Published in final edited form as:
Anxiety Stress Coping. 2009 May ; 22(3): 283–296. doi:10.1080/10615800802449602.

Examination of vigilance and disengagement of threat in social anxiety with a probe detection task

Heide Klumpp[a,*] and **Nader Amir**[b]
[a]University of Michigan, Ann Arbor, MI, USA
[b]San Diego State University, San Diego, CA, USA

Abstract

Selective attention for threat faces in social anxiety is commonly measured with a probe detection task. Various studies that have used this task show socially anxious individuals exhibit selective attention for threat faces (Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004b; Pishyar, Harris, & Menzies, 2004). Selective attention for threat when measured with a probe detection task is interpreted as an attentional shift toward threat ("vigilance"). Yet, there is data that show socially anxious individuals may have difficulty in shifting their attention away from threat ("disengagement"; Amir, Elias, Klumpp, & Przeworski, 2003). A step toward clarifying the extent to which selective attention for threat comprises vigilance or disengagement effects is described by Koster, Crombez, Verschuere, and de Houwer (2004). We adapted their modified probe detection task to examine vigilance and disengagement effects for threat and happy faces in individuals with and without social anxiety. The results indicate that socially anxious individuals exhibit vigilance for threat faces, but not for happy faces, compared to individuals without social anxiety. Our study is consistent with cognitive theories of anxiety that propose vigilance for threat may contribute to the maintenance of anxiety disorders.

Keywords

social anxiety; selective attention; vigilance; disengagement; probe detection task

Cognitive theories of anxiety propose selective attention for threat may contribute to the maintenance of anxiety disorders (e.g., Mathews & MacLeod, 1994; Williams, Watts, MacLeod, & Mathews, 1997). Selective attention in social anxiety may take the form of attentional bias to internal or external threat cues. Attentional bias to internal threat cues (e.g., physiological symptoms, negative social evaluative thoughts) may contribute to social anxiety by interfering with the ability to process external cues that disconfirm social fears (Clark & Wells, 1995). In contrast, excessive attention to external threat cues may render the environment more aversive than it actually is thus promoting anxiety (e.g., Bradley, Mogg, Falla, & Hamilton, 1998; Mogg & Bradley, 1998). In social anxiety disorder, threatening facial expressions may constitute threat cues given this disorder is characterized by excessive fears of negative evaluation by others (American Psychiatric Association, 2000). While both types of bias have implications for the maintenance of social anxiety, the aim of this study is to evaluate selective attention to threatening faces.

Among the types of tasks that may be used to measure selective attention in social anxiety, the probe detection task is one that is commonly used. The results for probe detection task

*Corresponding author. heidek@umich.edu.

studies have been mixed with some studies showing bias to threat faces (Mogg & Bradley, 2002; Mogg et al., 2004b; Pishyar et al., 2004), some showing bias away from threat faces (Chen, Ehlers, Clark, &Mansell, 2002; Mansell, Clark, Ehlers, & Chen, 1999), and some showing neither bias to threat or away from threat faces (Bradley et al., 1997; Gotlib et al., 2004; Mansell, Clark, & Ehlers, 2003; Pineles & Mineka, 2005). Complicating the issue are methodological differences among studies that may contribute to inconsistent results. For example,Gotlib et al. (2004) showed face pairs for 1000 ms and this presentation may have been too long to capture attentional bias in social anxiety. In support of this, Mogg and Bradley (2002), Mogg et al., (2004b), andPishyar et al. (2004) reported attentional bias to threat in social anxiety using face pairs that were presented for 500 ms. In addition to potential differences related to time course, stimuli pair types may also impact attentional bias. For example,Chen et al. (2002) and Mansell et al. (2003) found individuals with social anxiety avoid negative faces. However, these investigators did not use face pairs (e.g., angry face–neutral face); rather faces were paired with household objects (e.g., lamp). Moreover, attentional bias under social evaluative threat (e.g., public speaking challenge) has been associated with avoidance of emotional faces (e.g., Garner, Mogg, & Bradley, 2006; Mansell et al., 1999) indicating context may impact direction of bias. Lastly, individual differences (e.g., defensiveness; Derakshan, Eysenck, & Myers, 2007) may affect attentional bias to threat cues (i.e., internal vs. external). Notwithstanding the complexity of attentional bias to threat, probe detection findings indicate that certain methodological parameters capture attentional bias to threat faces in social anxiety (for review see Bögels & Mansell, 2004).

In the probe detection task, paired stimuli (e.g., angry face–neutral face) are usually presented briefly (e.g., 500 ms) and after the stimuli disappear, a probe (e.g., “E” or “F”) appears replacing one of the two stimuli (e.g., “E” replaces angry face). Participants are asked to identify the probe as quickly and accurately as possible. If socially anxious individuals have an attentional bias for threat, then their attention is consistently drawn to the threat stimulus, which leads to a reaction time (RT) advantage in probe detection. Therefore, selective attention for threat (e.g., angry face) is revealed when anxious individuals are faster at identifying probes that replace threat faces (“congruent trials”) than neutral faces (“incongruent trials”) compared to non-anxious individuals. Selective attention for threat based on these RTs is interpreted as facilitated detection of threatening stimuli compared to neutral stimuli that reflects a tendency to “shift attention to emotionally threatening stimuli” (MacLeod, Mathews, & Tata, 1986, p. 18). This process has been described as vigilance for threat (e.g., Bradley, Mogg, & Millar, 2000; Mathews, 1990; Mogg & Bradley, 1998). Therefore, probe detection task studies that show socially anxious individuals exhibit selective attention for threat faces (Mogg & Bradley, 2002; Mogg et al., 2004b; Pishyar et al., 2004) lend support for the hypothesis that vigilance for threat contributes to anxiety disorders (e.g., Mathews & MacLeod, 1994; Williams et al., 1997).

