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Keeping Your Eyes on the Prize:

Anger and Visual Attention to Threats and Rewards

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Abstract

Emotional states influence what we attend to in our environment. For instance, fear focuses attention on threats, whereas excitement may focus attention on rewards. The present study examined whether and how anger influences overt visual attention to threats and rewards. Anger is an unpleasant emotion associated with approach motivation. If the effects of emotions on visual attention depend on valence, anger should focus attention on threats. If, however, effects of emotions on visual attention depend on motivation, anger should focus attention on rewards. Using an eye-tracker, we examined the effects of anger, fear, excitement, and a neutral emotional state on overt visual attention to threatening, rewarding, and control images. We found that anger promoted visual attention to rewarding, but not threatening, information. Such findings demonstrate that anger increases attention to potential rewards and suggest that the effects of emotions on visual attention are motivationally-driven.

Keywords: Emotions, Visual Attention, Motivation, Rewards, Threat

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Emotions signal to us what is important in our environment. They influence how we think and act, in part, by influencing how we view the world around us. Given the multitude of stimuli in our environment, the ability to selectively attend to important and relevant information is crucial for survival (Van der Heijden, 1992). Attention, therefore, serves as the essential agent that ties cognition to emotion and motivation (Simon, 1994). There is substantial evidence for the link between emotion and visual attention (for reviews, see Mathews & MacLeod, 1994; Matthews, 1997; Williams, Watts, MacLeod & Mathews, 1997). However, the general mechanism that links emotion to visual attention has remained somewhat elusive. This investigation uncovers important aspects of this mechanism by testing the effects of anger on visual attention to threats and rewards.

Effects of Emotions on Visual Attention

Research on emotion and visual attention has focused on negative high arousal emotions, such as fear and anxiety, and visual attention to threatening information (see Williams et al, 1997). The most consistent finding is that anxious individuals selectively attend to threats, compared to non-threats (e.g., MacLeod, 1999; Mathews & MacLeod, 1985; Mogg, Mathews, Bird, & McGregor, 1990). Some studies also examined the link between positive high arousal emotions, such as excitement and happiness, on visual attention to rewarding information. Specifically, there is evidence to suggest that happy or excited individuals selectively attend to rewards, compared to non-rewards (Tamir & Robinson, 2007).

At least two different accounts can explain such findings. Based on two-dimensional frameworks of affect (e.g., Lang, Bradley & Cuthbert, 2008; Tellegen, 1985), emotions can be

located along the dimensions of valence (i.e., positive vs. negative) and engagement (i.e., high vs. low) (e.g., Mogg & Bradley, 1998). According to a valence-based account, emotional states that reflect increased engagement (i.e., high in arousal) bias visual attention by prioritizing the processing of information that is consistent with the valence of the emotional state. Anxiety, for example, is associated with increased engagement and is negatively valenced. Therefore, anxiety should increase attention to threatening information. Similarly, one might expect excitement to increase attention to rewarding information, as it is also associated with increased engagement, though is positively valenced.

Emotions, however, can also be mapped on to the two basic motivational systems of approach and avoidance. Emotions such as anxiety and fear reflect an active avoidance system, whereas emotions such as excitement and happiness reflect an active approach system (Cacioppo et al., 1999; Watson et al., 1999; Carver, 2001; Carver & Scheier, 1998). According to a motivation-based account, emotional states that reflect an active motivational system should bias visual attention by prioritizing the processing of motivationally-relevant information (Van der Heijden, 1992). Anxiety, for example, should increase attention to threatening information because it is associated with an active avoidance system. Similarly, one might expect excitement to increase attention to rewarding information, as it is associated with an active approach system.

The predictions of the valence- and motivation-based accounts are identical regarding fear and excitement, because in the case of these emotions, there is no direct way of distinguishing between the effects of valence and motivation. The available evidence, therefore, is consistent with the predictions of *both* accounts and does not allow us to differentiate between them. In order to test whether the influence of emotional states on visual attention is valence- or

motivation-based, it is necessary to examine visual attention in the context of emotional states in which valence- and motivation-based predictions do not overlap.

Testing the Effects of Anger on Visual Attention

Like fear and anxiety, anger is a negatively valenced emotion that is high in arousal. Unlike fear and anxiety, however, anger reflects an active approach motivational system (Carver & Harmon-Jones, 2009). According to a valence-based account, anger should increase attention to threats, as it is a negatively valenced emotion also associated with increased engagement with the environment. In contrast, according to a motivation-based account, anger should increase attention to rewards, as it reflects an active approach system. The current investigation was designed to test these alternative predictions by uniquely examining the potential effects of anger on visual attention.

Prior research has linked trait anger to selective attention to hostile information (e.g., Putman, Hermans, & van Honk, 2004; van Honk, Tuiten, de Haan, van den Hout, & Stam, 2001; Wilkowski, Robinson, Gordon, & Troop-Gordon, 2007). Such work, however, did not address the potential effects of anger on selective attention to threats and rewards, broadly construed. First, no research to date has examined the link between anger and selective attention to rewards. Second, prior research examined links between anger and hostile information, in particular, rather than threatening information, more generally. Third, most of the available research examined trait anger, rather than state anger. Trait and state anger are conceptually distinct and may be differentially linked to cognitive processing (see Wilkowski & Robinson, 2008). The current investigation, therefore, goes beyond the available research by testing the effects of state anger on selective attention to threats and rewards.

