility that the probe-detection task may be a reflection of enhanced attentional dwell-time on threat-related stimuli, rather than or in addition to a reflection of facilitated orienting towards threatening stimuli.

One of the unexpected results of our earlier studies (Fox et al., in press) was the finding that state-anxiety rather than trait-anxiety was the main predictor of increased dwell-time on threat-related stimuli. We argued that state anxiety may represent a purer activation of the fear detection system of the brain and that therefore elevations of state anxiety might more strongly influence attention effects. Nevertheless, several cognitive theories of emotion predict that variations in trait anxiety should be associated with variations in attentional bias (e.g., Eysenck, 1997; Williams et al., 1997). We would also expect that the ability to disengage from threat-related stimuli should be related to an individual's level of trait anxiety. A recent study is of particular interest in this context. Yiend and Mathews (in press) presented an attentional task somewhat similar to the cueing paradigm used by Fox et al. (in press). Yiend and Mathews (in press) found that when pictures were used as location cues, high trait anxious participants were slower than low trait anxious controls when responding to targets requiring attentional disengagement from threat. Like Fox et al., they also concluded that attentional bias involves a specific difficulty in disengaging attention from the location of potential threat. However, whereas one study found that this effect was primarily related to the level of state anxiety (Fox et al., in press), the other found that trait anxiety was the better predictor (Yiend & Mathews, in press).

Thus, the aim of the present experiments was to further investigate the *enhanced dwell-time* hypothesis, and to determine whether the delay in disengaging from the location of threat is affected by an individual's level of trait anxiety. General theories of emotion and attention (e.g., Armony & LeDoux, 2000; LeDoux, 1996; Öhman, 1993) would suggest, of course, that threatening stimuli should influence attentional processing in a fairly general way. Thus, we can hypothesise that participants will show a general tendency to dwell on threatening stimuli, but that this tendency might be further increased by elevated trait anxiety. Experiment 1 is a close replication of a previous experiment (Fox et al., in press: experiment 3). However, in the previous experiment we presented a target localisation task, such that the participant had to press either a left or a right-hand side button according to the *location* of a target (left or right) on the computer screen. One potential problem with this task is that the cue might directly activate a *response* (left or right) and therefore a motor preparation effect rather than an attentional effect might have produced the observed pattern of results (see Fox et al., in press, for further discussion). Moreover, a further problem with a location-based response is that, in principle, the information required to identify the probe location exists equally in both possible screen locations, rather than only in the location of the probe itself. Thus, a response could be made by simply attending to one side of the screen and making a “presence/absence” response. For these reasons, in the current experiment we presented a target categorisation task such that participants had to press one key if the target was a square and another key if the target was a circle. This change is important as any cue validity effects (i.e., faster responses on valid relative to invalid trials) cannot now be attributed to response preparation effects because the location of the cue (left or right) is not associated with the correct response (circle or square). In addition, information required to make the appropriate response can only be obtained by processing the probe itself in a probe categorisation task.

The primary aim of the current series of experiments was to further investigate whether attentional dwell-time increases when threatening facial expressions are presented as cues and whether this pattern is especially apparent in high trait anxious people. This can be measured on invalid trials when there is a short temporal lag between the cue and the target (e.g., Fox et al., in press). Experiments 2 and 3 both used the *inhibition of return* (IOR) paradigm (Posner & Cohen, 1984) to further investigate the enhanced dwell-time hypothesis. The task used was similar to that used in Experiment 1, except that the cue-target asynchrony was increased. IOR is the demonstration that target detection takes *longer* following a validly cued trial, relative to an invalidly cued trial, when the cue-target onset asynchrony is greater than about 600 ms. Posner and Cohen (1984) argued that IOR reflected a mechanism that served to favour novelty in visual scanning. In other words, visual attention is *inhibited* from returning to an already searched location, thus biasing the visual system towards "new" information. The mechanism proposed to underlie this pattern of early facilitation giving way to inhibition is as follows: (i) attention moves to the location of the cue; (ii) after a certain amount of time (e.g., > 300 ms) attention drifts back to a central location; and then (iii) attention is inhibited from returning to the initial location. If this sequence is correct then the IOR paradigm provides a unique test of the proposed disengage hypothesis. The logic is that if angry facial expressions are particularly effective in holding visual attention (i.e., increasing dwell-time), then IOR should be substantially reduced with these stimuli, or at least should be apparent over a longer time scale than that observed for neutral stimuli. Thus, three new experiments are reported to further test the enhanced dwell-time (or delayed disengagement) hypothesis as outlined by Fox et al. (in press).

EXPERIMENT 1

The aim of Experiment 1 was to replicate the findings of Fox et al. (in press: experiment 3) with a cueing paradigm that required a categorisation response. In our previous studies, a cue was presented to the left or right of fixation and the participant had to *localise* a target that could appear in either the left or right location. The key difference in the present study, however (the cue again appearing to the left or right of fixation), is that the target comprises either a square or a circle which the participant must *categorise* by pressing an appropriate key. The prediction is that participants will take longer to respond to a target on *invalid* trials when the cue is an angry facial expression, relative to when the cue is a happy or a neutral facial expression. This pattern is expected to be stronger for high trait anxious relative to low trait anxious people.

Method

Participants—These were 34 undergraduate students from the University of Essex campus community ranging in age from 18 to 32 years with a modal age in the 20s. Those scoring at or above a score of 40 ($n = 21$) on the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) and those scoring at or below 35 ($n = 13$) were classified as high and low trait anxious participants, respectively. In various previous samples tested at the University of Essex we have found that the median on the Spielberger trait anxiety scale is 37. Therefore, in this and subsequent experiments we excluded people scoring between 35 and 40 in order to exclude those scoring near the median. These cut-offs should give us more statistical power by strengthening the independent variable of trait anxiety. Each participant had normal or corrected-to-normal eyesight and took part in one experimental session lasting about 45 minutes for which they received payment of £4.00.

Materials and procedure—Schematic faces were created by assembling standardised facial features in a computerised drawing package. There were three main face types: neutral, happy, and angry as shown in Figure 1. These faces have been used in our previous research (see Fox et al., in press). Each of the faces was 2.5 cm in height and 1.8 cm wide on the computer screen. The face stimuli were used as cues in the experiment. The target that participants had to categorise was either a white square with a diameter of 0.3 cm, or a white circle with a diameter of 0.3 cm. Cue and target stimuli were presented inside two dark grey boxes that were 5.3 cm high and 3.0 cm wide and were displayed 2.0 cm to the left and the right of the central fixation point (cross shape). These boxes were continuously present on the computer screen. All stimuli were presented on a Pentium P5/120 PC with a 28 cm colour monitor and ATI Mach64 graphics card. All stimulus presentation and data collection was controlled by MEL software Version 2 (Schneider, 1988).