Because RTs are used to examine selective attention for threat as measured with a probe detection task, it is not entirely clear whether RTs reflect an initial shift of attention to threat stimuli as opposed to neutral stimuli. For example, the stimuli pair (e.g., threat face–neutral face) in a probe detection task may be presented long enough to allow for more than one shift of attention between the stimuli pair. In an effort to clarify the extent to which shifting attention to threat contributes to selective attention for threat in anxiety,Bradley et al. (2000) examined initial eye movements to threat faces during a probe detection task. In support of the vigilance hypothesis, those participants who exhibited eye movements toward threat faces also exhibited faster RTs of probes that replaced threat faces compared to non-threat faces. These investigators conclude that anxious compared to non-anxious individuals exhibited attentional vigilance for threat faces in the probe detection task and that this vigilance is associated with initial shifts of attention to threat.

Despite evidence for the vigilance to threat hypothesis in cognitive explanations of anxiety, this hypothesis has been challenged (e.g., Fox, Russo, Bowles, & Dutton, 2001). For example, studies that evaluate disengagement, the ability to shift attention away from stimuli (e.g., Posner, 1980; Posner & Petersen, 1990), indicate that anxious individuals have difficulty in disengaging their attention from threat (e.g., Amir et al., 2003; Fox et al., 2001; Yiend & Mathews, 2001). These studies commonly use exogenous cuing tasks. Unlike the probe detection task, which consists of trials in which two stimuli appear at the same time, exogenous cuing tasks consist of trials in which only one stimulus appears at a time. For example, in a social anxiety study conducted byAmir et al. (2003), participants completed an exogenous cuing task with word stimuli. Emotionally valenced words (positive, negative, or neutral) appeared either on the right side or left side of a computer monitor. After the word disappeared, a probe (“*”) replaced the word. Therefore, the word acted as a cue for the probe. On some trials the probe appeared in the same location as the word (valid trials) and on other trials the probe appeared in the opposite location as the word (invalid trials). The participants were asked to focus on a centrally placed fixation cross and identify whether the probe appeared on the right or left side of the monitor. Attentional disengagement effects for threat is determined by the extra time it takes to respond to invalid threatening trials compared to invalid neutral trials (Compton, 2000; Yiend & Mathews, 2001). The results showed that individuals with and without social anxiety exhibited greater RTs for all invalid trials compared to all valid trials. However, among invalid trials, group differences emerged for threat words. More specifically, socially anxious individuals were slower to disengage from threat words on invalid trials compared to individuals without social anxiety. There were no group differences for positive or neutral words. These findings are interpreted as evidence that socially anxious individuals have difficulty in disengaging their attention from threat (Amir et al., 2003).

Although exogenous cuing tasks provide evidence for disengagement difficulties from threat in anxiety (e.g., Amir et al., 2003; Fox et al., 2001; Yiend & Mathews, 2001), it has been argued that these tasks are not sensitive to vigilance effects. This is because trials comprise only one stimulus so that there is no competition for attentional resources. Unlike exogenous cuing tasks, probe detection tasks comprise trials of simultaneously presented stimuli (e.g., threat–neutral faces), which permits evaluation for the prioritization of threat stimuli (i.e., attentional shift to threat) (e.g., MacLeod et al., 1986).

In summary, both probe detection tasks and exogenous cuing tasks have strengths and limitations.Koster et al. (2004) propose that a probe detection task may be modified such that vigilance for threat and disengagement from threat may be assessed. More specifically, they suggest that the inclusion of baseline trials (neutral–neutral pictures) allows for the measurement of these components of attention. To this end,Koster et al. (2004) had 44 undergraduate students participate in a probe detection task that included baseline trials. In addition to neutral pictures (N), the study consisted of medium threat (MT) (e.g., man with knife) and high threat (HT) (e.g., mutilated face) pictures taken from the International Affective Picture System (Lang, Öhman, & Vaitl, 1988). Picture pairs (e.g., HT–N, MT–N, N–N) were presented for 500 ms. Results were significant for HT pictures only. When HT–neutral trials were examined,Koster et al. (2004) found that the mean RTs to detect probes in the spatial location previously occupied by threatening stimuli (“congruent trials”) was less than the mean RTs to detect probes in the location previously occupied by neutral stimuli (“incongruent trials”). This finding is consistent with other probe detection studies (e.g., MacLeod et al., 1986; Mogg et al., 2004b) and implies vigilance for threat. However, when HT–neutral trials were compared to baseline trials (N–N), disengagement effects were revealed. That is, the mean RTs for baseline trials (N–N) was less than the mean RTs for both congruent and incongruent HT–neutral trials.Koster et al. (2004) interpret this general slowing for HT–neutral trials compared to baseline trials as evidence that participants, regardless of level of anxiety, had difficulty in disengaging their attention from highly threatening pictures.

In conclusion, although the primary focus of theKoster et al. (2004) study was not anxiety on disengagement from threat per se, the study indicates the probe detection task may be used to examine vigilance and disengagement effects in anxious individuals. The aim of this study is to expand on theKoster et al. (2004) investigation by examining the extent to which vigilance or disengagement effects may contribute to selective attention for threat in social anxiety. To increase ecological validity, we used faces instead of pictures.