In the current investigation, we tested the effects of anger, fear, excitement, and a neutral emotional state on overt visual attention to threatening, rewarding, and control (i.e. neither threatening nor rewarding) information. To do so, after participants underwent an emotion induction, we measured their eye gaze to pairs of images. We expected participants in the fear condition to show increased attention to threats and participants in the excitement condition to show increased attention to rewards. Most importantly, we expected participants in the anger condition to show increased attention to either threats or rewards, depending on whether the effects of emotions on visual attention depend on valence or motivation, respectively.

Method

Participants

Sixty-four male undergraduate students (M_{age} = 19.81 years, SD_{age} = 1.41) participated for monetary compensation.

Materials and Procedure

Participants were randomly assigned to one of four emotion induction conditions: anger, fear, excitement, or neutral. They were told the study involved the effects of music and memory on visual attention and that they would recall a memory and listen to music before completing a visual attention task.

Participants then completed an eye tracker calibration session. Eye tracking was performed using a SensoMotoric Instruments iView X^{TM} Hi-Speed system, using monocular tracking at 1250Hz (< 0.01° tracking resolution, and 0.25° - 0.50° gaze position accuracy). We performed a 9-point calibration using the integrated automatic calibration package included with the system, and repeated it until the average error between all points fell below 0.5°. All participants had an approximate viewing distance of 80 cm.

After the eye-tracking calibration, emotional states were induced using a combination of autobiographical recall and emotion-eliciting music (e.g., Bradley, Mogg, & Lee, 1997). First, participants wrote about an emotional event from their past in which they were either angry (anger condition), anxious and afraid (fear condition), excited and happy (excitement condition), or felt little of any emotion (neutral condition). All participants were instructed to relive the event in their mind's eye as they wrote about it for a total of 15 minutes.

Participants then listened to instrumental music corresponding to their emotional state condition for 5 minutes. Participants in the anger condition listened to angry music (e.g., *Refuse/Resist* by *Apocalyptica*); participants in the fear condition listened to fearful music (e.g., *The Bone Dam* from the soundtrack of *The Descent*); participants in the exciting condition listened to exciting music (e.g., *Savor* by Carlos Santana); finally, participants in the neutral condition listened to neutral music (e.g., *Indecision* by Yo Yo Ma). Music was selected based on pilot testing which confirmed that the angry music induced more anger than the exciting, fearful and neutral music (*M*s = 3.00, 0.12, 2.13, and 0.17, respectively), $t(106)$s > 2.10, p_{rep}s > 0.95, ds > 0.41, the exciting music induced more excitement than the angry, fearful and neutral music (*M*s = 3.67, 2.20, 2.40, and 2.60, respectively), $t(106)$s > 2.73, p_{rep}s > 0.96, ds > 0.66, and the fearful music induced more fear than the angry, exciting or neutral music (*M*s = 4.16, 2.47, 0.60, and 0.71, respectively), $t(106)$s > 3.48, p_{rep}s > 0.99, ds > 0.78.

Participants then began the eye-tracking phase of the study. During this phase, all participants were instructed to carefully study an image pair presented on the screen. Each participant viewed 27 image pairs, which were presented on a 19" computer monitor (1280 x 1024 resolution) for 2 seconds.

Fifty-four images were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008), with 18 for each of the three image categories: rewarding (e.g. erotic couples, rushing waterfalls), threatening (e.g. people yielding weapons, mutilated bodies), and control (e.g. jet planes). Images in the three categories were identical in arousal (*M*s = 6.38). Valence ratings varied significantly and in the expected direction across the three categories (*M*s = 7.40, 2.64, and 4.86, in the rewarding, threatening, and control categories, respectively), $F(2, 53) = 381.9$, $p_{rep} > .99$ $\eta^2 = .94$. To ensure the three image categories did not differ in visual complexity, participants in a pilot study ($N = 12$) rated each image on complexity (1= very low; 5 = very high; Brunyé, Mahoney, Augustyn, & Taylor, 2009). A repeated-measures ANOVA confirmed that the image categories did not significantly differ from each other in visual complexity, (*M*s = 3.17, 3.18, and 3.12 in the rewarding, threatening, and control categories, respectively), $F(2, 22) = .06$, $p_{rep} = .13$, $\eta^2 = .005$.

Images were sized to 600x450 pixels. We created four sets of 27 image pairs consisting of combinations of rewarding, threatening and control images. We included all nine pairwise combinations of rewarding, threatening, and control images and presented three image pairs for each combination. Image pairs were created by horizontally aligning and separating two images by a 25 pixel gap. We used random selection processes to produce two sets of image pairs and created the other two sets by rotating the selected images in the first two sets from the left to the right position and vice versa.

