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Making Something out of Nothing: Neutral Content Modulates Attention in Generalized Anxiety Disorder

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Abstract

Although an attentional bias for threat has been implicated in generalized anxiety disorder (GAD), evidence supporting such a bias has been inconsistent. The current study examines whether exposure to different emotional content modulates attention disengagement and impairs the perception of subsequently presented nonemotional targets in GAD. Patients with GAD ($n = 30$) and controls ($n = 30$) searched for a target embedded within a series of rapidly presented images. Critically, an erotic, fear, disgust, or neutral distracter image appeared 200 ms or 800 ms before the target. Impaired target detection was observed among GAD patients relative to controls following only fear and neutral distractors. However, this effect did not significantly vary as a function of distractor stimulus duration before the target. Furthermore, group differences in target detection after fear distractors were no longer significant when controlling for target detection after neutral distractors. Subsequent analysis also revealed that the impaired target detection among those with GAD relative to controls following neutral (but not fear) distractors was mediated by deficits in attentional control. The implications of these findings for further delineating the function of attentional biases in GAD are discussed.

Keywords

GAD; Emotion; Attention; Attentional Control

The Diagnostic and Statistical Manual of Mental Disorders currently characterizes the defining features of generalized anxiety disorder (GAD) as excessive, uncontrollable worry across a variety of domains (American Psychiatric Association, 2000). Although significant advances have been made in the description of GAD (Barlow, 2002), much remains unknown about the underlying etiological mechanisms of the disorder. An attentional bias favoring threatening information is one mechanism that has been implicated in the development of anxiety disorders (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Beck & Clark, 1997; Cisler & Koster, 2010), including GAD. According to cognitive models (Eysenck, 1992; Mathews, 1990), anxiety is characterized by a hypervigilant mode of information processing. Anxiety prioritizes the initial automatic encoding of threat, leading to increased orienting towards and rapid detection of threat in the environment. Indeed, the modal finding in such research is increased allocation of attention

to threatening stimuli, through biases in the orienting of attention (vigilance; Mogg & Bradley, 1998), or in the continued engagement of attention (maintenance; Weierich, Treat, & Hollingworth, 2008). This attentional bias in GAD may operate to maintain excessive worry and anxiety because such patients are more likely to identify minor threat cues in the environment.

Attentional bias for threat in GAD may reinforce dysfunctional beliefs that the world is unsafe. This bias may reflect deficits in attention control, an individual difference trait that reflects the ability to regulate attention allocation (Cisler & Koster, 2010). This can be conceptualized as a 'top-down' regulatory ability (Posner & Rothbart, 2000), such that it inhibits the 'bottom up' influence of emotional distractors (Eysenck et al., 2007). Deficits in attentional control in GAD may be observed in two dimensions (Derryberry & Reed, 2002), corresponding to the components of attention that may be brought under voluntary control. Attentional focus consists of one's ability to maintain attentional engagement in the face of distraction, while attentional shifting consists of one's ability to execute attentional disengagement, in order to shift attention away from a distraction or towards a new task. The inability to regulate the focus or shifting of attention in GAD may moderate the degree to which attention can be disengaged from threatening stimuli. Accordingly, attentional control may be construed as a higher-order regulatory mechanism controlling the characteristics of attention biases towards threat in GAD.

Several studies have provided support for the notion that an attentional bias for threat operates as a risk factor for the development of GAD (see Mogg & Bradley, 2005 for review). For example, Mogg, Millar, and Bradley (2000) found that individuals with GAD were more likely to look first toward threat faces rather than neutral faces compared with controls and those with depression. A Stroop interference effect for negative emotional words among those with GAD compared to controls has also been found, suggesting that negative words interfere with attentional processes more in GAD (Taghavi et al., 2003). However, findings from this body of research have been far from consistent. For example, some studies have shown that those with GAD demonstrate an attentional bias *away* from threatening faces (e.g., Monk et al., 2006). In contrast, other studies have found an attentional bias *toward* both angry and happy faces (Bradley, Mogg, White, Groom, & de Bono, 1999; Waters, Mogg, Bradley, & Pine, 2008). Moreover, several studies have failed to find any attentional bias for threat in GAD (Freeman, Garety, Phillips, 2000; Gotlib, Krasnoperova, Yue, & Joormann, 2004; Rinck, Becker, Kellermann, & Roth, 2003).

The inconsistency in demonstrating an attentional bias for threat in GAD may be partially due to the frequent use of reaction times as an index of attentional bias, which is problematic because threatening stimuli slow reaction times regardless of attention processes (Algom, Chajut, & Lev, 2004). Thus, previous inconsistencies in identifying the specific components of attentional dysfunction in GAD may be due to non-specific effects of emotional stimuli in reaction-time based tasks. The inconsistency in demonstrating an attentional bias in GAD may also be partially attributed to the diffuse nature of worry concerns, as well as their idiosyncratic nature. Indeed, one of the most consistent findings differentiating patients with GAD from nonanxious controls is the degree of worry over seemingly idiosyncratic topics,

such as being late for appointments or having car problems (Craske, Rapee, Jackel, & Barlow, 1989; Roemer, Molina, & Borkovec, 1997).

