



# The Contribution of Attentional Bias to Negative Information to Social Anxiety-Linked Heightened State Anxiety During a Social Event

Ben Grafton<sup>1</sup> · Christian Long<sup>1</sup> · Colin MacLeod<sup>1</sup>

Accepted: 12 May 2023 / Published online: 26 May 2023  
© The Author(s) 2023

## Abstract

**Background** It has been proposed that people with high compared to low trait social anxiety pay greater attention to negative information concerning upcoming social events, and that such attentional bias drives the disproportionately elevated levels of state anxiety they exhibit in response to these events. These two hypotheses have not yet been adequately tested.

**Method** We recruited participants who were high or low in trait social anxiety. Participants completed a mock job interview, and reported their state anxiety during this experience. Prior attentional bias to negative, relative to benign, information concerning this event was assessed using a variant of the dual probe approach, in which participants were exposed to dual videos, each comprising two video clips of people who had completed the mock job interview, discussing either negative or benign aspects of this experience.

**Results** High compared to low trait social anxiety participants displayed higher attentional bias to negative social information, and this bias mediated the association between elevated trait social anxiety and heightened state anxiety experienced during the mock job interview.

**Conclusions** These findings demonstrate that elevated trait social anxiety is characterized by an attentional bias to negative, relative to benign, information concerning an upcoming social event, and that this attentional bias statistically predicts the disproportionately elevated state anxiety that people with high trait social anxiety experience during such an event.

Elevations in state anxiety can be triggered by social events, such as giving a speech or during a job interview (Hofmann, 2007). Importantly, people differ in their tendency to experience elevations in state anxiety when engaging in social events. This dimension of individual difference is known as trait social anxiety. People with high trait social anxiety, relative to those with low trait social anxiety, tend to exhibit elevated levels of state anxiety when engaging in a social event. Other people who have previously experienced such

events may share information about them concerning their negativity. It has been proposed that people with high trait social anxiety pay greater attention to negative, compared to benign, information concerning upcoming social events (regardless of the absolute level of bias exhibited), than people with low trait social anxiety, and that such attentional bias drives the disproportionately elevated levels of state anxiety they exhibit in response to these events (Heimberg et al., 2010). High trait social anxiety is particularly prevalent among adolescents and young adults (Spence & Rapee, 2016), and can exert a significant adverse impact on social, academic and occupational functioning (Davila & Beck, 2002; Stein & Kean, 2000). While there is considerable evidence demonstrating that people with high trait social anxiety display greater attentional bias to negative social information, such as negative socially relevant words (e.g. timid or embarrassed) or negative facial expressions (e.g. angry or disgusted; cf. Mathews & MacLeod, 2005),

This work was supported by Australian Research Council Grants DE200101570 and FL170100167.

✉ Ben Grafton  
ben.grafton@uwa.edu.au

<sup>1</sup> Centre for the Advancement of Research on Emotion, School of Psychology, M304, University of Western Australia, 35 Stirling Highway, 6009 Crawley, Australia

research has not yet investigated whether people with high trait social anxiety display greater attentional bias towards negative, compared to benign, information concerning upcoming social events. By extension, it also has not been investigated whether such attentional bias can statistically predict the disproportionately elevated levels of state anxiety that people with high trait social anxiety exhibit when engaging in these events. Thus, the aim of the present study was to test the validity of these two hypotheses.

The most common method of assessing attentional bias is the attentional probe task (MacLeod et al., 1986). In this task, participants are briefly presented with stimulus pairs, usually comprising one negative and one benign member. The stimuli presented are often simply pairs of emotionally toned words (e.g. timid / proud), or pairs of face images displaying different emotionally-toned facial expressions (e.g. angry / happy). A single visual probe stimulus is subsequently presented in the locus where either member of the stimulus pair was just displayed, and participants are required to quickly identify this probe, which remains on-screen until the identification response is detected. The degree to which this identification response is speeded for probes appearing in the locus of the negative compared to benign member of the stimulus pair provides an index of attentional bias to negative information. In studies that have used this conventional probe approach to compare patterns of attentional bias in people high and low in trait social anxiety, it has repeatedly been shown that the former individuals are disproportionately speeded to identify probes appearing in the locus of negative member of stimulus pairs, suggesting that high trait social anxiety is characterized by relatively greater attentional bias to such negative information (Asmundson & Stein, 1994; Gilboa-Schechtman et al., 1999; Vassilopoulos, 2005).

However, there are three limitations with these previous studies, in terms of their capacity to shed light on the two hypotheses under present consideration. First, these studies have relied upon the conventional attention probe task to assess attentional bias, which has been shown to have low psychometric reliability, with internal consistency of the attentional bias index often being  $<0.30$  (McNally, 2018). Second, these studies have not involved assessing participants' state anxiety response to a potentially stressful social event. Third, the stimulus information employed in these previous studies have typically been single words or faces, that do not convey negative and benign information concerning a specific social event that participants know they are about to experience.

