Published in final edited form as:
Cogn Emot. 2012 ; 26(2): 300–311. doi:10.1080/02699931.2011.602050.

Social anxiety and difficulty disengaging threat: Evidence from eye-tracking

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Abstract

Theoretical models of social phobia propose that biased attention contributes to the maintenance of symptoms; however these theoretical models make opposing predictions. Specifically, whereas Rapee and Heimberg (1997) suggest the biases are characterized by hypervigilence to threat cues and difficulty disengaging attention from threat, Clark and Wells (1995) suggest that threat cues are largely avoided. Previous research has been limited by the almost exclusive reliance on behavioral response times to experimental tasks to provide an index of attentional biases. The current study evaluated the relationship between the time-course of attention and symptoms of social anxiety and depression. Forty-two young adults completed a dot-probe task with emotional faces while eye movement data were collected. The results revealed that increased social anxiety was associated with attention to emotional (rather than neutral) faces over time as well as difficulty disengaging attention from angry expressions; some evidence was found for a relationship between heightened depressive symptoms and increased attention to fear faces.

Keywords

Social anxiety; depression; eye-tracking; vigilance; disengagement; attention; dot-probe

Cognitive-behavioral models of social phobia propose that biased attention plays a role in maintaining symptoms (cf. Clark & Wells, 1995; Rapee & Heimberg, 1997). Therefore, there have been significant efforts directed at understanding the role of attentional biases in this disorder. Interestingly, two of the primary models make opposing predictions about the nature of these biases. Specifically, Rapee and Heimberg's (1997) model posits that socially anxious individuals quickly detect cues that suggest negative evaluation and subsequently demonstrate difficulty disengaging their attention, whereas the Clark and Wells (1995) model suggests that threat signals are largely avoided. In both models; however, the argument is made that biased attention leads to overestimates of perceived risk in social situations, which presumably motivates the avoidance behavior known to maintain symptoms of anxiety (Foa & Kozak, 1986).

Despite both theoretical models implicating attentional biases in the maintenance of symptoms of social anxiety, experimental studies have yielded little consensus about the nature of these biases. Specifically, some research findings suggest that attention biases related to social anxiety are predominantly characterized by biased attention towards threat information (vigilance; Asmundson & Stein, 1994; Becker, Rinck, Margraf, & Roth, 2001;

Hope, Rapee, Heimberg, & Dombeck, 1990; Lundh & Öst, 1996; Maidenberg, Chen, Craske, Bohn, & Bystritsky, 1996; Mattia, Heimberg, & Hope, 1993; Mogg, Philippot, & Bradley, 2004; Mogg & Bradley 2002; Musa, Lepine, Clark, Mansell, & Ehlers, 2003; Pishyar, Harris, & Menzies, 2004), while other data suggest that increased social anxiety is related to avoiding threat information (avoidance; Amir et al., 1996; Chen, Ehlers, Clark, & Mansell, 2002; Horenstein & Segui, 1997; Kindt, Bogels, & Morren, 2003; Mansell, Clark, Ehlers, & Chen, 1999; Niekerk, Moeller, & Nortje, 1999). Furthermore, a number of published studies have yielded equivocal findings, without clear support for either a vigilant or avoidant pattern of attention (Gilboa-Schechtman, Foa, & Amir, 1999; Mansell, Ehlers, Clark, & Chen, 2002). In short, across many studies and various experimental paradigms, the findings have failed to provide a clear understanding of the nature of attentional biases in socially anxious participants.

Given this inconsistent literature, theorists have suggested that biases may be characterized by more sophisticated models of attention; suggesting that attention patterns vary over the time-course of stimulus presentation. Two of the predominant models explain patterns of attention in social anxiety differently. The vigilance-avoidance model (Mogg et al., 2004) states that attention is initially allocated towards threat, and after threat is detected it is subsequently avoided. An alternative proposal (difficulty disengaging; Amir, Elias, Klumpp, & Przeworski, 2003) states that there are not differences in the initial detection of threat information, but that individuals struggle to direct attention away from threat cues once they have been detected.[1] To date, difficulty disengaging attention is a proposal that has garnered significant empirical support in research addressing state/trait anxiety and attention. This literature has demonstrated that elevations in these more general measures of anxiety symptoms (i.e., not social anxiety specifically) are associated with maintaining attention on threat cues and difficulty disengaging from them even when there is no bias in the initial orienting of attention (Fox et al., 2001, 2002; Salemink, van den Hout, & Kindt, 2007). Similar to the theorized difficulty disengaging in social phobia (Amir et al., 2003), it has been hypothesized that individuals with depression demonstrate attentional biases characterized by difficulty disengaging attention from dysphoric stimuli (for a review, see Joormann, 2009).

