The Effect of Face Interpretation Training on Social Anxiety Symptoms

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The Effect of Face Interpretation Training on Social Anxiety Symptoms

Grace L. Wheeler

Thesis defense submitted to the
Eberly College of Arts and Sciences at West Virginia University
in partial fulfillment of the requirement of the degree of
Master of Science in Psychology

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ABSTRACT
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According to cognitive models of social anxiety disorder (SAD), individuals place excessive importance on gauging others’ reactions (e.g., facial expressions) to their social performance. Facial interpretation bias modification (FIBM) was developed to shift interpretations of ambiguous faces. The current study uses FIBM to test whether face interpretation is causally related to SAD symptoms in an unselected adult sample. Participants ($N=139$) were randomized to 1 of 3 conditions (positive, negative, accurate) in a single-session, online study. Pre- and post-intervention measures of face interpretation and SAD were completed. In line with hypotheses, individuals in the positive condition interpreted faces more positively at post-test compared to baseline, and individuals in the negative condition interpreted faces more negatively at post-test compared to baseline. Participants in the accurate condition were significantly more accurate at post-test compared to baseline. Contrary to hypotheses, FIBM did not affect SAD symptoms. Results demonstrate that FIBM successfully shifted face interpretations but did not affect SAD symptoms. Furthermore, FIBM scores did not correlate with any social anxiety measures. This suggests either the current study may have been limited due to methodological factors or that the interpretation of faces may not be causally related to SAD and highlights the need for refinement of SAD cognitive models.
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The defining feature of Social Anxiety Disorder (SAD) is an intense fear or anxiety regarding social situations in which the individuals may be judged by others (American Psychiatric Association, 2013). Negative impacts for individuals with SAD have been demonstrated in a variety of areas including income, productivity, academics, and friendships (Katzelnick et al., 2001; Stein et al., 1999; Van Ameringen et al., 2003; Whisman et al., 2000). The National Institute of Mental Health (NIMH) reports 7.1% of American adults experienced SAD in the past year, with relatively equivalent rates across genders. Furthermore, within their lifetimes, 12.1% of American adults will experience SAD.

The cognitive model of social anxiety posits that people develop social anxiety if they attach excessive importance to positive evaluation from others (Rapee & Heimburg, 1997). According to the model, individuals with social anxiety focus attention on maintaining their mental representation (i.e., beliefs about the social event and their own behavior), evaluating their social performance (e.g., a conversation at a party), and gauging audience reaction (e.g., approving, judging). When the individual is constantly assessing their actions and scanning the audience for their reaction, it increases anxiety, which leads to the misidentification of ambiguous cues from the audience. Neutral or ambiguous expressions are often interpreted as negative or threatening (Yoon & Zinbarg, 2008). This negative interpretation then furthers anxiety related to performance, acting as a negative feedback loop. This loop also leads to behavioral (e.g., avoidance) and emotional (e.g., increased distress) outcomes that contribute to impaired sociability.

Cognitive bias modification (CBM) was developed to test the theory that cognitive processes (e.g., negative interpretation, attention to threat) cause anxiety (Beck et al., 1985). In
CBM, cognitive biases are directly manipulated through repeated exercises aimed to counteract negative predispositions and subsequent effects on anxiety are measured. Some studies suggest that attention-based and interpretation-based CBM result in a decrease in social anxiety symptoms (Beard et al., 2011; MacLeod & Mathews, 2012; Hakamata et al., 2010; Hallion & Ruscio, 2011). However, other studies have found CBM’s effects on symptoms to be small or inconsistent (Fodor et al., 2020; Krebs et al., 2018; Liu et al., 2017). Meta-analyses suggest that age and gender do not moderate effects of CBM (Hakamata et al., 2010).

The current study tested a face interpretation bias modification task (FIBM), which is a CBM task designed to shift the interpretations of facial expressions (Penton-Voak et al., 2012; Penton-Voak et al., 2020; Peters et al., 2017; Kuin et al., 2020; Van Meter et al., 2021). The FIBM task was originally developed by Penton-Voak et al. (2012). In the FIBM task, participants complete a baseline phase, training phase, and post-test phase. In the baseline phase, participants are presented 1 of 15 faces which range from two different emotions (e.g., happy to angry) on a 15-face scale and categorize the emotion. Using this baseline data, researchers establish a balance point (i.e., the point within the 15-face range that the participant identified the face as happy instead of angry), or FIBM score, for each participant. In the training phase, participants are presented with the faces again, but given feedback (“correct” or “incorrect”) on their categorization of the emotion. The feedback is based on shifting the balance point by two increment faces on the 15-face continuum, inducing an interpretation bias. In the post-test phase, participants are presented with the same faces and categorize them; they are not given feedback. The post-test phase then reveals the effect of the training phase on facial interpretations, and whether a bias is induced.
Penton-Voak and colleagues (2012) originally developed and evaluated the FIBM task with undergraduate students with high levels of depressive symptoms. Subjects either received a positive or control FIBM intervention. In the positive intervention, individuals were trained to interpret faces more positively (faces morphed from happy to sad) by receiving feedback based on a balance point shift of two faces (e.g., if they had a FIBM score of 5 in the baseline trial, they received feedback to interpret the first 7 faces in the morph as positive). In the control intervention, participants identified emotional expression, but were not given feedback (i.e., were not trained to interpret faces positively). Participants completed six FIBM sessions over four days. Participants in the positive FIBM condition interpreted faces more positively in the post-test phase compared to their baseline phase, while control participants did not display this change. Results also demonstrated a slight, but non-significant decrease in depressive symptoms and negative affect in the positive FIBM condition.