Inconsistencies in demonstrating an attentional bias in GAD may also be partially due to the use of lexical stimuli in many studies; as such stimuli often lack ecological validity and are confounded by differential frequency of use by GAD patients compared to controls (Bradley et al., 1999). GAD is increasingly being conceptualized in terms of deficits in affective regulation (Mennin, Heimberg, Turk, & Fresco, 2002; Mennin, Heimberg, Turk, & Fresco, 2005). Valenced images may be more strongly related to affective information in GAD than words because, unlike words, images have privileged access to the system in which affective information is stored (Glaser & Glaser, 1989; Gotlib et al. 2004). Recent investigations have addressed this limitation by employing pictorial images of threat (e.g., MacNamara & Hajcak, 2010). However, such research is often limited by the unitary assessment of threat. This is concerning as recent research suggests that different types of threat, such as fear and disgust for example, are associated with a differential pattern of attentional processing (Santos, Iglesias, Olivares, & Young, 2008).

A more precise understanding of the components underlying attentional biases in GAD may also be informed by the use of novel experimental paradigms. The emotional attentional blink paradigm, a behavioral measure that probes attention at different time intervals through the rapid, serial visual presentation (RSVP) of stimuli may be a good method for probing the emotional modulation of attention in GAD. The earliest RSVP tasks used non-emotional, text stimuli which revealed diminished reports of the second target when attending to the first target, an effect termed the “attentional blink” (AB; Raymond, Shapiro, & Arnell, 1992). Most et al. (2005) adopted this paradigm for use with emotional stimuli in order to determine the extent to which task-irrelevant emotional distractors induce an attentional blink. On each trial of the task participants attempt to accurately detect a rotated target image among a set of rapidly presented distractors. Critically, the target image appears 200 ms (Lag 2) or 800 ms (Lag 8) after the onset of an emotional distractor. The shorter lag time is specifically sensitive to attentional capture by emotional stimuli, typically causing large deficits in target detection. In contrast, at longer delay times, individuals are typically able to reengage their attention despite the earlier capturing of their attention. The findings revealed that attentional biases to emotional information induced a temporary inability to process stimuli that people actively sought. In the present study we employed this emotional attentional blink paradigm in order to test the hypothesis that patients with GAD are excessively disrupted by emotional stimuli and to examine the extent to which these biases reflect initial capture or problems with disengagement. We further tested performance following neutral, erotic, fear, and disgust stimuli in order to test the level of specificity of observed effects.

Method

Participants

Participants consisted of 30 community adults who meet diagnostic criteria for GAD and 30 non-clinical controls (NCC). The Structured Clinical Interview for the DSM-IV (SCID-IV; First, Spitzer, Gibbon, & Williams, 1994) was administered by a trained clinical

psychologist to confirm diagnosis for all participants, with exclusionary criteria for the GAD group including a diagnosis of bipolar disorder, substance abuse, attention-deficit hyperactivity disorder, pervasive developmental disorders, mental retardation, or current or past neurological diseases. Many GAD patients had additional current Axis I diagnoses (47%), including 20% with major depressive disorder.

Diagnostic and Symptom Assessment

The *Structured Clinical Interview for the DSM-IV* (SCID-IV; First, Spitzer, Gibbon, & Williams, 1994) is a semi-structured interview for making the major DSM-IV diagnoses.

The *Penn State Worry Questionnaire* (PSWQ; Meyer et al., 1990) is a commonly used trait measure of anxiety intended to assess a person's overall tendency to experience worry. Participants respond to items using a 5-point Likert scale anchored by “not at all typical” and “very typical.” The PSWQ had good internal consistency in the present study ($\alpha = .95$).

The *State-Trait Anxiety Inventory - Trait* (STAI-T; Spielberger et al., 1983) is a 20-item measure of proneness towards experiencing distress and anxiety (trait anxiety). Each item is rated on a 4-point Likert scale that ranges from “1 = never” to 4 = “almost always”. The STAI-T had good internal consistency in the present study ($\alpha = .95$).

The *Beck Depression Inventory* (BDI, Beck, Steer, & Garbin, 1988) is a 21-item self-report measure of depressive symptoms or dysphoria. Each item is rated on a 4-point Likert scale that ranges from 0 to 3. The BDI had good internal consistency in the present study ($\alpha = .91$).

The *Attentional Control Scale* (ACS; Derryberry & Reed, 2002) is a 20-item measure of control of attention across two domains; *focusing*, the ability to maintain attention on a given task, and *shifting*, the ability to reallocate attention to a new task or to engage attention on multiple tasks. Each item is rated on a 4-point Likert scale from “1” (almost never) to “4” (always) with higher scores indicative of better attentional control. The ACS had adequate internal consistency ($\alpha = .87$).