To date, the bulk of previous research in both anxiety and depression has assessed biases by measuring manual reaction-times to stimuli presented at a certain point in time and then calculating latency bias scores. These bias scores suggest vigilance versus avoidance of threat based on either facilitated or slowed reaction time to detect probes (i.e., in the dot-probe task) or color-name threat words (i.e., Stroop task). In essence, this metric takes a snapshot of attention in time, thus undermining the ability to effectively capture overt shifts in attention over time. This limitation has prompted researchers to argue in support of measuring attention overtly (i.e., via the measurement of eye movements). It should be noted that attention can shift in the absence of explicit eye movements (i.e., covert attention), and research that infers attention from reaction-time latency scores may be capturing such shifts; however, under natural viewing conditions shifts of visual attention and the programming of eye movements are closely linked, both functionally and anatomically (e.g., Bolopolski & Theeuwes, 2009; Corbetta & Shulman, 2002). Thus eye movements enable the measurement of shifts of attention, locations onto which visual attention is focused, and the time course of visual selection. The methodological benefits of eye movement measures are particularly useful for testing the assumptions underlying the proposals of vigilance-avoidance and difficulty disengaging attention; eye movements can be used to discern the time course and

[1]Of note, these two proposals are not irreconcilable and further, evidence from the visual search task suggests that in fact the pattern of attention associated with anxiety is to demonstrate both facilitated attention and difficulty disengaging from threat cues (cf. Cisler, Bacon, & Williams, 2009).

the nature of visual selection. In short, the use of eye-tracking to precisely measure overt attention to threat allows for the measurement of both initial and subsequent viewing behavior (see Weirich, Treat, & Hollingworth, 2008 for a discussion), and such distinctions between orienting and disengagement are challenging when relying on reaction-time indices (see Salemink et al., 2007 for more detailed discussion). Lastly, previous research has suggested that in non-clinical samples the reaction-time latency index is an unreliable measure of attention allocation (Schmukle, 2005).

Two published studies have used eye-tracking methods to assess relative attention to threatening (versus non-threatening) emotional faces in socially anxious participants. Both of these studies have provided some support for an attentional pattern characterized by initial vigilance to detect social threat signals (Garner, Mogg, & Bradley, 2006; Gamble & Rapee, 2010). First, using an analogue sample of individuals with high vs. low social anxiety Garner and colleagues (2006) found that participants with high social anxiety rapidly oriented towards emotional information and subsequently attended more briefly to the emotional information when under elevated state anxiety (i.e., when they were anticipating giving a speech). However, in contrast to theoretical predictions, attention biases to emotional versus neutral faces were not found in the absence of elevated state anxiety and the bias that was observed was not specific to negative emotions (biased attention was found for both angry and happy faces). More recently, Gamble and Rapee (2010) found evidence of attention bias to angry faces in individuals diagnosed with social phobia. However, examination of the mean proportions of fixations to happy and angry faces within the initial 500 ms suggests that the observed effect was likely to be driven by *avoidance* of angry faces in the non-phobic controls as opposed to *hypervigilance* in participants with social phobia (cf., Gamble & Rapee, 2010; p.42). These studies were novel in using eye-tracking methods to delineate the role of biased attention in social anxiety; however, when analyzing the data neither study analyzed the continuous gaze data across the trial in segments of less than 1 second. Analyses of eye-tracking data in segments of a second or longer (as done in these studies) results in the loss of potentially important information given that it is typical to make 3 to 4 fixations per second (Rayner, 1998). In summary, the Garner et al., (2006) and Gamble and Rapee (2010) studies have advanced the methods for studying attention bias in social anxiety but the precise nature of such biases remains elusive.

Eye-tracking research in depression has provided initial evidence to suggest that individuals with depressed mood demonstrate preferential attention to dysphoric information. Evidence suggests that, in comparison to non-disordered controls, adults with depressed mood look longer at dysphoric stimuli (Kellough, Beevers, Ellis, & Wells, 2008) and on sad facial stimuli (Leyman, De Raedt, Vaeyens, Philippaerts, 2010). Further, in keeping with some of the work in anxiety, there has been some evidence to suggest that biases for emotional information are not evidenced in the early stages of stimuli processing, but rather while sustaining attention (i.e., difficulty disengaging; Caseras, Garner, Bradley, & Mogg, 2007; Sears, Thomas, LeHuquet, & Johnson, 2010). Interestingly, additional evidence for difficulty disengaging attention from dysphoric stimuli comes from findings suggesting that dysphoric individuals have compromised attentional control for emotional information (Derakshan, Salt, & Koster, 2009).

Therefore, the current study examined the relationship between attention to threat information to symptoms of social anxiety and depression. Specifically, this study measured participants' eye-gaze (continuous eye-tracking data) while they performed a dot-probe task with emotional (angry, happy, fear) and neutral faces. It was hypothesized that: 1) symptoms of social anxiety and depression would be related to increased overall attention to the negative emotions (anger, fear), 2) symptoms of social anxiety would be positively and

significantly related to attention to negative emotional faces in the initial stimulus presentation time (consistent with the vigilance to threat hypothesis 3) symptoms of social anxiety would be more strongly related to attention towards angry expressions than symptoms of depression (given this emotion's obvious connection to negative evaluation).

Methods

Participants

Participants were 42 undergraduate students (for a summary of demographic data see Table 1). Their age ranged from 18 to 21 years with a mean age of 19.24 (SD = .91). The sample consisted of 54.8% female students and the racial/ethnic composition was 61.9% Caucasian, 21.4% Asian, 4.8% African American, 4.8% Hispanic, 5% "Other," and 2.4% "More than one race." Participants were recruited through the psychology department participant pool and were provided with research course credit for participating.

