Cognitive Behaviour Therapy

ISSN: 1650-6073 (Print) 1651-2316 (Online) Journal homepage: http://www.tandfonline.com/loi/sbeh20

The Effects of Social Anxiety and State Anxiety on Visual Attention: Testing the Vigilance–Avoidance Hypothesis

J. Suzanne Singh, Michelle C. Capozzoli, Michael D. Dodd & Debra A. Hope

To cite this article: J. Suzanne Singh, Michelle C. Capozzoli, Michael D. Dodd & Debra A. Hope (2015) The Effects of Social Anxiety and State Anxiety on Visual Attention: Testing the Vigilance–Avoidance Hypothesis, Cognitive Behaviour Therapy, 44:5, 377-388, DOI: 10.1080/16506073.2015.1016447

To link to this article: http://dx.doi.org/10.1080/16506073.2015.1016447

Cognitive Behaviour Therapy, 2015
Vol. 44, No. 5, 377–388, http://dx.doi.org/10.1080/16506073.2015.1016447

Routledge
Taylor & Francis Group

The Effects of Social Anxiety and State Anxiety on Visual Attention: Testing the Vigilance–Avoidance Hypothesis

J. Suzanne Singh[1], Michelle C. Capozzoli[2], Michael D. Dodd[2] and Debra A. Hope[2]

[1]*Hazelden Graduate School of Addiction Studies, 151 N. Michigan Avenue, #1112, Chicago, IL 60601, USA;* [2]*Department of Psychology, University of Nebraska-Lincoln, Lincoln, NE 68588, USA*

Abstract. A growing theoretical and research literature suggests that trait and state social anxiety can predict attentional patterns in the presence of emotional stimuli. The current study adds to this literature by examining the effects of state anxiety on visual attention and testing the vigilance–avoidance hypothesis, using a method of continuous visual attentional assessment. Participants were 91 undergraduate college students with high or low trait fear of negative evaluation (FNE), a core aspect of social anxiety, who were randomly assigned to either a high or low state anxiety condition. Participants engaged in a free view task in which pairs of emotional facial stimuli were presented and eye movements were continuously monitored. Overall, participants with high FNE avoided angry stimuli and participants with high state anxiety attended to positive stimuli. Participants with high state anxiety and high FNE were avoidant of angry faces, whereas participants with low state and low FNE exhibited a bias toward angry faces. The study provided partial support for the vigilance–avoidance hypothesis. The findings add to the mixed results in the literature that suggest that both positive and negative emotional stimuli may be important in understanding the complex attention patterns associated with social anxiety. Clinical implications and suggestions for future research are discussed. *Key words: eyetracking; threat; attention; vigilance–avoidance; social anxiety.*

Received 30 January 2015; Accepted 4 February 2015

Correspondence address: Debra A. Hope, PhD, Department of Psychology, University of Nebraska-Lincoln, Lincoln, NE, 68588, USA. Tel: 402-472-2351. Fax: 402-472-6804. Email: dhope1@unl.edu

Ample empirical evidence from a variety of methodologies supports an association between social anxiety and attentional biases to negative social-evaluative information, including angry and disgusted facial stimuli (for a review, see Van Bockstaele et al., 2014). These attentional biases are predictive of cognitive-behavioral treatment outcome and decrease as symptoms of social anxiety disorder remit (Calamaras, Tone, & Anderson, 2012; Pishyar, Harris, & Menzies, 2008; Price, Tone, & Anderson, 2011). Furthermore, laboratory studies have demonstrated the efficacy of interventions utilizing modification of attention to angry and disgusted facial stimuli for the treatment of social anxiety (Amir, Weber, Beard, Bomyea, & Taylor, 2008; Li, Tan, Qian, & Liu, 2008; Schmidt, Richey, Buckner, & Timpano, 2009), although effects may not generalize outside of the research laboratory (Boettcher, Hasselrot, Sund, Andersson, & Carlbring, 2014; Carlbring et al, 2012).

Although the importance of attention to negative emotional stimuli in social anxiety is well established, at least two questions have not received sufficient attention in the literature. First, findings are mixed for the timing of engagement and disengagement of attention to emotional faces. The vigilance–avoidance

Portions of this work were presented at the 2011 convention for the Association for Behavioral and Cognitive Therapies in Toronto, Canada.

hypothesis (Mogg, Bradley, Miles, & Dixon, 2004) proposes that individuals with elevated anxiety are initially hypervigilant for threat, but subsequently avoid threat at longer exposure durations. Among social anxious individuals, some studies have documented the existence of vigilance for—or avoidance of—threat, but there are inconsistencies among these studies regarding the timing of the vigilance and avoidance. Some researchers have reported vigilance for angry faces or negative social-evaluative words at 500 ms following the onset of emotional-neutral paired stimuli (Mogg et al., 2004; Sposari & Rapee, 2007), whereas others reported avoidance of emotional stimuli at that time (Chen, Ehlers, Clark, & Mansell, 2002; Vassilopoulos, 2005). However, these studies employed the dot probe task, which is limited in that (a) it is only indicative of where attention may be at a single point in time with no ability to determine where attention has been and where it is going and (b) slow response times indicate that attention is not at the probed location, but does not indicate where attention is at that moment. A methodology such as eyetracking, which allows for continuous assessment of visual attention across time, would help clarify when socially anxious individuals engage and disengage their attention from experimental stimuli.