To ensure participants were motivated to equally attend to both images in the pair, they were told that after viewing each set of images, they would have to answer a question about the visual details in one of the two images, without knowing in advance which image that would be. Questions were specific to each image pair and referred to inanimate and mundane objects that

appeared in the image (e.g., "*Did you see a key?*", *"Did you see a tree?"*). Approximately half of the questions featured an item that appeared in the image and half did not. To prevent spatial viewing preferences, half of the questions to be answered in the affirmative referred to an object in the left image, and half to an object in the right image. Questions were presented immediately after the image pair and were centered on the monitor. Participants were instructed to respond by directing their gaze to the word YES or NO displayed on the monitor above and below the question, respectively. Participants were given 4 seconds until the question disappeared, then a central fixation cross appeared for 1 second and the next trial began (see Figure 1). Each trial took 7 seconds, for a total of 3 minutes and 9 seconds of eye tracking.

Finally, to evaluate the effectiveness of the emotion inductions, participants rated their current feelings on a scale of 0 (= not at all) to 8 (= extremely). To assess feelings of anger, we averaged across ratings of *frustrated, irritated, annoyed,* and *angry* (α = .87). To assess feelings of fear, we averaged across ratings of *nervous, scared, afraid* and *worried* (α = .88). To assess feelings of excitement, we averaged across ratings of *excited*, *enthusiastic, cheerful,* and *joyful* (α = .75).

Results

Manipulation Check

As expected, the induction technique successfully induced the intended emotional states (means appear in Table 1). Independent sample *t*-tests confirmed that ratings of anger were highest in the anger condition, $t(30)$s > 3.61, p_{rep}s > .98, ds > 1.28, ratings of fear were highest in the fear condition, $t(30)$s > 2.80, p_{rep}s > .95, ds > .99, and ratings of excitement were highest in the excitement condition, $t(30)$s > 2.79, p_{rep}s > .95, ds > .99. Also, within the anger condition, anger was experienced more intensely than other emotions, $t(15)$s > 4.13, p_{rep}s > .99, ds > 1.03,

in the fear condition, fear was experienced more intensely than other emotions, $t(15)$s > 1.31, p_{rep}s > .72, ds > .33, and in the excitement condition, excitement was experienced more intensely than other emotions, $t(15)$s > 6.67, p_{rep}s > .99, ds > 1.67.

Effects on Visual Attention

Eye gaze data were assessed by examining average fixation durations, which are composite measures of overt visual attention derived by dividing total fixation duration by the number of fixations in a particular region of interest (ROI). This measure is one of the most common and widely accepted measures of gaze behavior during scene perception, as it takes into account both duration and frequency of fixations (Henderson & Hollingsworth, 1998). The minimum amount of time to qualify as a fixation was 80msec (see Inhoff & Radach, 1998).

For each image pair we created two rectangular ROIs, one for each image. Eye gaze data were collapsed across left and right counterbalanced image positions. This process created six image pairings of interest: Rewarding-Rewarding, Rewarding-Control, Rewarding-Threatening, Threatening-Threatening, Threatening-Control, and Control-Control. For each of these pairs, we calculated difference scores to assess the relative average fixation duration on each image type within the pair. These difference scores allowed us to assess relative overt visual attention (as inferred via eye gaze) for each image type.

As expected, when all difference scores were entered as levels of a dependent measure in a repeated measures ANOVA, with Emotion Condition (anger, fear, excitement, neutral) as a between subjects factor, we found a significant Attention x Emotion Condition interaction, $F(6, 104) = 5.77$, $p_{rep} = .97$, $\eta^2 = .24$. We then examined the main difference scores of interest by conducting six one-way ANOVAs, with Emotion Condition (anger, fear, excitement, neutral) as the independent variable and one of each of the fixation difference scores as the dependent

variable. We expected all three different-category scores (e.g. Threatening-Control, Rewarding-Control, and Rewarding-Threatening) to differ significantly as a function of Emotion Condition.

First, we tested whether Emotion Condition influenced visual attention to threatening (vs. control) images. As expected, there was a significant effect of Emotion Condition on the Threatening-Control difference scores, $F(3, 62) = 3.19$, $p_{rep} = .95$, $\eta^2 = .14$. Consistent with prior research, relative to the neutral condition, those in the fear condition showed higher average fixation durations to threatening relative to control images, $t(29) = 3.23$, $p_{rep} = .98$, $d = 1.15$ (see Figure 2). As might be expected, those in the excitement condition did not differ significantly from those in the neutral condition, $t(30) = .35$, $p_{rep} = .33$, $d = .13$. Most importantly, those in the anger condition did not differ significantly from those in the neutral condition in relative fixation duration to threatening (vs. control) images, $t(30) = .69$, $p_{rep} = .50$, $d = .24$.

Next, we examined whether emotions influenced visual attention to rewarding (vs. control) images. As expected, we found a significant effect of Emotion Condition on the Rewarding-Control difference scores, $F(3, 63) = 6.92$, $p_{rep} > .99$, $\eta^2 = .26$. Consistent with some prior research, relative to the neutral condition, those in the excitement condition showed higher average fixation durations to rewarding relative to control images, $t(30) = 2.71$, $p_{rep} = .95$, $d = .96$ (see Figure 3). Also, as might be expected, those in the fear condition did not differ significantly from those in the neutral condition, $t(30) = .89$, $p_{rep} = .19$, $d = .05$. Most importantly, we found that relative to the neutral condition, those in the anger condition showed significantly higher average fixation durations to rewarding (vs. control) images, $t(30) = 3.58$, $p_{rep} = .99$, $d = 1.27$.