FIBM has been used in healthy samples as well as samples with depression, anger and aggressive behavior, and bipolar disorder (Kuin et al., 2020; Penton-Voak et al., 2020; Peters et al., 2017; Van Meter et al., 2021). All studies have demonstrated a significant change in face interpretations. Penton-Voak and colleagues (2020) looked at the neural response to emotional faces after the FIBM intervention and found increased neural activation for happy faces in the medial prefrontal cortex and bilateral amygdala. However, none of these studies have shown significant effects on measures of psychopathology, such as state and trait anxiety, depression, stress, anger, or behavioral outcomes on prosocial behavior and aggressive behavior (Kuin et al., 2020; Penton-Voak et al., 2020; Peters et al. 2017; Van Meter et al., 2021).

Earlier studies looked at the impact of FIBM on depressive symptoms in participants with higher levels of depressive symptoms and with bipolar disorder. Research has demonstrated that
individuals in a major depressive episode have a bias to attend to sad faces compared to neutral faces (Disner et al., 2021). Additionally, individuals who are more vulnerable to depression tend to perceive social features as more negative (Bourke et al., 2010). However, interpretation of ambiguous faces is not theorized to be a causal mechanism of depression, which may explain the lack of effect of FIBM on depressive symptoms (Penton-Voak et al., 2012; Van Meter et al., 2021). Similarly, research has also evaluated the impact of FIBM on the State-Trait Anxiety Inventory measure, which is not theoretically tied to the interpretation of facial expressions (Peters et al., 2017). Finally, Kuin et al. (2020) investigated the impact of FIBM on anger and aggressive behavior in male prison inmates and did not find significant effects. The current study expected to see effects of FIBM on social anxiety because facial interpretation for audience evaluation is one of the core tenets in the social anxiety cognitive model (Rapee & Heimburg, 1997).

Two studies have found an effect of FIBM on psychopathology. Penton-Voak et al. (2013) demonstrated an effect of FIBM balance point change in a one-session intervention on healthy adults as well as a decrease in self-reported and observer-reported anger and aggression after a 4-5 day FIBM intervention in high-risk youth. In this study, individuals completed the same FIBM intervention as Penton-Voak et al. (2012) except the faces morphed from happy to angry. Results are in line with past hostility research and suggest that the interpretation of ambiguous faces may be causally related to behavioral aggression and anger (Dillon et al., 2020; van Teffelen et al., 2021).

Rawdon et al. (2018) was the first and only study so far to assess FIBM on social anxiety. Specifically, Rawdon et al. (2018) examined the FIBM task’s effect on social anxiety symptoms in adolescents with high social anxiety and demonstrated an effect of face interpretations and a
decrease in depressive symptoms at a two-week follow-up but found no change in social anxiety symptoms. It is unclear why FIBM significantly affected depression in this study, given the intervention’s focus on social anxiety, and null results on depression and other mood measures in previous studies. Nevertheless, this effect on depression suggests that FIBM may be able to affect psychopathology symptoms. Rawdon et al. (2018), like other studies, only used a two-point shift from the balance point for the training phase; it is thus possible that this shift in balance point was not enough to influence social anxiety symptoms. This study also used a face morph from happiness to disgust; however, anger may be more potent for training given that individuals with high social anxiety (compared to individuals with low social anxiety) have demonstrated a sensitivity for anger recognition (i.e., more accurate at recognition and shorter recognition time; Cui et al., 2021).

 Though previous research assessed the effect of positive training within FIBM, the current one-session proof of principle study was the first to assess FIBM effects on social anxiety symptoms in adults, and the first to evaluate negative and accurate FIBM conditions. A negative interpretation bias induction tested the causal relationship between interpretation of audience expressions and symptoms of SAD theorized in the cognitive model of social anxiety (Rapee & Heimburg, 1997). An accurate condition was designed to test if improved accuracy (instead of inducing a positive bias) might reduce social anxiety symptoms. Overall, the inclusion of two new conditions may elucidate possible intervention targets.

 Methodological issues (e.g., theoretical match between FIBM and investigated disorder/mood measures, timed presentation of face stimuli, emotions selected for face stimuli morph) in previous research may have led to nonsignificant results on psychopathology symptoms and as such several changes were made in the current study to strengthen potential
impact on social anxiety symptoms. The current FIBM task used more relevant stimuli and theoretically relevant measures. Before starting the task, participants were instructed to imagine they are giving a presentation, and the following faces were faces in the audience. This prompt was included to simulate a real-life scenario in assessing audience reaction and be more closely tied to the cognitive model of social anxiety (Rapee & Heimburg, 1997). The FIBM task was strengthened by increasing the balance-point shift from two faces to include the entire middle range of five faces. Faces also remained on the screen until the participant answered the categorization question to evaluate interpretation of facial expressions (versus interpretation of a memory of the stimulus). This untimed version of the face stimuli assessed one’s interpretation bias while previous timed stimulus may have assessed memory bias (given that ratings are made after the face is no longer visible). The task was strengthened by using a happy to angry face morph series, as previous research has established a sensitivity for anger recognition in individuals with high social anxiety (Cui et al., 2021). The current study’s inclusivity for all levels of social anxiety led to the ability to analyze participants based on baseline severity. Baseline symptoms of social anxiety and fear of positive evaluation were also assessed to explore if either moderated the effect of FIBM.

In the current study, the FIBM task originally developed in Penton-Voak et al. (2012) was conducted with the following modifications: 1) Similar to Penton-Voak et al. (2013), FIBM task was conducted in one session to decrease attrition and decrease burden on participants; 2) Faces morphed from happy to angry (instead of happy to sad); 3) The FIBM task included a positive bias condition, a negative bias condition, and an accuracy-based condition (vs. only positive and control conditions); 4) Instead of a two-point balance shift, the entirety of middle range ambiguous expressions (5 faces) was used for training; therefore, individuals were trained
to interpret a larger subset of the faces under each condition; 6) Faces stayed on the screen for 60 seconds, or until participants answered the categorization question. In the positive and negative conditions, for the five middle faces on the 15-face range, participants were instructed to respond with “approval” or “criticism” respectively. In the accurate condition, participants were instructed to respond with “ambiguous” to the five middle faces. It was predicted that this more dramatic shift in emotion training would lead to stronger effects on social anxiety symptoms. This was also the first time the intervention was conducted entirely online.