Based on the literature, our primary hypothesis was that socially anxious individuals would exhibit vigilance for threat when baseline trials were not taken into account. That is, they would be faster in their detection of threat faces on congruent trials (i.e., probes replace threat faces) than incongruent trials (probes replace neutral faces) compared to individuals without social anxiety.

For our secondary hypothesis, we proposed that socially anxious individuals would be faster at detecting probes that replaced baseline (neutral–neutral) trials compared to probes that replaced threat faces during congruent (threat–neutral) trials.

Method

Participants

Seventy-six undergraduate students from the University of Georgia completed the study for partial course credit. Participants were assigned to a low social anxiety (LSA) or high social anxiety (HSA) group based on a median split score on the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel, Dancu, & Stanley, 1989). Therefore, participants with a score below 74 were assigned to the LSA group ($n = 37$) and those with a score above 74 were assigned to the HSA group ($n = 39$). The mean score for the HSA group (100.2±22.9) was similar to that of a treatment-seeking sample of socially anxious individuals (e.g., 103.30±28.1; Beidel, Turner, & Cooley, 1993).

Materials and procedure

Face stimuli for probe detection task—Face stimuli comprised standardized male and female angry, happy, and neutral faces with each person portraying either an angry and neutral expression or portraying a happy and neutral expression (Matsumoto & Ekman, 1988). No person portrayed all expressions (i.e., angry, happy, and neutral). Therefore, neutral expressions were either associated with a person who showed anger or a person who showed happiness. Faces were matched in terms of expression and gender and set to grayscale, and each face measured 5.5 cm in width and 4 cm in length with a resolution of 72,000 pixels per inch. Measured from their centers, the faces were approximately 13 cm apart.

Probe detection task—This task comprised six practice trials, which consisted of faces that were not used in the experimental session. For emotional trials, each face was paired with a neutral face from the same person (e.g., angry–neutral). For baseline trials, a neutral face was paired with a neutral face from the same person who expressed an angry face or a happy face. In total there were 96 experimental trials. These trials involved four different people (two male and two female), six face pairs (angry–neutral, happy–neutral, neutral–angry, neutral–happy, $neutral_a$–$neutral_a$[1], $neutral_h$–$neutral_h$[1]), two probe types (“E” vs. “F”), and two probe positions (top vs. bottom) for a total of 96 combinations. Trials were counterbalanced and presented randomly.

Each trial began with a fixation cross that appeared in the center of the screen for 500 ms; participants were asked to focus on this cross. Subsequently, two faces appeared vertically for 500 ms and then one of the faces in the pair was replaced with a probe ("E" or "F"). Comparable to other probe detection studies (e.g., Asmundson, Sandler, Wilson, & Walker, 1992; Asmundson & Stein, 1994; MacLeod et al., 1986), to control for individual differences in initial orienting to one of two stimuli (i.e., top vs. bottom), we asked participants to attend to the top face at the start of every trial. Participants were asked to identify the probe as quickly and accurately as possible. The probe detection task was run on a 2002 Windows XP computer system with a monitor refresh rate of 60 Hz.

Social Phobia and Anxiety Inventory (SPAI)—The SPAI (Turner et al., 1989) is a questionnaire consisting of 45 items asking about fears in social situations (e.g., "I feel anxious when entering social situations where there is a large group"). Responses are based on a Likert-type scale (1 = never; 7 = always). The SPAI has two subscales, one for agoraphobia and one for social phobia. The recommended total score is derived by subtracting the agoraphobia subscale score from the social phobia subscale score (Turner et al., 1989). Test–retest reliability for two weeks is $r = .86$ (Turner et al., 1989).

State-Trait Anxiety Inventory (STAI)—The STAI (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a 40-item self-report measure that comprises 20 questions that pertain to current level of anxiety (state), and 20 that concern anxiety in general (trait). Responses are based on a Likert-type scale (e.g., 1 = not at all, 4 = very much so). Test–retest reliability for 21 days between tests is $r = .45$ for state anxiety and $r = .97$ for trait anxiety (Metzger, 1976).

Beck Depression Inventory (BDI)—The BDI (Beck & Steer, 1987) is a questionnaire that consists of 21 items that assess depressive symptoms. Each item is composed of four statements that reflect symptom severity. The participant selects one statement from each group that best describes the way he or she feels. The statements are scaled from zero (no disturbance) to three (maximal disturbance). Test–retest reliability for 1–3 months is $r = .74$ (Beck & Steer, 1987).

Participants completed a consent form followed by a demographics questionnaire consisting of items regarding the participant's age, date of birth, level of education, and gender. After completing this questionnaire, they completed the SPAI, STAI, BDI, and probe detection task. Then they were debriefed.

Results

Participant characteristics

The LSA and HSA groups differed significantly on social anxiety ($t(74) = 130.47$, $p < .001$), trait anxiety ($t(74) = 56.07$, $p < .001$), state anxiety ($t(74) = 24.20$, $p < .001$), and depression ($t(74) = 25.5$, $p < .001$). However, groups were similar in age ($t(74) = .01$, $p < .91$) and education level ($t(74) = .10$, $p = .77$). See Table 1 for demographic and self-report data.