Second, for individuals with high trait anxiety, it is unclear whether elevated state anxiety is associated with biases toward or away from negative emotional stimuli and whether state anxiety affects attention to both positive and negative emotional stimuli, or if effects are more specific to negative emotional stimuli. Some studies have found that increases in state social anxiety are associated with increased attention to both positive and negative emotional stimuli (Mansell, Ehlers, Clark, & Chen, 2002; Rutherford, MacLeod, & Campbell, 2004). Other studies have found that attentional biases toward negative emotional stimuli are only present with elevated trait and state social anxiety (Lee & Telch, 2008; Pineles & Mineka, 2005) and that state anxiety does not affect attention to emotional stimuli more generally (Lee & Telch, 2008; Pineles & Mineka, 2005). Yet, another study indicated that the combination of high trait social anxiety and high state anxiety results in avoidance of positive and negative emotional stimuli (Mansell et al., 1999).

At least six published studies have examined attention to emotional faces in socially anxious individuals using eyetracking methodologies. Results have provided mixed support for the vigilance–avoidance hypothesis. Garner, Mogg, and Bradley (2006) found that high social anxiety participants demonstrated faster fixation on and disengagement from angry and happy faces, relative to individuals low in social anxiety. Notably, this effect was only found when participants were anticipating a speech. Schofield, Johnson, Inhoff, and Coles (2012) found that although social anxiety was not related to initial orienting or number of fixations on emotional faces, social anxiety level was positively related to dwell time on angry and happy faces. Using a clinical sample, Gamble and Rapee (2010) found an early attentional bias toward angry faces among individuals with social anxiety disorder relative to non-clinical control participants. However, social anxiety participants were also vigilant for happy faces at 500 ms, at an amount equivalent to control participants. In contrast, Buckner, Maner, and Schmidt (2010) found no initial attention bias toward disgusted faces in high relative to low social anxiety participants, although socially anxious participants appeared to have difficulty disengaging from disgusted (but not happy) faces at later durations. Similarly, Chen, Clarke, MacLeod, and Guastella (2012) found no initial attentional bias differences between social anxiety disorder and control participants, although socially anxious participants spent significantly less time overall viewing angry and happy faces. Finally, Weeks, Howell, and Goldin (2013) examined eye gaze covertly among individuals with social anxiety disorder and non-anxious controls using video-based stimuli. Relative to control participants, individuals with social anxiety disorder displayed reduced eye contact with both positive and negative emotional stimuli. Findings of many of these studies suggest that stimuli of both positive and negative emotional valences are aversive to socially anxious individuals, consistent with a bivalent fear of evaluation (Weeks & Howell, 2012). Collectively, the results of these few studies using this more precise and comprehensive methodology seem contradictory and more research is needed to clarify the vigilance–avoidance hypothesis of social anxiety.

This study serves as both a replication and an extension of the existing literature. Like the

aforementioned eyetracking studies, this study examines the influence of social anxiety on visual attention to emotional faces using an eyetracking methodology that allows the continuous assessment of visual attention across time. Unlike the aforementioned studies, this study manipulates (as opposed to measures) state anxiety to examine its influence on attention to emotional faces.

In light of evidence supporting the vigilance–avoidance hypothesis, it was expected that, when presented simultaneously with angry and neutral faces, individuals with high trait anxiety would initially fixate faster than individuals with low trait anxiety. After this initial fixation, it was expected that those with high trait anxiety would subsequently return their attention less frequently to the angry faces. State anxiety was also manipulated to test whether it influenced the pattern proposed by the vigilance–avoidance hypothesis and whether high state anxiety would facilitate visual attention to positive and negative emotional stimuli, not just threatening stimuli as has been found in some previous research.

Method

Participants

Participants were 91 students (52.70% women, average age 20.40 years, SD = 3.27) recruited from an undergraduate psychology pool who had participated in a mass screening. Students scoring in the highest and lowest quartiles on the Brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983) for each gender were invited to participate in the second phase of the study. High fear of negative evaluation (FNE) men ($M = 49.05$; SD = 5.06; range 43–60) and women ($M = 51.30$; SD = 4.82; range 45–60) scored on the BFNE at or above 43 and 45, respectively, whereas low FNE men ($M = 23.87$; SD = 3.82; range 17–31) and women ($M = 27.46$; SD = 3.49; range 20–33) scored at or below 31 and 33, respectively. The majority of participants (84.62%) self-identified as white.

Measures

The Brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983). The BFNE served as the primary measure of trait social anxiety. The 12-item self-report measures the extent to which respondents worry that others have an unfavorable view of them on a 1–5 scale. Internal consistency was high in this study (coefficient $\alpha = .95$). Although not explicitly designed as a measure of social anxiety per se, the BFNE was chosen to measure trait social anxiety for this study because FNE is the core feature of social anxiety (American Psychiatric Association, 2013) not limited by focus on specific social situations. The BFNE correlates highly with self-report measures of social anxiety (e.g., Weeks & Howell, 2012) and discriminates between individuals with social anxiety disorder compared to panic and agoraphobia (Collins, Westra, Dozois, & Stewart, 2005). In this study, the high and low FNE groups differed on state anxiety during the speech, $F(1, 38) = 5.69$, $p = .02$, suggesting the selection criteria were relevant to the behavioral manipulation.

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS is a commonly used measure of affect that consists of two 10-item adjective lists for which participants rate the extent to which they *generally* feel this way, on a scale of 1–5. Only the negative affect scale, PANAS-NA, was used and internal consistency was high (coefficient $\alpha = .86$). Negative affect was assessed to determine whether any effects were specific to social anxiety or attributable to negative affect in general.