Participants were undergraduate students ($N = 140$) at West Virginia University. Prior to the FIBM task, participants completed the Social Interaction Anxiety Scale (SIAS) and Fear of Positive Evaluation Scale (FPES) measures at baseline (see Appendix A). Participants were then randomized to group condition and completed the FIBM task, which included a baseline phase, a training phase, and a post-test phase. Afterwards, participants completed the Liebowitz Social Anxiety Scale – Self-report (LSAS-SR) and SIAS again. Weeks and colleagues (2008a) posit SAD is built upon fear of evaluation in general, not just negative evaluation as Rapee and Heimburg (1997) outline. Given this, the current study investigated the relationship between fear of positive evaluation and the effect of FIBM on social anxiety in exploratory analyses. All FIBM and study procedures were conducted over Zoom with a trained research assistant.

It was hypothesized that the positive FIBM condition would lead to higher FIBM scores (indicating a more positive interpretation bias) in the post-test phase compared to the baseline phase. It was hypothesized subjects in the negative condition would have lower FIBM scores in the post-test phase compared to the baseline phase. It was also hypothesized that subjects in the positive condition would have a higher FIBM score at the post-test phase than subjects in the negative condition. The accurate condition was not included in between-group analyses due to its
alternate choice format with three options (approving, criticizing, ambiguous) while both the positive and negative conditions only had two options (approving, criticizing).

Furthermore, at post-intervention, it was hypothesized that social anxiety scores would be lowest in the positive condition, then accurate condition, and highest in the negative condition. It was also hypothesized that subjects in the positive condition would have lower post-intervention social anxiety scores compared to baseline and subjects in the negative condition would have higher post-intervention social anxiety scores compared to baseline.

As an exploratory test, the Fear of Positive Evaluation Scale score, baseline severity of social anxiety, and participant race were evaluated as potential covariates given participants of different races might evaluate white faces differently.

Methods

Participants

The sample consisted of 140\(^1\) adults recruited through the West Virginia University psychology department participant pool and a university survey listserv. One participant was excluded due to researcher error\(^2\). Of the remaining 139 participants, 64.7% \((n = 90)\) identified as cisgender female, 28.8% \((n = 40)\) identified as cisgender male, 5% \((n = 7)\) identified as non-binary, 0.7% \((n = 1)\) identified as transgender male, and 0.7% \((n = 1)\) identified as other. The average age was 22.53 years (range: 18-58, \(SD = 6.13\)). Additionally, 71.9% \((n = 100)\) of participants identified as White, 10.1% \((n = 14)\) identified as Asian/Pacific Islander, 3.6% \((n = 5)\) identified as Black/African American, 10.1% \((n = 14)\) identified as multi-racial, and 4.3% \((n = 6)\)

\(^1\) Sample size was determined by power analyses for a RM-ANOVA used G*power analysis (Faul et al., 2007). Given the lack of significant effects found in previous studies, a power analysis to detect a small effect size \((f = 0.15)\) with a power of 0.85 (alpha = .05) was conducted, leading to an optimal \(N\) of at least 126.

\(^2\) Participant was told their condition assignment prior to the intervention and was removed from all analyses.
identified as Other. Furthermore, 7.9% \((n = 11)\) of the sample identified as Hispanic (see Table 1). All participants were able to read and write in English.

**Measures**

*Baseline Measures*

*Demographics.* Demographic data was collected on all participants including age, gender, race, and ethnicity.

Fear of Positive Evaluation Scale (FPES) was used to assess baseline fear of positive evaluation (Weeks et al., 2008a). The FPES is a 10-item self-report assessment with a 10-point Likert-type response scale (e.g., “0 (not at all true)” to “9 (very true)”). Items refer to social situations in which the individual would be subjected to positive evaluation (Weeks et al., 2008a). The FPES score was calculated from summing the 8-composite total score items (items 5 and 10 are excluded from scoring), leading to a range of 0-72, with higher scores indicating greater fear of positive evaluation. Scores on the FPES demonstrated strong internal consistency \((\alpha = 0.80)\) as well as significant test-retest reliability at 5 weeks \((ICC = 0.70; \text{Weeks et al., 2008a})\). The FPES also displayed concurrent validity through a significant correlation with scores on the Social Interaction Anxiety Scale – Straightforward scale \((r = 0.48; \text{Weeks et al., 2008a})\). In the current study, the FPES had strong internal consistency \((\alpha = 0.82)\).

Social Interaction Anxiety Scale (SIAS) was used to assess baseline social anxiety and post-intervention effects of FIBM on social anxiety (Mattick & Clarke, 1998). As the instructions for the LSAS-SR were modified for the current study, the SIAS was included as a non-modified, validated measure of social anxiety. Item 14 was adjusted to be inclusive of non-heterosexual orientations. The SIAS is a 20-item, self-report instrument with a Likert response scale (e.g., “0 - Not at all”, “4 - Extremely”) with three items reverse coded \((5, 9, 11)\). The SIAS
presents statements and the participant rates how characteristic the statement is to them. The SIAS total score was calculated from summing its 20-items (Mattick & Clarke, 1998). Total scores range from 0-80, with higher scores indicating greater social anxiety (Mattick & Clarke, 1998). The SIAS scores have demonstrated strong internal consistency ($\alpha = 0.93 - 0.94$) and significant test-rest reliability for a 12-week period ($r = 0.92$; Carter et al., 2014; Mattick & Clarke, 1998). The SIAS scores have shown concurrent validity through significant Pearson correlation coefficient of $r = 0.66$ with scores on Fear of Negative Evaluation Scale (FNES; Mattick & Clarke, 1998). The SIAS has also shown to be a sensitive measure for one session studies evaluating effects on anxiety (Possis et al., 2019). In the current study, the SIAS demonstrated strong internal consistency during baseline assessment ($\alpha = 0.92$) and post-intervention assessment ($\alpha = 0.95$).