To overcome the low psychometric reliability of the attentional probe task, Grafton, Teng and MacLeod (2021) recently developed a dual probe attentional bias assessment approach. Specifically, rather than presenting a single probe

on each trial in the locus of either member of stimulus pairs, which remains on-screen until the participant executes an identification response, the dual probe approach instead involves the simultaneous presentation of two probes, very briefly (200 ms), one in the locus of negative information and the other in the locus of benign information. The participant simply identifies whichever probes they see. The proportion of correctly identified probes appearing in the locus of negative information provides an index of attentional bias to such information. In addition, a major advantage of the dual probe approach is that it can readily be delivered using continuous video stimuli, thereby enabling presentation of richer information than the type of stimuli typically delivered within the conventional single probe task (i.e. simple word or pictorial stimuli). Grafton et al. showed that, when the dual probe task is configured to present such video stimuli, it is capable of sensitively detecting anxiety-linked attentional bias, and importantly, the resulting attentional bias index demonstrates high psychometric reliability (internal consistency = 0.97).

In the present study, this dual probe approach was employed in a manner that overcame the other two limitations of previous research, to test the validity of the two hypotheses under consideration. Recruitment was focused on young adults given the prevalence of high trait social anxiety amongst this cohort. To assess variation in the degree to which participants who were high or low in trait social anxiety experienced elevations in state anxiety in response to a potentially stressful social event, we delivered a mock job interview at the end of the experimental session. To assess prior attentional bias to negative relative to benign information concerning this event, we employed a variant of the dual probe approach in which participants were exposed to dual videos, each comprising two video clips that were a head and shoulder shot of a first-year university student who had previously completed the mock job interview, discussing either negative or benign aspects of this experience. This enabled test of the first hypothesis, that people with high trait social anxiety display relatively greater attentional bias towards negative, compared to benign, information concerning upcoming social events. If this hypothesis is correct, then participants high in trait social anxiety will display higher negative attentional bias index scores than participants low in trait social anxiety. To test the second hypothesis, that such bias can statistically predict the disproportionately elevated levels of state anxiety that people with high trait social anxiety exhibit in response to upcoming social events, participants state anxiety during the mock job interview was assessed. It was assumed that participants high in trait social anxiety, relative to participants low in trait social anxiety, would exhibit disproportionately elevated levels of state anxiety during this job interview. If the

second hypothesis is correct, then this association between trait social anxiety and state anxiety during the mock job interview will be mediated by attentional bias to negative information.

## Method

### Participants

Six-hundred and eleven first year psychology students at the University of Western Australia were screened for trait social anxiety using the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke 1998a, b) at the beginning of the university semester. Twenty-five participants were recruited from the upper third of the SIAS score distribution (scoring 35 or above) and were designated the High Trait Social Anxiety Group. Twenty-five participants were recruited from the lower third of the SIAS score distribution (scoring 20 or below) and were designated the Low Trait Social Anxiety Group<sup>1</sup>. This gave rise to a between-group factor of Trait Social Anxiety Group (High Trait Social Anxiety vs. Low Trait Social Anxiety).

### Materials

#### Questionnaires

**Social Interaction Anxiety Scale.** The Social Interaction Anxiety Scale assesses a person's tendency to experience elevations in state anxiety when engaging in social events, and so it can be considered a measure of trait social anxiety (SIAS; Mattick & Clarke 1998a, b). The SIAS comprises 20 items that each describe an anxiety symptom that could be elicited by exposure to social situations. Respondents are required to rate each item on a five-point scale ranging from 0 ("Not at all characteristic or true of me") to 4 ("Extremely characteristic or true of me"). This yields a score between 0 and 80, with higher scores indicating higher levels of trait social anxiety. The SIAS is one of the most used measures of trait social anxiety (Rodebaugh et al., 2006), and has been shown to have high reliability and validity (Hedman et al., 2010).

**Spielberger State Anxiety Inventory – Short Form.** The Spielberger State Anxiety Inventory – Short Form was programmed for computer delivery to assess state anxiety (STAI-S; Marteau & Bekker 1992). The short form of the STAI-S comprises six items. Three items describe feelings that indicate high state anxiety (e.g. I feel tense), whereas the other three items describe feelings that indicate low state

anxiety (e.g. I feel calm). Participants responded to each item using a visual analogue scale. Each scale consisted of a 15 cm horizontal line, divided into 60 equal partitions, with the terminal labels "Not at all" and "Very much", and the intermediary labels "Somewhat" and "Moderately". Using the mouse, participants moved a cursor along the line to a point that corresponded to their state anxiety experience, by pressing the left mouse button to register their response. This resulted in a score ranging from 1 to 60. The three items describing feelings that indicate low state anxiety were reversed scored, before a mean score was computed across all six items, which ranged from 1 to 60, with higher scores indicating higher levels of state anxiety.