Measures

The *Social Interaction Anxiety Scale* (SIAS; Mattick & Clark, 1998) was used to assess symptoms of social anxiety. The measure was selected primarily because of its use in previous non-clinical samples assessing the time-course of overt attention (cf. Buckner et al., 2010). In addition, the SIAS is particularly relevant to attentional biases to emotional facial expressions given its focus on capturing symptoms of anxiety specifically focused on interactions with other people (i.e., as opposed to performing or worrying about what others think). The SIAS demonstrates strong correlations with the Social Phobia and Anxiety Inventory (SPAI) (r=0.85; Peters, 2000), supporting the convergent validity of these measures. Further, the internal consistency in the current sample suggests good reliability (α =.85).

A *Visual Analogue Scale* (VAS) was presented to participants at the initiation of the experiment. Participants were provided the image of a horizontal scale with anchors at 0, 50, and 100. Participants were provided the explanation that "0" represents "no anxiety at all, the most relaxed you can imagine being," whereas "100" represents "the most anxious you have ever felt or could ever imagine feeling." Prior to completing the dot-probe task participants were asked to verbally report to the experimenter the number the most appropriately represented how anxious they felt at that time.

The *Beck Depression Inventory-II* (BDI-II; Beck, Steer, & Brown, 1996) is a 21-item self-report measure created to assess both the presence and the severity of depressive symptoms. This scale has been used extensively in research and demonstrates strong psychometric properties; confirmatory factor analyses indicate that a two-factor structure provides and adequate fit for this measure (Beck et al, 1996; Dozois, Dobson, & Ahnberg, 1998). This sample demonstrated good internal consistency on this measure (α = .82).

Attentional biases for facial displays of emotions were assessed using the modified dot-probe task (cf. MacLeod, C., Mathews, A., & Tata, P., 1986). Emotional stimuli included in the dot-probe task consisted of 224 pictures of color face pairs of the same actor (64 angry-neutral pairs, 64 fear-neutral pairs, 64 happy-neutral pairs, 32 neutral-neutral pairs). The images were 80 × 70 mm wide and their centers were separated by 170mm (with 90mm from edge of one image to the other). These images were drawn from the standardized MacArthur NimStim Face stimulus set, which has demonstrated high inter-rater agreement (NimStim Face Stimulus Set; Tottenham et al., 2008).

Procedure

Participants sat 90cm from the computer screen, resulting in a 5° vertical visual angle. The experiment began with a 2-dimensional calibration of the eye-tracking system in which participants were asked to fixate a visual marker that appeared at 9 different locations on the screen in random order (in the four corners of the screen as well as midway in between these locations and the screen center). Following this, a validation cycle verified that the eye movement measurement was consistent and accurate to the nearest .3 degree of visual angle. Each trial began with a 1,000 ms initial fixation cross at the center of the screen. The cross was then replaced by a pair of facial stimuli displayed for 1,500 ms to the right and left of the previously visible fixation cross. This relatively long stimulus presentation was selected to provide an opportunity for the capture of engagements and disengagements of attention, given past research suggesting that social anxiety and depression may be characterized by difficulty disengaging from threat (Amir et al., 2003; Caseras et al., 2007). Immediately following the offset of the stimulus presentation a probe (an arrow pointing up or down) appeared in the position of one of the faces (replicating the design employed by Mogg & Bradley, 2006). Participants were instructed to respond as quickly as possible indicating what type of probe appeared (up or down arrow). Trials were randomized based on emotional face position (left or right), probe type (up or down), and probe position (left or right). The experiment consisted of 16 practice trials and 112 experimental stimuli pairs (32 angry-neutral, 32 fear-neutral, 32 happy-neutral, and 16 neutral-neutral pairs). Each stimulus pair was presented twice for a total of 224 experimental trials. The pace of the experiment was experimenter-controlled, thus inter-trial interval varied naturally. Given the length of the experiment, participants were given the opportunity to rest on two occasions (after trials 75 and 150); recalibration on the 9-point task was conducted after each break.

The time course of facial inspections was measured using an SR Research Eyelink 1000 tower system. The system recorded the position of the right eye at a rate of 1000 Hertz with an accuracy of better than .3 degrees of visual angle while participants binocularly viewed the stimulus presentations. Participant head location was held stable by a chinrest and forehead bar throughout trials. Eyelink software was used to parse the sampled stream of eye location measurements into movements (saccades), and subsequent viewing (fixation) durations, and custom-developed software was used to map each saccade and subsequent saccades onto corresponding visual image locations. Two areas of interest (AOIs) were identified for each trial with each corresponding to the total area of one of the two visible faces that were presented as part of the dot-probe task.

Data Analysis Plan

Our primary aim was to examine the relation between social anxiety and time-course of attention to emotional versus neutral faces. Attention was operationalized in terms of initial face selection and overall emotion-specific dwell-time such that the amount of time a participant fixated on a stimulus indexed overt visual attention allocated to it. Then, in order to investigate attention over time (i.e., time-course), we divided each of our 1,500ms stimulus trials into three 500ms segments (consistent with previous eye-tracking studies; Buckner et al., 2010; Hermans et al., 1999).

Further, in order to facilitate comparisons between this study and previous work, we conducted the same analyses that Garner and colleagues (2006) used in measuring preferential initial detection of the emotional faces. That is, Garner and colleagues proposed an “eye movement (EM) direction bias score” which is calculated by measuring the number of trials in which the first eye movement was toward the emotional stimulus as a percentage of the number of trials with EMs (e.g., for angry faces it the number of trials in which the

first eye movement was directed towards the angry face divided by the total number of trials with EMs to neutral-angry face pairs; cf., Garner et al., 2006, p. 762).