**Task**

Face Interpretation Bias Modification Task was used to train participants in the negative, positive, and accurate conditions for expression categorization. The FIBM task used composite faces from images in the Karolinska Directed Emotional Faces (Lundqvist et al., 1998) and used a similar procedure to that used in Penton-Voak et al. (2012). The FIBM task was presented via Qualtrics. Fifteen faces were selected from Karolinska Directed Emotional Faces that provided a morphed range from happy to angry faces (Lundqvist et al., 1998). Each FIBM session consisted of three phases: baseline phase, training phase, and post-test phase.

Prior to beginning the baseline phase, participants received the following instructions, “Please imagine you are giving a speech in front of a crowd. The faces you will see are faces from the audience. You will be asked to choose which label best describes the face presented from several options.” For the training and post-test phase, the participants received the
following the instructions, “Please remember to imagine you are giving a speech in front of a crowd. The faces you will see are faces from the audience. You will be asked to choose which label best describes the face presented from several options.” For the negative and positive conditions, in the baseline phase participants were presented with a face in the center of the screen and instructed to categorize the expression of the presented face in a two-option forced choice procedure (e.g., “approving”, “criticizing”) below the face in each trial. Participants in the accurate condition were given a three-option forced choice procedure (e.g., “approving”, “ambiguous”, “criticizing”) for each phase. Each face was presented three times for a total of 45 trials and the face remained on the screen for 60 seconds or until the participant selected a response. If a response was not selected within 60 seconds, the trial automatically proceeded to the next face. In the baseline phase, participants did not receive feedback on their choice.

In the training phase, participants were presented with the same fifteen faces and the same forced choice response. Each face was presented twice for a total of 30 trials. However, participants were then provided feedback to each trial (e.g., “Correct! That face was approving”, “Incorrect! That face was criticizing”, “Correct! That face was ambiguous”) based on their group condition; feedback remained on the screen for one second. Participants in the positive condition were given feedback based on the categorization that the five middle faces in the 15-face morph were “approving”. Participants in the negative condition were given feedback based on the categorization that the five middle faces in the 15-face morph were “criticizing”. Finally, participants in the accurate condition were given feedback based on the categorization that the five middle faces in the 15-face morph were “ambiguous”. In the post-test phase (matching the baseline phase), each face was presented three times, for a total of 45 trials, but participants were not provided feedback.
The face stimuli used from Karolinska Directed Emotional Faces displayed a composite
face morphing from happy to angry in 15 stages (Lundqvist et al., 1998).

**FIBM Scoring**

FIBM task is scored by the number of faces categorized as happy divided by 45 (total
number of trials in phase), then multiplied by 15 (number of unique faces in trial), and finally
rounded to the nearest whole integer (Penton-Voak et al., 2012; Peters et al., 2017). The accuracy
condition was analyzed separately with a paired samples t-test given its use of three (vs. two)
response choices. The “approving” choice was coded as correct (“1”) for the first five faces, the
“ambiguous” choice was coded as correct (“1”) for the middle five faces, and the “criticizing”
choice was coded as correct (“1”) for the last five faces. The correct choices were summed,
divided by 45 (total number of trials in phase), multiplied by 15 (number of unique faces in trial), and rounded to the nearest whole integer for a final accuracy score.

*Post-Intervention Measures*

Liebowitz Social Anxiety Scale – Self Report (LSAS-SR) was used to assess post-intervention effects of FIBM on social anxiety (Baker et al., 2002). The LSAS-SR is a 24-item, self-report instrument used to measure social anxiety in respondents (Baker et al., 2002). The LSAS-SR measures social anxiety by presenting the respondent with 24 items (e.g., “Participating in small groups”) and the response format is two Likert-type scales for fear and avoidance. Fear is rated on a 0-3 scale Likert-type scale for intensity (e.g., “0 – None”; “3 – Severe”) and avoidance is rated on a 0-3 Likert-type scale for frequency (e.g., “0 – Never”; “3 – Usually”; Baker et al., 2000). Instructions were modified to focus on anticipated reactions in future scenarios. The LSAS-SR total score was calculated from summing its 24 items (range 0-144), with greater scores indicating greater social anxiety. The LSAS-SR total score has demonstrated strong internal consistency ($\alpha = 0.95 - 0.96$) and significant test-retest reliability for a 12-week period ($r = 0.83$; Baker et al., 2000; dos Santos et al., 2013). The LSAS-SR total score has shown concurrent validity through significant Pearson correlation coefficient of $r = 0.83$ with scores on Social Phobia and Anxiety Inventory (SPAI; Baker et al., 2000). In the current study, the LSAS-SR demonstrated strong internal consistency ($\alpha = 0.95$).

The SIAS was also completed again at post-intervention to assess social anxiety.

*Procedure*

This procedure was approved by the West Virginia University (WVU) Institutional Review Board. Participants completed the study session over Zoom with a trained research
assistant and were instructed to complete all measures and tasks on the Qualtrics form. In this session, participants were randomized to 1 of the 3 post-test conditions, and then completed demographic information, SIAS, and FPES (in a fixed order). Participants were blind to condition. Participants in each group completed the FIBM baseline session, FIBM training session, and FIBM post-test session. Participants then completed the LSAS-SR and then SIAS. Participants were then debriefed on the purpose of the study and compensated with their choice of half a credit in a psychology course or $5. During the debriefing, the research assistant informed the participant of their condition assignment, the purpose of the study, the goal for each condition, gave support resources for anxiety, and provided a citation for a past FIBM research paper (Peters et al., 2017).