State-Trait Anxiety Inventory-State (STAI; Spielberger, Gorsuch, & Lushene, 1970). The state portion of the STAI is a well-validated 20-item self-report measure of the current intensity of the experience of anxiety. Internal consistency was high (coefficient $\alpha = .92$ and .96 for the first and second administrations, respectively).

Facial Stimuli

The facial stimuli were from the NimStim face stimulus set provided by the Research Network on Early Experience and Brain Development. Untrained individuals can reliably identify the intended emotions portrayed by the men and women in the stimulus set (Tottenham et al., 2009). Given the evidence that even positive emotional stimuli differentially affect attentional patterns (e.g., Weeks et al., 2013), this study included neutral–angry, neutral–happy, and angry–happy

stimuli pairs in order to distinguish between the effects of positive and negative emotional stimuli on attentional patterns.

Eyetracking equipment

The eye tracker was an SR Research Ltd. EyeLink II system (Mississauga, Ontario, Canada), with high spatial resolution and a sampling rate of 500 Hz. The Eyelink IIis a video-based eyetracking system in which cameras are mounted on a headset (one for each eye). For all participants, the dominant eye was monitored. Thresholds for detecting the onset of a saccadic movement were acceleration of 8000°/s2, velocity of 30°/s, and distance of 0.5° of visual angle. Movement offset was detected when velocity fell below 30°/s and remained at that level for 10 consecutive samples. Three eyetracking measures were of interest in this investigation (first fixation time, run count, and dwell time) and are described in the Results.

Procedure

Upon arrival, a trained research assistant reviewed the informed consent and procedures, including the possibility that participants would be asked to perform a speech. Informed consent procedures occurred in a room with a podium facing a set of chairs and a video camera. Next, participants completed the STAI-state before being randomly assigned to either the speech or no speech condition using a block randomization procedure. Half of the participants completed the questionnaire packet, followed by the eyetracking task, whereas the other half of the participants completed the procedures in reverse order in order to control for priming effects and to minimize carry-over effects. Unfortunately, coding for the order effect was lost so it was not possible to test for possible order effects on the dependent variables, possibly adding to error variance.

For the eyetracking task, participants were seated in front of a computer screen and fitted with the eyetracking equipment. For calibration and validation purposes, participants visually tracked a dot that appeared on the computer screen until the tracker accurately determined the location of their gaze. Finally, participants were instructed to view the pairs of faces on the screen. It was emphasized that there were no specific instructions concerning where they looked and that we were merely interested in where individuals look when presented with more than one image (standard free view instructions).

Participants viewed 36 randomly ordered trials. Each 3 s trial involved the simultaneous presentation of two facial stimuli (neutral–angry, neutral–happy, and happy–angry). Each type of stimulus (i.e., neutral, angry, and happy) appeared on the right and left sides of the screen with equal frequency, and each stimuli pairing appeared with equal frequency. Direction of gaze was monitored continuously during the task.

Following the eyetracking task, participants were reminded of their assignment to the speech or the no speech condition and completed the STAI again. Participants in the no speech condition watched a video of an individual delivering a speech, and participants in the speech condition gave three-minute speeches on a controversial topic (i.e., the death penalty or abortion) to an audience of three research assistants. Finally, participants were debriefed and thanked. All procedures were approved by the university Institutional Review Board. The entire experiment took 60 min.

Results

The data of five participants were omitted from analyses as they could not achieve acceptable levels of calibration on the eyetracker. Of these five participants, four were in the low trait social anxiety group, four were assigned to the no speech condition, and three were women. The final analyses are based on the data of the remaining 86 participants.

State anxiety manipulation check

A 2 (speech vs. no speech) X 2 (1st vs. 2nd STAI administration) mixed factor ANOVA found a main effect of speech condition, $F(1, 83) = 11.07$, $p = .001$, such that participants in the speech condition had higher STAI scores than participants in the no speech condition, regardless of time of administration. There was a significant main effect of time of administration, $F(1, 83) = 24.71$, $p < .001$, such that STAI scores increased, regardless of speech condition, but the interaction showed scores increased more for

participants who gave a speech, $F(1, 83) = 44.38$, $p < .001$ (see Figure 1).

Negative affect

Evidence suggests that forms of negative affect other than anxiety (e.g., depression) influence visual attention to emotional stimuli (Kellough, Beevers, Ellis, & Wells, 2008). As expected, low social anxiety participants had less negative affect as measured by the PANAS-NA ($M = 15.61$, $SD = 4.52$) than high anxiety participants ($M = 21.38$, $SD = 6.22$), $t(89) = -5.12$, $p < .001$. Therefore, negative affect was used as a covariate in the following analyses in order to increase the specificity of the findings. All means reported are corrected for PANAS-NA, unless otherwise indicated.

Dependent variables

There were three eyetracking measures of interest in this investigation:

(1) *First fixation time*: the amount of time that elapses following the start of each trial until the first fixation on each face. A fixation was defined as when the eye is relatively stationary (i.e., moving less than 30°/s) for at least 100 ms.
(2) *Run count*: the number of times the participants returned their attention to each face. Run count was calculated for the first 1000 ms of each trial, the last 2000 ms of the trial, and for each trial as a whole.
(3) *Dwell time*: the amount of time participants spent attending to each type of face. Dwell time was calculated for the first 1000 ms of each trial, the last 2000 ms of the trial, and for each trial as a whole.