Examination of accuracy and preparation of data

The mean accuracy (i.e., correctly identifying whether the probe was an E or an F) was 96%. Accuracy did not differ significantly between groups ($t(74) = 1.77$, $p = .08$). After the elimination of inaccurate trials, RTs below 100 or above 3000 were eliminated (1% of

[1]Neutral$_a$–neutral$_a$ describes neutral faces matched to same person who displayed an angry expression and neutral$_h$–neutral$_h$ describes neutral faces matched to same person who displayed a happy expression.

trials), as these are indicative of human or computer error. Then, RTs three standard deviations above each participant's mean RTs were eliminated (1% of trials).

Baseline trials

To determine if groups responded similarly to baseline trials, mean RTs on neutral–neutral trials were submitted to a 2 (Group: LSA, HSA) × 2 (Face Type: neutral matched to angry faces, neutral matched to happy faces) × 2 (Probe Position: top, bottom) repeated measures analysis of variance (ANOVA). The results showed no main effects for Group ($F(1, 74) = 1.20$, $p = .28$), Face Type ($F(1, 74) = 1.12$, $p = .29$), or Probe Position ($F(1, 74) = .04$, $p = .84$). The Group × Face Type × Probe Position was not significant ($F(1, 74) = 2.12$, $p = .15$).

Congruent/Incongruent comparison

Mean RTs on congruent trials (probes replaced top or bottom emotional faces paired with neutral faces) and incongruent trials (probes replaced top or bottom neutral faces paired with emotional faces) were submitted to a 2 (Congruency Trial Type: congruent, incongruent) × 2 (Group: LSA, HSA) × 2 (Face Type: angry, happy) × 2 (Probe Position: top, bottom) repeated measures ANOVA. The results showed no main effects for Congruency Trial Type ($F(1, 74) = 1.24$, $p = .27$), Group ($F(1, 74) = .00$, $p = .96$), Face Type ($F(1, 74) = .05$, $p = .82$), or Probe Position ($F(1, 74) = 1.35$, $p = .25$). There was, however, a Congruency Trial Type × Group × Face Type × Probe Position interaction ($F(1, 74) = 6.55$, $p < .01$). To explore this interaction, we performed separate analyses for congruent and incongruent trials. See Table 2 for mean RTs.

Congruent trials only—Mean RTs on congruent trials (probes always replaced emotional faces) were submitted to a 2 (Group: LSA, HSA) × 2 (Face Type: angry, happy) × 2 (Probe Position: top, bottom) repeated measures ANOVA.[2] Results showed no main effects for Group ($F(1, 74) = .34$, $p = .56$), Face Type ($F(1, 74) = .00$, $p = .97$), or Probe Position ($F(1, 74) = .03$, $p = .87$). There was, however, a Group × Face Type × Probe Position interaction ($F(1, 74) = 4.77$, $p < .03$). To explore this interaction, we submitted mean RTs for congruent trials in which probes always replaced the *top* face. For these trials a 2 (Group: LSA, HSA) × 2 (Face Type: angry, happy) repeated measures ANOVA revealed no main effects for Group ($F(1, 74) = .28$, $p = .60$) or Face Type ($F(1, 74) = .74$, $p = .39$) and the Group × Face Type interaction was not significant ($F(1, 74) = .00$, $p = .99$). For trials in which probes always replaced the *bottom* face, a 2 (Group: LSA, HSA) × 2 (Face Type: angry, happy) repeated measures ANOVA revealed no main effects for Group ($F(1, 74) = .32$, $p = .58$) or Face Type ($F(1, 74) = .60$, $p = .44$); however, there was a significant Group × Face Type interaction ($F(1, 74) = 6.78$, $p < .01$).

To examine this interaction, we performed two-tailed t-tests with alpha level set at .05. The results showed that the HSA group had faster RTs for angry faces than the LSA group ($t(74) = 2.14$, $p < .04$) indicating they were faster at detecting angry faces. Groups did not differ in their RTs for happy faces ($t(74) = .67$, $p = .50$). Within group analyses revealed that the HSA group had faster RTs for angry faces compared to happy faces ($t(38) = 2.15$, $p < .04$). In contrast, the LSA group responded similarly to both angry and happy faces ($t(36) = 1.54$, $p = .13$).

[2]In addition to elevated levels of social anxiety, the high socially anxious (HSA) group relative to the low socially anxious (LSA) group, reported high levels of trait anxiety. It has been argued that co-varying factors attributable to group membership (e.g., high trait anxiety in social anxiety) is not appropriate (Miller & Chapman, 2001). Therefore, to explore the possibility that similar results may be obtained in high and low trait anxious groups, all participants were reassigned to these groups based on a median split on the STAI-trait anxiety measure (Spielberger et al., 1983). Mean RTs were submitted to the same omnibus analysis used to evaluate the socially anxious groups. The results showed no significant main effects or higher order interaction.

Incongruent trials only—Mean RTs on incongruent trials (probes always replaced neutral faces matched with emotional faces) were submitted to a 2 (Group: LSA, HSA) × 2 (Face Type: angry, happy) × 2 (Probe Position: top, bottom) repeated measures ANOVA.[2] The results showed no main effects for Group ($F(1, 74) = .18$, $p = .68$), Face Type ($F(1, 74) =.11$, $p =.74$), or Probe Position ($F(1, 74) = 3.14$, $p =.08$); there was no significant interaction ($F(1, 74) = 3.02$, $p =.09$).

