

## INTERPRETATION BIAS FOR FACIAL EXPRESSIONS IN HIGH AND LOW SOCIALLY ANXIOUS INDIVIDUALS: EFFECTS OF STIMULUS DURATION

*Stephanos P. Vassilopoulos*

*University of Patras, Greece*

**Abstract:** The present article reports two experiments suggesting that the presentation time of an emotional facial expression can influence interpretations in an analogue sample for social anxiety. Participants scoring high and low on the Fear of Negative Evaluation questionnaire (high and low social-anxiety group) were instructed to observe photographs of negative, positive and neutral faces presented at two exposure durations: 200 and 500 ms. Overall, it was found that high socially anxious individuals rated all emotional faces as appearing more critical of them, compared with the low social anxiety group. Additionally, both social anxiety groups interpreted the negative faces as less negative at 500 ms than at 200 ms presentation time. Finally, high levels of trait anxiety and depression were associated with increased negative ratings of facial expressions. Implications for treatment interventions and limitations of the results are discussed.

**Key words:** Facial expressions, Interpretation, Social anxiety.

### INTRODUCTION

Social anxiety disorder involves more than anxiety-related symptoms. It is also an interpersonal disorder, a condition in which anxiety impairs the person's ability to relate to others (Alden & Taylor, 2004). In particular, individuals with social anxiety are excessively afraid of entering a social situation where they are exposed to potential scrutiny (American Psychiatric Association, 1994) and where they may be negatively

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**Address:** Stephanos P. Vassilopoulos, Department of Primary Education, University of Patras, 261 10 Patras, Greece. Phone: +30-2610-969724. E-mail: stephanosv@upatras.gr

evaluated by others (e.g., a student attending a class, a teacher giving a lecture, etc.). As a result, they experience marked impairment in multiple domains of functioning (education, employment, interpersonal relationships; Schneier et al., 1994). Several cognitive models of social anxiety posit that anxious individuals process social information in a biased fashion and that this biased processing serves to maintain their anxiety (Beck, Emery, & Greenberg, 1985; Clark & Wells, 1995; Rapee & Heimberg, 1997). Additionally, during the last two decades, a range of studies have investigated the perceptual and processing biases that may be involved. It has been demonstrated that socially anxious individuals display biases in allocating attention to social threat (Mansell, Clark, Ehlers, & Chen, 1999; Vassilopoulos, 2005) as well as interpretation and judgmental biases concerning social information (Amir, Foa, & Coles, 1998; Vassilopoulos, 2006).

### *Facial expressions and social anxiety*

To increase their ecological validity, many studies have used facial expressions to study the role of information-processing biases in social anxiety. Understanding the processing of facial expressions is important for understanding social anxiety given that facial expressions are an important form of communication during social interactions (Ekman, 2003) and given that errors in decoding emotional expressions in faces is significantly correlated with low relationship well-being (Carton, Kessler, & Pape, 1999). Research examining attentional bias between faces has provided contradictory results, with some studies showing *avoidance* of emotional stimuli (i.e., both positive and negative facial expressions) presented for 500 ms (Mansell et al., 1999) and others demonstrating *vigilance* for threatening stimuli only (Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004).

However, this apparently contradictory sets of findings can be reconciled if we take into consideration the three stages of information processing connected to anxiety, involving various automatic and strategic thought processes, which were put forward by Beck and Clark (1997). In the first stage, the theorists argue, rapid and automatic registration of the threat stimulus takes place. In the second and third stage of information processing, construction of an appraisal of the threat stimulus and preparation of a response to it is considered to involve a range of both automatic and strategic processes. Vassilopoulos (2005) has demonstrated this empirically, showing that an attentional bias towards emotional threat cues on a dot-probe task is present in socially anxious individuals when the probe appears for just 200 ms, but is reversed when the probe appears for 500 ms. Therefore, initial support for a vigilance-avoidance pattern of attentional processing in social anxiety was provided.