### Stimulus Videos Describing Negative and Benign Aspects of Upcoming Social Event

The present study required the creation of 24 dual videos, each comprising one video clip in which an individual conveyed negative information concerning the mock job interview experience, and one video clip in which a different individual conveyed benign information concerning the mock job interview experience. To achieve this, we recruited a separate cohort of 24 first-year university students, who performed as "actors" to create video content (12 male and 12 female). We wanted to ensure that the informational content of the videos was credible, and so each of these student actors was first required to complete the mock job interview, before then recording two video clips: one in which they described negative aspects of the mock job interview experience (negative video clips), and the other in which they described benign aspects of the mock job interview experience (benign video clips).

Each video clip began and ended with a scripted opening and closing statement respectively. Between these statements, the video content was unscripted, but was structured such that the student actors described negative or benign aspects of the mock job interview, with respect to each of four predetermined topics. For the negative video clips, these four topics were: (i) thought of self-doubt; (ii) physical symptoms of anxiety experienced during the mock job interview; (iii) difficulties in organizing coherent answers under pressure; and (iv) concern that others watching their recorded interview would judge them poorly. For the benign video clips, these four topics were: (i) the rewarding feeling that comes from having completed a challenging experience; (ii) increased confidence in public speaking having completed the mock job interview; (iii) experience gained for an interview in real-life; and (iv) the absence of any negative experience. The order in which student actors were required to talk about each of these topics was randomized. Each video clip lasted for 60 s. Each video was edited to

<sup>1</sup> Due to technical error, the data for one participant from the Low Trait Social Anxiety Group was not recorded.

ensure that the face of the student actor was centered on vertical and horizontal axes, and occupied two-thirds of the video.

From these video clips, we created 24 dual videos, using VideoPad Video Editor® (Version 5.02, NCH Software, 2017). To achieve this, we first generated 12 pairs of male and female student actors, at random. Then, for each student pair, we created two dual videos, each comprising one negative video clip and one benign video clip. In one of these dual videos, the student in the negative video clip was the male of the pair and the student in the benign video clip was the female. In the other dual video, the student in the negative video clip was the female of the pair and the student in the benign video clip was the male. The purpose of counterbalancing valence of information, and biological sex of the actor was to avoid any confound between differing valence of information and the visual/auditory differences that distinguish biological males and females. Across the dual videos, the negative video clip began in the left and right position, with equal frequency. In each dual video, the component video clips each measured 17.2 cm x 13 cm. The centre of one component video clip in the dual video was positioned 11.5 cm to the left, and the centre of other was positioned 11.5 cm to the right, of screen centre. The audio tracks for the left or right video clips were played through the left and right audio channel, respectively, and were equalised in VideoPad Video Editor prior to compilation of the dual video. The position of the two component video clips, within each dual video, switched with each other at random intervals of five, six, or seven seconds, such that across the 60 s duration of each dual video, the positions of the two component video clips switched 9 times.

## Experimental Tasks

### Attentional Bias Assessment Task

During presentation of each dual video, at pseudorandom points, a pair of small visual probe stimuli was presented for 200 ms. These probe pairs never appeared within the 2 s window preceding or following a switch in the position of the two component videos. These probe stimuli were grey, 3×3 grids on a black background, in which one of the outer eight grid positions was occupied by a small grey square. One probe appeared in the centre of the location in which the video clip in the left position had been playing, and the other probe appeared in the centre of the location in which the video clip in the right position had been playing. The identity of the probes in each pair was always different, but participants were informed that the identity of the probes in each pair were always the same. Participants were required to identify whatever probes they saw, and to

indicate probe identity using the 3×3 number pad on the keyboard to respond, pressing the key that corresponded to the position of the small grey square within the 3×3 probe grid (see Fig. 1). Across each dual video, 10 probe pairs were presented. Thus, across the task, 240 probe pairs were presented. The 24 dual videos were presented in a random order, with the constraint that all student actors were presented once, before appearing again. A brief rest period was provided after every six dual videos. The attentional bias assessment task last approximately 24 min.