We also examined whether emotions influenced visual attention to rewarding (vs. threatening) images. We found a significant effect of Emotion Condition on the Rewarding-Threatening difference scores, $F(3, 63) = 11.57$, $p_{rep} > .99$, $\eta^2 = .37$. Relative to the neutral

condition, those in the fear condition showed higher average fixation durations to threatening relative to rewarding images, $t(30) = 2.91$, $p_{rep} = .96$, $d = 1.03$ (see Figure 4). In contrast, relative to the neutral condition, those in the excitement condition showed higher average fixation durations to rewarding relative to threatening images, $t(30) = 3.72$, $p_{rep} = .99$, $d = 1.32$. Most central to this investigation, relative to the neutral condition, those in the anger condition showed higher average fixation durations to rewarding relative to threatening images, $t(30) = 2.94$, $p_{rep} = .96$, $d = 1.04$.

Finally, we examined difference scores comparing same-category images (Rewarding-Rewarding, Threatening-Threatening, and Control-Control). We expected such scores to approach zero and not vary as a function of Emotion Condition. Three one-way ANOVAs confirmed that this was the case for Rewarding-Rewarding, $F(3, 63) = .02$, $p_{rep} = .03$, $\eta^2 = .001$, Threatening-Threatening, $F(3, 63) = .03$, $p_{rep} = .08$, $\eta^2 = .001$, and Control-Control pairs, $F(3, 63) = .06$, $p_{rep} = .04$, $\eta^2 = .003$.

Accuracy

Accuracy when responding to the questions following each image pair was very high ($M = .98$, $SD = .04$) and did not differ by Emotion Condition ($p_{rep} = .38$).

Discussion

Our findings demonstrate, for the first time, that anger can influence visual attention. We found that anger increases visual attention to rewarding, but not threatening, information. Consistent with prior findings, we also found that fear increases visual attention to threatening information and provided further evidence that excitement increases visual attention to rewarding information. Such findings were obtained even though participants were instructed to allocate equal attention to the simultaneously presented images in order to optimize their

performance. Because anger is a negative emotion that reflects an approach motivational system (Carver & Harmon-Jones, 2009), our findings suggest that the effects of emotional states on overt visual attention depend on the motivational implications of emotions, rather than their valence, per se.

Theoretical Implications

Multi-level models of emotion and cognition recognize that different emotional states serve distinct functions in the way they organize perception, cognition and action, based on their motivational implications (Izard, 1971; 1991). According to such models, different emotional states may influence different stages of cognitive processing in different ways. Consistent with this approach, the current findings demonstrate that emotional states, such as fear, excitement, and anger, exert unique effects on visual attention, as a function of their motivational underpinnings. Such findings further point to the importance of examining the links between cognitive processing and distinct types of emotional experiences, rather than focusing on valence alone.

From an evolutionary perspective, goals that should be addressed efficiently (e.g., avoiding a deadly snake bite) are likely to influence attention mechanisms. The behavioral implications of emotions may be driven, in part, by the enhanced processing of motivationally-relevant information. Anxiety, for instance, may help individuals avoid threats in their environment, in part, by focusing attentional resources on threatening information and thus promoting its efficient processing (Mogg & Bradley, 2004). Similarly, it is possible that excitement helps individuals attain rewards in their environment, in part, by focusing attentional resources on rewarding information. Anger, in turn, is characterized as a reaction to an event where there is a violation to what 'ought' to be (Frijda, 1986). It is possible, therefore, that by

orienting attention to rewarding information (i.e., what 'ought' to be), anger helps individuals to remove an existing violation and restore the desired state (Carver & Harmon-Jones, 2009).

Our findings show that emotional states promote the cognitive processing of motivationally-relevant stimuli, but do not impair the processing of motivationally-irrelevant stimuli. Fear influenced attention to threats, but not to rewards. Excitement influenced attention to rewards, but not to threats. This distinction is particularly important in the context of anger, where conclusions about the link between anger and sensitivity to threats have been somewhat inconsistent. Whereas some research has linked anger to a decreased sensitivity to threat (e.g., Lerner & Keltner, 2000), other research suggests that anger is largely unrelated to threat sensitivity (Lindquist & Barrett, 2008). Consistent with the latter, we found that anger was largely unrelated to threat processing, at least in the context of visual attention. Anger does, however, appear to be linked to reward sensitivity, as rewarding information was more likely to capture the attention of angry individuals, compared to those in a neutral or fearful state. These findings suggest that anger could lead people to attend to potential rewards (e.g., an ex-girlfriend one has feelings for), without influencing attention to possible threats (e.g., her current jealous partner).