Results

Descriptive statistics

All variables fell in acceptable range for skewness ($<2|)$ and kurtosis ($<4|$). One participant was an extreme outlier for their FIBM scores (FIBM baseline and post-test scores were more than three times the interquartile range from the first quartile). This participant’s FIBM data was removed. Descriptive statistics for questionnaire measures (FPES, SIAS, and LSAS-SR) can be found in Table 2. Baseline SIAS ($M = 30.16$) suggest the sample had higher levels of social anxiety symptoms than unselected samples ($M = 19$), and about the same as clinical samples ($M = 34.6; SD = 16.4$; Mattick & Clarke, 1998).

Group differences

To assess if there were differences between conditions at baseline, a chi-square test for independence for categorical variables and univariate analysis of variances (ANOVAs) for continuous variables were conducted. There were no differences between conditions in gender
[χ² (8, N = 139) = 0.72, p = 0.653], ethnicity [χ² (2, N = 139) = 0.27, p = 0.277], or race [χ² (8, N = 139) = 0.57, p = 0.512]. However, the accurate condition had an average age of 20.62 years old, which was significantly younger than the negative condition (24.13 years old) [F(2, 136) = 4.11, p = 0.019, η² = 0.06], but not significantly different than the positive condition (22.87 years old). Consequently, primary analyses were re-run with age as a covariate (see Exploratory covariate analyses section). There were no significant differences between conditions at baseline for FPES [F (2, 134) = 1.91, p = 0.153, η² = 0.03], SIAS [F (2, 134) = 0.43 p = 0.649, η² = 0.01], or FIBM score [t(90) = 0.23, p = 0.815, Cohen’s d = 0.05].

**FIBM effects on interpretation of faces**

To assess the effect of condition on FIBM scores, a repeated measures ANOVA with condition (positive, negative) as the between-subject variable and phase (baseline, post-test) as the within-subject variable was conducted. There was a main effect of condition [F(1, 90) = 13.85, p < 0.001, η² = 0.13], such that participants in the positive condition had higher FIBM scores than participants in the negative condition. There was not a main effect of phase [F(1, 90) = 1.20, p = 0.277, η² = 0.01].

In line with hypotheses, there was a significant time by condition interaction [F (1, 90) = 66.96, p < 0.001, η² = 0.28]. At post-test, participants in the positive condition had significantly greater FIBM scores than participants in the negative condition, t(90) = 6.69, p < 0.001, Cohen’s d = 1.40. Within the positive condition, participants’ FIBM scores significantly increased following FIBM, t(46) = 5.13, p < 0.001, Cohen’s d = 0.71. Within the negative condition, participants’ FIBM scores significantly decreased following FIBM, t(46) = 3.36, p = 0.002, Cohen’s d = 0.53.

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3 Note that FIBM score could only be compared positive and negative conditions.
To assess if the accurate condition led to more accurate interpretations of faces, a paired samples t-test was conducted. As hypothesized, participants in the accurate condition were significantly more accurate at identifying facial expressions at post-test compared to baseline, $t(45) = 4.58, p = < 0.001$, Cohen’s $d = -0.78$.

**FIBM effects on social anxiety**

To assess if FIBM affected SIAS scores from baseline to post-intervention, a repeated measures ANOVA with condition (positive, negative, accurate) as the between-subject variable and phase (baseline, post-test) as the within-subject variable was conducted. Results demonstrated that there was a significant effect of time on SIAS scores in which SIAS scores at post-test were significantly greater than SIAS scores at baseline [$F(1, 132) = 8.56, p = 0.004, \eta^2 = 0.06$]. There was not a main effect of condition [$F(2, 132) = 0.51, p = 0.601, \eta^2 = 0.01$]. Contrary to hypotheses, there was not a significant time by condition interaction for SIAS scores [$F(2, 132) = 0.60, p = 0.549, \eta^2 = 0.01$].

To assess if there were differences between groups for post-intervention LSAS-SR scores, a one-way ANOVA was conducted with condition (positive, negative, accurate) as the between-subject variable. Similar to SIAS scores, there was not a significant difference between groups for Total LSAS-SR scores, $[F(2, 132) = 0.07, p = 0.928, \eta^2 < 0.01]$.

**Exploratory moderator analyses**

Exploratory analyses were conducted to assess potential moderators of the relationship between FIBM and outcome variables. Two repeated measures ANOVAs were conducted with the proposed moderator (FPES or SIAS), condition (positive, negative) as the between-subject variable, and phase (baseline, post-test) as the within-subject variable. Results revealed FPES (all $p > 0.141$) and baseline SIAS (all $p > 0.196$) did not moderate condition effects on any analyses.
**Exploratory covariate analyses**

To assess if demographics influenced FIBM effects, two repeated measures analyses of covariance (ANCOVAs) were conducted with potential covariates (participant race or age), condition (positive, negative) as the between-subject variable, and phase (baseline, post-test) as the within-subject variable. Participant race (not FIBM composite faces, as all composite faces were white) was evaluated as a covariate. Results showed participant race did not change patterns of results for FIBM analyses, SIAS analyses, or LSAS-SR analyses. When including age as a covariate for the accurate condition changed FIBM analyses, the change in FIBM scores from baseline to post-test was no longer not significant \( F(1, 44) = 0.41, p = 0.527, \eta^2 = 0.01 \).

Including age as a covariate did not affect the pattern of results for FIBM analyses in the negative and positive conditions, SIAS analyses, or LSAS-SR analyses.