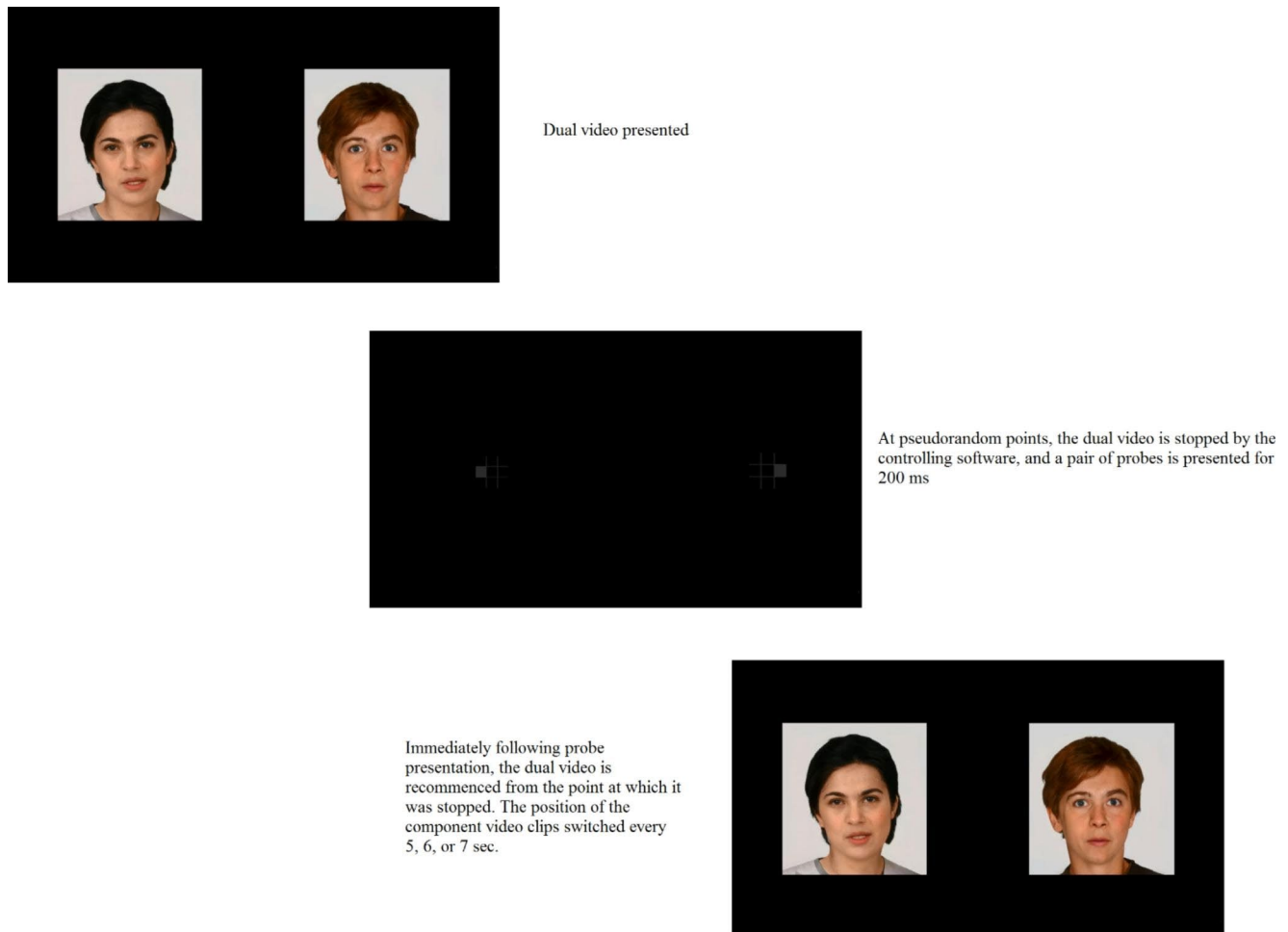
As Grafton et al. (2021) point out, attentional distribution can only be accurately inferred only if participants correctly identify probes. Thus, in keeping with Grafton et al., participants who failed to identify probes within at least 80% of dual probe presentations were excluded. The rationale underpinning the dual probe task assumes that participants will most often see, and therefore identify, those probes that appear in the locus of the component video clip to which they were attending. Therefore, attentional bias to negative, compared to benign, information concerning the upcoming social event can be indexed by calculating the proportion of the correctly identified probes, overall, that had appeared in the locus of the negative component video clips within the dual videos. Thus, we computed this index of attentional bias to negative information using the following equation:

$$\text{Index of Attentional Bias to Negative Information About Interview} = \frac{\text{Number of correctly identified probes in locus of negative video clips}}{\text{Total number of correctly identified probes}}$$

A higher score on this index reflects greater attentional bias to negative, compared to benign, information concerning the upcoming mock job interview event.

### Social Event: Mock Job Interview

As previously noted, participants were aware that, at the end of the experimental session, they would be required to complete a social event, which in the present study was a mock job interview. The mock job interview can be considered a social event as it involves communicative interaction with other people. Participants were told that this would be a mock job interview for the role of a research assistant within the University of Western Australia's psychology department. This role was chosen given that it represents the type of employment opportunity university students may seek. During this mock job interview, participants were shown a video, which participants were informed had been pre-recorded, in which four 'interviewers' were sitting at a table facing the participant. Each interviewer asked one question (e.g. "What personal qualities in general make you a good employee, and could you provide some examples?"), and the participant had 60 seconds to respond aloud to this



**Fig. 1** Illustrative depiction of event during attentional bias assessment task

question. Participants were instructed that their response to each question should make full use of the allocated 60 seconds. A count-down clock positioned in the top-right hand corner of the video displayed the amount of time that the participant had left to respond. Participants were told that their responses would be video recorded, and also livestreamed to the experimenter, who would be seated outside the testing room.