The content of visual attention may speak to the goals people pursue, but not necessarily to the ways in which they pursue them. Despite their distinct psychological and behavioral implications, we found that both excitement and anger increased attention to rewards. It may be that both excitement and anger can promote the attainment of rewards by increasing attention to them, but that they do so in very different ways. For instance, excitement or happiness may promote reward attainment by facilitating collaboration with others, whereas anger may do so by facilitating competition or confrontation with others (e.g., Tamir & Ford, 2009b; Van Kleef, De

Dreu, & Manstead, 2004). Such possibilities remain to be tested, yet they speak to the complex relationships between emotions, cognition, and behavior.

Future Directions

Research on anxiety and visual attention has found that threat-oriented attention in anxiety is found with both supraliminal and subliminal exposures, suggesting that attentional effects of emotions may involve early preattentive as well as later postattentive stages (MacLeod & Rutherford, 1992; Mogg, Bradley & Hallowell, 1994; Mogg, Bradley, Williams & Mathews, 1993). In this investigation, we sought to test whether anger can affect visual attention at all, rather than to examine the time course of such potential effects. An important task for future research, therefore, is to examine how early in cognitive processing anger influences visual attention.

Visual attention is a complex process that involves distinct component processes, including engagement, attention shifting, and disengagement (Posner, Inhoff, & Friedrich, 1987). Some have argued that anxiety influences the engagement or initial orienting of attention (e.g., Mogg, Garner, & Bradley, 2007), whereas others proposed that anxiety has little impact on the initial detection of threat but has a stronger effect on the inability to disengage attention from threat (e.g., Fox, 2004; Fox, Russo, Bowles, & Dutton, 2001). Our design did not allow us to reliably examine engagement and disengagement processes. Therefore, future research could examine whether anger affects specific component processes of visual attention.

Finally, research on anxiety and visual attention has shown that increased attention to threatening information may play a causal role in the genesis of anxiety-related states (MacLeod, 1999; MacLeod, Rutherfold, Campbell, Ebsworthy, & Holker, 2002). What are the implications of the current findings for emotional experiences? Our findings suggest that the implications of

visual attention for emotional experience may depend on the motivational context at hand. One possibility is that increased attention to rewards may help maintain either excitement or anger, depending on the preliminary state of the individual or the characteristics of the present context. The current findings set the stage for testing such exciting ideas.

References

Bradley, B., Mogg, K., & Lee, S. (1997). Attentional biases for negative information in induces and naturally occurring dysphoria. *Behaviour Research and Therapy, 35,* 911-927.

Brunyé, T. T., Mahoney, C. R., Augustyn, J. S., & Taylor, H. A. (2009). Emotional state and local versus global spatial memory. *Acta Psychologica, 130,* 138-146.

Cacioppo, J., Gardner, W. & Berntson, G. (1999). The affect system has parallel and integrative processing components: Form follows function. *Journal of Personality and Social Psychology, 76,* 839-855.

Carver, C. (2001). Affect and the functional bases of behavior: On the dimensional structure of affective experience. *Personality and Social Psychology Review, 5*, 345-356.

Carver, C. & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin, 135,* 183-204.

Carver C. & Scheier, M. (1998). *On the self-regulation of behavior*. New York, NY: Cambridge University Press.

Fox, E. (2004). Maintenance or capture of attention in anxiety-related biases? In J. Yiend (Ed.), *Cognition, emotion and psychopathology: Theoretical, empirical and clinical directions*. (pp. 86-105). New York, NY: Cambridge University Press.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General, 130*, 681-700.

Frijda, N. (1986). The Emotions. Cambridge University Press, New York.

Harmon-Jones, E. & Carver, C. (2008). Anger is an approach-related affect: Evidence and Implications. *Psychological Bulletin, 135,* 183-204.

Henderson, J. M., & Hollingworth, A. (1998). Eye movements during scene viewing: An overview. In G. D. M. Underwood (Ed.), Eye Guidance in Reading and Scene Perception. New York, NY: Elsevier.

Inhoff, A. W., & Radach, R. (1998). Definition and computation of oculomotor measures in the study of cognitive processes. In G. Underwood (Ed.), *Eye Guidance in Reading and Scene Perception.* New York, NY: Elsevier.

Izard, C. (1971). *The face of emotion*. East Norwalk, CT: Appleton-Century-Crofts.

Izard, C. (1991). *The psychology of emotions. Emotions, personality, and psychotherapy*. New York, NY: Plenum Press.

Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (2008). *International affective picture system (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8*. University of Florida, Gainesville, FL.

Lerner, J. & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgment and choice. *Cognition & Emotion. Special Issue: Emotion, cognition, and decision making, 14*, 473-493.

Lindquist, K. & Barrett, L. (2008). Constructing emotion: The experience of fear as a conceptual act. *Psychological Science, 19*, 898-903.

MacLeod, C. (1999). Anxiety and anxiety disorders. In T. Dalgleis & M. Power (Eds.), *Handbook of cognition and emotion*. (pp. 447-477). New York, NY: John Wiley & Sons Ltd.

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.

MacLeod, C., Rutherfold, E., Campbell, L., Ebsworthy, G. & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*, 107-123.