Eyetracking variables

For each hypothesis, a 2 (high vs. low trait social anxiety) X 2 (speech vs. no-speech) X 6 (facial stimulus: neutral paired with angry vs. neutral paired with happy vs. angry paired with neutral vs. angry paired with happy vs. happy paired with neutral vs happy paired with angry). (Note that the first stimulus in each pair represents the critical image of interest within each analysis given that we were interested in visual behavior as a function of the valence of the target image and as a function of the type of image it was compared with; this means that for each of the three conditions—angry–neutral, happy–neutral, and angry–happy—there was a separate analysis for each image in the pair.) Negative affect served as a covariate. Each analysis differs only by the dependent variable (unless otherwise specified).

First fixation time. Results were contrary to the hypothesis that individuals with high trait social anxiety would fixate more quickly on angry faces than individuals with low trait social anxiety. There was a significant interaction between facial stimulus type and trait social anxiety, $F(5, 400) = 2.41$, $p = .04$. However, least significant difference (LSD) follow-up analyses of cell means (minimum mean difference = 58.06) indicated that high and low trait social anxiety groups did not differ in first fixation time on the angry faces. Of note, low trait social anxiety participants were slower to fixate on the non-angry faces (in

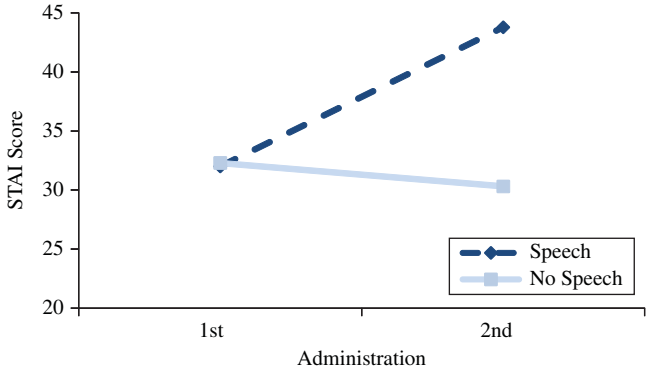

Figure 1. State anxiety scores by speech condition and administration. Note. STAI, State-Trait Anxiety Inventory – State.

trials containing angry faces) than high trait social anxiety participants (see Table 1 for descriptive statistics). This pattern indicates that the high trait social anxiety participants avoid angry faces and instead focus more quickly on non-negatively valenced stimuli.

Contrary to the hypothesis that individuals in the speech condition would fixate more quickly on emotional stimuli than individuals in the no speech condition, the interaction between speech condition and facial stimulus type was not significant, $F(5, 400) = 1.97$, $p = .08$. There were no other significant effects on first fixation time.

Run count. Contrary to the hypothesis that high trait anxiety participants would return their attention less frequently than low trait anxiety participants to angry facial stimuli, the interaction between facial stimulus type and trait social anxiety was not significant, $F(5, 400) = 1.19$, $p = .31$.

There was a significant interaction between speech condition and facial stimulus type, $F(5, 400) = 3.10$, $p = .01$. LSD follow-up analyses of the cell means (minimum mean difference = .06) indicated that the no speech group returned their attention to the happy face in happy–angry trials less often than the speech group. On neutral–happy trials, the no speech group returned their attention more often to the neutral face than the speech group. No other differences emerged between the speech groups. There were no other significant effects on run count.

Dwell time and dwell time bias. There were no significant effects for dwell time. In order to test the hypothesis that the high trait social anxiety group initially would spend more time examining angry faces than individuals in the low trait social anxiety group, but that they would subsequently spend less time examining angry faces, a new dependent variable was calculated. *Dwell time bias* was calculated by dividing the dwell time for the angry face by the dwell time for the non-angry face on the trials that contained an angry face. Scores with an absolute value greater than 1 on the dwell time bias variable indicate a bias toward greater dwell time on the angry face. Scores were calculated for the first 1000 ms and the last 2000 ms of each trial.

A $2 \times 2 \times 2 \times 2$ mixed group ANCOVA was conducted with trait social anxiety (high vs. low) and speech condition (speech vs. no speech) as between-group independent variables, with trial type (angry–neutral or angry–happy) and trial time (first 1000 ms or last 2000 ms) as within-group independent variables, with negative affect as a covariate, and with dwell time bias as the dependent variable.

Contrary to the hypothesis that there would be an interaction between trial time and trait social anxiety group, the interaction was not significant, $F(1, 79) = .03$, $p = .87$.

There was a significant main effect of speech condition, $F(1, 79) = 2.74$, $p = .04$, on dwell time bias such that participants in the no speech condition spent more time examining

Table 1. *First fixation time (ms) by trait social anxiety and facial stimulus type.*

				95% CI	
Trait social anxiety	Facial stimulus	Mean	Std. Error	LL	UL
Low	Angry (with neutral)	694.00	32.26	629.80	758.19
	Neutral (with angry)	876.32	33.43	809.80	942.85
	Angry (with happy)	749.18	31.27	686.94	811.41
	Happy (with angry)	801.67	32.22	737.56	865.78
	Happy (with neutral)	730.17	33.89	662.73	797.61
	Neutral (with happy)	822.58	33.76	755.39	889.76
High	Angry (with neutral)	701.57	36.32	629.29	773.85
	Neutral (with angry)	800.49	37.64	725.58	875.40
	Angry (with happy)	754.09	35.21	684.01	824.16
	Happy (with angry)	681.24	36.27	609.06	753.43
	Happy (with neutral)	716.28	38.16	640.35	792.22
	Neutral (with happy)	756.68	38.01	681.04	832.33

Note. *CI, confidence interval; LL, lower limit; UL, upper limit.*

angry faces ($M = 1.26$) than individuals in the speech condition ($M = 1.13$).