### Experimental Hardware

A Hewlett-Packard i7-6700 Desktop PC, 21.5-inch LG Flatron-E2211 monitor with inbuilt webcam, standard QWERTY keyboard and two-button mouse, and Sennheiser HD202 headphones, were used to deliver the experimental tasks.

### Procedure

Each participant was tested individually. The test session commenced with the participant reading an information

sheet, providing informed consent, and completing the Social Interaction Anxiety Scale. They were informed that they would later be required to complete a mock job interview, and that their performance would be recorded, and livestreamed to the experimenter outside the testing room. Next, the participant was told that, before they completed this mock job interview, they would be given the opportunity to view videos in which people who had previously completed the task described their personal appraisals of this experience. The participant was then seated approximately 60 cm in front of the computer screen, and provided with instructions for the attentional bias assessment task. They were instructed that, during presentation of the videos, they should allow their attention to move as it normally would, and should identify any probes they saw, using the number pad. Next, the participant completed a short practice involving two dual videos, each comprising two benign video clips, before completing the attentional bias assessment task. During this task, state anxiety was assessed after every six dual videos. The participant notified the experimenter when they had completed the attentional bias assessment task, and was

then taken to an adjacent testing room to complete the mock job interview. In the mock job interview, the participant was instructed to stand one meter in front of a computer screen, which was positioned at eye-level. They were reminded that their responses would be recorded via the monitor's inbuilt webcam, and livestreamed to the experimenter who would be seated outside the testing room. They were then left to complete the mock job interview. Immediately upon its completion, the participant rated the degree to which they had experienced state anxiety during the mock job interview. Finally, the participant was debriefed about the purpose of the study, and thanked for their participation.

## Results

### Group Characteristics at Time of Testing

As will be recalled, the High and Low Trait Social Anxiety Groups were created based upon SIAS scores obtained as part of a mass screening procedure conducted at the beginning of the university semester. It was recognized that, at the point of the test session, participants' SIAS scores may have regressed towards the mean. Thus, to ensure that no participant was inappropriately classified as being high or low in trait social anxiety, a median split was carried out on the SIAS scores obtained at test time. Any member of the High Trait Social Anxiety Group who at test time scored below the median ( $SIAS = 25$ ) of the test time SIAS score distribution was eliminated, as was any member of the Low Trait Social Anxiety Group who at test time scored above this median. This resulted in the exclusion of one participant from each group. The resulting High Trait Social Anxiety Group comprised 16 females and 8 males, with a mean age of 19.35 years ( $SD = 1.87$ ), and a mean SIAS score of 42.33 ( $SD = 8.82$ ). The resulting Low Trait Social Anxiety Group comprised 10 females and 13 males, with a mean age of 19.45 years ( $SD = 2.34$ ), and a mean SIAS score of 14.83 ( $SD = 4.94$ ). The two groups differed significantly in terms of SIAS scores, as intended,  $t(45) = 13.10$ ,  $p < .001$ , and they did not differ significantly in terms gender ratio,  $\chi^2(1, n = 47) = 2.55$ ,  $p = .11$ , or age,  $t(45) = 0.17$ ,  $p = .87$ .

### Did Participants High in Trait Social Anxiety Exhibit Disproportionately Elevated State Anxiety During the Mock Job Interview?

If the mock job interview served as a social stressor, then the high compared to low trait social anxiety participants would report greater levels of state anxiety during this experience. To confirm this assumption, we subjected the state anxiety scores indicating state anxiety experienced during

the mock job interview to an independent samples t-test that considered the between-group factor Trait Social Anxiety Group (High Trait Social Anxiety vs. Low Trait Social Anxiety). Before doing so, the data was inspected for outliers using the Median Absolute Deviation approach (Leys et al., 2013). No outlying scores were identified. The analysis revealed a significant main effect of Trait Social Anxiety Group,  $t(45) = 4.54$ ,  $p < .001$ , Cohen's  $d = 1.32$ , reflecting the fact that participants in the High Trait Social Anxiety Group ( $M = 39.49$ ,  $SD = 10.80$ ) reported higher state anxiety scores compared to participants in the Low Trait Social Anxiety Group ( $M = 26.89$ ,  $SD = 7.96$ ), thus verifying that the high trait social participants experienced greater state anxiety during the mock job interview than did their low trait social counterparts<sup>2</sup>.