Matthews, A. (1997). Information-processing biases in emotional disorders. In D. Clark, & C. Fairburn (Eds.), *Science and practice of cognitive behaviour therapy*. Oxford medical publications. (pp. 47-66). New York, NY: Oxford University Press.

Mathews, A. & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy, 23*, 563-569.

Mathews, A. & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45,* 25-50.

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

Mogg, K. & Bradley, B. (2004). A cognitive-motivational perspective on the processing of threat information and anxiety. In J. Yiend (Ed.), *Cognition, emotion and psychopathology: Theoretical, empirical and clinical directions*. (pp. 68-85). New York, NY: Cambridge University Press.

Mogg, B., Bradley, B., & Hallowell, N. (1994). Attentional bias to threat: Roles of trait anxiety, stressful events, and awareness. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*, *47*, 841-864.

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

Mogg, K., Garner, M., & Bradley, B. (2007). Anxiety and orienting of gaze to angry and fearful faces. *Biological Psychology, 76*, 163-169.

Mogg, K., Mathews, A., Bird, C. & McGregor, R. (1990). Effects of stress and anxiety on the processing of threat stimuli. *Journal of Personality and Social Psychology*, *59*, 1230-1237.

Posner, M, Inhoff, A., Friedrich, F., & Cohen, A. (1987). Isolating attentional systems: A cognitive-anatomical analysis. *Psychobiology, 15,* 107-121.

Putman, P., Hermans, E, & van Honk, J. (2004). Emotional Stroop Performance for Masked Angry Faces: It's BAS, Not BIS. *Emotion*, 4, 305-311.

Simon, H. (1994). The bottleneck of attention: Connecting thought with motivation. In W. Spaulding (Ed.), *Integrative views of motivation, cognition, and emotion*. *Nebraska symposium on motivation, Vol. 41.* (pp. 1-21). Lincoln, NE: University of Nebraska Press.

Tamir, M. & Ford, B. Q. (2009b). When feeling bad is expected to be good: Emotion regulation and outcome expectancies in social conflicts. *In review.*

Tamir, M. & Robinson, M. (2007). The happy spotlight: Positive mood and selective attention to rewarding information. *Personality and Social Psychology Bulletin, 33*, 1124-1136.

Tellegen, A. (1985). Structures of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. Tuma & J. Maser (Eds.), *Anxiety and the anxiety disorders.* (pp. 681-706). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Watson, D., Wiese, D., Vaidya, J. & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76*, 820-838.

Wilkowski, B. & Robinson, M. (2008). The cognitive basis of trait anger and reactive aggression: An integrative analysis. *Personality and Social Psychology Review, 12*, 3-21.

Wilkowski, B., Robinson, M., Gordon, R., & Troop-Gordon, W. (2007). Tracking the evil eye: Trait anger and selective attention within ambiguously hostile scenes. *Journal of Research in Personality, 41*, 650-666.

Williams, R., Watts, F., MacLeod, C. & Mathews, A. (1997). *Cognitive psychology and emotional disorders*. Chichester: Wiley.

Van der Heijden, A. (1992). *Selective attention in vision. International library of psychology.* Florence, KY: Taylor & Frances/Routledge.

Van Honk, J., Tuiten, A., de Haan, E., van den Hout, M., & Stam, H. (2001). Attentional biases for angry faces: Relationships to trait anger and anxiety. *Cognition and Emotion, 15*, 279-297.

Van Kleef, G., De Dreu, C., & Manstead, A. (2004). The interpersonal effects of emotions in negotiations: A motivated information processing approach. *Journal of Personality and Social Psychology, 87*, 510-528.

Table 1. Mean ratings and standard errors for experience of target emotions as a function of emotion condition.

	Experience of Target Emotion					
	Anger		Fear		Excitement	
Emotion Condition	*M*	*SE*	*M*	*SE*	*M*	*SE*
Anger	2.94	.39	0.98	.23	1.63	.18
Fear	1.13	.18	2.41	.46	1.78	.33
Excitement	0.97	.38	0.81	.38	4.26	.19
Neutral	0.77	.22	0.84	.28	3.06	.25