There was a significant interaction between trial type and speech condition, $F(1, 79) = 4.79$, $p = .03$. LSD follow-up analyses of the cell means (minimum mean difference = .19) indicated that for angry–happy trials, there was no difference between participants in the speech and no speech condition in dwell time bias on angry faces. However, on the angry–neutral trials, participants in the no speech condition had a greater dwell time bias on the angry faces than speech condition participants (see Figure 2).

There was a significant interaction between trial time, trait social anxiety group, and speech condition, $F(1, 79) = 6.77$, $p = .01$. LSD follow-up analyses of the cell means (minimum mean difference = .31) indicated that for high trait social anxiety participants in the speech condition, there was no difference between the dwell time bias on the angry face in the first 1000 ms of the trials and the last 2000 ms of the trials. In addition, high trait social anxiety participants in the no speech condition spent more time examining angry faces in the first 1000 ms than in the last 2000 ms of the trials. The pattern was reversed for participants in the low trait social anxiety condition such that low trait social anxiety participants in the no speech condition spent an equivalent amount of time examining the angry faces in the first 1000 ms of the trials and the last 2000 ms of the trials. However, low trait social anxiety participants in the speech condition spent a greater amount of time examining the angry face during the first 1000 ms than the last 2000 ms of the trials (see Figure 3). There were no other significant effects on dwell time bias.

Discussion

The purpose of this study was to test the vigilance–avoidance hypothesis and to examine the effects of state anxiety on attention to emotional stimuli using eyetracking technology.

Vigilance–avoidance

The study did not support the vigilance–avoidance hypothesis in the expected manner. Participants high in trait social anxiety fixated more quickly than low trait social anxiety participants on neutral stimuli, but not on angry faces, in neutral–angry trials. Furthermore, there were no differences between the high and low trait social anxiety groups in frequency that participants returned their attention to angry faces or in the duration of examination of angry faces.

Although unexpected, these findings are not necessarily inconsistent with theories of anxiety as having a threat detection function or the tenets of the vigilance–avoidance hypothesis. Results are consistent with a pattern in which high social anxiety participants are initially aware of, but actively avoid, angry faces. On average, trait socially anxious participants made their first fixations on angry images in the angry–neutral trials around 700 ms after the onset of the stimuli. Since detection typically occurs within 100 ms (Utama, Takemoto, Koike, & Nakamura, 2009), it is possible that participants covertly detected angry faces prior to fixation and that

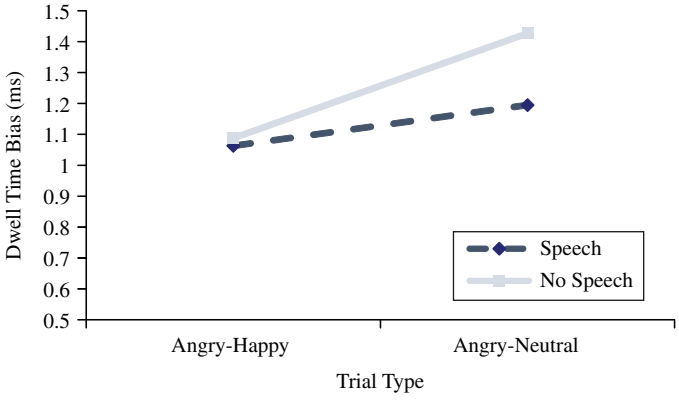

Figure 2. Dwell time bias by trial type and speech condition.

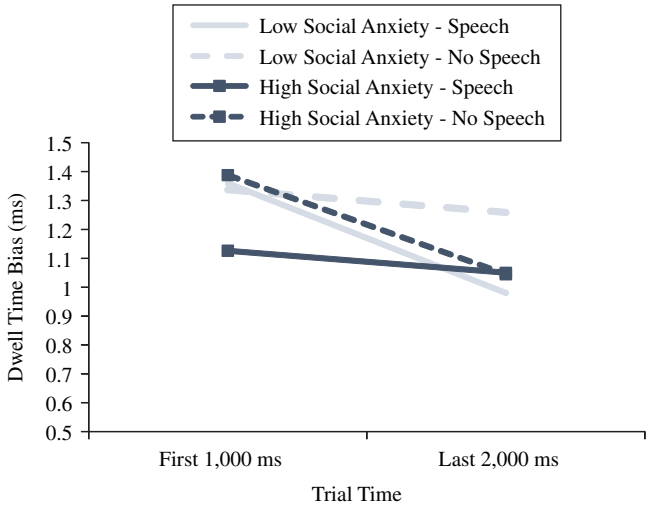

Figure 3. Dwell time bias by trial type, trait social anxiety, and speech condition.

high trait social anxiety participants actively avoided angry stimuli by fixating more quickly on non-angry stimuli. This is consistent with the idea that high trait social anxiety participants avoid angry faces.

The null results concerning the return and duration of attention are not surprising considering the mixed state of the data concerning the avoidance of negatively valenced emotional stimuli. For example, at exposure durations of 500 ms, some research has found evidence of avoidance of stimuli with negative emotional valence (Chen et al., 2002; Vassilopoulos, 2005), while other studies have found evidence of attentional bias toward such stimuli (Sposari & Rapee, 2007). Our findings are consistent with studies that demonstrate that anxiety does not always moderate patterns of attention to stimuli of negative emotional valence (e.g., Esteves, 1999; Fox et al., 2000).

Unexpected findings concerning the vigilance–avoidance hypothesis may be accounted for by methodological differences between this study and past investigations of the vigilance–avoidance hypothesis that often used the dot probe task (e.g., Schofield et al., 2012), which infers the location of visual attention for a specific point in time.