### Did Participants High in Trait Social Anxiety Exhibit Relatively Greater Attentional Bias to the Negative Information?

As mentioned, participants who failed to identify probes on at least 80% of dual probe presentations were eliminated. This resulted in the further exclusion of one participant from each group. The remaining participants, on average, correctly identified probes on 92.25% ( $SD = 4.62\%$ ) of dual probe presentations. For each participant, we computed the Index of Attentional Bias to Negative Information About Job Interview, as described in the [Method](#) section. Outlier analysis was conducted in the same manner as before. The attentional bias scores of six participants (two in the High Trait Social Anxiety group and four in the Low Trait Social Anxiety group) were identified as outliers. These scores were Winsorized into the nearest value within the variable sample, as recommended by Field (2013), with the resulting distribution of attentional bias scores remaining normally distributed (skew =  $-0.15$ ; kurtosis =  $-0.69$ ). Reassuringly, the internal consistency of the attentional bias index scores, which was computed by calculating split-half reliability across odd and even trials, was extremely high, at 0.93, again underscoring the excellent psychometric reliability of the dual probe task.

To determine the validity of the hypothesis that people with high trait social anxiety display relatively greater attentional bias towards negative, compared to benign, information concerning an upcoming social event, we subjected the attentional bias index scores to an independent samples t-test that considered the between-group factor Trait Social

<sup>2</sup> Participants in the High Trait Social Anxiety Group ( $M = 27.59$ ,  $SD = 10.02$ ) also reported higher state anxiety scores compared to participants in the Low Trait Social Anxiety Group ( $M = 14.35$ ,  $SD = 7.35$ ), during the attentional bias assessment task,  $F(1, 45) = 28.00$ ,  $p < .001$ , partial  $\eta^2 = 0.38$

Anxiety Group (High Trait Social Anxiety vs. Low Trait Social Anxiety). This analysis revealed a significant main effect of Trait Social Anxiety Group,  $t(45) = 2.25, p < .05$ , Cohen's  $d = 0.67$ . This significant main effect reflected the fact that participants in the High Trait Social Anxiety Group ( $M = 0.48, SD = 0.09$ ) displayed higher attentional bias to negative social information scores than participants in the Low Trait Social Anxiety Group ( $M = 0.42, SD = 0.10$ ), and is consistent with the hypothesis that, compared to their low trait counterparts, the high trait socially anxious participants would display relatively greater attentional bias to negative information concerning an upcoming social event.

### Did Attentional Bias to Negative Information Mediate the Association Between Trait Social Anxiety and State Anxiety During the Mock Job Interview?

Having confirmed that participants with high trait social anxiety experienced heightened state anxiety during the mock job interview, and that elevated people with high trait social anxiety display relatively greater attentional bias to negative information concerning this upcoming social event, we went on to test the validity of the predictions generated by the second hypotheses under consideration, that this negative attentional bias would mediate the association between elevated trait social anxiety and heightened state anxiety during the mock job interview, by conducting a simple mediation analysis. In this analysis, conducted on the data from the 45 participants remaining following the above described exclusions, Trait Social Anxiety (TSA) Group was entered as the predictor variable, State Anxiety During Job Interview (SA) scores were entered as the outcome variable, and Attentional Bias to Negative Information About Interview Index (ABI) scores were entered as the mediator variable. In keeping with Hayes (2013), the analysis was conducted using bootstrapping with 5000 resamples to calculate 95% bias-corrected confidence intervals (CIs) for the indirect effect.

The result of this mediation analysis confirmed that TSA Group predicted the SA scores ( $c'$  path;  $\beta = 0.89, p < .001$ ), and the ABI scores ( $a$  path;  $\beta = 0.64, p < .05$ ). These ABI scores also predicted the SA scores ( $b$  path;  $\beta = 0.33, p < .05$ ). Of most relevance to the hypothesis under consideration, TSA Group predicted the SA scores in a manner that was mediated by ABI scores ( $ab$  path), as the bootstrapped 95% CIs of this indirect effect did not include zero (0.10–5.28). Thus, these results indicate that attentional bias to negative information about the interview did indeed mediate the association between elevated trait social anxiety and heightened state anxiety experienced during the mock job interview.

## Discussion

The aim of the current study was to test the validity of two hypotheses: the first hypothesis was that people with high trait social anxiety display relatively greater attentional bias to negative, compared to benign, information concerning upcoming social events, and the second hypothesis was that such attentional bias statistically predicts the heightened state anxiety that these individuals experience during social events. To enable test of these hypotheses, we capitalised upon the dual probe variant of the attentional probe task recently developed by Grafton et al. (2021). Unlike the conventional single probe variant of this task, this new approach has been shown to have excellent psychometric reliability. In our current dual probe task, the internal consistency of the attentional bias index scores was extremely high, at 0.93, which is comparable to that reported by Grafton et al., and is considerably higher than what is typically obtained on the conventional single probe variant of the attentional probe task. The dual probe task also readily enables presentation of ecologically valid information conveying the negative and benign aspects of an upcoming social event, delivered using video clips of individuals who had previously experienced the event. Employing such video stimuli, we have demonstrated that people with high trait social anxiety display relatively greater attentional bias to negative information concerning an upcoming social event, consistent with the first hypothesis under test.