Disengagement/Vigilance

To examine whether the above results for angry faces reflected disengagement problems for angry faces or vigilance for such faces, we compared the mean RTs for angry faces on congruent trials (probes replaced bottom angry faces) to baseline trials (probes replaced bottom neutral faces). For the HSA group, results showed faster RTs on congruent trials compared to baseline trials ($t(38) = 2.05$, $p<.05$) suggesting vigilance for angry faces. There were no differences between trial types for the LSA group ($t(36) =.44$, $p =.66$)[3] (Figure 1). When we compared mean RTs for angry faces on incongruent trials (angry on top; probes replaced bottom neutral faces) to baseline trials (probes replaced bottom neutral faces) there was no difference between trial types for the HSA group ($t(36) =.24$, $p =.82$) or LSA group ($t(38) =.72$, $p =.48$) indicating no disengagement effects.

Discussion

We examined vigilance and disengagement effects for threat faces in an analogue sample of socially anxious individuals with a probe detection task adapted byKoster et al. (2004). The aim of this study was to expand on theKoster et al. (2004) investigation by examining the extent to which vigilance for threat faces or disengagement from threat faces may contribute to selective attention for threat in social anxiety as measured with a probe detection task. To increase ecological validity, we used threat faces instead of threat pictures (Koster et al., 2004).

Our primary hypothesis was that socially anxious individuals would exhibit vigilance for threat when baseline trials were not taken into account. That is, they would be faster in their detection of threat faces on congruent trials (i.e., probes replace threat faces) than incongruent trials (probes replace neutral faces) compared to individuals without social anxiety. This hypothesis was partially supported. More specifically, similar to other studies (e.g., Asmundson et al., 1992; Asmundson & Stein, 1994; MacLeod et al., 1986), participants were asked to attend to the top face at the start of every trial to control for individual differences in initial orienting to faces. This was done to reduce the possibility of multiple shifting between simultaneously presented stimuli. The results revealed no group differences for probes that replaced threat or happy faces when such faces were at the top of the monitor indicating there was no additive effect when initially directing attention to threat among socially anxious individuals compared to individuals without social anxiety. However, group differences emerged when the probe replaced threat faces at the bottom of the monitor. That is, socially anxious individuals were faster at detecting threat faces, but not happy faces, compared to individuals without social anxiety. Similar to other probe detection studies that show socially anxious individuals exhibit selective attention for threat

[3]To examine whether vigilance effects may be attributed to facilitated processing of baseline (neutral–neutral) trials as neutral faces in such trials were also used in emotional (threat–neutral) trials, we evaluated the relative difference between mean reaction times (RT) for baseline trials (probes replaced bottom neutral faces) and threat-neutral trials (probes replaced bottom angry faces) by subtracting baseline trials from threat-neutral trials; results showed no group effects for this difference value ($t(74)$ .69, $p = .49$). Moreover, when emotional trials were submitted to a one-sample t-test, there were significant results in both the high social anxiety group ($t(38)$ 24.41, $p<.005$) and low social anxiety group ($t(36)$ 25.50, $p < .005$). Similar results were obtained for baseline trials in the high social anxiety ($t(38)$ 26.97, $p < .005$) and low social anxiety ($t(36)$ 33.48, $p < .005$) groups. These results do not indicate baseline trials were easier to process than emotional trials.

faces (Mogg & Bradley, 2002; Mogg et al., 2004b; Pishyar et al., 2004), results support the hypothesis that selective attention to threat may contribute to the maintenance of anxiety disorders (e.g., Williams et al., 1997).

For our secondary hypothesis, we proposed socially anxious individuals would be faster at detecting probes replacing neutral faces during baseline (neutral–neutral) trials compared to probes replacing threat faces during congruent trials (i.e., probes replace angry faces in angry–neutral pairs). This hypothesis was based on exogenous cuing studies, which data indicates anxious individuals have difficulty disengaging their attention from threat (e.g., Amir et al., 2003; Fox et al., 2001; Yiend & Mathews, 2001). This hypothesis was not supported. Indeed, socially anxious individuals exhibited faster RTs for trials in which the probes replaced threat faces at the bottom of the monitor compared to trials in which the probes replaced baseline neutral faces at the bottom of the monitor. These results indicate that socially anxious individuals exhibit vigilance for threat faces. This suggests that vigilance for threat may contribute to the maintenance of social anxiety by perhaps making the social environment appear to be psychologically or physically dangerous.

The reasons that our secondary hypothesis was not supported include methodological and population differences. For example, differences between the probe detection task and an exogenous cuing task make direct comparison difficult. Additionally, the only exogenous cuing task that examined disengagement effects in social anxiety used word stimuli (Amir et al., 2003). Although beyond the scope of this study, selective attention for threat may be somewhat sensitive to the type of stimuli used. For example, in a probe detection study conducted byPishyar et al. (2004), socially anxious individuals exhibited selective attention for threat faces but not for threat words. More naturalistic anxiety-provoking stimuli such as faces may have contributed to our results. With regard to our modification of the probe detection task byKoster et al. (2004), we used angry and happy faces as opposed to high threat (e.g., mutilated face) and mild threat (e.g., man with knife) pictures.Koster et al. (2004) did not find disengagement difficulties for mild threat pictures and in our sample, angry faces may have been perceived as relatively mild. Nevertheless, the use of angry faces is typical in probe detection task studies that examine selective attention in social anxiety (e.g., Bradley et al., 1997; Gotlib et al., 2004; Mogg & Bradley, 2002; Mogg et al., 2004b).