### *Interpretation of facial expressions*

Of most relevance to the present study are the studies which have focused on the interpretation of facial expressions of emotion. Often in social situations, people do not provide clear, unambiguous feedback about what they think of other persons and their facial expressions may not reflect a clear message, such as approval or disapproval. How do high and low socially anxious individuals differ in their ability at identifying other people's feelings, intentions or attitudes towards them? Cognitive theories of social anxiety suggest that individuals with high social anxiety are more likely to misinterpret ambiguous or neutral social cues (e.g., facial expressions) as negative (Rapee & Heimberg, 1997). Three studies have investigated interpretation bias for pictures of faces in social anxiety so far, and they appear to have arrived at contrasting results. In an experiment by Winton, Clark, and Edelman (1995), high and low socially anxious individuals were instructed to identify briefly presented (60 ms) slides of either negative or neutral expressions. This presentation time was used to make it difficult for the participants to identify the expressions, as may be the case in many real-life social situations, where people's expressions are noticed briefly or their expressions are ambiguous. The study found that the high social-anxiety group correctly identified more negative faces and less neutral faces than the low social-anxiety group. However, a signal detection analysis on the data showed that the high socially anxious individuals' greater accuracy at identifying negative expressions was the result of their rating more of all the faces as negative rather than as a consequence of any increased accuracy at identifying negative faces. Therefore, the results of the Winton et al.'s (1995) study appear to suggest that socially anxious individuals have a bias to interpret other people's expressions as negative.

Such a bias is consistent with cognitive theories of social anxiety suggesting that socially anxious individuals tend to over-attribute a meaning of social threat to social signals (Beck, Emery, & Greenberg, 1985; Clark & Wells, 1995; Rapee & Heimberg, 1997). However, other studies have failed to evidence any consistent evaluative bias in emotional facial expression decoding in social phobics (Merckelbach, Van Hout, Van den Hout, & Mersch, 1989; Mullins & Duke, 2004; Philippot & Douilliez, 2005). In particular, Philippot and Douilliez (2005) employed morphed facial expressions of varying intensities, morphing between neutral expressions to emotional expressions, thereby assessing the impact of subtle emotional cues. Results did not show group differences between individuals with social phobia, individuals with other anxiety disorders, and non-anxious controls on decoding accuracy.

A possible explanation for the discrepancy in the results might be the difference in stimulus presentation times used in the studies mentioned above. In the study by

Winton et al. (1995) participants could observe the facial expressions only for 60 ms, whereas in the study by Merckelbach et al. (1989), Mullins and Duke (2004), and Philippot and Douilliez (2005) participants observed the faces for a longer time length and, thus, in more detail, due to the significantly longer stimulus exposure duration<sup>1</sup> and, probably, due to their attempt to perform well. Therefore, the results of these studies appear to suggest that socially anxious individuals are more likely to rate briefly presented facial expressions as negative in the absence of having abstracted more affective information from the expressions. In such a case their processing of the facial expressions, probably, relies more on their pre-existing mental structures (e.g., negative self-schema) and less on external cues. However, when they were motivated to observe other people's reactions in more detail, they are able to interpret them more objectively and in a less negative fashion. Thus, having unlimited time may obfuscate differences occurring at initial processing of facial expressions. In similar lines, Philippot and Douilliez (2005) speculated that despite the lack of an existing evaluative bias, these biases may manifest in implicit or automatic processing as well as in ratings of the potential importance (or meaning) of the stimuli to oneself.

### *The present study*

In the light of this evidence one might anticipate that more differences in interpretation bias for emotional facial expressions between high and low socially anxious individuals emerge with shorter than longer stimulus exposure durations. The present study further investigated interpretation biases for faces by introducing two different stimulus presentation times. Therefore, high and low socially anxious individuals were presented with photos of (positive, negative and neutral) facial expressions, either for 200 or 500 ms, and were required to judge whether the persons on the photos were *critical* or not. The trait word "critical" was used because it is hypothesized to be part of a more highly organized network of meaning structures in social anxiety (Lundh & Öst, 1996). It was also used because it refers to the *social cost* associated with these emotional cues and there is already evidence from research, focused primarily on the interpretation of social scenarios presented as text, that individuals high in social anxiety estimate the cost of ambiguous and negative social events to be greater than non-anxious individuals (Foa, Franklin, Perry, & Herbert, 1996; Vassilopoulos, 2006).