Early in the academic year, participants completed the STAI in a group testing session. On arrival at the laboratory toward the end of the academic year (about five weeks prior to examinations), each participant once again completed the STAI state anxiety scale, which gave a measure of state anxiety at test. On completion of the questionnaires, participants were asked to move to a computer in the same room for the reaction time experiment, where they were seated about 50 cm from the computer monitor. The participant's task was to categorise the target that appeared in either the left or right hand location by pressing the “z” key for square and the “/” key for circle on a standard computer keyboard. Participants had to remember these response assignments which were not marked on the keyboard. The response assignments were reversed for half of the participants. The cue display consisted of one of the faces being presented in the upper half of either the left or the right box. The target (square or circle) later appeared in the lower half of either the left or the right box. This was to prevent any forward masking of the target by the face cue. The sequence of events within each trial was as follows. A fixation point (X) was presented at the centre of the screen for 1000 ms. A face cue was then presented in one of the peripheral boxes for 250 ms. The cue was then blanked out and 50 ms later the target (square or circle) was presented in the lower half of either the left or the right box until the participant responded (or until 2000 ms elasped). This gave a cue-target onset asynchrony of 300 ms. There was an intertrial interval of 1000 ms.

Each participant completed 30 practice trials, followed by 240 experimental trials, divided into four blocks of 60. Three-quarters (75%) of the experimental trials (180) were valid (i.e., the target appeared in the same spatial location as the cue), and one-quarter (60) were invalid (i.e., the target appeared in the opposite spatial location to the cue). Neutral, happy, and angry face cues appeared 60 times each on valid trials and 20 times each on invalid trials. The probability of any particular cue appearing in the left- and right-handside boxes was equal. Thus, each type of cue was presented 80 times in the experimental trials: 40 times on the right (30 valid, 10 invalid) and 40 times on the left (30 valid, 10 invalid). Each target type (square or circle) appeared equally often in each condition of the experiment. The trials were presented in a different random order for each participant. Participants were told that the face cue would predict the location of the subsequent target on most (75%) trials, but they were told to try and keep their eyes focused on the centre of the screen and to respond as quickly and as accurately as possible.

Design—A 2 (Anxiety: high and low trait anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, happy, angry) ANOVA factorial design was used. Trait anxiety was a between-subjects factor while Cue Validity and Cue Valence were within-subjects factors. The main prediction was an Anxiety × Cue Validity X Cue Valence interaction such that cue validity effects (i.e., faster RTs on valid relative to invalid trials) should be *larger* on angry face trials than on either neutral or happy face trials. This larger validity effect is expected to be due to *slower* RTs on *invalid* angry face trials rather than to faster RTs on valid angry face trials. This pattern is expected to be particularly strong for high trait anxious participants.

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Results

As shown in Table 1, the high trait anxious group scored significantly higher on measures of state anxiety compared to the low trait anxious group. A mixed design 2 (Anxiety: high and low trait anxiety) × 2 (Time of Testing: state anxiety at baseline and test) ANOVA revealed a significant main effect for the Trait Anxiety group, $F(1, 32) = 9.54$, $MS_e = 177.9$, $p < .004$, such that the high trait anxious participants had higher state anxiety scores than the low trait anxious participants. No other effects were significant.

Incorrect responses (< 3.5% of trials) and RT latencies of between 150 ms or above 1200 ms were eliminated from the data. The mean correct RT data are shown in Figure 2. In this and subsequent experiments, we report values for the Pillais multivariate test of significance (exact *F*-test) whenever the sphericity assumption was violated in univariate tests involving within-subjects factors. The RT data were subjected to a 2 (Anxiety: high and low trait anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, happy, angry) ANOVA with participants as a random factor. There were main effects for Cue Validity, $F(1, 32) = 240.3$, $MS_{>e} = 738.7$, $p < .001$, and for Cue Valence, Pillais $F(2, 31) = 4.12$, $p < .026$. Of greater theoretical importance, there was a significant Cue Validity × Cue Valence interaction, *Pillais* $F(2, 31) = 4.44$, $p < .020$, while the predicted Trait Anxiety × Cue Validity × Cue Valence interaction approached significance, *Pillais* $F(2, 31) = 3.08$, $p < .060$. In order to break down this three-way interaction we examined the data for high and low anxious groups separately.

High trait anxiety—A 2 (Cue Validity) × 3 (Cue Valence) ANOVA revealed the predicted interaction, *Pillais* $F(2, 19) = 8.02$, $p < .003$. Further analysis revealed that there was no main effect for Cue Valence on the valid trials. However, as expected, there was a significant main effect for Cue Valence on the invalid trials, *Pillais* $F(2, 19) = 6.62$, $p < .007$. Paired *t*-tests revealed that RTs following angry faces were slower (468 ms) than RTs following neutral, 454 ms: $t(20) = 3.59$, $p < .001$, but not happy, 468 ms: $t(20) < 1$ faces. Reaction times following happy faces did not differ from RTs following neutral faces, 468 ms vs. 454 ms: $t(20) = 1.69$, $p < .106$, 2-tailed. Planned comparisons revealed that the cue validity effect with angry faces (mean = 66 ms, confidence interval [CI] = 53.6 to 77.6) was larger than that observed for neutral faces, mean = 49 ms; CI = 38.4 to 59.9: $t(20) = 3.76$, $p < .001$, but was comparable to the cue validity effect for happy faces, mean = 68 ms; CI = 50.9 to 84.7: $t(20) < 1$. There was also a difference between the cue validity effect with happy faces (68 ms) relative to neutral faces, 49 ms: $t(20) = 2.25$, $p < .036$, 2-tailed.

Low trait anxiety—A 2 (Cue Validity) × 3 (Cue Valence) ANOVA revealed a main effect for Cue Validity, $F(1, 12) = 96.8$, $MS_e = 737.7$, $p < .001$, such that the mean RT on valid trials was faster (382 ms) than the mean RT on invalid (442 ms) trials. There was no main effect for Cue Valence and no Cue Validity × Cue Valence interaction. The means and CI for the cue validity effects were 61 ms, and 44.9 to 77.4 for neutral, 54 ms and 39.9 to 68.9 for happy, and 66 ms and 52.3 to 79.6 for angry faces, respectively.

Discussion

As expected, there was a large cue validity effect in this experiment such that participants were faster in categorising a target that appeared in a validly cued location relative to an invalidly cued location. The magnitude of the cue validity effect did not differ between the high and low anxiety groups. As we used a target *categorisation* task, this cue validity effect can be attributed to an attentional mechanism, rather than a response preparation mechanism, as the location of the cue was not predictive of the required response. Of more interest, an interaction between the valence of the cue and the level of self-reported trait anxiety of the participant had a bearing on the magnitude of the cue validity effect.