In summary, while there is evidence that anxious individuals may exhibit disengagement difficulties from threat, these studies are generally limited to non-probe detection task studies (e.g., exogenous cuing tasks) that do not allow for examination of threat prioritization. The probe detection task on the other hand may be used to evaluate prioritization of threat as stimuli compete for attention.

An important issue raised by our study is the use of probe detection tasks when evaluating selective attention for threat in anxiety. In addition to social anxiety, probe detection studies with threat pictures or faces show high trait anxious individuals (e.g., Koster, Verschuere, Crombez, & van Damme, 2005; Mogg, Bradley, Miles & Dixon, 2004a), individuals with generalized anxiety disorder (Bradley, Mogg, White, Groom, & de Bono, 1999), and spider fearful individuals (Mogg & Bradley, 2006) exhibit selective attention for threat. These results may reflect vigilance for threat but without comparison to baseline trials, disengagement effects may not be examined. Therefore, potential differences between anxiety disorders may not be revealed.

In conclusion, our study supports the hypothesis that vigilance for threat may contribute to selective attention for threat in social anxiety within certain parameters. As mentioned previously, selective attention for threat is a complex construct that may be influenced by individual differences (e.g., defensiveness; Derakshan et al., 2007) and context, for example, our study was not conducted under social evaluative threat, which is associated with avoidance of emotional faces (Garner et al., 2006; Mansell et al., 1999); therefore, our results may not generalize to all individuals with elevated levels of social anxiety or in contexts in which social-relevant fears are evoked.

One possible therapeutic application of our probe detection results is attention training. For example, socially anxious individuals may benefit from shifting their attention *away* from threat cues such as angry faces and *toward* positive or neutral cues. Consistent with this application, MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) demonstrated that moderately trait anxious individuals exhibit a reduction in anxiety in response to stress after completing a probe detection task in which such individuals' attention was primarily directed toward neutral stimuli and away from threatening stimuli. Taken together, socially anxious individuals may experience a reduction in anxiety in social and performance situations when vigilance for threat faces is reduced. Another route of intervention may be to disrupt attentional processing that is maladaptive whether it be vigilance for external threat (e.g., angry faces) or excessive self-focused attention (e.g., focus on interoceptive cues, social evaluative thoughts) with mindfulness or task concentration training (Bögels, Sijbers, & Voncken, 2006). Instead of retraining attention away from external threat, mindfulness and task concentration training are designed to draw attentional focus away from contributors to maladaptive attentional processing (e.g., fear of negative evaluation) to what is going on in the moment (e.g., listening to a conversation; Bögels et al., 2006). These types of interventions to treat social anxiety disorder may be tailored to reduce or eliminate maladaptive attentional bias that is based on context (e.g., self-focused attention during public speaking) as well as individual differences. Lastly, psychotherapy for social anxiety (e.g., cognitive behavioral therapy) has been shown to reduce attentional bias to threat in treatment responders (Lundh & Öst, 2001). Therefore, intervention at the level of negative thoughts via cognitive restructuring and/or exposure to social fears may modify attentional bias to threat.

Our study is not without limitations, which includes the narrow scope of evaluating vigilance and disengagement with a probe detection task without including tasks that may contribute to the elucidation of potential mechanisms involved in attention processing (e.g., attentional control measures). Additionally, our data is based on relatively few observations compared to other probe detection task studies as our instruction to have participants focus on the top face throughout the task resulted in significant outcomes that were limited to probes that replaced the bottom face. Another methodological limitation is the lack of baseline trials with novel neutral faces. The use of neutral faces matched to the same person who displayed a happy or angry emotion in neutral–neutral baseline trials as well as emotional trials (e.g., angry–neutral) may have made the processing of baseline trials easier relative to emotional faces though our results do not suggest this possibility contributed to vigilance effects.[3] In addition to this limitation, no person in the set of face stimuli displayed all three expressions (i.e., angry, happy, neutral), therefore, it is possible that neutral faces associated with people who displayed angry expressions may appear relatively more negative than neutral faces associated with people who showed happy expressions. We attempted to control for this by separating neutral trials related to angry faces from those related to happy faces (i.e., $neutral_a$–$neutral_a$[1], $neutral_h$–$neutral_h$[1]). Regarding participants, we had an analogue sample of socially anxious participants and this sample was not based on extreme scores of social anxiety; hence, our results may not generalize to a clinical sample. In addition, the socially anxious participants were not matched to a group that controlled for depression or state and trait anxiety; therefore, we cannot rule out the possibility that other indices of negative affect may have contributed to results. Lastly, we acknowledge that the probe detection task has limitations. For example, it only provides a snapshot of attentional processes. Despite these limitations, our results indicate a probe detection task modified to include baseline trials may be useful in examining vigilance and disengagement effects for threat.

References

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed., Text Rev. Washington, DC: Author; 2000.

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, Sandler LS, Wilson KG, Walker JR. Selective attention toward physical threat in patients with panic disorder. Journal of Anxiety Disorders. 1992; 6:295–303.

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. Beck depression inventory manual. San Antonio, TX: Psychological Corporation; 1987.

Beidel DC, Turner SM, Cooley MR. Assessing reliable and clinically significant change in social phobia: Validity of the social phobia and anxiety inventory. Behaviour Research and Therapy. 1993; 31:331–337. [PubMed: 8476409]

Bögels SM, Mansell W. Attention processes in the maintenance and treatment of social phobia: Hypervigilance, avoidance and self-focused attention. Clinical Psychology Review. 2004; 24:827–856. [PubMed: 15501558]

Bögels SM, Sijbers GFVM, Voncken M. Mindfulness and task concentration training for social phobia: A pilot study. Journal of Cognitive Psychotherapy: An International Quarterly. 2006; 20:33–44.