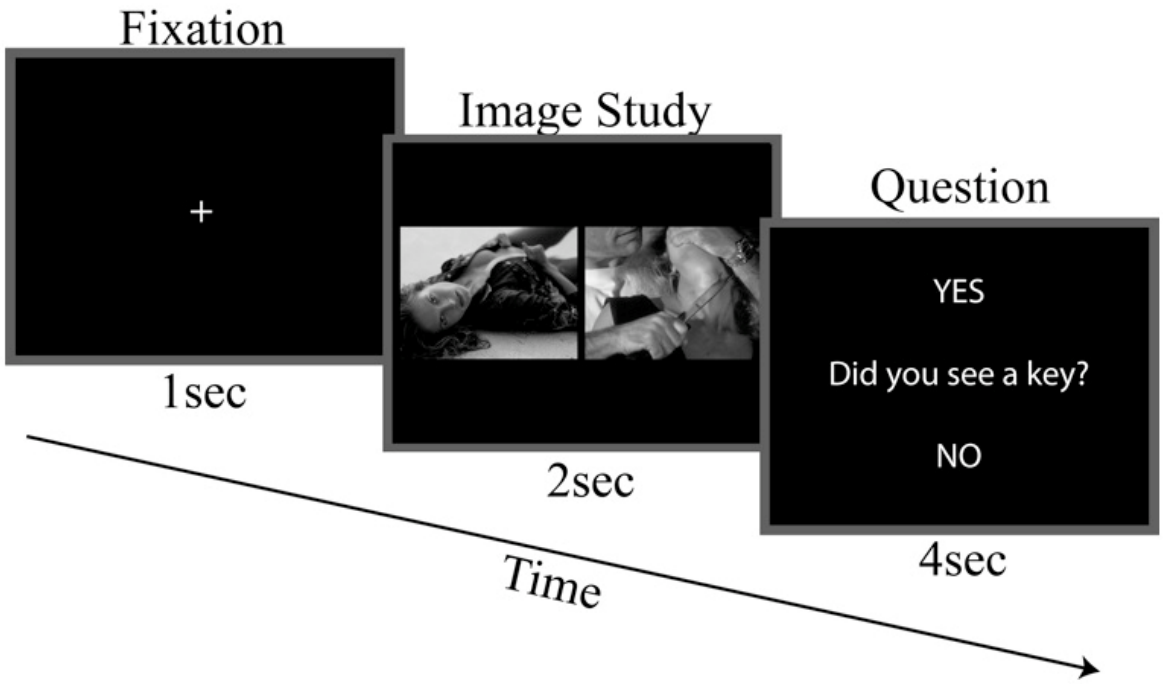
Figure Legends

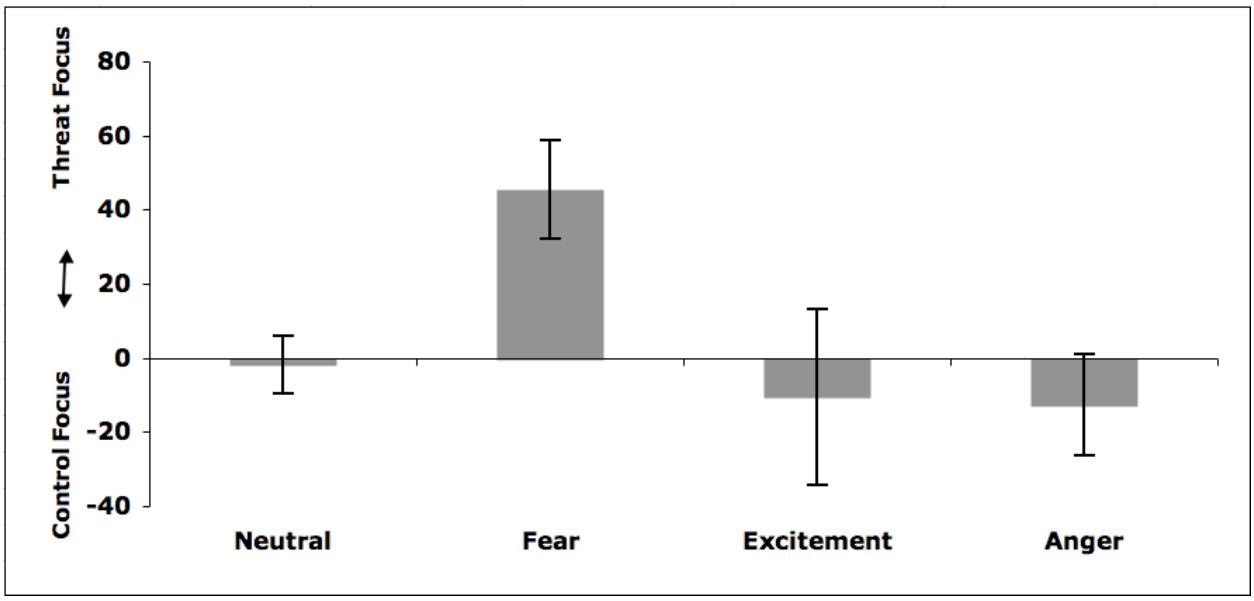
Figure 1. Sample trial involving the pairing of a rewarding (left) and threatening (right) image, and a question correctly answered NO. Note that images were always presented in color.