Rapid Serial Visual Presentation (RSVP) Task

The visual stimuli were images consisting of 168 distractor images drawn from four categories of emotional images (42 disgusting, 42 erotic, 42 fear evoking, 42 neutral), 252 upright landscapes/architectural filler images (appearing before the distractor, between the distractor and the target, and after the target) and 80 target images consisting of landscape/architectural photos 40 rotated 90° degrees to the left and 40 rotated 90° to the right. One trial consisted of 17 images, including one distractor image and one target image that was rotated 90° to the left or right (see Figure 1). Each image was presented for 100ms. Each trial consisted of a disgust (contaminated or diseased items including roaches, feces, and maggot-ridden food products), fear (animals bearing teeth in a threatening manner, humans brandishing weapons, and explosions), erotic (nude male-female couples engaging in sexual scenarios)¹, or neutral (scenic in style and including both animals and humans) distractor image that appeared 200ms (lag 2) or 800ms (lag 8) before the rotated image.²

Fear, disgust, and neutral pictures were partially drawn from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) and were supplemented with similar images drawn from publicly available sources. Erotic images were mainly obtained from publicly available sources and have been employed in previous research (Most et al., 2007). Participants completed 6 blocks with 28 trials per block. Of the total 168 trials, there were 42 trials for each distractor type with 2 trials per distractor type containing no target; the 2 lags were equally distributed for the 40 trials with targets present per distractor type. The position of the distractors was equally distributed by emotion category and lag positions in the RSVP stream. Participants were instructed to indicate if they saw a rotated (yes, no; *detection*) image and which direction it was rotated (right, left; *accuracy*). Participants received 16 practice trials to ensure mastery of the task with 4 of the trials containing no rotated target image, 6 trials with the target image rotated to the right, and 6 trials with the target image rotated to the left.

Procedure

Participants were seated at a computer where they first completed the self-report questionnaires listed above and then the RSVP task.

Results

Participant Characteristics

As shown in Table 1, GAD participants and NCCs were well-matched on gender, age, ethnicity, and education with no significant differences between the two groups ($p > .05$). However, a chi square analysis for socioeconomic status (SES) was significant ($\chi^2 = 8.99$, $p < .05$) indicating generally lower income among those in the control group. A chi square analysis for marital status was also significant ($\chi^2 = 7.68$, $p < .05$) indicating a higher portion of married participants in the GAD group. As expected, Table 2 shows that GAD participants reported significantly more severe symptoms of worry, trait anxiety, depression, and difficulty with attention control than NCCs ($p < .001$).

RSVP Task Accuracy

Means and standard deviations of percent accuracy on the RSVP by emotion, lag, and group are presented in Table 3. A 2 (Group; GAD, NCC) X 2 (Lag; 2, 8) X 4 (Emotion; disgust, fear, erotic, neutral) mixed model Analysis of Variance (ANOVA) on percent accuracy³

¹Emerging research suggests that the arousal value of a stimulus, and not its valence (negative versus positive versus neutral) is more important for modulating attention (Most, Smith, Cooter, Levy, & Zald, 2007; Vogt et al., 2008). Erotic (i.e., sexually explicit) stimuli in particular, which have high arousal value but minimal valence, have been found to affect attention to a greater degree than stimuli with negative valence (Arnell, Killman, & Fijavz, 2007). Thus, erotic stimuli may be excellent stimuli to employ in attentional bias research among anxious populations to control for arousal levels when examining the effects of valenced stimuli on attention.

²An independent sample of participants ($n = 23$; 65.2% female; 65.2% Caucasian, mean age = 20.35, SD = 2.57) rated each Disgust (valence = -24.69, SD = 7.29; arousal = 46.26, SD = 14.65), Erotic (valence = 4.45, SD = 15.59; arousal = 41.77, SD = 20.42), Fear (valence = -15.83, SD = 7.17; arousal = 31.98, SD = 10.36), and Neutral (valence = 4.87, SD = 3.66; arousal = 6.18, SD = 5.05) image for valence (-50 = extremely negative, +50 = extremely positive, 0 = being no positive or negative valence/neutral) and arousal (0 = none to 100 = extremely/most imaginable). A significant difference for valence ratings between disgust images and all other categories was found such that disgust images were rated the most negative ($p < .001$). Fear images were rated as significantly more negative than erotic and neutral images ($p < .001$). However, the valence of erotic and neutral images did not significantly differ from each other ($p > .90$). Neutral images were rated significantly less arousing than all other images ($p < .001$). Fear images were significantly less arousing than disgust images ($p < .001$), but not erotic images ($p > .05$). Lastly, arousal ratings for disgust and erotic images did not significantly differ from each other ($p > .05$).

revealed a significant main effect of Group [$F(1, 58) = 6.29, p < .02$, partial $\eta^2 = .10$], reflecting higher accuracy for NCCs relative to those with GAD, Lag [$F(1, 58) = 311.21, p < .001$, partial $\eta^2 = .84$], reflecting higher accuracy at Lag 8 than Lag 2, and Emotion [$F(3, 174) = 58.80, p < .001$, partial $\eta^2 = .50$], reflecting differential performance across stimulus categories. These main effects were qualified by significant Group X Emotion [$F(3, 174) = 2.88, p < .04$, partial $\eta^2 = .05$] and Lag X Emotion [$F(3, 174) = 61.60, p < .001$, partial $\eta^2 = .52$] interactions. The Group X Lag interaction [$F(1, 174) = 2.22, p = .14$, partial $\eta^2 = .04$] and the Group X Lag X Emotion interaction were not significant [$F(3, 174) = 1.53, p = .20$, partial $\eta^2 = .03$].⁴

To examine the Group X Emotion interaction, we performed *t*-tests for Group differences for each emotion (collapsed across the two lags). As depicted in Figure 2, the extent to which NCCs outperformed GAD patients varied with emotion. NCCs showed greater accuracy than GAD patients after presentation of fear [$t(58) = 2.54, p < .02$] and neutral [$t(58) = 3.26, p < .01$] distractors. By contrast, group differences in percent accuracy failed to reach statistical significance for targets following disgust [$t(58) = 1.66, p = .10$] and erotic distractors [$t(58) = 0.64, p = .52$]. Given that GAD participants showed poorer accuracy following neutral stimuli, the extent to which a general deficit (as reflected by poor performance in the neutral condition) could explain poorer accuracy following fear stimuli was examined. These results revealed that the group differences in percent accuracy after presentation of fear distractors were no longer significant after controlling for group differences in percent accuracy following neutral distractors ($p = .84$).