State anxiety effects

Contrary to predictions, state social anxiety did not affect the speed with which participants fixated on emotional stimuli or overall dwell time. However, state anxiety did predict biased attention in trials that contained happy faces. Specifically, the high state anxiety group returned attention to the non-happy faces less often than the low state anxiety group. Furthermore, on the angry–neutral trials, but not angry–happy trials, participants in the low state anxiety condition had a greater dwell time bias on the angry faces than the high state anxiety condition participants, suggesting that state anxiety facilitates attention away from angry faces. Overall, it appears as though elevation in state anxiety results in biases toward more positive stimuli. These and other eyetracking results (e.g., Chen et al., 2012, Weeks et al., 2013) support the emerging relationship between increased anxiety and bias toward positive facial stimuli, including possible anxiety reduction with training attention toward positive stimuli (Boettcher et al., 2013). In this study, however, biased attention toward positive faces was limited to state anxiety, and no such effects were found for trait anxiety.

The mixed results are not entirely surprising given the inconsistencies in the literature on the predictive ability of state anxiety (e.g., MacLeod, Mathews, & Tata, 1986; Mansell et al., 1999; Pineles & Mineka, 2005). One factor may be the nature of the stimuli (Mansell et al., 2002; Reinholdt-Dunne, Mogg, & Bradley, 2009). Elevations in state anxiety may lead individuals to avoid emotional facial stimuli and attend to emotional verbal stimuli. Dissimilarity in

stimulus intensity and ease of processing between facial and verbal stimuli might explain the differences in their effects, as these factors have been shown to be important predictors of attentional behavior (Beall & Herbert, 2008; Wilson & MacLeod, 2003).

Timing was not important for participants in either of the extreme conditions (i.e., high trait and state anxiety; low trait and state anxiety), as their lack of vigilance toward angry faces remained constant. Relative to each other, the high state and trait social anxiety group remained avoidant of angry faces across time, whereas the low state and trait social anxiety group remained vigilant for angry faces across time. For participants in the other two groups, timing was important. In fact, both of the non-extreme conditions showed a similar vigilance–avoidance pattern.

Theoretically, individuals with high trait and state social anxiety should exhibit vigilance for angry faces (e.g., Barlow, 2000; Rapee & Heimberg, 1997). However, this was not found in this study. It is possible that high baseline trait anxiety combined with impending threat (i.e., speech) caused participants in the high trait and state social anxiety condition to reach an intensity of anxiety in which avoidance is a more adaptive mechanism. Alternatively, consistent with Clark and Wells (1995), it is possible that when social anxiety is elevated, individuals focus on internal, rather than external, threat cues. Although the mechanism that produced these patterns is unknown, this study suggests that trait and state social anxiety and timing are important variables to assess when studying the effect of anxiety on attention to angry faces.

Clinical implications

This study most directly informs attention modification interventions for social anxiety disorder, which has been shown to be effective in some studies (e.g., Amir et al., 2008 but see Boettcher et al., 2014 as well). Based on the idea that individuals with high trait social anxiety may benefit from attending to angry and disgusted faces similarly to those with low social anxiety, results of this study suggest that intervention programs should encourage slower fixations on neutral stimuli paired with angry or disgusted facial stimuli. However, this suggestion seems to conflict with the findings that the existing programs that direct attention toward neutral or positive stimuli at 500 ms are effective in reducing social anxiety. The possibility also remains that the primary mechanism of attention modification interventions is exposure to feared stimuli, not remediation of attentional bias (Boettcher et al., 2013).

Limitations

Study results should be interpreted in light of its limitations. One limitation is the use of a non-clinical sample, which may limit generalizability of results to those with clinical levels of social anxiety. However, non-clinical samples have primarily been used to study attentional patterns in anxiety (for a review, see Van Bockstaele et al., 2014), and transient social anxiety is thought to differ quantitatively, rather than qualitatively, from the experience of individuals with social anxiety disorder (Rapee & Heimberg, 1997). Furthermore, the effect size associated with threat-related attentional biases does not differ significantly between participants with social anxiety disorder and high anxiety, non-clinical participants (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). Nevertheless, replication of this study with a social anxiety disorder sample would demonstrate the implications for clinical populations.

The participants were selected based on their scores on a measure of FNE, not social anxiety. It was not feasible with available resources to conduct diagnostic interviews to assess for social anxiety disorder. Therefore, FNE was used to identify potential participants with the core construct of interest, independent of fear in specific social situations, which is important given the heterogeneity of feared situations in social anxiety disorder (e.g., Safren et al., 1999). It is possible that some participants had high FNE and were not socially anxious, but for those participants, the fear should have still been relevant for the angry faces. This study did not consider fear of positive evaluation, which also occurs in social anxiety (Weeks, Heimberg, Rodebaugh, & Norton, 2008).

Finally, it is possible that regardless of speech condition, participants experienced elevated anxiety during the experiment. Prior to the manipulation of state anxiety, all participants were informed that they may engage in a speech task. This knowledge might have created anxiety that did not completely

return to baseline following their assignment, thus reducing the difference in state anxiety between the speech conditions.

Conclusion

Results suggest that individuals with high trait social anxiety avoid angry faces, despite knowledge of the presence of angry faces. This finding is not necessarily inconsistent with the tenets of the vigilance–avoidance hypothesis, although findings did not completely support the hypothesis and add to the mixed results in the literature.

Overall, it appears as though elevated state anxiety results in biases toward more positive stimuli. However, state anxiety appears to interact with trait social anxiety to predict attention. Relative to each other, the high state and trait social anxiety group remained avoidant of angry faces across time, whereas the low state and trait social anxiety group remained vigilant toward angry faces across time. Participants with both high trait social anxiety and low state anxiety or with both low trait social anxiety showed a similar vigilance–avoidance pattern of attention to angry faces.