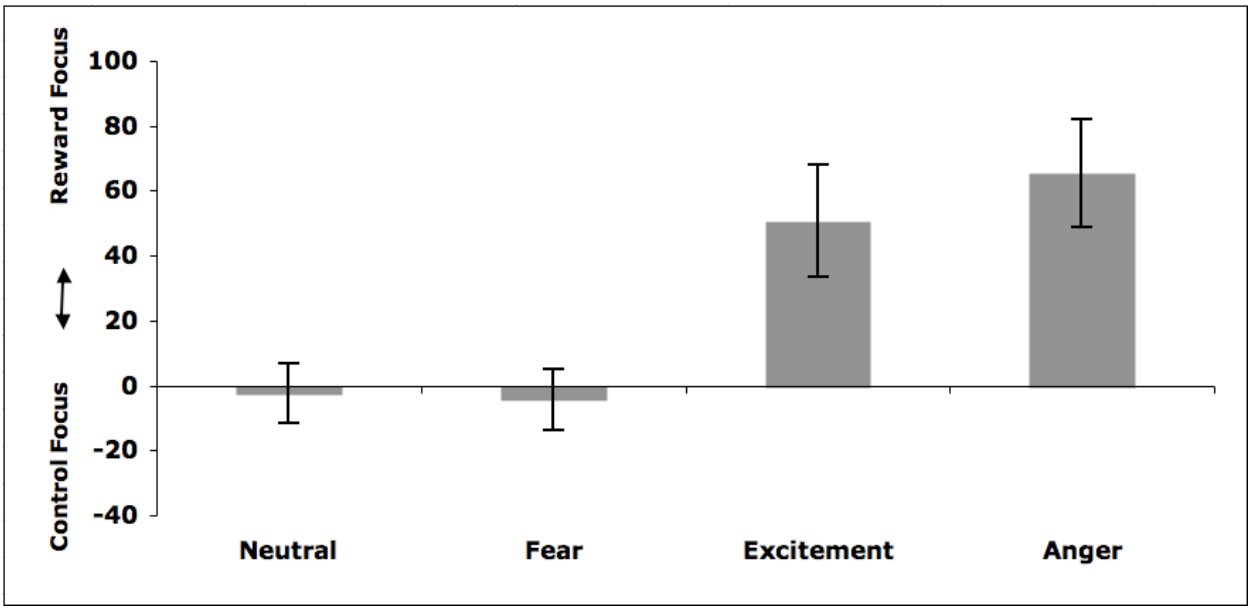
Figure 2. Mean difference scores (in msec) and standard errors when comparing average fixation durations to threatening versus control images, as a function of emotion condition.

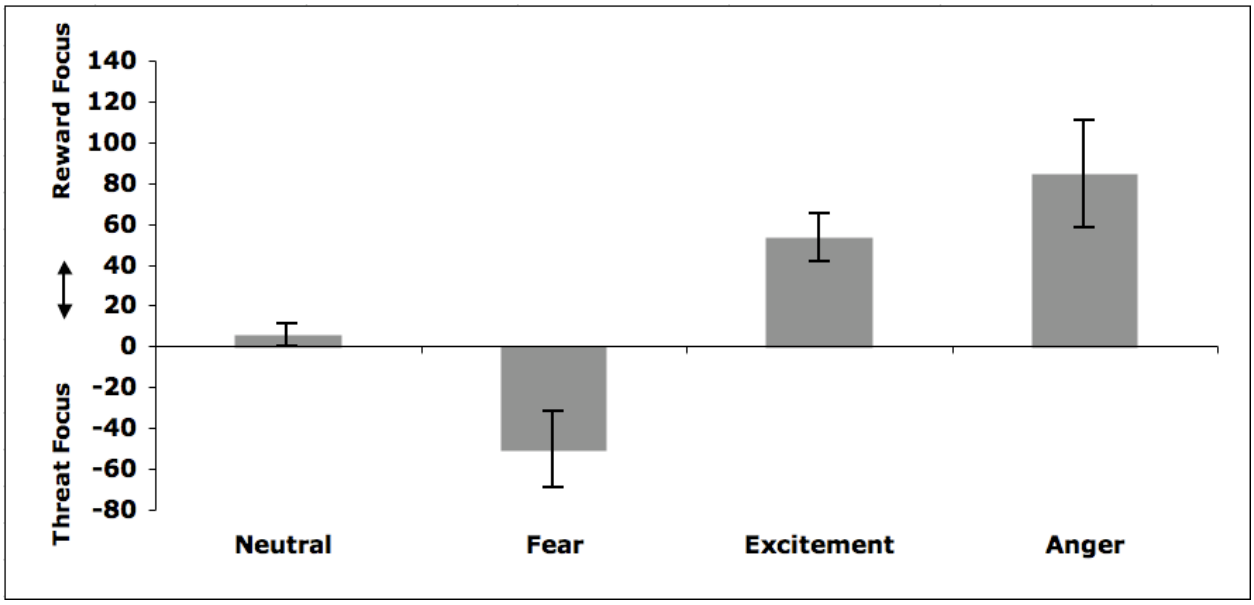
Figure 3. Mean difference scores (in msec) and standard errors when comparing average fixation durations to rewarding versus control images, as a function of emotion condition.

Figure 4. Mean difference scores (in msec) and standard errors when comparing average fixation durations to rewarding versus threatening images, as a function of emotion condition.


Fixation
+
1sec
Image Study
2sec
Question
YES
Did you see a key?
NO
4sec
Time


Threat Focus
Control Focus
80
60
40
20
0
-20
-40
Neutral
Fear
Excitement
Anger


Reward Focus
Control Focus
100
80
60
40
20
0
-20
-40
Neutral
Fear
Excitement
Anger


Reward Focus
Threat Focus
140
120
100
80
60
40
20
0
-20
-40
-60
-80
Neutral
Fear
Excitement
Anger