The significant Group X Emotion interaction was also tested by examining percent accuracy after the emotional distractors for each group separately. A main effect of Emotion was found for GAD patients [$F(3, 87) = 49.91, p < .001$, partial $\eta^2 = .63$] and NCCs [$F(3, 87) = 16.02, p < .001$, partial $\eta^2 = .36$]. Subsequent pairwise comparisons revealed that percent accuracy following neutral distractors did not significantly differ from percent accuracy following fear distractors for those with GAD ($p = .24$). Percent accuracy following disgust distractors was only marginally different from percent accuracy following erotic distractors among those with GAD ($p = .07$). Pairwise comparisons for percent accuracy following the remaining emotional distractors did significantly differ from each other in the GAD sample ($ps < .01$). Among NCCs, percent accuracy was greatest following neutral distractors followed by fear, disgust, and erotic distractors. Furthermore, percent accuracy following the four emotional distractors differed significantly from each other ($ps < .01$).

To examine the Lag X Emotion interaction, a mixed model ANOVA on percent accuracy for the four emotional categories was performed separately at each lag. A main effect of Emotion was found at Lag 2 [$F(3, 177) = 72.74, p < .001$, partial $\eta^2 = .55$]. Pairwise comparisons revealed that percent accuracy after erotic distractors was significantly worse compared to disgust, fear, and neutral distractors ($ps < .001$). Percent accuracy after disgust distractors was also significantly worse compared to fear and neutral distractors ($ps < .001$).

³Analyses for accuracy, rather than detection, are presented as they reflect more precise performance on the RSVP. Furthermore, the pattern of findings did not differ when detection is employed as the dependent variable.

⁴The pattern of findings from the 2 (Group; GAD, NCC) X 2 (Lag; 2, 8) X 4 (Emotion; disgust, fear, erotic, neutral) mixed model ANOVA on percent accuracy was unchanged when controlling for the group differences in SES and marital status.

Percent accuracy after fear distractors was marginally worse compared to neutral distractors ($p = .07$). A main effect of Emotion was also observed at Lag 8 [$F(3, 177) = 9.37, p < .001$, partial $\eta^2 = .18$]. Pairwise comparisons revealed that percent accuracy after erotic distractors was significantly better compared to disgust and fear distractors ($ps < .001$) but equal to neutral distractors ($p = .30$). Percent accuracy after disgust distractors was significantly worse compared to neutral distractors ($ps < .001$) and marginally worse compared to fear distractors ($p = .07$). Percent accuracy after fear distractors was also marginally worse relative to neutral distractors ($p = .06$).

Symptom Correlates

The association between percent accuracy for each emotional distractor and various symptoms in the full sample was also examined. As shown in Table 4, percent accuracy after fear ($r = -.31, p < .05$) and neutral ($r = -.42, p < .01$) distractors correlated inversely with worry symptoms as assessed by the PSWQ, indicating that subjects with greater worry symptoms showed a weakened ability to accurately identify the target after fear and neutral distractors. A similar, albeit more modest, inverse association occurred for percent accuracy after neutral distractors and the STAI-T ($r = -.29, p < .05$). In contrast, percent accuracy after fear ($r = .29, p < .05$) and neutral ($r = .46, p < .01$) distractors was positively associated with the self-reported ability to control attention, as indicated by the ACS.

Mediation of Attentional Control

Difficulty with attentional control has been implicated as a higher-order mechanism that may confer risk for the development of GAD (Eysenck et al., 2007). Using the recommendations of Baron and Kenny (1986), attentional control was examined as a mediator of the relationship between group (GAD vs. NCC) and percent accuracy after fear distractors. Evidence of mediation requires the following conditions to be present: (a) a significant relationship between attentional control and group ($r = -.61, p < .01$), (b) a significant association between percent accuracy after fear distractors and group ($r = -.32, p < .02$), (c) a significant relationship between attentional control and percent accuracy after fear distractors ($r = .29, p < .03$), and (d) the statistically significant relationship between percent accuracy after fear distractors and group diminishes or disappears when attentional control is controlled. Pearson correlation coefficients indicated that conditions (a), (b), and (c) above were met.

Condition (d), the critical test of mediation, was investigated by examining the magnitude of the relationship between group and percent accuracy following fear distractors after controlling for attentional control. A two-step regression equation was estimated for percent accuracy after fear distractors by entering, in order, group and attentional control as predictors. The key comparison involved the change in standardized regression coefficients for group from step 1 (total effect) to step 2 (direct effect controlling for attentional control). As depicted in Figure 3A, the significant relationship between group and percent accuracy after fear distractors became non-significant after controlling for attentional control. Thus, all a priori conditions were met. However, examination of the Sobel test ($z = 0.98, p = .32$) suggests that the effect of group on percent accuracy after fear distractors is not transmitted via group differences in attentional control. A similar mediational analysis was conducted

to determine if attention control mediated the relationship between group (GAD vs. NCC) and percent accuracy after neutral distractors. As shown in Figure 3B, this pattern of findings, along with a significant Sobel test ($z = 2.21, p < .03$), confirmed that the group difference in percent accuracy after neutral distractors is transmitted via group differences in attentional control.