Specifically, high trait anxious people took longer to categorise a target when it appeared in an invalidly cued location when the cue had been an emotionally valenced face (angry or happy), relative to when the face had been emotionally neutral. We predicted this pattern for *angry* facial expressions but the enhanced attentional dwell-time for *happy* facial expressions was unexpected. It is worth noting that this general emotionality effect has been sometimes reported in the literature (e.g., with homophones: Russo, Patterson, Roberson, Stevenson, & Upward, 1996) but does not seem to be consistent. For the low trait anxious participants, the valence of the cue made little difference to the speed of response on either the validly or the invalidly cued trials. Although the valence of the cue had no statistically significant effect for the low trait anxious participants, it is worth noting that the magnitude of the cue validity effects did not differ between the anxiety groups for either angry, happy, or neutral face cues (66 ms vs. 66 ms; 68 ms vs. 54 ms; 49 ms vs. 61 ms, respectively: all ts < 1.3). Nevertheless, reaction times on invalid trials did not differ across cue types for the low anxious group, while they did increase significantly following angry and happy faces relative to neutral faces for the high anxious group. The real issue here is how best to measure bias, between groups or between within-subject conditions? Our view is that, although the cue validity effects might have been similar for the angry faces between the high and the low trait anxious groups, the proportional increase in cue validity effects between the neutral and the angry faces was different for the low anxious and the high anxious groups (.07 and .26, respectively). This demonstrates that there is a difference in how high trait anxious people respond to different classes of emotional stimuli.

EXPERIMENT 2

The findings of Experiment 1 suggested that an emotionally valenced facial expression produced delayed disengagement in high trait anxious people. Our previous research has found similar results with variations of state anxiety, although usually the pattern has been specific to *angry* facial expressions, and has not been found for *happy* facial expressions. Similar to the current results, a recent study using pictorial stimuli has found that high trait anxious people take longer to disengage attention from the location of emotionally threatening pictures (Yiend & Mathews, in press). The Yiend and Mathews study did not include emotional pictures with a positive valence and therefore it is not known whether similar results would occur with positive and negative stimuli, relative to neutral stimuli. Because we generally found differences in disengaging attention from the location of angry faces and not from happy faces in our previous research (Fox et al., in press), we are inclined to believe that increased dwell-time should be particularly salient with threatening stimuli. However, there is some evidence against this in a recent investigation of three people with chronic unilateral neglect and visual extinction (Vuilleumier & Schwartz, 2001). On trials in which line drawings were presented simultaneously to the left and right visual fields, these patients extinguished schematic faces in the contralesional field much less often than shapes. Of more relevance, faces with angry or happy expressions were extinguished much less than faces with a neutral expression (Vuilleumier & Schwartz, 2001). Thus, faces with either a positive or a negative emotional expression did not differ in terms of capturing attention, but both were more effective than neutral faces. Therefore, it might be the case that the brain mechanisms involved in producing enhanced dwell-time on visual stimuli might not differentiate between positive and negative emotional expressions.

Experiment 2 further tested attentional disengagement from the location of emotional facial expressions (angry and happy) relative to neutral facial expressions. The cue-target stimulus onset asynchrony (SOA) was increased from 300 ms to 960 ms, thus rendering this an IOR task. The logic is as follows: if an angry (or happy) face holds attention for a longer period of time than a neutral face, then the magnitude of IOR should be reduced for angry (or happy) face cues over the same time scale. This is because attention will be held for longer

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in the location of an angry (or happy) cue and thus will not drift back to a central location in time for the application of inhibitory processes. To our knowledge, this is the first modification of the IOR paradigm in which faces with varying emotional expressions are used as cues. One of the problems is choosing an appropriate SOA given that we do not know the precise time scale of disengagement especially concerning possible anxiety-related differences. However, an SOA of 960 is fairly standard in the IOR literature and we also conducted a pilot study with low trait anxious people using neutral and jumbled face cues and found a typical IOR effect of around 19 ms with an SOA of 960 ms. Thus, as a first step we tested for cue valence differences using a standard SOA. We do acknowledge, however, that anxiety-related differences may be difficult to detect until more is known about the time scale of disengagement processes. Thus, on the basis of previous research (e.g., Fox et al., in press; Yiend & Mathews, in press), we tentatively predicted an interaction between Trait Anxiety, Cue Validity, and Cue Valence such that high anxious people will demonstrate a reduced IOR effect to angry faces, relative to neutral faces. Given the results of Experiment 1, we might also expect a reduced IOR effect for happy facial expressions.

Three key changes were made from Experiment 1. First, the SOA was increased from 300 ms to 960 ms. Second, target localisation was used rather than target categorisation. Although this reintroduces some of the problems outlined in Experiment 1 it was considered necessary because previous research has shown that IOR often does not occur with categorisation tasks but is reliable with localisation tasks (Klein & Taylor, 1994). This methodological change, of course, allows for the possibility that response preparation effects may influence the results. However, we would argue that differences in the magnitude of the IOR effect are interesting regardless of whether attentional or response preparation mechanisms is the primary determinant of IOR. The possibility that participants might strategically attend to just one side of the screen and respond to that side if something occurs there, and to the other side if nothing occurs is unlikely, but something that cannot be excluded. Third, the percentage of valid and invalid trials was 50/50 because IOR is eliminated if the proportion of valid trials is higher than 50% (see Klein & Taylor, 1994, for review).

Method

Participants—These were 48 undergraduate students from the University of Essex campus community. Participants ranged in age from 18 to 32 years with a modal age in the 20s. Those scoring at or above a score of 40 ($n = 25$) on the STAI trait anxiety scale and those scoring at or below 35 ($n = 23$) were classified as high and low trait anxious participants respectively. Each person had normal or corrected-to-normal eyesight and participated in one experimental session as part of an undergraduate laboratory class.

Materials and procedure—The schematic “neutral”, “happy”, and “angry” faces from Experiment 1 were used (see Figure 1). The target that participants had to localise was a black circle with a diameter of 0.4 cm. Cue and target stimuli were presented inside two light grey boxes that were 5.3 cm high and 3.0 cm wide and were displayed 2.0 cm to the left and the right of the central fixation point (cross shape). These squares were continuously present on the computer screen. All stimuli were presented on a MacIntosh computer with a 28 cm colour monitor.

The procedure was the same as Experiment 1. The sequence of events within each trial differed from Experiment 1 as follows. A fixation point (X) was presented at the centre of the screen for 800 ms. A face cue was then presented in one of the peripheral boxes for 300 ms. The cue was subsequently blanked out and 200 ms later the central cross was darkened for a further 300 ms. The initial fixation display was then presented for 160 ms and then the target was presented in the lower half of either the left or the right box until the participant responded (or until 2000 ms elasped). This gave a cue-target onset asynchrony (SOA) of 960 ms. There was an intertrial interval of 1000 ms. See Figure 3 for a graphic example of a single trial.