This study highlights the need for future research on attentional patterns of socially anxious individuals in the presence of angry faces. Further research using eyetracking would help to clarify the relationship between social anxiety and attention to angry faces, as this methodology allows examination of visual attention in a way that is different than, albeit complementary to, other methods of attentional assessment.

Disclosure statement: The authors have declared that no conflict of interest exists.

References

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Amir, N., Weber, G., Beard, C., Bomyea, J., & Taylor, C.T. (2008). The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. *Journal of Abnormal Psychology*, *117*, 860–868. doi:10.1037/a0013445

Bar-Haim, Y., Lamy, P., Pergamin, L., Bakermans-Kranenburg, M.J., & van IJzendoorn, M.H (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*(1), 1–24. doi:10.1037/0033-2909.133.1.1

Barlow, D.H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, *55*, 1247–1263. doi:10.1037/0003-066X.55.11.1247

Beall, P.M., & Herbert, A.M. (2008). The face wins: Stronger automatic processing of affect in facial expressions than words in a modified Stroop task. *Cognition & Emotion*, *22*, 1613–1642. doi:10.1080/02699930801940370

Boettcher, J., Hasselrot, J., Sund, E., Andersson, G., & Carlbring, P. (2014). Combining attention training with Internet-based cognitive-behavioural self-help for social anxiety: A randomised controlled trial. *Cognitive Behaviour Therapy*, *43*, 34–48. doi:10.1080/16506073.2013.809141

Boettcher, J., Leek, L., Matson, L., Holmes, E.A., Browning, M., MacLeod, C., …, Hashimoto, K. (2013). Internet-based attention bias modification for social anxiety: A randomised controlled comparison of training towards tegative and training towards positive cues. *PLoS One*, *8*, e71760. doi:10.1371/journal.pone.0071760

Buckner, J.D., Maner, J.K., & Schmidt, N.B. (2010). Difficulty disengaging attention from social threat in social anxiety. *Cognitive Therapy and Research*, *34*, 99–105. doi:10.1007/s10608-008-9205-y

Calamaras, M.R., Tone, E.B., & Anderson, P.L. (2012). A pilot study of attention bias subtypes: Examining their relation to cognitive bias and their change following cognitive behavioral therapy. *Journal of Clinical Psychology*, *68*, 745–754. doi:10.1002/jclp.21875

Carlbring, P., Apelstrand, M., Sehlin, H., Amir, N., Rousseau, A., Hofmann, S., & Andersson, G. (2012). Internet-delivered attention bias modification training in individuals with social anxiety disorder – a double blind randomized controlled trial. *BMC Psychiatry*, *12*, 66. doi:10.1186/1471-244X-12-66

Chen, N.M., Clarke, P.F., MacLeod, C., & Guastella, A.J. (2012). Biased attentional processing of positive stimuli in social anxiety disorder: An eye movement study. *Cognitive Behaviour Therapy*, *41*, 96–107. doi:10.1080/16506073.2012.666562

Chen, Y.P., Ehlers, A., Clark, D.M., & Mansell, W. (2002). Patients with generalized social phobia direct their attention away from faces. *Behaviour Research and Therapy*, *40*, 677–687. doi:10.1016/S0005-7967(01)00086-9

Clark, D.M., & Wells, A. (1995). A cognitive model of social phobia. In R.G. Heimberg, M. R. Liebowitz, D.A. Hope, & F.R. Schneier (Eds.), *Social phobia: Diagnosis, assessment, and treatment* (pp. 69–93). New York, NY: Guilford Press.

Collins, K.A., Westra, H.A., Dozois, D.J.A., & Stewart, S.H. (2005). The validity of the brief version of the Fear of Negative Evaluation

Scale. *Journal of Anxiety Disorders*, *19*, 345–359. doi:10.1016/j.janxdis.2004.02.003

Esteves, F. (1999). Attentional bias to emotional facial expressions. *European Review of Applied Psychology*, *49*, 91–97.

Fox, E., Lester, V., Russo, R., Bowles, R.J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition & Emotion*, *14*, 61–92. doi:10.1080/026999300378996

Gamble, A.L., & Rapee, R.M. (2010). The time-course of attention to emotional faces in social phobia. *Journal of Behavior Therapy and Experimental Psychiatry*, *41*, 39–44. doi:10.1016/j.jbtep.2009.08.008

Garner, M., Mogg, K., & Bradley, B.P. (2006). Orienting and maintenance of gaze to facial expressions in social anxiety. *Journal of Abnormal Psychology*, *115*, 760–770. doi:10.1037/0021-843X.115.4.760

Kellough, J.L., Beevers, C.G., Ellis, A.J., & Wells, T.T. (2008). Time course of selective attention in clinically depressed young adults: An eye tracking study. *Behaviour Research and Therapy*, *46*, 1238–1243. doi:10.1016/j.brat.2008.07.004

Leary, M.R. (1983). A brief version of the fear of negative evaluation scale. *Personality and Social Psychology Bulletin*, *9*, 371–375. doi:10.1177/0146167283093007

Lee, H., & Telch, M.J. (2008). Attentional biases in social anxiety: An investigation using the inattentional blindness paradigm. *Behaviour Research and Therapy*, *46*, 819–835. doi:10.1016/j.brat.2008.04.001

Li, S., Tan, J., Qian, M., & Liu, X. (2008). Continual training of attentional bias in social anxiety. *Behaviour Research and Therapy*, *46*, 905–912. doi:10.1016/j.brat.2008.04.005