Discussion

This investigation examined the extent to which emotional stimuli modulate attention in GAD on an emotional attentional blink paradigm. A main effect was observed such that patients with GAD were generally less accurate than NCCs in target detection accuracy in the RSVP task. The poorer target detection in GAD patients compared to NCCs may reflect a generalized attention control-related deficit that may be observed at multiple stages of information processing (Eysenck et al., 2007). The emotional attentional blink paradigm has the advantage over many attention paradigms in its ability to distinguish between sensitivity to attentional capture at shorter lags, and problems with disengagement at later lags. Strikingly patients with GAD showed worse performance at both lags, perhaps suggesting more generalized deficit in attention control. A significant lag x emotion in interaction was also observed such that percent accuracy after erotic distractors was generally worse compared to other emotional distractors at lag 2 but significantly better relative to the other emotional distractors at lag 8. This finding is consistent with prior research suggesting that emotional stimuli may impair intentional allocation of attention at early temporal stages, but at later temporal stages, emotional stimuli can have an enhancing effect on directed attention (Bocanegra & Zeelenberg, 2009). Such findings highlights the importance of examining emotional influences on attention over a longer timescale as more dynamic and complex processes may be observed.

The present findings did reveal that fear and neutral stimuli uniquely induced deficits in visual processing that differentiated GAD patients from NCCs. The difficulty disengaging from fearful images for the purposes of target identification among those with GAD relative to controls is consistent with prior research that has demonstrated an attention bias for threat among those with GAD (MacNamara & Hajcak, 2010; Mogg et al., 2000). The absence of an effect for lag duration is also in line with prior research demonstrating an attentional vigilance for threat among GAD patients independent of stimulus duration (Bradley et al., 1999). In the present study, variation in stimulus duration could have revealed biases in different attentional components, for example, if patients with GAD initially oriented attention to threat (deficits in performance at Lag 2), but then the subsequently shifted their attention away from threat (enhanced performance at Lag 8). However, the present findings are more in line with the view that attention among patients with GAD, relative to controls, is being directed towards fear and neutral distractors and also maintained on these distractors at least up to 800 ms.

The finding of difficulty disengaging attention from neutral content for the purposes of target identification among those with GAD relative to controls was found to be more robust than the group differences in target accuracy after exposure to fear images. Such findings raise the possibility that patients with GAD may appraise neutral distractors as more

emotionally salient than controls. A closer examination of the findings did reveal that neutral distractors received comparable processing as fear distractors among GAD patients. In contrast, neutral distractors resulted in significantly higher target detection accuracy than fear distractors among NCC. Thus, attention in NCCs benefits from the presence of neutral distractors relative to threatening distractors, whereas those with GAD do not appear to receive such benefits. This finding raises the possibility that GAD patients may have difficulty inhibiting the threat detection system in the presence of safety cues.

The present findings support a lack of specificity for threat stimuli in attentional biases observed in GAD. This is consistent with recent work in other anxiety disorders demonstrating a deficit in inhibiting the reflexive orienting to neutral as well as to emotional facial expressions (Wieser, Pauli, & Mühlberger, 2009). Although GAD patients did not differ from NCCs in accuracy after presentation of erotic images in the present study, an attentional bias for positive information has been found for happy faces in GAD (Bradley et al., 1999). This lack of content-specificity for threat stimuli suggests that the specific context and the strategic processes employed may be a more important determinant of attentional biases in GAD. This view is consistent with cognitive models of anxiety which posit that the stimulus evaluation process determines the threat value of external stimuli, and is also responsible for triggering attentional biases through the activation of goal-engagement processes (Mogg & Bradley, 1998). In the absence of clear danger signals, the stimulus evaluation process in GAD may appraise relatively innocuous content as threatening, which may interfere with goal-directed behavior.

The present findings suggest that emotionally negative stimuli may not be exclusive in their ability to capture and hold attention in GAD. This may reflect the fact that worry content in GAD are rather diverse (Mogg & Bradley, 2005). However, patients with GAD did not differ from NCCs in percent accuracy after the presentation of disgust distractors. Disgust stimuli may be more representative of concerns observed in anxiety disorders (e.g., obsessive compulsive disorder; Olatunji, Cisler, McKay, & Phillips, 2010) other than GAD. The chronic worry that is characteristic of GAD may function to heighten difficulty disengaging attention from threatening and ambiguous cues in the environment that are specifically associated with uncertainty. This view is consistent with the present finding that percent accuracy after fear and neutral distractors correlated with worry symptoms, indicating that those with greater worry symptoms showed a weakened ability to disengage their attention. Excessive worry in GAD may hinder successful attempts to suppress distractors that may impair processing of other information.