Each participant completed 16 practice trials, followed by 360 experimental trials, divided into five blocks of 72. Of the experimental trials, 50%(180) were valid (i.e., the target appeared in the same spatial location as the cue), and 50% (180) were invalid (i.e., the target appeared in the opposite spatial location to the cue). Neutral, happy and angry face cues appeared 60 times each on valid trials and 60 times each on invalid trials. The probability of any particular cue appearing in the left- and right-handside boxes was equal. Participants were told that the position of the face did not predict the location of the target and therefore they should ignore the face and keep their eyes focused on the centre of the screen and respond as quickly and as accurately as possible.

Design—A 2 (Anxiety: high and low trait anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, happy, and angry) ANOVA factorial design was used. Trait anxiety was a between-subjects factor while Cue Validity and Cue Valence were within-subjects factors. The main prediction was a Trait Anxiety × Cue Validity × Cue Valence interaction such that IOR effects (i.e., slower RTs on valid relative to invalid trials) should be *reduced* on angry face trials compared to neutral face trials. We might also expect a reduced IOR effect on happy relative to neutral face trials given the results of Experiment 1. This reduced IOR effect on angry (and happy) face trials was expected to be particularly strong for high trait anxious participants.

Results

As shown in Table 1, the high trait anxious group scored significantly higher on the measure of state-anxiety compared to the low trait anxious group.

Incorrect responses (< 1% of trials) and RT latencies of below 150 ms or above 1200 ms were eliminated from the RT data. The mean correct RT data are shown in Figure 4. These data were subjected to a 2 (Trait Anxiety: high and low trait-anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, happy, angry) ANOVA with participants as a random factor. There were main effects for Trait Anxiety, $F(1, 46) = 4.35$, $MS_e = 12{,}536.7$, $p < .042$, and for Cue Validity, $F(1, 46) = 51.9$, $MS_e = 179.6$, $p < .001$. There was a significant Cue Validity × Cue Valence interaction, *Pillais* $F(2, 45) = 3.94$, $p < .027$, while the Trait Anxiety × Cue Validity × Cue Valence interaction did not reach significance, *Pillais* $F(2, 45) = 1.28$, $p < .288$.

Further analysis for all participants (high and low trait anxious combined) revealed that a significant IOR effect occurred for both Happy, mean = −19 ms; CI = −10.2 to −27.2: $t(47) = 4.43$, $p < .001$, and Neutral, mean = −14 ms; CI = −9.6 to −17.7:$t(47) = 6.76$, $p < .001$, but not for Angry, mean = −2 ms; CI = −5.2 to 9.5: $t(47) < 1$ face cues. Likewise, the IOR effects with Happy and Neutral face cues did not differ from each other $t(47) = 1.29$, while both Happy, $t(47) = 2.32$, $p < .025$, and Neutral, $t(47) = 2.83$, $p < .007$ face cues produced a greater magnitude of IOR than Angry face cues.

Discussion

As predicted, the magnitude of IOR was significantly less when angry facial expressions were used as cues, relative to either happy or neutral facial expressions. This supports our assumption that attentional dwell-time increases when an angry face is presented and that this disrupts the IOR effect. There was a hint in the data that the pattern was more pronounced for the high, relative to the low trait anxious group (see Figure 4), but this was not supported by the statistical analysis. Instead, a general effect was observed such that all participants tended to take longer to disengage attention from an angry facial expression, compared to either a happy or a neutral facial expression. As noted previously, however, this paradigm might miss differences in disengagement between high and low trait anxious groups. For example, imagine that low anxious participants take about 300 ms to disengage from an initial threat stimulus while high anxious participants take about 600 ms to disengage from the same stimulus. This pattern would be consistent with the theoretical hypothesis but would not be reflected in any IOR differences with an SOA of 960 ms. Our ongoing research will examine the time scale of disengagement processes and the magnitude of the IOR effect with different SOAs in more detail. For the moment, the novelty of the current results is the first demonstration that the valence of a cue can influence the magnitude of IOR.

The results of the experiment support the suggestion that the disruption to the IOR mechanism is specific to *angry* facial expressions, and was not found with happy facial expressions. These results are important in showing that the valence of a cue can disrupt the IOR effect. It is worth noting that these results with a sample of nonbrain damaged young adults are conceptually similar to the finding that people with right parietal damage do not extinguish emotional faces (angry or happy) as efficiently as neutral faces (Veuilleumier & Schwartz, 2001). As a general point, therefore, it seems that the valence or meaning of a stimulus can disrupt IOR. We discuss this further in the General Discussion.

EXPERIMENT 3

Experiment 2 supported the hypothesis that angry facial expressions might disrupt the IOR effect. However, the results of Experiment 2 showed that any differences between high and low trait anxious people in terms of how disruptive the angry facial expression was to the IOR effect did not reach statistical significance. One possibility is that all individuals are equally affected in paradigms of this type by a potentially threatening stimulus. It makes adaptive sense not to inhibit returning attention to the location of potential threat. Alternatively, there may have been differences that were not detected by this task because the SOA was not appropriate. Finally, it is also possible that the high trait anxious participants in our study did not differ from low anxious people on the IOR task because they did not have elevated levels of state anxiety. Previous research has shown that attentional effects are often determined by a complex interaction between levels of trait and state anxiety (e.g., MacLeod & Mathews, 1988; Mogg et al., 1994). Moreover, our previous research on attentional disengagement found that state anxiety was a stronger determinant of delayed disengagement than trait anxiety (Fox et al., in press). Therefore, we hypothesised that we might find differences in attentional disengagement between high and low trait anxious participants if levels of state anxiety were elevated above baseline. To this aim, we introduced a simple mood induction procedure in Experiment 3 in an attempt to elevate state anxiety above baseline levels. Once again, the IOR paradigm was presented to high and low trait anxious participants, but this time following a task requiring participants to rate distressing photographs for threat value. Previous research in our laboratory has shown that this procedure is often successful in increasing the level of self-reported state anxiety. As before, we predict a Trait Anxiety × Cue Validity × Cue Valence interaction such that high trait anxious people will show reduced IOR for angry face cues, relative to neutral face cues. In this experiment we included the angry and neutral facial expressions from the previous experiments as well as a jumbled face. The jumbled face consisted of the features of the angry face (see Figure 1) and was included because pilot work with low trait anxious participants has shown that we get standard IOR effects with jumbled face stimuli. Moreover, if we get a different pattern of results with the normal angry and the jumbled angry face we can rule out the possibility that some low-level visual feature of the face was producing the results, rather than the emotional expression of the face (see Fox et al., 2000, for further discussion). In contrast, if we find a similar pattern of results with the normal and the jumbled angry faces we can conclude that a particular feature of the face is producing the results rather than the holistic facial expression.