One participant was missing BDI-2 data and 3 participants were missing VAS data. Given this relatively small number of missing variables and the unselected nature of this sample, missing data was handled with list-wise deletion.

Results

Preliminary analyses were conducted to examine the distribution of the self-report measures. Results of these analyses indicate that scores on the SIAS, and the BDI-II were normally distributed, whereas VAS data were positively skewed (skew was corrected via square-root transformation). This unselected sample had a range of scores on each of the self-report questionnaires of clinical symptoms, with mean scores falling in the non-clinical range. For a summary of scores on self-report measure see Table 1.

The first two analysis sections address study hypotheses, followed by an analysis to facilitate comparisons with previous research (cf. Garner et al., 2006) and an exploratory analysis of disengagement from threat.

Total Dwell time on emotional faces

First, we tested our first hypothesis that social anxiety and depression would be significantly associated with increased attention to emotional faces (see Table 2). Consistent with this hypothesis, results revealed relatively strong and reliable correlations between social anxiety (SIAS scores) and the amount of time participants attended to emotional faces. Specifically, increased social anxiety was related to total dwell time across the 1500ms stimulus presentation interval for Angry (r= .44, p =.004), Fear (r= .35, p =.02), and Happy faces (r= .34, p =.03). Next, we examined the specificity of these relationships by also examining whether depressive symptoms were associated with increased attention to emotional faces. BDI-2 scores were weakly (non-significantly) correlated with attention to angry (r= .27, p =.09) and happy (r= .24, p =.13) expressions. However, increases in depressive symptoms were more reliably correlated with longer dwell-time to fearful expression (r= .32, p =.04). Further, state anxiety levels were not correlated with any dwell-time variables (smallest p =.10). To explore the potential interactions between different symptoms, regression analyses were performed where social anxiety and depression scores were entered in step 1, and their interaction in step 2. The interactions of social anxiety and depression did not significantly predict total dwell time to any of the emotional faces (anger: β = -.16, $t(40) = -1.10$, p = .28, fear: β = -.11, $t(40) = -1.04$, p = .30, happy: β = -.18, $t(40) = -1.13$, p = .27). Similar non-significant results were found for the interaction of state anxiety and social anxiety (anger: β = -.16, $t(38) = -1.07$, p = .29, fear: β = -.16, $t(38) = -1.04$, p = .30, happy: β = -.18, $t(38) = -1.13$, p = .27). In short, results revealed that neither depression nor state anxiety interacted with symptoms of social anxiety to predict dwell time to any of the emotional faces.[2]

Dwell time on emotional faces by 500ms segments

Table 2 provides a summary of the relationship between symptoms of social anxiety and depression with visual attention across the 1500ms stimulus presentation time. According to the vigilance to threat hypothesis, participants with relatively high levels of social phobia were expected to orient quickly to faces with negative emotional valence (Hypothesis 2). The results revealed a more complex pattern. Evaluating the time-course of attention across

[2]These interaction effects were similarly tested predicting total number of fixations, EM bias index, and disengagement indices. Interactions of social anxiety x depression and social anxiety x state anxiety did not predict any of these variables.

the 1500ms suggested that social anxiety levels were associated with longer dwell times on angry expressions across all three 500ms epochs; whereas attention to the other emotional expressions (fear, happy) was significantly associated with symptoms of social anxiety only in the last 500ms of the stimulus presentation (1000–1500ms; fear, r= .44, p =.004, happy, r= .37, p =.017). Symptoms of depression, on the other hand, were consistently correlated with attention to the emotional face only in the middle 500ms of stimulus presentation, and there was no significant relationship between state anxiety and dwell time segments (all rs <. 25, all ps >.05).

Of note; however, tests of dependent correlations revealed that the relationship between symptoms of social anxiety and visual attention was not significantly different than the relationship between symptoms of depression and visual attention (Hypothesis 3). That is, none of the correlations between anxiety and attention were significantly stronger than the correlations between depression and attention (when controlling for the relationship between anxiety and depression; largest z=.95, p=.34).

Comparison with previous research

Similar to previous work, our results demonstrated that participants initially directed their gaze more frequently to the emotional face than the neutral face. Further, a one-sample t test confirmed that this bias was significantly greater than 50% for all of the emotional faces [angry, $t(41) = 4.98$, p <.001, fearful $t(41) = 4.43$, p <.001, and happy $t(41) = 3.78$ p <.001].

Consistent with Garner and colleagues, our results provided no evidence for a relationship between eye movement (EM) bias to any of the emotional faces and symptoms of anxiety or depression. Specifically, correlations between symptoms of social anxiety and EM direction bias to angry (r = .01), fearful (r = -.17), and happy (r = -.004) faces were all small in magnitude and failed to reach statistical significance (smallest p =.27). Similar results were found for the relationship between symptoms of both depression and state anxiety to EM bias to the emotional faces, which were also all non-significant (smallest p = .21).