The difficulty disengaging attention from fear and neutral content among patients with GAD may be accounted for by impairment in higher-order cognitive processes. According to the attentional control theory of anxiety, impairment in the volitional control of attention is a prominent feature in the anxiety disorders (Eysenck et al., 2007). Indeed, the present study found that attentional control was associated with difficulty disengaging attention from fear and neutral content in the full sample. Attentional control may account for the likelihood that distractors will intrude into consciousness and interfere with target detection in GAD. Consistent with this notion, Peers and Lawrance (2009) found that participants with good attentional control were less affected by both neutral and emotional distractors than

participants with poorer attentional control and more pronounced distraction deficits were seen for emotional relative to neutral distractors in individuals with poor attentional control. Although the effect of diagnostic group on accuracy after fear distractors was not found to be mediated by attentional control, the effect of diagnostic group on accuracy after neutral distractors was found to be transmitted via attentional control. Although definitive causal inferences cannot be made based on these cross-sectional data (see Cole & Maxwell, 2007), these meditational findings suggest that deficits in attentional control account for instances when neutral stimuli interfere with attention in GAD.

Given that GAD participants performed poorly across conditions, it is possible that their apparent difficulty with the task is not specifically an attentional problem but reflects a more perceptual processing problem. Specifically, the RSVP task requires rapid processing of images, as images only last for 100 ms each. A modest impairment in processing speed could produce the general pattern of less accurate performance in the GAD group. However, existing evidence does not suggest a general impairment in processing speed in this population (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lönnqvist, 2008). Moreover, participants showed similar differences in accuracy across conditions, making it clear that the GAD performance was sensitive to both stimulus type and lag effects indicating that the results were not due to a fundamental inability to perform the task. The meditational findings also suggest that attentional control may be a stronger determinant of poorer target detection on the RSVP among those with GAD than perhaps perceptual processing deficits.

Recent research has shown that attention modification designed to decrease attentional biases towards threat reduces symptoms of GAD (Amir, Beard, Burns, & Bomyea, 2009). However, the present findings suggest that cognitive tasks that train flexibility in attentional control per se, not necessarily to avoid threat, may be therapeutic for GAD. Although this is the first investigation, to our knowledge, demonstrating that neutral content differentiates attention disengagement difficulty in GAD relative to controls, other studies have found that trait anxiety, a vulnerability factor for GAD, is associated with difficulty inhibiting neutral, non-threatening distractors (Fox, 1993), due to decreased recruitment of prefrontal regions associated with attentional control (Bishop, 2009). However, inferences based on the present findings must be considered within the context of the study's limitations. Implications for the importance of assessing the extent to which attention in GAD fails to benefit from the presence of safety (or the absence of danger) cues, in addition to the extent to which the presence of danger cues hinders attention, are limited by the absence of an idiographic assessment of worry themes which may reveal a more robust effect for negative relative to neutral stimuli among GAD patients. Inclusion of a psychiatric control group (that does not overlap with GAD in symptom phenomenology) in future research may also clarify the extent to which difficulty disengaging attention from neutral stimuli is unique to GAD. Research along these lines may further elucidate causal attentional mechanisms specific to GAD that can be directly targeted during treatment.

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References

- Algom D, Chajut E, Lev S. A rational look at the emotional Stroop paradigm: a generic slowdown, not a Stroop effect. *Journal of Experimental Psychology: General*. 2004; 133:323–338. [PubMed: 15355142]
- American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th edition, text revision. American Psychiatric Association; Washington DC: 2000.
- Amir N, Beard C, Burns M, Bomyea J. Attention modification program in individuals with generalized anxiety disorder. *Journal of Abnormal Psychology*. 2009; 118:28–33. [PubMed: 19222311]
- Arnell KM, Killman KV, Fijavz D. Blinded by emotion: target misses follow attention capture by arousing distractors in the RSVP. *Emotion*. 2007; 7:465–477. [PubMed: 17683203]
- Bar-Haim Y, Lamy D, Pergamin L, Bakermans-Kranenburg MJ, van IJzendoorn MH. Threat-related attentional bias in anxious and non-anxious individuals: A meta-analytic study. *Psychological Bulletin*. 2007; 133:1–24. [PubMed: 17201568]
- Barlow, DH. Anxiety and its disorders: The nature and treatment of anxiety and panic. 2nd ed.. The Guilford Press; New York: 2002.
- Beck AT, Clark DA. An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy*. 1997; 35:49–58. [PubMed: 9009043]
- Beck AT, Steer RA, Garbin MG. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review*. 1988; 8:77–100.
- Bishop SJ. Trait anxiety and impoverished prefrontal control of attention. *Nature Neuroscience*. 2009; 12:92–98. [PubMed: 19079249]
- Bocanegra BR, Zeelenberg R. Dissociating emotion-induced blindness and hypervision. *Emotion*. 2009; 9:865–873. [PubMed: 20001129]
- Bradley BP, Mogg K, White J, Groom C, de Bono J. Attentional bias for emotional faces in generalized anxiety disorder. *British Journal of Clinical Psychology*. 1999; 38:267–278. [PubMed: 10532148]
- Castaneda AE, Tuulio-Henriksson A, Marttunen M, Suvisaari J, Lönnqvist J. A review on cognitive impairments in depressive and anxiety disorders with a focus on young adults. *Journal of Affective Disorders*. 2008; 106:1–27. [PubMed: 17707915]
- Cisler JM, Koster EHW. Mechanisms of attentional bias towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review*. 2010; 30:203–216. [PubMed: 20005616]
- Cole DA, Maxwell SE. Testing mediational models with longitudinal data: Questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology*. 2003; 112:558–577. [PubMed: 14674869]
- Craske M, Rapee R, Jackel L, Barlow D. Qualitative dimensions of worry in DSM-III-R generalized anxiety disorder subjects and nonanxious controls. *Behaviour Research and Therapy*. 1989; 27:397–402. [PubMed: 2775149]
- Derryberry D, Reed MA. Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology*. 2002; 111:225–236. [PubMed: 12003445]
- Fox E. Attentional bias in anxiety: selective or not? *Behaviour Research and Therapy*. 1993; 31:487–493. [PubMed: 8333823]
- Eysenck MW, Derakshan N, Santos R, Calvo MG. Anxiety and cognitive performance: Attentional control theory. *Emotion*. 2007; 7:336–353. [PubMed: 17516812]
- First, MB., Spitzer, RL., Gibbon, M., Williams, JWB. Structured clinical interview for DSM-IV Axis I disorders. American Psychiatric Association; Washington, DC: 1997.