Method

Participants—These were 80 undergraduate students from the University of Essex or the University of Padua campus communities. Participants ranged in age from 18 to 40 years with a modal age in the 20s. Those scoring at or above a score of 40 ($n = 43$) on the STAI trait anxiety scale and those scoring at or below 35 ($n = 37$) were classified as high and low trait anxious participants respectively. Each person had normal or corrected-to-normal eyesight and participated in one experimental session lasting about 45 minutes for which they received payment of £4.00, or course credits.

Materials and procedure—The schematic “angry” and “neutral” faces from Experiment 1 were used in addition to a jumbled face (see Figure 1). The target, which participants had to localise was a white circle with a diameter of 0.3 cm. Cue and target stimuli were presented inside two dark grey boxes that were 5.3 cm high and 3.0 cm wide, and were displayed 2.0 cm to the left and the right of the central fixation point (cross shape). These boxes were continuously present on the computer screen. All stimuli were presented on a Pentium P5/120 PC with a 28 cm colour monitor and ATI Mach64 graphics card. All stimulus presentation and data collection was controlled by MEL software Version 2 (Schneider, 1988).

Early in the academic year, participants completed the STAI: trait and state (baseline) anxiety scales in a group testing session. On arrival at the laboratory, each participant was shown 10 colour photographs taken from magazine articles showing scenes from war zones (e.g., victims of war, mutilated bodies, etc.). They were told this was part of a separate study and asked to rate each photograph on a 7-point scale from “pleasant” to “extremely threatening”. Participants did not spend more than about 2 minutes on any of the photographs. The aim of this simple mood induction procedure was to attempt to elevate state anxiety levels above baseline. Each participant then completed the STAI state anxiety scale, which gave a measure of state anxiety at test. On completion of the state anxiety questionnaire, participants were asked to move to a computer in the same room for the reaction time experiment, where they were seated about 50 cm from the computer monitor. The task was identical to Experiment 2 except that a jumbled face was presented instead of the happy face.

Design—A 2 (Trait Anxiety: high and low trait anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, angry, and jumbled) ANOVA factorial design was used. Trait anxiety was a between-subjects factor while Cue Validity and Cue Valence were within-subjects factors. The main prediction was a Trait Anxiety × Cue Validity × Cue Valence interaction such that IOR effects (i.e., slower RTs on valid relative to invalid trials) were expected to be *reduced* on angry face trials compared to either neutral or jumbled face trials. This reduced IOR effect on angry face trials was expected to be particularly strong for high trait anxious participants.

Results

As shown in Table 1, the high trait anxious group scored significantly higher on measures of state anxiety compared to the low trait anxious group. A 2 (Anxiety: high and low trait anxiety) × 2 (Time of Testing: state anxiety at baseline and test) ANOVA revealed main effects for Trait Anxiety group, $F(1, 78) = 63.8$, $MS_e = 72.9$, $p < .001$, and for Time of Testing, $F(1, 78) = 21.4$, $MS_e = 36.6$, $p < .001$. There was also a Trait Anxiety × Time of Testing interaction, $F(1, 78) = 15.1$, $MS_e = 36.6$, $p < .001$. Further analysis showed that state anxiety increased from baseline to test for the high trait anxious group, $t(42) = 5.02$, $p < .001$, but not for the low trait anxious group, $t(36) < 1$.

Incorrect responses (< 1% of trials) and RT latencies of below 150 ms or above 1200 ms were eliminated from the data. The mean correct RT data are shown in Figure 5. These data were subjected to a 2 (Trait Anxiety: high and low trait-anxiety) × 2 (Cue Validity: valid and invalid) × 3 (Cue Valence: neutral, happy, angry) ANOVA with participants as a random factor. There was a main effect for Cue Validity, $F(1, 78) = 16.8$, $MS_e = 739.3$, $p < .001$, showing an IOR effect. Of greater theoretical importance, however, the predicted Trait Anxiety × Cue Validity × Cue Valence interaction was significant, $F(2, 156) = 6.78$, $p < .002$. In order to break down this three-way interaction we examined the data for high and low anxious groups separately.

High trait anxiety—A 2 (Cue Validity) × 3 (Cue Valence) ANOVA revealed the predicted interaction, $F(2, 84) = 8.13$, $p < .001$. Further analysis revealed that the IOR effect was significant for neutral face cues, mean = −19 ms; CI = −28.1 to −10.1: $t(42) = 4.3$, $p < .001$, but not for either angry, mean = +3.4 ms; CI = −8.1 to 14.9: $t(42) < 1$, or jumbled (mean = −0.71; CI = −8.9 to 10.3: $t(42) < 1$ face cues. Planned comparisons revealed that the IOR effect with angry faces (+3.3 ms) was smaller than that observed for neutral faces, −19 ms: $t(42) = 3.6$, $p < .001$, but was comparable to that observed for jumbled faces, +0.71 ms: $t(42) < 1$. The IOR observed for neutral faces was larger than that found for jumbled face cues, $t(42) = 3.17$, $p < .003$.

Low trait anxiety—A 2 (Cue Validity) × 3 (Cue Valence) ANOVA revealed a main effect for Cue Validity, $F(1, 36) = 19.9$, $MS_e = 658.6$, $p < .001$, showing a reliable IOR effect. There was no main effect for Cue Valence and no Cue Validity × Cue Valence interaction. The means and CI for IOR effects were −12.5 ms and −21.5 to −3.6 for the neutral faces, −21.8 ms and −33.3 to −10.2 for the angry faces, and −11.9 ms and −21.3 to −2.6 for the jumbled faces.

Discussion

The first point to note is that the mood induction procedure was only effective for the high trait anxious participants. Moreover, the level of state anxiety at test in this experiment was very similar to the state anxiety levels at test in Experiment 2. Thus, we cannot assume that the level of state anxiety was elevated to a greater extent in Experiment 3 compared to Experiment 2. However, the predictions of this study were partially confirmed. First, an overall IOR effect was observed, and the trait anxiety level of the participant, as well as the valence of the cue influenced the magnitude of IOR. However, the precise pattern of results was not exactly as predicted. For high trait anxious participants, reliable IOR was found for neutral face cues, but not for either angry *or* jumbled face cues. We expected to find reduced IOR for the angry face cues while IOR was expected to be normal for the jumbled face cues. One possibility is that because the jumbled face comprised the jumbled features of an *angry* face, perhaps one or more of the features (e.g., eyebrows) of the angry face was a fundamental threat signal which led subsequently to delayed disengagement. There is some evidence for this speculation from research showing that downward turned eyebrows, as used here, are important determinants of the threat value of schematic faces (Aronoff, Woike, & Hyman, 1992; Lundqvist, Esteves, & Öhman, 1999). Thus, it might have been the case that the high trait anxious people delayed disengaging from the eyebrow stimuli even when they were embedded in a jumbled face. In a partial attempt to confirm this, we asked