**Correlation analyses**

Pearson correlations were conducted between all baseline and outcome variables (see Table 3). As expected, baseline FIBM score was significantly correlated to post-test FIBM score. Additionally, all social anxiety measures were correlated with each other. Surprisingly, FIBM scores were not significantly correlated to social anxiety measures.

**Discussion**

The current study tested the effect of a FIBM task on interpretations of ambiguous faces and social anxiety symptoms in an unselected college sample. Results revealed that the FIBM task successfully shifted interpretation of ambiguous faces in the expected directions for all three conditions, but such shifts did not affect social anxiety.

In line with hypotheses, the FIBM positive condition successfully led to more positive interpretations of ambiguous faces. This is in line with similar FIBM studies demonstrating the
effectiveness of a positive condition (Penton-Voak et al., 2012; Rawdon et al., 2018). This condition’s success in inducing a positive bias supports the effectiveness of FIBM in a single-session, online setting, which had not previously been studied in the literature. Additionally, these results suggest the interpretation of ambiguous faces is malleable; this quality can be a focus of future social anxiety work given interventions that target ambiguous expression interpretations are supported by the proposed maintaining role of audience reaction in the social anxiety cognitive model (Rapee & Heimburg, 1997).

This is the first study that evaluated a negative condition and an accurate condition within the FIBM task, and as hypothesized both conditions were successful in impacting interpretation of ambiguous faces. This reveals that FIBM can be used to test if changes in interpretations can lead to both symptom reduction and symptom exacerbation. This finding also opens other avenues for research given the fact that negative interpretation biases are implicated in other disorders, like depression (Bourke et al., 2010; Disner et al., 2021). Future studies could evaluate if FIBM negative condition worsens depressive symptoms, assessing if a negative interpretation bias maintains or causes depression.

Contrary to the present hypotheses, shifts in interpretation biases did not lead to shifts in social anxiety. This result was surprising given Rapee and Heimburg (1997) included audience evaluation as one of the core tenets in the social anxiety cognitive model. Though the current study is hesitant to interpret null results, this result suggests that the interpretation of ambiguous faces may not be causally related to social anxiety, and thus this cognitive model may need modification. The lack of findings for the social anxiety hypotheses does match similar patterns of results in previous FIBM research regarding a lack of effect on mood measures (Kuin et al., 2020; Penton-Voak et al., 2020; Peters et al. 2017; Van Meter et al., 2021).
Given Rawdon et al. (2018) found an impact on depressive symptoms at two-week follow-up in their study on social anxiety, it is possible that the modified FIBM in this study may have impacted other mood measures (e.g., depression, anger), but such measurements were not collected as part of the current analyses. In line with this thinking, it may be that FIBM interventions are better suited to depressive symptoms and therefore to target depression rather than social anxiety. However, other research has attempted to use FIBM to impact depressive symptoms and has not been successful (Penton-Voak et al., 2012; Van Meter et al., 2021).

Additionally, the only studies to find effects on mood measures (Rawdon et al., 2018 and Penton-Voak et al., 2013) used adolescent samples. It is possible that FIBM might have a stronger impact on mood measures in younger samples because their mood and psycho/social attributes might be more sensitive to change in cognitive biases. Future research should attempt to investigate this pattern by studying even a younger sample of children (e.g., pre-adolescents).

The current study attempted to modify the FIBM task by focusing on anger (instead of sadness). Given the findings that individuals with high social anxiety have a sensitivity for anger recognition, it was believed that the modification of shifting the FIBM faces from happy to angry would lead to a significant impact on social anxiety measures (Cui et al., 2021). However, this modification did not affect social anxiety symptoms.

Surprisingly, the current study did not find significant correlations between FIBM scores and any social anxiety measures at baseline. This may indicate that the composite faces chosen for this study or the emotions selected (happy, labeled as “approving”, and angry, labeled as “criticizing”) were not appropriate measures to represent the audience reaction piece in the cognitive model by Rapee and Heimburg (1997). On the other hand, this lack of a relationship
may also indicate that the interpretation of ambiguous faces is not associated with social anxiety, and calls into question this tenant of Rapee and Heimberg’s cognitive model (1997).

The null results of FIBM on social anxiety may be due to methodological limitations associated with a single session and/or online design. Research on cognitive bias modification has varied on treatment design, but some analyses report than multiple sessions and in person interventions compared to single-session and online format, respectively, lead to larger effects (Beard et al., 2012; Fodor et al., 2010; Hakamata et al., 2010; Hallion & Ruscio, 2011). The current study was unable to control participant focus and distraction, given participants completed the study online. Further research should examine multiple sessions of modified FIBM used in the current study as well as in person sessions. Additionally, it could be that a longer delay between FIBM post-test phase and social anxiety measurement may have also led to seeing effects on SAD symptoms; as CBM studies with multiple sessions also have multiple day delay inherent to the procedure and have seen effectiveness (Beard et al., 2012; Fodor et al., 2010; Hakamata et al., 2010; Hallion & Ruscio, 2011).

Exploratory analyses revealed that fear of positive evaluation and baseline social anxiety did not moderate the effectiveness of FIBM intervention at shifting facial interpretations. These findings suggest FIBM can impact interpretations regardless of baseline fear of evaluation and baseline social anxiety. Additionally, the current study determined participant race was not a covariate for condition effects of FIBM. This indicates that participants did not tend to interpret the composite faces differently based on the participants’ own races. However, since the composite faces in this study were white, future research should use composite faces of other races to allow for analyses on hostility interpretation biases in between-race interpretations. Hugenberg and Bodenhausen (2003) showed that White participants who were high in implicit
racial prejudice were quicker to identify anger in Black men compared to White men in videos of changing facial expressions; this research supports a bias implicated in racial prejudice towards interpreting anger on Black faces.