- Freeman D, Garety PA, Phillips ML. An examination of hypervigilance for external threat in individuals with generalized anxiety disorder and individuals with persecutory delusions using visual scan paths. *Quarterly Journal of Experimental Psychology*. 2000; 53A:549–567.
- Glaser WR, Glaser MO. Context effects in Stroop-like word and picture processing. *Journal of Experimental Psychology: General*. 1989; 118:13–42. [PubMed: 2522504]
- Gotlib IH, Krasnoperova E, Neubauer DL, Joormann J. Attentional biases for negative interpersonal stimuli in clinical depression. *Journal of Abnormal Psychology*. 2004; 113:127–135.
- Lang, PJ., Bradley, MM., Cuthbert, BN. International affective picture system (IAPS): Technical manual and affective ratings. University of Florida, Center for Research in Psychophysiology; Gainesville: 1999.
- MacNamara A, Hajcak G. Distinct electrocortical and behavioral evidence for increased attention to threat in Generalized Anxiety Disorder. *Depression and Anxiety*. 2010; 27:234–243. [PubMed: 20196100]
- Mennin DS, Heimberg RG, Turk CL, Fresco DM. Applying an emotion regulation framework to integrative approaches to generalized anxiety disorder. *Clinical Psychology: Science and Practice*. 2002; 9:85–90.
- Mennin DS, Heimberg RG, Turk CL, Fresco DM. Preliminary evidence for an emotion regulation deficit model of generalized anxiety disorder. *Behaviour Research and Therapy*. 2005; 43:1281–1310. [PubMed: 16086981]
- Mogg K, Bradley BP. A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy*. 1998; 36:809–848. [PubMed: 9701859]
- Mogg K, Bradley BP. Attentional bias in generalized anxiety disorder versus depressive disorder. *Cognitive Therapy and Research*. 2005; 29:29–45.
- Mogg K, Millar N, Bradley BP. Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology*. 2000; 109:695–704. [PubMed: 11195993]
- Monk CS, Nelson E, McClure E, Mogg K, Bradley BP, Leibenluft E, et al. Ventrolateral prefrontal cortex activation and attention bias in response to angry faces in adolescents with generalized anxiety disorder. *American Journal of Psychiatry*. 2006; 163:1091–1097. [PubMed: 16741211]
- Most SB, Chun MM, Widders DM, Zald DH. Attentional rubbernecking: Attentional capture by threatening distractors induces blindness for targets. *Psychonomic Bulletin and Review*. 2005; 12:654–661. [PubMed: 16447378]
- Most SB, Smith SD, Cooter AB, Levy BN, Zald DH. The naked truth: Positive, arousing distractors impair rapid target perception. *Cognition & Emotion*. 2007; 21:964–981.
- Olatunji BO, Cisler JM, McKay D, Phillips M. Is disgust associated with psychopathology? Emerging research in the anxiety disorders. *Psychiatry Research*. 2010; 175:1–10. [PubMed: 19969378]
- Peers PV, Lawrence AD. Attentional control of emotional distraction in rapid serial visual presentation. *Emotion*. 2009; 9:140–145. [PubMed: 19186928]
- Posner MR, Rothbart MK. Developing mechanisms of self-regulation. *Development and Psychopathology*. 2000; 12:427–441. [PubMed: 11014746]
- Raymond JE, Shapiro KL, Arnell KM. Temporary suppression of visual processing in an RSVP task: an attentional blink? *Journal of Experimental Psychology: Human Perception and Performance*. 1992; 18:849–860. [PubMed: 1500880]
- Rinck M, Becker ES, Kellermann J, Roth WT. Selective attention in anxiety: Distraction and enhancement in visual search. *Depression and Anxiety*. 2003; 18:18–28. [PubMed: 12900949]
- Roemer L, Molina S, Borkovec T. An investigation of worry content among generally anxious individuals. *Journal of Nervous and Mental Disease*. 1997; 185:314–319. [PubMed: 9171808]
- Santos IM, Iglesias J, Olivares EI, Young AW. Differential effects of object-based attention on evoked potentials to fearful and disgusted faces. *Neuropsychologia*. 2008; 46:1468–1479. [PubMed: 18295286]
- Spielberger, CD., Gorsuch, RL., Lushene, R., Vagg, PR., Jacobs, GA. Manual for the State-Trait Anxiety Inventory. Consulting Psychologists Press, Inc.; Palo Alto, CA: 1983.