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12 adults from the campus community to rate the angry, neutral, and jumbled angry faces on a 1–7 scale (1 = very positive, 7 = very threatening). The stimuli were presented on pages in a random order and were embedded among "happy" and jumbled "happy" and "neutral" schematic face stimuli. The results showed a significant difference in the threat ratings for the stimuli used in this experiment (angry, neutral, jumbled angry), $F(2, 22) = 48.6$, $MS_e = 0.76$, $p < .001$. Follow-up *t*-tests (2-tailed) revealed that the "angry" face was rated as more threatening (mean = 6.4) than the "neutral" face, mean = 3.1; $t(11) = 9.4$, $p < .001$, but did not differ significantly from the jumbled angry face, mean = 5.7; $t(11) = 2.0$, $p < .07$). The "jumbled angry" face was rated as significantly more threatening than the neutral "face", 5.7 vs. 3.1; $t(11) = 7.7$, $p < .001$. Thus, the rating data give some weight to the notion that the jumbled face may have been perceived as a threatening stimulus in this experiment, and that this is why the magnitude of IOR to these stimuli was not significant for high trait anxious individuals. An alternative possibility is that it was not the threat value of the jumbled face that was important, but rather, its ambiguity. As can be seen in Figure 1, the jumbled cue is face-like but it's expression is ambiguous. Thus, it may have been the emotional ambiguity of the jumbled face that was important in driving the results than the threat value *per se*. It is therefore possible that the reduced IOR effect with jumbled faces reflects a more general emotionality effect, rather than a threat-specific effect.

The results for the low trait anxious participants were as expected. This group showed a strong IOR effect and this did not differ across the three types of cue (angry, neutral, and jumbled). Thus, the results of this experiment provide some support for the notion that high trait anxious participants, under conditions of elevated state anxiety, take longer to disengage from threat-related and emotionally ambiguous facial stimuli. This was reflected in a reduced IOR effect following angry (and jumbled angry) face cues relative to neutral face cues.

GENERAL DISCUSSION

Although it is well established that visual attention is automatically captured by the sudden onset of a new perceptual object (Yantis, 1996), the novelty of the present study is that we manipulated the *valence* of a briefly presented object. Following Fox et al. (in press), this was achieved by using schematic faces with angry, neutral or happy expressions as the *cue* in Posner's (1980) cueing paradigm. The logic was as follows: If angry faces are particularly effective in holding visual attention (i.e., increasing dwell-time), then (i) response times should *increase* on invalid trials following threat cues when the SOA is short, and (ii) when the SOA is long, the magnitude of the IOR effect should be *reduced* on trials with threat-related cues. The hypothesis that angry facial expressions would lead to enhanced dwell-time (delayed disengagement), especially in high trait-anxious individuals, was partially supported in these studies.

First, in Experiment 1 with a short SOA, we did find that the valence of the cue affected the cue validity effect only for high trait anxious individuals. However, the pattern of results was not exactly as predicted. The results showed that the high trait anxious people took longer to disengage from angry *and* happy facial expressions, relative to neutral expressions as reflected by increased response times on invalid trials. Response times on invalid trials were equivalent across the different cue types for the low trait anxious participants. Thus, the presence of an emotionally valenced face (positive or negative) resulted in delayed disengagement in high, but not in low, trait anxious people.

In Experiment 2, the SOA was increased to assess whether the magnitude of IOR would be reduced with angry face cues, relative to happy or neutral face cues in high trait anxious people. However, the results did not confirm an anxiety-linked disruption of the IOR effect with angry facial expressions as cues. Instead, it was found that *all* participants showed a reduced IOR effect with angry facial expressions as cues, relative to either happy or neutral facial expressions. The results of this experiment support the notion that there is something special about *angry* faces, and that, contrary to the findings of Experiment 1, attentive resources are not necessarily disrupted by faces expressing positive as well as threatening emotions. It seems likely that evolution would have favoured the capacity to efficiently process and respond to threat signals (e.g., an angry face) in the visual environment. In line with this, Öhman and Soares (1993) found that fear-relevant stimuli, such as snakes and angry faces, were special in that they were processed at a pre-attentive level with no apparent need for conscious representation before a phobic response could be elicited. This result is also consistent with evidence that negative social information is more "attention grabbing" than positive social information (Pratto & John, 1991).

In Experiment 3, an interaction was found between IOR and trait anxiety such that high trait anxious people showed reduced IOR to angry and jumbled face cues, relative to neutral face cues. Low trait anxious people showed an equivalent amount of IOR across the three cue types. In retrospect, we realised that constructing the jumbled face from the features of an angry face was unwise. It is possible that a key feature of the angry face, such as the down-turned eyebrows, might have led to the disruption of the IOR effect. For example, it has been found that these features are especially important in determining the threat value of a face (Lundqvist et al., 1999). A *post-hoc* rating of the stimuli used in Experiment 3 supported this notion in showing that the jumbled face was rated as more threatening than the neutral face, and the rating was almost as high as the "angry" face. However, as noted previously the emotional ambiguity of the face might have been confusing and the ambiguity might be more important that the threat value of the jumbled face in affecting IOR. Thus, the results of this experiment support the general hypothesis that the presence of threat or ambiguous cues can disrupt the IOR effect in people with high levels of trait anxiety. We argue that this result provides converging evidence for the hypothesis that threatening stimuli lead to delayed disengagement of visual attention in anxious people (Fox et al., in press; Yiend & Mathews, in press). Moreover, the results suggest that emotionally ambiguous stimuli might also delay disengagement processes in high trait anxious people.

These results add tentatively to the growing evidence that people (especially when they are anxious) take longer to disengage from threat-related stimuli such as angry facial expressions (Fox et al., in press) and threatening pictures (Yiend & Mathews, in press). These results are similar to our earlier findings with angry faces, although in that study (Fox et al., in press) we found that the difficulty in disengaging from threatening facial expressions was related to levels of state anxiety and not so strongly to levels of trait anxiety. The question of whether trait or state anxiety is the main determinant of attentional biases towards threat is complex. Some studies find that trait anxiety is a stronger predictor, some that state anxiety is a stronger predictor, and some that the appearance of attentional bias only occurs in high trait anxious individuals when they are experiencing an elevation in state anxiety (e.g., MacLeod & Mathews, 1988; Mogg et al., 1994). For example, MacLeod and Mathews (1988) found that high trait anxious people only showed evidence for attentional bias toward threat words when they were tested prior to end of year examinations and their state anxiety levels were elevated. Even though the state anxiety levels of the low trait anxious participants was also elevated this group did not show any bias towards threat. Thus, an interaction between trait and state anxiety seems important. In our future research, we intend to test participants in both low and high stress periods to investigate the relations between state and trait anxiety and performance on IOR tasks more directly.