Results should be interpreted in light of several limitations. First, as previously noted, this was a single-session online study, and this design might have led the lack of impact on social anxiety symptoms. Second, future studies should include baseline mood measures as it might impact FIBM’s effect on social anxiety symptoms; furthermore, baseline mood is not currently captured in the baseline SIAS measure. Finally, the current sample was composed of WVU students with an average age of approximately 23 years, majority white, and majority female-identifying; this composition limits the generalizability of results to community or other samples.

In conclusion, the present study successfully tested the negative and accurate conditions in an FIBM task and was successfully able to influence facial interpretations as a single session, online study. However, impacts on social anxiety were not seen from inducing interpretation biases. This research is important as it challenges the importance of evaluating audience reaction in the Rapee and Heimburg (1997) cognitive model of social anxiety.
References


https://doi.org/10.1176/appi.books.9780890425596


trial of transfer to self-report and cognitive measures in a healthy sample. *Royal Society Open Science, 4*(12), 170681. [https://doi.org/10.1098/rsos.170681](https://doi.org/10.1098/rsos.170681)


### Table 1.

Demographic composition of study conditions.

<table>
<thead>
<tr>
<th>Age</th>
<th>Positive</th>
<th></th>
<th>Negative</th>
<th></th>
<th>Accuracy</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
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<td>Age</td>
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<td>5.00</td>
<td>24.13</td>
<td>8.50</td>
<td>20.62</td>
<td>3.34</td>
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<table>
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<th>Percentage</th>
<th>N</th>
<th>Percentage</th>
<th>N</th>
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<td>29</td>
<td>63.04</td>
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<td>68.09</td>
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<td>Cisgender</td>
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<td>30.43</td>
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<td>27.66</td>
<td>13</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
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<table>
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<td>White</td>
<td>69.57</td>
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<td>70.21</td>
<td>33</td>
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<td>13.04</td>
<td>6</td>
<td>4.26</td>
<td>2</td>
</tr>
<tr>
<td>Islander</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black / African American</td>
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<td>2.17</td>
<td>1</td>
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<td>2</td>
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<tr>
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<th>Percentage</th>
<th>N</th>
<th>Percentage</th>
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<td>Non-Hispanic</td>
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<td>86.96</td>
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<td>95.74</td>
<td>45</td>
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<td>13.04</td>
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</table>
Table 2.

Descriptive statistics for baseline and post-intervention measures.

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Positive</th>
<th>Negative</th>
<th>Accurate</th>
<th>Total Sample</th>
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<td></td>
<td>M</td>
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<td>M</td>
<td>SD</td>
</tr>
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<td>FIBM*</td>
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<td>2.03</td>
<td>6.78</td>
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</tr>
<tr>
<td>SIAS</td>
<td>29.60</td>
<td>15.05</td>
<td>28.73</td>
<td>15.48</td>
</tr>
<tr>
<td>FPES</td>
<td>32.53</td>
<td>14.15</td>
<td>28.43</td>
<td>11.83</td>
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</table>

Post-intervention

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
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<td>FIBM*</td>
<td>8.30</td>
<td>2.01</td>
</tr>
<tr>
<td>SIAS</td>
<td>31.07</td>
<td>17.13</td>
</tr>
<tr>
<td>LSAS-SR</td>
<td>59.20</td>
<td>27.93</td>
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</table>

* FIBM total sample scores cannot be calculated due to different scoring for the accurate condition compared to the positive and negative condition.
Table 3.

Correlation coefficients calculated for baseline and outcome variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>FIBM Base</th>
<th>FIBM Post</th>
<th>FIBM Acc Base</th>
<th>FIBM Acc Post</th>
<th>FPES Baseline</th>
<th>FPES Post</th>
<th>SIAS</th>
<th>SIAS Change</th>
<th>LSAS Anxiety</th>
<th>LSAS Avoid</th>
<th>LSAS Total</th>
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<tr>
<td>FIBM Base</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIBM Post</td>
<td>0.43**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIBM Acc Base</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIBM Acc Post</td>
<td>-</td>
<td>-</td>
<td>0.33*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPES</td>
<td>-0.10</td>
<td>0.05</td>
<td>-0.06</td>
<td>-0.05</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline SIAS</td>
<td>-0.15</td>
<td>-0.15</td>
<td>0.11</td>
<td>-0.12</td>
<td>0.62**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post SIAS</td>
<td>-0.13</td>
<td>-0.12</td>
<td>0.18</td>
<td>-0.11</td>
<td>0.65**</td>
<td>0.95**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SIAS Change</td>
<td>0.06</td>
<td>0.07</td>
<td>0.23</td>
<td>-0.01</td>
<td>0.28**</td>
<td>0.13</td>
<td>0.44**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSAS Anxiety</td>
<td>-0.20</td>
<td>-0.18</td>
<td>0.09</td>
<td>-0.09</td>
<td>0.63**</td>
<td>0.82**</td>
<td>0.85**</td>
<td>0.35**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LSAS Avoid</td>
<td>-0.11</td>
<td>-0.18</td>
<td>0.24</td>
<td>-0.01</td>
<td>0.54**</td>
<td>0.75**</td>
<td>0.78**</td>
<td>0.32**</td>
<td>0.83**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>LSAS Total</td>
<td>-0.16</td>
<td>-0.18</td>
<td>0.17</td>
<td>-0.05</td>
<td>0.61**</td>
<td>0.83**</td>
<td>0.86**</td>
<td>0.35**</td>
<td>0.96**</td>
<td>0.951**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. FIBM Base = baseline score for face interpretation bias modification task for positive and negative conditions

FIBM Post = post-test score for face interpretation bias modification task for positive and negative conditions

FIBM Acc Base = baseline score for face interpretation bias modification task for accurate condition

FIBM Acc Post = post-test score for face interpretation bias modification task for accurate condition

** = Correlation is significant at the 0.01 level (2-tailed)

* = Correlation is significant at the 0.05 level (2-tailed)
Appendix B. Figures

Figure 1.