We suggest that future researchers should now build on this novel finding, to test more refined hypotheses concerning the patterns of attentional bias that characterise elevated trait social, perhaps by refining the precise nature of the information conveyed by video clip stimuli delivered within the dual probe task. For example, it has long been recognised that the selective processing of negative socially-relevant information may be adaptive, if that information concerns aspects of an upcoming event that can be controlled in ways that reduce the likelihood of experiencing a negative social outcome (e.g. Ledley & Heimberg 2006). Indeed, everyone may attend to negative information concerning an upcoming social event, when that information concerns controllable aspects of the event, with people high in trait social anxiety only showing greater attention to negative information concerning an upcoming social event, when this information concerns *uncontrollable* aspects of the event. In the present study, the information presented within the video clip stimuli was not developed to permit dissociation of attentional responding to information that concerns controllable vs. uncontrollable aspects of an upcoming social event. However, such stimuli could be readily developed and delivered within the dual probe task to enable tests of

more fine-grained hypotheses concerning the attentional basis of high trait social anxiety.

Turning to the second hypothesis under test, the present results confirmed that the measure of negative attentional bias significantly mediated the association between trait social anxiety group and degree of state anxiety experienced during the mock job interview. These findings are consistent with the hypothesis that attentional bias to negative information concerning an upcoming social event statistically predicts the disproportionately elevated state anxiety that people with high trait social anxiety experience when they then engage in this social event.

Of course, the approach taken in the present study to investigate this second hypothesis involved testing only the naturally occurring associations between variables using mediation analysis, precluding strong claims about the potential causal role of the candidate mediator (Fiedler et al., 2011). To more powerfully test the functional contribution of such attentional bias, we suggest that future researchers employ an attentional bias modification (ABM) approach (cf. MacLeod & Grafton, 2016), to determine whether the transient modification of attentional bias to negative information about an upcoming social event significantly alters levels of state anxiety experienced when people engage in such an event, as would be predicted if this attentional bias serves causally to elevate state anxiety. Such extensions of the present research will further advance understanding of the attentional basis of elevated trait social anxiety, and inform the development of ABM procedures that can potentially exert a more powerful therapeutic impact on such disposition (Heeren et al., 2015).

The present study was not designed to assess the degree to which introduction of the mock job interview served to elevate state anxiety. Although we observed that attentional bias to negative information predicted state anxiety experienced during the mock job interview, the design did not involve expressing this anxiety in terms of the elevation in state anxiety from when the mock job interview was introduced. Assessing state anxiety during the session, before completion of the job interview, would not enable suffice to achieve this aim, given that the study required participants to be aware of the interview. To address this issue, future research could deliver the attentional bias assessment task to participants who did not know they themselves would be completing the mock job interview, and then assess the degree to which introduction of the mock interview served to elevate state anxiety.

It should be noted that, in the present study, participants retrospectively reported the level of state anxiety they experienced during the mock job interview. While this retrospective assessment approach was adopted to ensure the experience of the interview was not disrupted by the need to

concurrently report state anxiety, it is possible that variation in attentional bias influenced how participants reconstructed their state anxiety experience when making this retrospective report. We suggest that future researchers address this possibility by replicating the present study, but assessing state anxiety during the interview using concurrent physiological markers, such as, heart rate variability (Dimitriev et al., 2016). Such future work should also consider exposing participants to social stressors other than a mock job interview. Indeed, the types of stressors that evoke social anxiety are likely to differ from one person to the next. By employing a range of social stressors, future researchers will be able to determine the generalisability of the present findings. It should also be noted that the sample size in the present study was relatively small. Post-hoc power analysis revealed that the study had 0.60 power to detect the social anxiety-linked group difference in attentional bias to negative information, and 0.50 power to detect the hypothesised indirect effect, reflecting the mediating impact of such attentional bias on the association between elevated trait social anxiety and heightened state anxiety experienced during the interview. Thus, we suggest that future researchers seek to replicate the present study with larger samples. When doing so, we recommend that these replications be pre-registered, as doing so would increase confidence in the results obtained. Finally, we suggest that future researchers seek to extend the current work by determining whether the presently observed pattern of findings are displayed by people high in trait social anxiety across the full developmental trajectory, across different socio-economic groups, across different races and ethnicities, and when such anxiety is assessed using complementary measures of trait social anxiety, for example, the Social Phobia Scale (Mattick & Clarke, 1998a, b).