It is worth noting at this point that the results observed in our IOR experiments (Experiments 2 and 3) appear to support an attentional account of IOR and not a motor account. As noted

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in the introduction, the attentional account (e.g., Posner & Cohen, 1984) explains IOR as a reflection of attention being inhibited from returning to a previously attended location. However, Klein and Taylor (1994) have proposed a motor account of IOR which suggests that IOR is a bias against responding to an event that occurs in a location to which a response has previously been prepared. The finding, for example, that IOR only occurs with central cues (e.g., an arrow pointing left or right) if participants were instructed to prepare an eye movement to the cued location supports an non-attentional account of IOR (Rafal, Calabresi, Brennan, & Sciolto, 1989). If IOR is an attentional effect, then it should not matter how attention was allocated to a location. More recent research, however, has supported an attentional account in showing that IOR occurs regardless of whether the response was location or identity-based (Pratt, Kingstone, & Khoe, 1997). For example, Pratt et al. (1997) found IOR even when the spatial mapping between the cue stimulus and the response was orthogonal. This result is inconsistent with a motor account of IOR. Although space does not permit a detailed overview of attentional and motor-based theories of IOR here, we note that the current results would seem to support an attentional account. Even though our paradigm had a strong spatial component (participants responded to the *location* of a target), the fact that the *valence* of the cue influenced the magnitude of IOR suggests that attentional factors are important. Presumably participants prepared a motor response on every trial, but it was only when the cue was threat-related that the IOR was disrupted. In summary, the present results demonstrate for the first time that the valence of a cue can influence the magnitude of the IOR effect. Second, we have shown that individuals with high levels of self-reported trait anxiety are especially sensitive to the valence of a cue in these attentional paradigms. Taken together, these results provide converging evidence that high levels of trait (and state) anxiety may increase attentional dwell-time and disengagement of attention from threat-related stimuli. Our current research is concerned with investigating the time course of this phenomenon.

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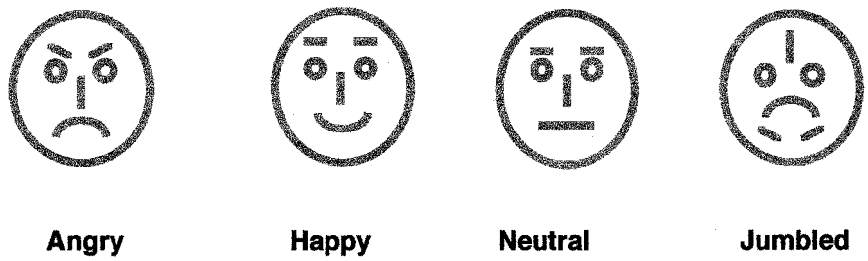

Figure 1.
Example of schematic faces used in Experiments 1, 2, and 3. The jumbled face consisted of features of the “angry” face and was used in Experiment 3.

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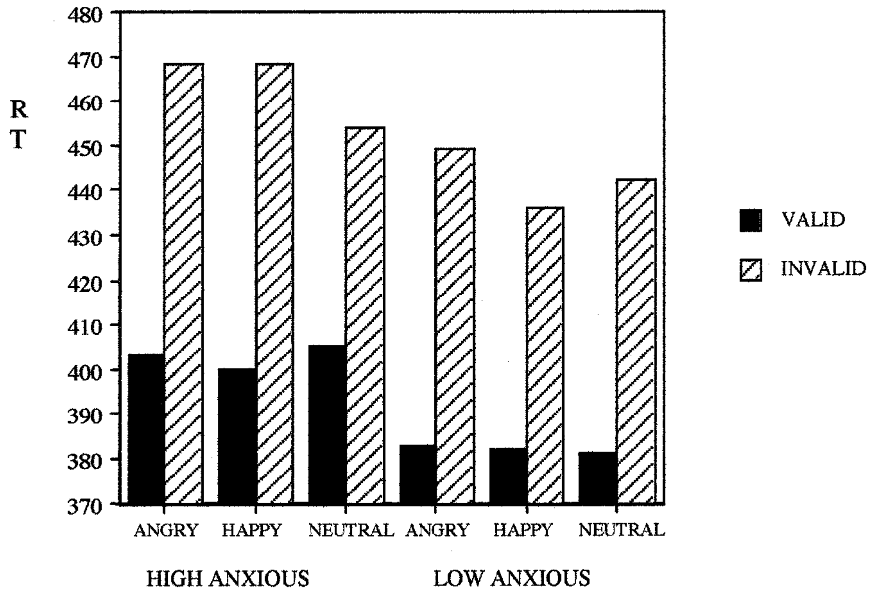

Figure 2.
Mean reaction times ini ms (RT) for high and low trait anxious people as a function of cue validity and cue valence in Experiment 1.