*Significant changes in FIBM score from baseline to post-test for negative and positive conditions.*
Figure 2.

Non-significant changes in social anxiety from baseline to post-test by condition.
Appendix C. Study Flow Chart

**Study Session (Zoom)**

- Consent ($N = 140$)
- Randomization
- Positive ($N = 46$)
- Negative ($N = 46$)
- Accurate ($N = 48$)
- Demographics
  - Baseline Questionnaires (SIAS, FPES)
  - FIBM Task
  - Post-intervention Questionnaires (LSAS-SR, SIAS)
- Debrief and payment
Appendix D. Measures

Social Interaction Anxiety Scale (SIAS)

_For each item, please circle the number to indicate the degree to which you feel the statement is characteristic or true for you. The rating scale is as follows:  
0 = Not at all characteristic or true of me.  
1 = Slightly characteristic or true of me.  
2 = Moderately characteristic or true of me.  
3 = Very characteristic or true of me.  
4 = Extremely characteristic or true of me._

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Very</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I get nervous if I have to speak with someone in authority (teacher, boss, etc.)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>I have difficulty making eye contact with others</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>I become tense if I have to talk about myself or my feelings</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>I find it difficult to mix comfortably with the people I work with</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>I find it easy to make friends my own age</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>I tense up if I meet an acquaintance in the street</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>When mixing socially, I am uncomfortable</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>I feel tense if I am alone with just one other person</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>I am at ease meeting people at parties, etc.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>I have difficulty talking with other people</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>I find it easy to think of things to talk about</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>I worry about expressing myself in case I appear awkward</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>I find it difficult to disagree with another’s point of view</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>14</td>
<td>I have difficulty talking to persons I find attractive</td>
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<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
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<td>I find myself worrying that I won’t know what to say in social situations</td>
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<tr>
<td></td>
<td>Question</td>
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<td>--------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
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<td>I am nervous mixing with people I don’t know well</td>
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<tr>
<td>17</td>
<td>I feel I’ll say something embarrassing when talking</td>
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<tr>
<td>18</td>
<td>When mixing in a group, I find myself worrying I will be ignored</td>
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<td>19</td>
<td>I am tense mixing in a group</td>
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<tr>
<td>20</td>
<td>I am unsure whether to greet someone I know only slightly</td>
<td></td>
<td></td>
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</table>

0 1 2 3 4
Fear of Positive Evaluation Scale (FPES)

*Read each of the following statements carefully and fill in a numbered bubble on the answer sheet to indicate the degree to which you feel the statement is characteristic of you, using the following scale.*

<p>| | | | | | | | | | |</p>
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<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Not at all True</td>
<td>Somewhat true</td>
<td>Very True</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. I am uncomfortable exhibiting my talents to others, even if I think my talents will impress them 0 1 2 3 4 5 6 7 8 9
2. It would make me anxious to receive a compliment from someone that I am attracted to 0 1 2 3 4 5 6 7 8 9
3. I try to choose clothes that will give people little impression of what I am like 0 1 2 3 4 5 6 7 8 9
4. I feel uneasy when I receive praise from authority figures 0 1 2 3 4 5 6 7 8 9
5. If I have something to say that I think a group will find interesting, I typically say it 0 1 2 3 4 5 6 7 8 9
6. I would rather receive a compliment from someone when that person and I were alone than when in the presence of others 0 1 2 3 4 5 6 7 8 9
7. If I was doing something well in front of others, I would wonder whether I was doing ‘‘too well.’’ 0 1 2 3 4 5 6 7 8 9
8. I generally feel uncomfortable when people give me compliments 0 1 2 3 4 5 6 7 8 9
9. I don’t like to be noticed when I am in public places, even if I feel as though I am being admired 0 1 2 3 4 5 6 7 8 9
10. I often feel underappreciated and wish people would comment more on my positive qualities 0 1 2 3 4 5 6 7 8 9
11. I am uncomfortable exhibiting my talents to others, even if I think my talents will impress them 0 1 2 3 4 5 6 7 8 9
Liebowitz Social Anxiety Scale – Self Report (LSAS-SR)

The following is a list of situations you may encounter in the future. Read each situation carefully and answer two questions about it; the first question asks how anxious or fearful you would feel in the situation; the second question asks how often you would avoid it. If you come across a situation that you ordinarily do not experience, we ask that you imagine “what if you were faced with that situation”, and then rate the degree to which you would fear this hypothetical situation and how often you would tend to avoid it (using the 0 to 3 scales below).

<table>
<thead>
<tr>
<th>Fear or Anxiety</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Avoidance</td>
<td>Never (0%)</td>
<td>Occasionally (1-33%)</td>
<td>Often (33-67%)</td>
<td>Usually (67-100%)</td>
</tr>
</tbody>
</table>

1. Telephoning in public
2. Participating in small groups
3. Eating in public places
4. Drinking with others in public places
5. Talking to people in authority
6. Acting, performing, or giving a talk in front of an audience
7. Going to a party
8. Working while being observed
9. Writing while being observed
10. Calling someone you don’t know very well
11. Talking with people you don’t know very well
12. Meeting strangers
13. Urinating in a public bathroom
14. Entering a room when others are already seated
15. Being the center of attention
16. Speaking up at a meeting
17. Taking a test
18. Expressing a disagreement or disapproval to people you don’t know very well
19. Looking at people you don’t very well in the eyes
20. Giving a report to a group
21. Trying to pick up someone
22. Returning goods to a store
23. Giving a party
24. Resisting a high pressure salesperson
Appendix E. Face Stimuli

The face stimuli used from Karolinska Directed Emotional Faces displayed a composite face morphing from happy to angry in 15 stages (Lundqvist et al., 1998).

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 
13. 
14. 
15.