Disengagement from emotional expressions

Given the suggestion from the dwell-time data that symptoms of social anxiety were associated with visual attention oriented towards the emotional expression late in the stimulus presentation (i.e., 1000–1500ms), we further explored the theoretical proposal that social anxiety is associated with difficulty disengaging attention from emotional threat cues. Specifically, a disengagement index was created that measured how long it took individuals to shift attention away from the emotional face if the following conditions were met: 1) they were looking at the emotional face when the probe appeared, and 2) the probe was invalid, such that it appeared in the opposite visual field from the emotional face (for the neutral-neutral trials the conditions were modified such that we measured how long it took the participant to shift away from the neutral face when the probe followed the other neutral face). Under these conditions, participants had to disengage their visual attention from the field where they had been looking and shift their visual attention in order to accurately detect the probe. Participant's disengagement index was calculated by summing their detection time (i.e., duration from when the probe appeared to when they initiated a saccade away from the emotional face) across trials and dividing by the number of trials in which the aforementioned conditions were met, such that a higher disengagement index suggests longer latency (difficulty) disengaging visual attention.

Paired-sample t-tests revealed that across the sample participants demonstrated facilitated disengagement from angry emotional faces relative to happy faces, $t(41) = -2.26$, p=.03. Interestingly; however, there was a specific relationship between symptoms of social anxiety

and disengagement from angry faces, such that symptoms of social anxiety were significantly associated with longer latency to disengage from angry expressions, r= .34, p =.03. Further, on these angry-neutral trials, there was a trend to suggest that social anxiety may be related to difficulty disengaging attention from neutral expressions when they were paired with angry expressions (r= .29, p =.07). Additional evidence for the specificity of this effect was that there was no relationship between symptoms of social anxiety and disengagement from fearful (r= -.08, ns) happy (r= .02, ns) or neutral (r= .09, ns) expressions (note: a slightly modified assessment of disengagement was conducted on the neutral-neutral trials such that disengagement was characterized by how long it took individuals to shift attention away from the face if the neutral face they were looking at when the probe was presented was *not* the face the probe followed). Further, no significant relationships were found between symptoms of depression or state anxiety and disengagement from emotional or neutral expressions (see Table 3).

Discussion

This study contributes to the growing body of research aimed at measuring the nature of attentional biases in anxious individuals. It replicates aspects of previous research in that symptoms of social anxiety were not related to initial orienting towards emotional faces. These results are in contrast to predictions suggesting that social anxiety is characterized by vigilance to detect threat, though importantly this finding requires further assessment in clinical populations. Despite this evidence that social anxiety is not associated with an increased rate of saccades to emotional expressions, our results indicate that in the first 500ms of stimulus presentation there was a significant relationship between attentional dwell time for angry expressions and symptoms of social anxiety, suggesting that although social anxiety may not be associated with significantly pathological orienting behavior, it may be associated with a biased pattern to attend relatively more to threat signals than neutral signals. Further, in the current sample, there was not evidence for a relationship between symptoms of depression and attention to angry expressions; thus the observed bias to angry expressions is specific to social anxiety and not negative affect more generally. Together, these results partially support our hypothesis that social anxiety would be related to vigilance towards threat cues; this vigilance was observed in dwell-time during the early stages of face viewing and not by initial saccadic behavior.

Our hypothesis that symptoms of both social anxiety and depression would be related to attention towards negative emotions was partially supported by evidence suggesting that symptoms of both social anxiety and depression were related to longer overall dwell time for fearful expressions. It is worth noting that in the absence of classically dysphoric (i.e., sad) expressions, this study unfortunately cannot speak to the attentional biases that are typically implicated in individuals with symptoms of mood disorders. Further, it is interesting that fearful emotions appeared to be relevant for participants reporting depressive symptoms given that, of the three emotional expressions, fear presumably represents the most vulnerable of the emotions. For angry expressions, overall attention was significantly related to symptoms of social anxiety but not depression (although the magnitude of these relationships were not significantly different from one another).

Our follow-up exploratory analyses provided some evidence that symptoms of social anxiety may also be associated with difficulty disengaging attention from threat information (i.e., anger expressions). The specificity of this finding was strengthened by the results on both other emotional trial types (i.e., fear-neutral and happy-neutral pairs) and neutral-neutral face pairs in which there was no relationship between social anxiety and disengagement from faces. Lastly, although non-significant, there was a trend suggesting that, on trials where an angry face was paired with a neutral face, elevated social anxiety may be related to

slower disengagement from *the neutral* expressions (as well as the aforementioned slowed disengagement from angry). This preliminary effect is worth exploring in future research, as it may suggest that the presence of social threat information yields a general deficit in attentional control.

Given that previous literature has implicated state anxiety in attentional biases for threat (e.g., Bradley et al., 2000; Fox et al., 2001), it is perhaps surprising that state anxiety levels were not related to eye-movement indices; and further, that they did not interact with social anxiety to predict overt attention biases. However, it is worth noting that state anxiety was not manipulated in this study and, perhaps as a result, participants reported relatively low levels of state anxiety with a restricted range (i.e., the mean was very low and the maximum was the mid-point of the scale). Given findings from previous research, investigating the impact of state anxiety and the potential interaction between state and trait anxiety will be worthwhile in future work.