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*, 15–20. doi:10.1037/0021-843X.95.1.15

Mansell, W., Clark, D.M., Ehlers, A., & Chen, Y.P. (1999). Social anxiety and attention away from emotional faces. *Cognition & Emotion*, *13*, 673–690. doi:10.1080/026999399379032

Mansell, W., Ehlers, A., Clark, D.M., & Chen, Y. (2002). Attention to positive and negative social-evaluative words: Investigating the effects of social anxiety, trait anxiety and social threat. *Anxiety, Stress & Coping*, *15*, 19–29. doi:10.1080/10615800290007263

Mogg, K., Bradley, B.P., Miles, F., & Dixon, R. (2004). Time course of attentional bias for threat scenes: testing the vigilance-avoidance hypothesis. *Cognition & Emotion*, *18*, 689–700. doi:10.1080/02699930341000158

Pineles, S.L., & Mineka, S. (2005). Attentional biases to internal and external sources of potential threat in social anxiety. *Journal of Abnormal Psychology*, *114*, 314–318. doi:10.1037/0021-843X.114.2.314

Pishyar, R., Harris, L.M., & Menzies, R.G. (2008). Responsiveness of measures of attentional bias to clinical change in social phobia. *Cognition & Emotion*, *22*, 1209–1227. doi:10.1080/02699930701686008

Price, M., Tone, E.B., & Anderson, P.L. (2011). Vigilant and avoidant attention biases as predictors of response to cognitive behavioral therapy for social phobia. *Depression and Anxiety*, *28*, 349–353. doi:10.1002/da.20791

Rapee, R.M., & Heimberg, R.G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*, 741–756. doi:10.1016/S0005-7967(97)00022-3

Reinholdt-Dunne, M., Mogg, K., & Bradley, B.P. (2009). Effects of anxiety and attention control on processing pictorial and linguistic emotional information. *Behaviour Research and Therapy*, *47*, 410–417. doi:10.1016/j.brat.2009.01.012

Rutherford, E.M., MacLeod, C., & Campbell, L.W. (2004). Negative selectivity effects and emotional selectivity effects in anxiety: differential attentional correlates of state and trait variables. *Cognition & Emotion*, *18*, 711–720. doi:10.1080/02699930341000121

Safren, S.A., Heimberg, R.G., Horner, K.J., Juster, H.R., Schneier, F.R., & Liebowitz, M.R. (1999). Factor structure of social fears. *Journal of Anxiety Disorders*, *13*, 253–270. doi:10.1016/S0887-6185(99)00003-1

Schmidt, N.B., Richey, J.A., Buckner, J.D., & Timpano, K.R. (2009). Attention training for generalized social anxiety disorder. *Journal of Abnormal Psychology*, *118*, 5–14. doi:10.1037/a0013643

Schofield, C.A., Johnson, A.L., Inhoff, A.W., & Coles, M.E. (2012). Social anxiety and difficulty disengaging threat: Evidence from eye-tracking. *Cognition & Emotion*, *26*, 300–311. doi:10.1080/02699931.2011.602050

Spielberger, C.D., Gorsuch, R.L., & Lushene, R.E. (1970). *STAI manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.

Sposari, J.A., & Rapee, R.M. (2007). Attentional bias toward facial stimuli under conditions of social threat in socially phobic and nonclinical participants. *Cognitive Therapy and Research*, *31*, 23–37. doi:10.1007/s10608-006-9073-2

Tottenham, N., Tanaka, J.W., Leon, A.C., McCarry, T., Nurse, M., Hare, T.A., …, Nelson, C. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research*, *168*, 242–249. doi:10.1016/j.psychres.2008.05.006

Utama, N.P., Takemoto, A., Koike, Y., & Nakamura, K. (2009). Phased processing of facial emotion: An ERP study. *Neuroscience Research*, *64*, 30–40. doi:10.1016/j.neures.2009.01.009

Van Bockstaele, B., Verschuere, B., Tibboel, H., De Houwer, J., Crombez, G., & Koster, E.W. (2014). A review of current evidence for the causal impact of attentional bias on fear and anxiety. *Psychological Bulletin*, *140*, 682–721. doi:10.1037/a0034834

Vassilopoulos, S. Ph. (2005). Social anxiety and the vigilance-avoidance pattern of attentional processing. *Behavioural and Cognitive Psychotherapy*, *33*, 13–24. doi:10.1017/S1352465804001730

Watson, D., Clark, L.A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070. doi:10.1037/0022-3514.54.6.1063

Weeks, J.W., Heimberg, R.G., Rodebaugh, T.L., & Norton, P.J. (2008). Exploring the relationship between fear of positive evaluation and social anxiety. *Journal of Anxiety Disorders*, *22*, 386–400. doi:10.1016/j.janxdis.2007.04.009

Weeks, J.W., & Howell, A.N. (2012). The bivalent fear of evaluation model of social anxiety: Further integrating findings on fears of positive and negative evaluation. *Cognitive Behaviour Therapy*, *41*, 83–95. doi:10.1080/16506073.2012.661452

Weeks, J.W., Howell, A.N., & Goldin, P.R. (2013). Gaze avoidance in social anxiety disorder. *Depression and Anxiety*, *30*, 749–756. doi:10.1002/da.22146

Wilson, E., & MacLeod, C. (2003). Contrasting two accounts of anxiety-linked attentional bias: Selective attention to varying levels of stimulus threat intensity. *Journal of Abnormal Psychology*, *112*, 212–218. doi:10.1037/0021-843X.112.2.212