For the moment, however, the present findings demonstrate that people with trait social anxiety display relatively greater attentional bias to negative information concerning an upcoming social event, and the pattern of observed mediation is consistent with the possibility that this attentional bias can statistically predict the disproportionately elevated state anxiety that people with high trait social anxiety experience when they engage in this social event. We hope that these findings, and the new approach we have employed to assess social anxiety-linked selective attention, will be of value to future investigators seeking to better understand contribution of attentional bias to elevated trait social anxiety.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s10608-023-10389-2>.

**Funding** Open Access funding enabled and organized by CAUL and



its Member Institutions

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethics Approval** This study was approved by the Human Research Ethics committee of the XXX (Ethics approval: RA/4/1/5243).

**Consent to Participate** Informed consent was obtained from all individual participants included in the study.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Asmundson, G. J. G., & Stein, M. B. (1994). Selective processing of social threat in patients with generalized social phobia: Evaluation using a dot-probe paradigm. *Journal of Anxiety Disorders*, 8, 107–117.
- Davila, J., & Beck, J. G. (2002). Is social anxiety associated with impairment in close relationships? A preliminary investigation. *Behavior Therapy*, 33, 427–446.
- Dimitriev, D. A., Saperova, E. V., & Dimitriev, A. D. (2016). State anxiety and nonlinear dynamics of heart rate variability in students. *PLoS one*, 11, e0146131.
- Fiedler, K., Schott, M., & Meiser, T. (2011). What mediation analysis can (not) do. *Journal of Experimental Social Psychology*, 47, 1231–1236.
- Field, A. (2013). *Discovering statistics using IBM SPSS Statistics* (4th ed.). Los Angeles, USA: Sage.
- Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition & Emotion*, 13, 305–318.
- Grafton, B., Teng, S., & MacLeod, C. (2021). Two probes and better than one: Development of a psychometrically reliable variant of the attentional probe task. *Behaviour Research and Therapy*, 138.
- Hayes, A. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.
- Hedman, E., Ljótsson, B., Rück, C., Furmark, T., Carlbring, P., Lindfors, N., & Andersson, G. (2010). Internet administration of self-report measures commonly used in research on social anxiety disorder: A psychometric evaluation. *Computers in Human Behavior*, 26, 736–740.
- Heeren, A., Mogoase, C., Philippot, P., & McNally, R. (2015). Attentional bias modification for social anxiety: A systematic review and meta-analysis. *Clinical Psychology Review*, 40, 76–90.
- Heimberg, R., Brozovich, F., & Rapee, R. (2010). A cognitive behavioural model of social anxiety disorder: Update and extension. In S. Hofmann & P. DiBartolo (Eds.), *Social Anxiety: Clinical, developmental, and social perspectives 2nd Ed* (pp. 395–422). London, UK: Academic Press.
- Hofmann, S. (2007). Cognitive factors that maintain social anxiety disorder: A comprehensive model and its treatment implications. *Cognitive Behaviour Therapy*, 36, 193–209.
- Ledley, D., & Heimberg, R. (2006). Cognitive vulnerability to social anxiety. *Journal of Social and Clinical Psychology*, 25, 755–778.
- Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use standard deviation around the median. *Journal of Experimental Social Psychology*, 49, 764–766.
- MacLeod, C., & Grafton, B. (2016). Anxiety-linked attentional bias and its modification: Illustrating the importance of distinguishing processes and procedures in experimental psychopathology research. *Behaviour Research and Therapy*, 86, 68–86.
- MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, 95, 15–20.
- Marteau, T., & Bekker, H. (1992). The development of a six-item short-form of the state scale of the Spielberger state-trait anxiety inventory (STAI). *British Journal of Clinical Psychology*, 31, 301–306.
- Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Review of Clinical Psychology*, 1, 167–195.
- Mattick, R., & Clarke, J. (1998a). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy*, 36, 455–470.
- Mattick, R., & Clarke, C. (1998b). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy*, 36, 455–470.
- McNally, R. (2018). Attentional bias for threat: Crisis or opportunity? *Clinical Psychology Review*, 69, 4–13.
- Rodebaugh, T., Woods, C., Heimberg, R., Liebowitz, M., & Schneier, F. (2006). The factor structure and screening utility of the Social Interaction anxiety scale. *Psychological Assessment*, 18, 231–237.
- Spence, S., & Rapee, R. (2016). The etiology of social anxiety disorder: An evidence-based model. *Behaviour Research and Therapy*, 86, 50–67.
- Stein, M. B., & Kean, Y. M. (2000). Disability and quality of life in social phobia: Epidemiologic findings. *American Journal of Psychiatry*, 157, 1606–1613.
- Vassilopoulos, S. (2005). Social anxiety and the vigilance-avoidance pattern of attentional processing. *Behavioural and Cognitive Psychotherapy*, 33, 13–24.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.