Taken together, the results of this study are consistent with theory suggesting that disengagement from threat cues is problematic for individuals with social anxiety. These findings are consistent with the results of a recent study by Buckner and colleagues (2010). This experiment used a passive viewing task in which participants were presented with one face and 3 non-face stimuli for 2,000ms. Their results suggested that on trials where a negative emotion was present (disgust), socially anxious participant spent more time looking at the negative emotion later during the last 500ms of the trial. Like our study, the effects were evident only in the final 500ms that the stimuli were present. Of note; however, our results were inconsistent with the findings presented by Buckner and colleagues on visual attention to happy expressions. Whereas our data suggested a positive relationship between symptoms of social anxiety and attention towards happy expressions, Buckner and collegues found no relationship between symptoms of social anxiety and time attended to happy expressions. Our data is suggestive that attentional biases may not be unique to overtly threatening images, and suggests the importance of considering the interpretation of (what are commonly considered to be) “positive” emotional expressions, a point that has been discussed in recent research using eye-blink startle (Garner, Clarke, Graystone, & Baldwin, 2011). That is, if an individual is concerned about being laughed at by others for things that they do or say (a common fear reported by individuals with social phobia), a smiling face could be considered threatening rather than reassuring, a point that is supported by data suggesting that for some individuals with social anxiety, happy expressions are rated less positively compared to non-anxious controls (Schofield, Gibb, & Coles, 2007). In short, although this finding is consistent with the general bias to attend to emotional expressions reported by Garner and colleagues (2006), it is in conflict with other empirical and theoretical work, and therefore highlights the importance of replication.

Although this study’s notable strengths include the measurement of visual attention dynamically as well as the measurement of symptoms of both social anxiety and depression, the current findings should also be considered in light of the study limitations. First, the design of the dot-probe task does not directly assess a participant’s disengagement from the presence of a threat stimulus. Instead this task measures disengagement from the place on the screen where the threat stimuli *used to be.* Thus, future research should consider using paradigms that enable more direct assessment of disengagement. Further, this study relies on correlational and cross-sectional data of a non-clinical population, thereby undermining our ability to draw conclusions about the anxiety disorders. Lastly, future research investigating these biases prospectively will be important in understanding their potential contribution to the etiology and maintenance of symptoms of social anxiety. Specifically, despite theoretical predictions suggesting that these biases play a role in the etiology and maintenance of social anxiety, to these authors’ knowledge there has been no prospective longitudinal research

characterizing the role of attentional biases in the development of pathological anxiety. Given the exciting line of research suggesting that modifying attentional biases may be a clinically useful intervention for patients with social phobia (Amir, Weber, Beard, Bomyea, & Taylor, 2008; Amir et al., 2009; Schmidt, Richey, Buckner, & Timpano, 2009), a better understanding of their development will undoubtedly inform both these programs and potentially prevention-focused work.

Although eye-tracking enables a dynamic measurement of overt visual attention, the current paradigm does not allow for the measurement of covert attention, or the shifting of attention *mentally* (i.e., shifting attention without making an eye-movement). Although related, these two processes are distinct mechanisms of orienting, and covert attention can shift much more quickly relative to overt orienting (Müller & Rabbitt, 1989). Given that the overt attentional processes that are captured by eye movements are always preceded by shifts in covert attention (Klein, 1980), the current study's failure to capture vigilance to threat is potentially explained by its measurement of overt attention exclusively. Consistent with that claim, it has been proposed that the inconsistency in the literature on attentional bias in anxiety may be a result in part of the failure to measure both covert and over orienting (Weierich, Treat, & Hollinghead, 2008). Thus, future research assessing both covert and overt attention may facilitate our understanding of the nature and role of attentional biases towards threat in social anxiety.

References

Amir N, Beard C, Taylor CT, Klumpp H, Elias J, Burns M, Chen X. Attention training in individuals with generalized social phobia: A randomized controlled trial. Journal of Consulting and Clinical Psychology. 2009; 77:961–973. [PubMed: 19803575]

Amir N, Weber G, Beard C, Bomyea J, Taylor CT. The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. Journal of Abnormal Psychology. 2008; 117:860–868. [PubMed: 19025232]

Amir N, McNally RJ, Riemann BC, Burns J, Lorenz M, Mullen JT. Suppression of the emotional Stroop effect by increased anxiety in patients with social phobia. Behaviour Research and Therapy. 1996; 34:945–948. [PubMed: 8990547]

Amir N, Elias J, Klumpp H, Przeworski A. Attentional bias to threat in social phobia: Facilitated processing of threat or difficulty disengaging attention from threat? Behaviour Research and Therapy. 2003; 41:1325–1335. [PubMed: 14527531]

Asmundson GJG, Stein MB. Selective processing of social threat in patients with generalized social phobia: evaluation using a dot-probe paradigm. Journal of Anxiety Disorders. 1994; 8:107–117.

Beck, AT.; Steer, RA.; Brown, GK. Beck Depression Inventory manual. 2. San Antonio, CA: Psychological Corporation; 1996.

Becker ES, Rinck M, Margraf J, Roth WT. The emotional stroop effect in anxiety disorders: General emotionality of disorder specificity? Journal of Anxiety Disorders. 2001; 8:107–117.

Belopolsky AV, Theeuwes J. When are attention and saccade preparation dissociated? Psychological Science. 2009; 20:1340–1344. [PubMed: 19788530]

Bradley BP, Mogg K, Millar NH. Covert and overt orienting of attention to emotional faces in anxiety. Cognition and Emotion. 2000; 14:789–808.