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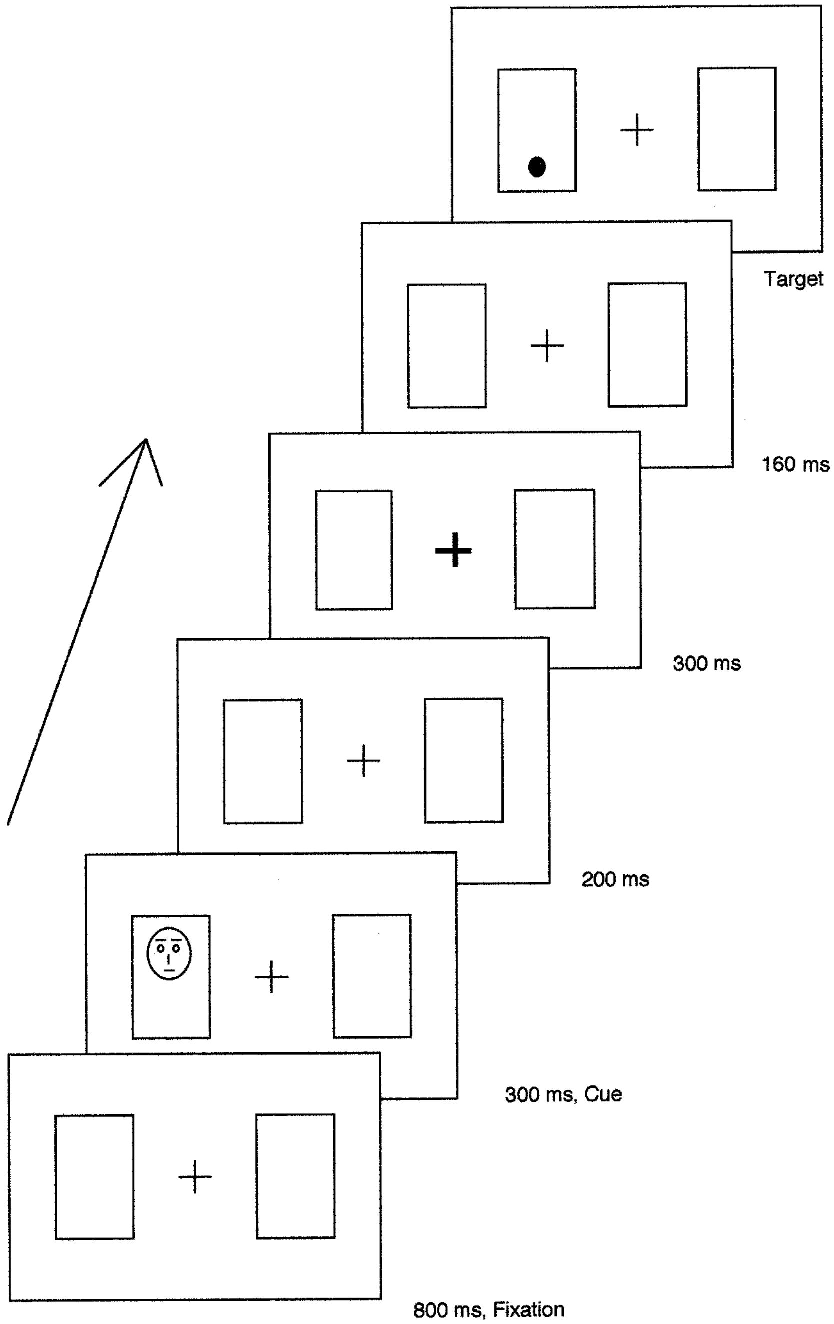

Figure 3.
Diagram of a valid trial in the IOR paradigm used in Experiment 2 and 3.

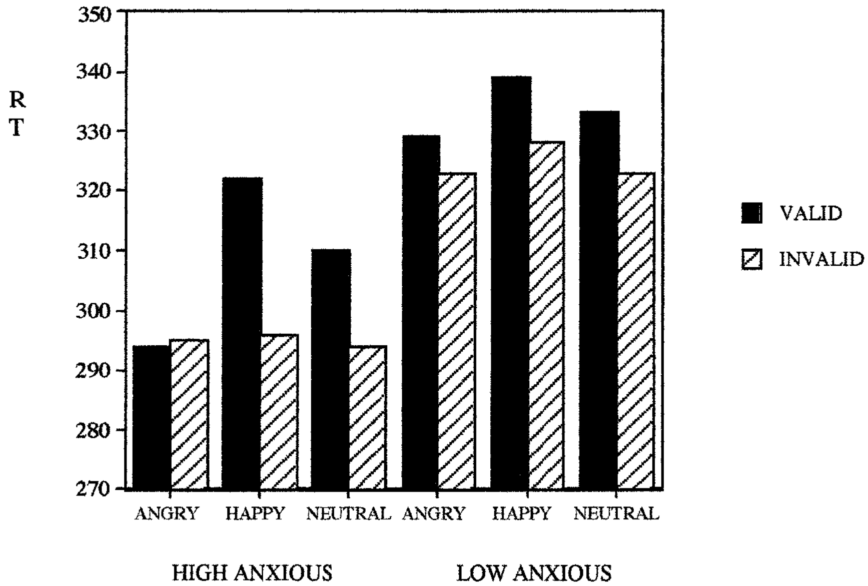

Figure 4.
Mean reaction times in ms (RT) for high and low trait anxious people as a function of cue validity and cue valence in Experiment 2.

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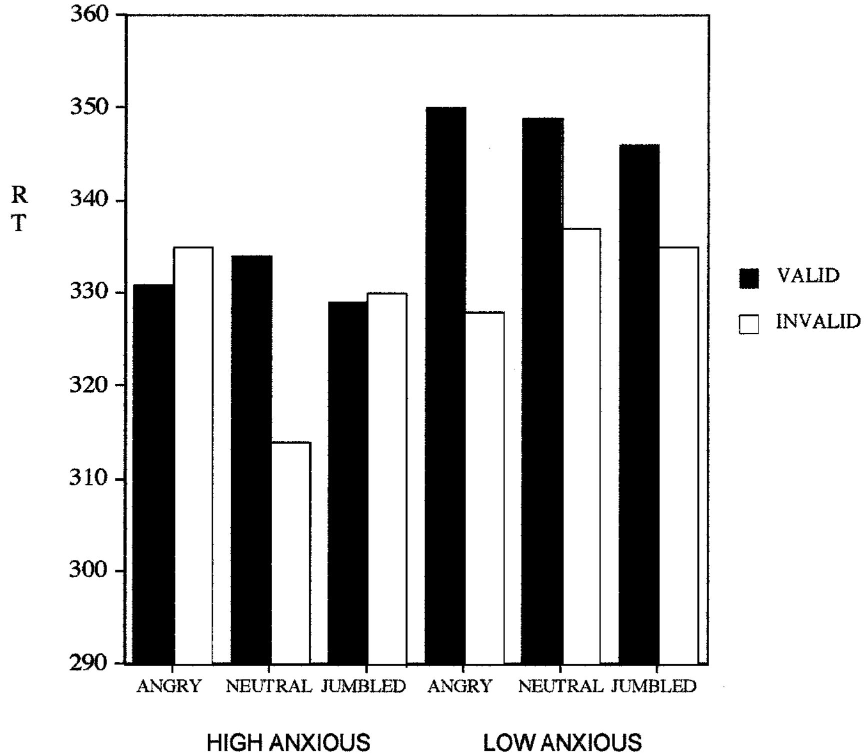

Figure 5.
Mean reaction times in ms (RT) for high and low trait anxious people as a function of cue validity and cue valence in Experiment 3.

TABLE 1

Mean trait and state anxiety scores at baseline (B) and at testing (T), with (standard deviations), for high and low trait anxious participants in each of the three experiments

	High anxious	***Low anxious***	***t***
Experiment 1			
n	21	13	
Trait anxiety	47 (5)	29 (4)	
State anxiety (B)	39 (10)	28 (9)	3.2**
State anxiety (T)	41 (12)	31 (10)	2.6*
Experiment 2			
n	25	23	
Trait anxiety	50 (6)	31 (4)	
State anxiety (T)	45 (10)	27 (4)	7.8***
Experiment 3			
n	43	37	
Trait anxiety	52 (8)	29 (4)	
State anxiety (B)	39 (10)	32 (5)	3.9***
State anxiety (T)	47 (8)	33 (4)	9.7***

* $p < .05$;

** $p < .01$;

*** $p < .001$.