Bradley BP, Mogg K, Falla SJ, Hamilton LR. Attentional bias for threatening facial expressions in anxiety: Manipulations of stimulus duration. Cognition and Emotion. 1998; 12:737–753.

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

Bradley BP, Mogg K, Millar N, Bonham-Carter C, Fergusson E, Jenkins J, et al. Attentional biases for emotional faces. Cognition and Emotion. 1997; 11:25–42.

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]

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]

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

Compton RJ. Ability to disengage attention predicts negative affect. Cognition and Emotion. 2000; 14:401–415.

Derakshan N, Eysenck MW, Myers LB. Emotional information processing in repressors: The vigilance-avoidance theory. Cognition and Emotion. 2007; 21:1585–1614.

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

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

Gotlib IH, Kasch KL, Traill S, Joormann J, Arnow BA, Johnson SL. Coherence and specificity of information-processing biases in depression and social phobia. Journal of Abnormal Psychology. 2004; 113:386–398. [PubMed: 15311984]

Koster EHW, Crombez G, Verschuere B, de Houwer J. Selective attention to threat in the dot probe paradigm: Differentiating vigilance and difficulty to disengage. Behaviour Research and Therapy. 2004; 42:1183–1192. [PubMed: 15350857]

Koster EHW, Verschuere B, Crombez G, van Damme S. Time-course of attention for threatening pictures in high and low trait anxiety. Behaviour Research and Therapy. 2005; 43:1087–1098. [PubMed: 15922291]

Lang, PJ.; Öhman, A.; Vaitl, D. The international affective picture system (photographic slides). Gainesville, FL: The Center for Research in Psychophysiology, University of Florida; 1988.

Lundh LG, Öst LG. Attentional bias, self-consciousness and perfectionism in social phobia before and after cognitive-behaviour therapy. Scandinavian Journal of Behaviour Therapy. 2001; 30:4–16.

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

MacLeod C, Rutherford E, Campbell L, Ebsworthy G, Holker L. Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. Journal of Abnormal Psychology. 2002; 111:107–123. [PubMed: 11866165]

Mansell W, Clark DM, Ehlers A. Internal versus external attention in social anxiety: An investigation using a novel paradigm. Behaviour Research and Therapy. 2003; 41:555–572. [PubMed: 12711264]

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

Mathews A. Why worry? The cognitive function of anxiety. Behaviour Research and Therapy. 1990; 28:455–468. [PubMed: 2076083]

Mathews A, MacLeod C. Cognitive approaches to emotion and emotional disorders. Annual Review of Psychology. 1994; 45:25–50.

Matsumoto, D.; Ekman, P. The Japanese and Caucasian facial expressions of emotion (JACFEE) and neutrals (JACNeuF) [Slides]. 1600 Holloway Avenue, San Francisco, CA 94132, USA: Intercultural and Emotional Research Laboratory, Department of Psychology, San Francisco State University; 1988.

Metzger RL. A reliability and validity study of the state-trait anxiety inventory. Journal of Clinical Psychology. 1976; 32:276–278.

Miller GA, Chapman JP. Misunderstanding analysis of covariance. Journal of Abnormal Psychology. 2001; 110:40–48. [PubMed: 11261398]

Mogg K, Bradley BP. A cognitive-motivational analysis of anxiety. Behaviour Research and Therapy. 1998; 36:809–848. [PubMed: 9701859]

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, 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]

Mogg K, Bradley BP, Miles F, Dixon R. Time course of attentional bias for threat scenes: Testing the vigilance-avoidance hypothesis. Cognition and Emotion. 2004a; 18:689–700.

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

Pineles SL, Mineka S. Attentional biases to internal and external sources of potential threat in social anxiety. Journal of Abnormal Psychology. 2005; 114:314–318. [PubMed: 15869362]

Pishyar R, Harris LM, Menzies RG. Attentional bias for words and faces in social anxiety. Anxiety, Stress & Coping. 2004; 17:23–36.

Posner MI. Orienting of attention. Quarterly Journal of Experimental Psychology. 1980; 32:3–25. [PubMed: 7367577]

Posner MI, Petersen SE. The attention system of the human brain. Annual Review of Neuroscience. 1990; 13:25–42.

Spielberger, CD.; Gorsuch, RL.; Lushene, RE.; Vagg, PR.; Jacobs, GA. Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press; 1983.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Turner SM, Beidel DC, Dancu CV, Stanley MA. An empirically derived inventory to measure social fears and anxiety: The social phobia and anxiety inventory. Journal of Consulting and Clinical Psychology. 1989; 1:35–40.

Williams, JMG.; Watts, FN.; MacLeod, C.; Mathews, A. Cognitive psychology and emotional disorders. 2nd ed. Chichester, UK: Wiley; 1997.