Buckner JD, Maner JK, Schmidt NB. Difficulty disengaging attention from social threat in social anxiety. Cognitive Therapy and Research. 2010; 34:99–105. [PubMed: 20182655]

Caseras X, Garner M, Bradley BP, Mogg K. Biases in visual orienting to negative and positive scenes in dysphoria: An eye movement study. Journal of Abnormal Psychology. 2007; 116:491–497. [PubMed: 17696705]

Chen YP, Ehlers A, Clark DM, Mansell W. Patients with generalized social phobia direct their attention away from faces. Behaviour Research and Therapy. 2002; 40:677–687. [PubMed: 12051486]

Cisler J, Bacon AK, Williams NL. Phenomenological characteristics of attentional biases toward threat: A critical review. Cognitive Therapy and Research. 2009; 33:221–234. [PubMed: 20622985]

Clark, DM.; Wells, A. A cognitive model of social phobia. In: Heimberg, RG.; Liebowitz, MR.; Hope, DA.; Schnieder, FR., editors. Social phobia: Diagnosis, Assessment, and Treatment. New York: The Guilford Press; 1995. p. 69-93.

Corbetta M, Shulman GL. Control of goal-directed and stimulus-driven attention in the brain. Neuroscience (Nature Reviews). 2002; 3:201–215.

Derakshan N, Salt M, Koster EHW. Attentional control in dyspohoria: An investigation using the antisaccade task. Biological Psychology. 2009; 80:251–255. [PubMed: 18950676]

Dozois DJA, Dobson KS, Ahnberg JL. A psychometric evaluation of the Beck Depression Inventory-II. Psychological Assessment. 1998; 10:83–89.

Eizenmann M, Yu LH, Grupp L, Eizenman E, Ellenbogen M, Gemar M, Levitan RD. Psychiatry Research. 2003; 118:117–128. [PubMed: 12798976]

Foa EB, Kozak MJ. Emotional processing of fear: Exposure to corrective information. Psychological Bulletin. 1986; 99:20–35. [PubMed: 2871574]

Fox E, Russo R, Bowles &, Dutton D. Do threatening stimuli draw or hold visual attention in subclinical anxiety? Journal of Experimental Psychology: General. 2001; 130:681–700. [PubMed: 11757875]

Fox E, Russo R, Dutton D. Attentional bias for threat: Evidence for delayed disengagement from emotional faces. Cognition and Emotion. 2002; 16:355–379. [PubMed: 18273395]

Garner M, Mogg K, Bradley B. Orienting and maintenance of gaze to facial expressions in social anxiety. Journal of Abnormal Psychology. 2006; 115:760–770. [PubMed: 17100533]

Garner M, Clarke G, Graystone H, Baldwin DS. Defensive startle response to emotional social cues in social anxiety. Psychiatry Research. 2011; 186:150–152. [PubMed: 20833435]

Gamble AL, Rapee RM. The time-course of attention to emotional faces in social phobia. Journal of Behavior Therapy and Experimental Psychiatry. 2010; 41:39–44. [PubMed: 19781689]

Gilboa-Schechtman E, Foa EB, Amir N. Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. Cognition & Emotion. 1999; 13:305–318.

Hermans D, Vansteenwegen D, Eelen P. Eye movement registration as a continuous index of attention deployment: Data from a group of spider anxious students. 1999; 13:419–434.

Hope DA, Rapee RM, Heimberg RG, Dombeck MJ. Representations of the self in social phobia: Vulnerability to social threat. Cognitive Therapy and Research. 1990; 14:177–189.

Horenstein M, Segui J. Chronometrics of attentional processes in anxiety disorders. Psychopathology. 1997; 30:25–35. [PubMed: 9042679]

Joormann, J. Cognitive aspects of depression. In: Gotlib, IH.; Hammen, CL., editors. Handbook of Depression. 2. New York: Guilford; 2009. p. 298-321.

Kellough JL, Beevers CG, Ellis AJ, Wells TT. Time course of selective attention in clinically depression in young adults: An eye tracking study. Behaviour Research and Therapy. 2008; 46:1238–1243. [PubMed: 18760771]

Kindt M, Bogels S, Morren M. Processing bias in children with separation disorder, social phobia, and generalized anxiety disorder. Behavior Change. 2003; 20:143–150.

Leyman L, De Raedt R, Vaeyens R, Philippaerts RM. Attention for emotional facial expressions in dysphoria: An eye-movement registration study. Cognition & Emotion. 2010; 25:111–120. [PubMed: 21432658]

Lundh LG, Öst LG. Recognition bias for critical faces in social phobics. Behaviour Research and Therapy. 1996; 34:787–794. [PubMed: 8952121]

MacLeod C, Mathews A, Tata P. Attentional bias in emotional disorders. Journal of Abnormal Psychology. 1986; 95:15–20. [PubMed: 3700842]

Maidenberg E, Chen E, Craske M, Bohn P, Bystritsky A. Specificity of attentional bias in panic disorder and social phobia. Journal of Anxiety Disorders. 1996; 10:529–541.

Mansell W, Clark DM, Ehlers A, Chen Y. Social anxiety and attention away from emotional expressions. Cognition and Emotion. 1999; 13:673–690.

Mansell W, Ehlers A, Clark DM, Chen Y. Attention to positive and negative evaluative words: Investigating the effects of social anxiety, trait anxiety, and social threat. Anxiety, Stress, & Coping. 2002; 15:19–29.