- Taghavi MR, Dalgleish T, Moradi AR, Neshat-Doost HT, Yule W. Selective processing of negative emotional information in children and adolescents with generalized anxiety disorder. *British Journal of Clinical Psychology*. 2003; 42:221–230. [PubMed: 14565889]
- Vogt J, De Houwer J, Koster EHW, Van Damme S, Crombez G. Allocation of spatial attention to emotional stimuli depends upon arousal and not valence. *Emotion*. 2008; 8:880–885. [PubMed: 19102600]
- Waters AM, Mogg K, Bradley BP, Pine DS. Attentional bias for emotional faces in children with generalized anxiety disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2008; 47:435–442. [PubMed: 18388762]
- Weierich MR, Treat TA, Hollingworth A. Theories and measurement of visual attentional processing in anxiety. *Cognition & Emotion*. 2008; 22:985–1018.
- Williams JMG, Mathews A, MacLeod C. The emotional Stroop task and psychopathology. *Psychological Bulletin*. 1996; 120:3–24. [PubMed: 8711015]
- Wieser MJ, Pauli P, Mühlberger A. Probing the attentional control theory in social anxiety: An emotional saccade task. *Cognitive, Affective, and Behavioral Neuroscience*. 2009; 9:314–322.

Figure 1.

The trial procedure for the emotional attentional-blink paradigm. Note that the distracter consisted of four distinct categories (disgust, erotic, fear, and neutral) presented at 200 and 800ms time lags.

Figure 2.
Percent accuracy by emotion and group. Bars represent standard error.

(A)

(B)

Figure 3.

Attentional control as a mediator of the effect of Group (GAD vs. NCC) on accuracy after fear (A) and neutral (B) distractors. Parenthetical coefficients represent the direct effects.

Asterisks indicate significant relationships ($*p < .05$, $**p < .01$)

Table 1

Demographic information by diagnostic group

	GAD	NCC
<i>N</i>	30	30
% female	50	50
Age	38.63 (11.26)	39.50 (10.29)
% Caucasian	86.7	73.3
% SES		
<\$39,999	37.9	66.7
\$40,000-\$69,999	31.0	30.0
>\$70,000	31.0	3.3
Marital Status		
% Married	65.5	30.0
% Single	27.6	50.0
% Divorced	6.9	20.0
Highest Education Level		
% High School	27.5	26.7
% College Degree	37.9	46.6
% Masters/Doctorate	34.6	26.7

Note: GAD = Generalized-anxiety disorder; NCC = Non-clinical control.

Table 2

Means and standard deviation by group on symptom measures

Symptom Measures	GAD M (SD)	NCC M (SD)	<i>t</i>	<i>d</i>
PSWQ	62.00 (10.34)	35.43 (8.67)	10.70	1.62
STAI - T	53.34 (10.24)	35.50 (8.73)	7.20	1.37
BDI	15.45 (8.55)	4.76 (4.69)	5.97	1.23
ACS	47.21 (8.46)	58.52 (6.72)	5.63	1.19

Note: All *t*-values were significant at $p < .001$. GAD = Generalized-anxiety disorder; NCC = Non-clinical control; PSWQ = Penn State Worry Questionnaire; STAI-T = State Trait Anxiety Inventory - Trait Subscale; BDI = Beck Depression Inventory; ACS = Attention Control Scale. Cohen's *d* was calculated as the difference between the mean scores in each group divided by the pooled standard deviation.

Table 3

Rapid serial visual presentation task means and standard deviations of accuracy percentage by emotion, lag, and group

Lag	GAD				NCC			
	Disgust M (SD)	Erotic M (SD)	Fear M (SD)	Neutral M (SD)	Disgust M (SD)	Erotic M (SD)	Fear M (SD)	Neutral M (SD)
2	56.81 (17.59)	41.25 (18.09)	66.81 (11.81)	67.22 (14.30)	60.42 (12.61)	38.75 (13.05)	71.25 (12.05)	78.05 (13.58)
8	69.86 (11.97)	75.83 (10.80)	71.11 (11.78)	73.89 (12.47)	75.28 (11.52)	81.80 (11.50)	79.58 (11.34)	81.25 (8.17)

Note: GAD = Generalized-anxiety disorder; NCC = Non-clinical control.

Table 4

Pearson correlation coefficients for symptom measures and target accuracy following the different emotional distractors for the full sample

Symptom Measures	Mean Target Accuracy			
	Disgust	Erotic	Fear	Neutral
PSWQ	-.22	-.09	-.31 *	-.42 **
STAI - T	-.16	.00	-.15	-.29 *
BDI	-.22	-.02	-.11	-.22
ACS	.17	.16	.29 *	.46 **
M (SD)	65.59 (10.63)	59.40 (10.45)	72.18 (10.29)	75.10 (11.65)

Note:

PSWQ = Penn State Worry Questionnaire; STAI - T = State Trait Anxiety Inventory - Trait Subscale; BDI = Beck Depression Inventory; ACS = Attention Control Scale.

*
 $p < .05$

**
 $p < .01$.