Yiend J, Mathews A. Anxiety and attention to threatening pictures. The Quarterly Journal of Experimental Psychology. 2001; 54:665–681. [PubMed: 11548029]

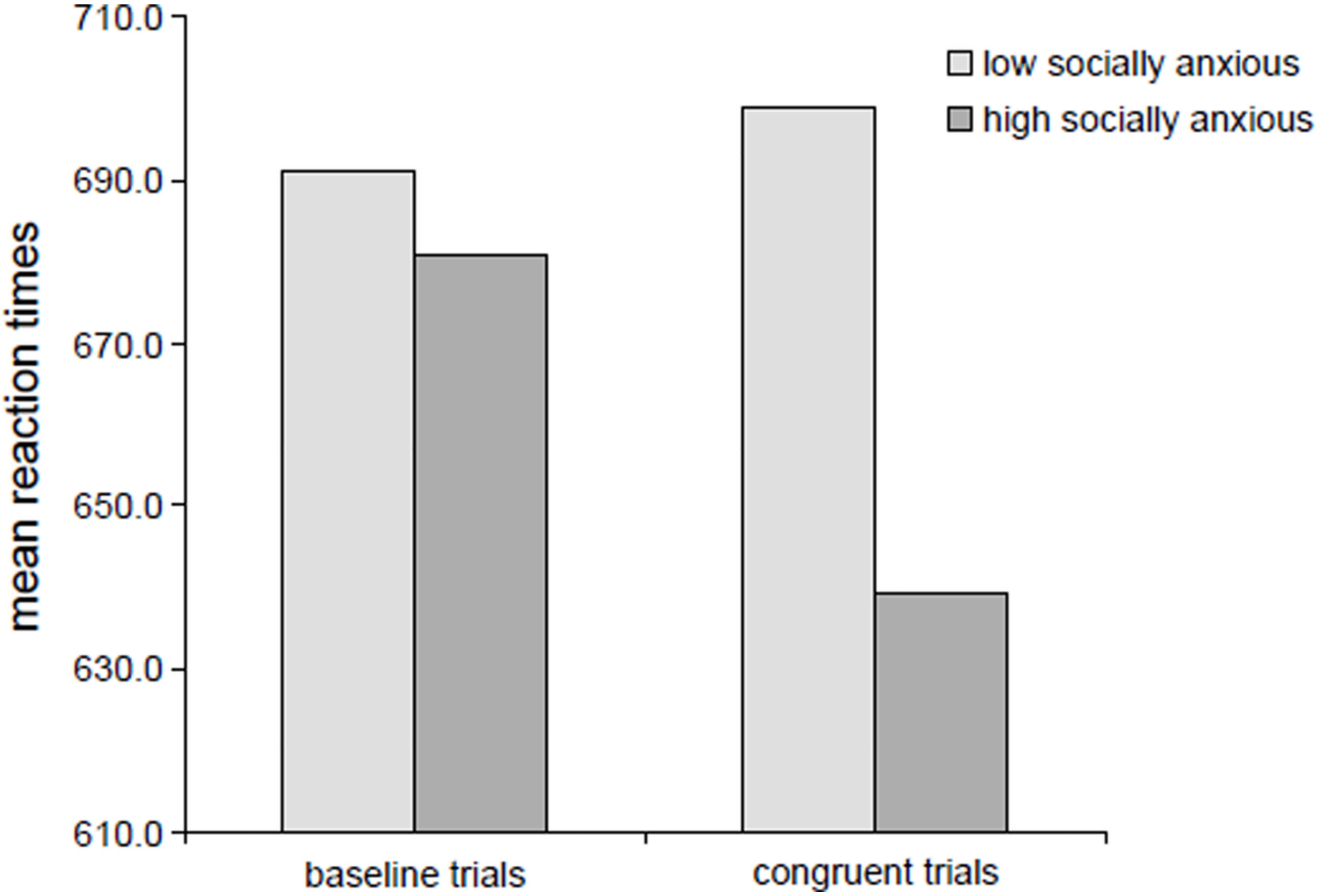

Figure 1.
Mean reaction times for trials when probe replaces bottom face.

Table 1

Demographics and self-report.

	Low socially anxious (n = 37)	High socially anxious (n = 39)
	***M* (*SD*)**	***M* (*SD*)**
Females (%)	49%	51%
Age	19.7 (1.9)	19.7 (1.3)
Education	14.0 (1.1)	14.1 (1.1)
BDI	5.6 (3.9)	12.3 (7.2)
STT	32.8 (6.3)	46.1 (8.9)
STS	28.9 (6.3)	39.2 (11.2)
SPAI	47.9 (16.3)	100.2 (22.9)

Note: BDI, Beck Depression Inventory; STS, Spielberger, State-Trait Anxiety Inventory, State Version; STT, Spielberger, State-Trait Anxiety Inventory, Trait Version; SPAI, Social Phobia Anxiety Inventory.

Table 2

Reaction time means and standard error of the means.

	Probe position	
Group/Face type	**Top**	**Bottom**
Low socially anxious		
Angry on top	692.5 (23.5)	685.6 (26.8)
Angry on bottom	683.4 (21.8)	698.9 (23.8)
Happy on top	678.9 (23.3)	696.1 (25.3)
Happy on bottom	644.9 (16.2)	668.7 (24.5)
$Neutral_a$	694.0 (32.5)	691.1 (20.6)
$Neutral_h$	687.3 (25.4)	706.1 (21.7)
High socially anxious		
Angry on top	675.5 (19.9)	699.9 (28.7)
Angry on bottom	674.2 (28.0)	639.6 (14.2)
Happy on top	662.2 (31.4)	698.9 (27.2)
Happy on bottom	690.5 (29.9)	694.9 (29.8)
$Neutral_a$	673.9 (25.8)	680.9 (25.2)
$Neutral_h$	664.4 (32.3)	630.2 (19.6)

$Neutral_a$: Neutral faces matched to same person who displayed an angry expression.

$Neutral_h$: Neutral faces matched to same person who displayed a happy expression.