Mattia JL, Heimberg RG, Hope DA. The revised stroop colour-naming task in social phobics. Behaviour Research and Therapy. 1993; 31:305–313. [PubMed: 8476405]

Mattick RP, Clark JC. Development and validitation of measures of social phobia scrutiny fear and social interaction anxiety. Behaviour Research and Therapy. 1998; 36:455–470. [PubMed: 9670605]

Mogg K, Bradley BP. Selective orienting of attention to masked threat faces in social anxiety. Behaviour Research and Therapy. 2002; 40:1403–1414. [PubMed: 12457635]

Mogg K, Philippot P, Bradley BP. Selective attention to angry faces in clinical social phobia. Journal of Abnormal Psychology. 2004; 113:160–165. [PubMed: 14992669]

Mogg K, Bradley BP. Time course of attentional bias for fear-relevant pictures in spider-fearful individuals. Behaviour Research and Therapy. 2006; 44:1241–1250. [PubMed: 16870133]

Müller HJ, Rabbitt PM. Reflexive and voluntary orienting of visual attention: Time course of activation and resistance to interruption. Journal of Experimental Psychology: Human Perception and Performance. 1989; 15:315–330. [PubMed: 2525601]

Musa C, Lepine JP, Clark DM, Mansell W, Ehlers. Selective attention in social phobia and the moderating effect of a concurrent depressive disorder. Behaviour Research and Therapy. 2003; 41:1043–1054. [PubMed: 12914806]

Niekerk JK, Moeller AT, Nortje C. Self-schema in social phobia and panic disorder. Psychological Reports. 1999; 84:843–854. [PubMed: 10408207]

Peters L. Discriminant validity of the Social Phobia and Anxiety Scale (SIAS). Behaviour Research and Therapy. 2000; 38:943–950. [PubMed: 10957828]

Pishyar R, Harris LM, Menzies RG. Responsiveness of measures of attentional biases to clinical change in social phobia. Cognition and Emotion. 2004; 22:1209–1227.

Rapee RM, Heimberg RG. A cognitive-behavioral model of anxiety in social phobia. Behaviour Research and Therapy. 1997; 8:741–756. [PubMed: 9256517]

Rayner K. Eye movements in reading and information processing: 20 years of research. Psychological Bulletine. 1998; 124:372–422.

Salemink E, van den Hout MA, Kindt M. Selective attention and threat: Quick orienting versus slow disengagement and two versions of the dot probe task. Behaviour Research and Therapy. 2007; 45:607–615. [PubMed: 16769035]

Schmukle SC. Unreliability of the dot-probe task. European Journal of Personality. 2005; 19:595–605.

Schmidt NB, Richey JA, Buckner JD, Timpano KR. Attention training for generalized social anxiety disorder. Journal of Abnormal Psychology. 2009; 118:5–14. [PubMed: 19222309]

Schofield C, Coles M, Gibb B. Social anxiety and interpretation biases for facial displays of emotion: Emotion detection and ratings of social cost. Behaviour Research and Therapy. 2007; 45:2950–2963. [PubMed: 17868640]

Sears CR, Thomas CL, LeHuquet JM, Johnson JCS. Attentional biases in dysphoria: An eye-tracking study of the allocation and disengagement of attention. Cognition & Emotion. 2010; 24:1349–1368.

Tottenham N, Tanaka J, Leon A, McCarry T, Nurse M, Hare TA, Marcus DJ, Westerlund A, Casey BJ, Nelson C. The NimStim set of facial expressions: Judgements from untrained research participants. Psychiatry Research. 2009; 168:242–249. [PubMed: 19564050]

Weierich MR, Treat TA, Hollingworth A. Theories and measurement of visual attentional processing in anxiety. Cognition and Emotion. 2008; 22:985–1018.

Table 1

Summary of demographic variables

Demographic Variable	**Percent**		
Caucasian	61.9		
Hispanic	4.8		
African American	4.8		
Asian	21.4		
More than one race	2.4		
Other	4.8		
	Mean (SD)	Range	Skewness
Age (Years)	19.2 (.91)		
BDI-II	8.6 (6.56)	0 – 24	1.35
SIAS	19.0 (10.65)	0 – 44	0.60
VAS raw	13.7 (17.12)	0 – 50	2.77
VAS sqrt transformed	2.71 (2.55)	0 – 7	1.11

Table 2

Correlation between symptoms of social anxiety (SIAS), depression (BDI-2) and state anxiety (VAS) with overt visual attention (dwell time) to emotional faces

	Dwell time on emotional face (overt visual attention)			
SIAS	**Total 1500ms**	**0–500ms**	**500–1000ms**	**1000–1500ms**
Anger	.44**	.43**	.34*	.46**
Fear	.35*	.26	.23	.44**
Happy	.34*	.32*	.25	.37*
BDI-2				
Anger	.27	.17	.33*	.23
Fear	.32*	.13	.39*	.29
Happy	.24	.15	.33*	.17

* $p < .05$

** $p < .01$

Table 3

Correlation between symptoms of social anxiety (SIAS), depression (BDI-II), state anxiety (VAS) and disengagement from emotional faces

	SIAS	BDI-II	VAS
Anger	.34*	.21	.11
Fear	.02	-.14	.03
Happy	-.08	.03	-.13
Neutral	.09	-.03	-.06
Neutral (on Angry-Neutral trials)	.29t	.01	-.09

$^{t}p = .07$

$^{*}p < .05$

$^{**}p < .01$