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<sup>1</sup> Participants in the Merckelbach et al.'s (1989) study observed each facial expression for eight seconds whereas Philippot and Douilliez (2005) as well as Mullins and Duke (2004) introduced no specific stimulus exposure duration in their experiment.

In the present study all the participants were told that they have to give a speech after the task and that their performance will be evaluated. This threat induction was designed to simulate the social evaluation that is present in most feared interpersonal situations. Although the study is exploratory in its basis, however, some predictions were made. Therefore, it was hypothesized that, compared to the low socially anxious group, individuals high in social anxiety will perceive all the faces as more critical of them (Hypothesis 1a) and that this bias will be greater with the neutral and/or positive faces due to the greater ambiguity innate in them. For example, a positive face can be both interpreted as expressing happiness or ridicule (Hypothesis 1b).

Additionally, the difference in interpretation bias between the two social anxiety groups would be greater when the faces are presented for 200 rather than for 500 ms (Hypothesis 2). This might occur (a) due to the (automatic) vigilance to emotional threat cues briefly presented for 200 ms which has been observed in the high social anxiety group (Vassilopoulos, 2005) and (b) because by attending less to other people's facial expressions, socially anxious individuals have less chance to observe their responses in detail and therefore unlikely to collect from other people the information that would help them to see that they, in general, come across more positively than they think, as Clark and Wells (1995) have suggested. Therefore, they tend to complete the missing information by making judgments or interpretations which are influenced, in part, by their negative self-schemata and negative self-evaluations.

Finally, a recognition memory task was conducted in order to test Hypothesis 3 that high socially anxious individuals, compared to low socially anxious ones, might have a better memory for emotional facial expressions due to their vigilance for emotional threat cues presented for 200 ms (Vassilopoulos, 2005).

In what follows, the results of two experiments examining these hypotheses are reported.

## **EXPERIMENT 1**

Socially anxious individuals are excessively afraid of being negatively evaluated by others (Clark & Wells, 1995). Additionally, facial expressions are an important form of communication during social interactions because they convey essential social information such as approval or disapproval (Ekman, 2003). Cognitive theories of social anxiety suggest that socially anxious individuals tend to over-attribute a meaning of social threat to social signals, and, in particular, they are more likely to misinterpret ambiguous or neutral social cues (e.g., facial expressions) as negative

(Rapee & Heimberg, 1997). To test this hypothesis, individuals high and low in social anxiety in Experiment 1 were required to observe various facial expressions briefly presented for 500 ms and judge whether they perceived the person seen as critical of them or not. In line with the findings of Winton et al. (1995) and the cognitive models of social anxiety the prediction was that, compared to the low socially anxious group, individuals high in social anxiety will perceive all the faces as more critical of them (Hypothesis 1a) and that this bias will be greater with the neutral and/or positive faces due to greater ambiguity innate in them than in negative faces (Hypothesis 1b).

### **Method**

**Participants.** Experiment 1 was approved by the Institutional Review Board of the Royal Holloway University of London. Participants were 48 students at the Royal Holloway who were recruited through announcements and received a 5£ reimbursement for their participation in the study. They were selected from an initial sample of 135 volunteers because they had scores in the top 25% and bottom 25% on the Fear of Negative Evaluation questionnaire (Watson & Friend, 1969). Cut-offs were over 17 for the high social-anxiety group and under 9 for the low social-anxiety group. There were 25 high socially anxious (mean age = 20.40,  $SD = 2.71$ ; 18 females, 7 males) and 23 low socially anxious individuals (mean age = 21.70,  $SD = 4.66$ ; 15 females, 8 males).

**Measures.** The following measures were used:

**1. Instantaneous mood.** Participants rated their instantaneous mood before and after the threat induction using four visual analogue scales in which 0 represented "I do not feel at all happy/ angry/ anxious/ depressed" and 100 represented "I feel extremely happy/ angry/ anxious/ depressed". "At this moment" was typed at the top of the sheet to indicate that instantaneous mood was to be rated.

**2. Fear of Negative Evaluation questionnaire.** The Fear of Negative Evaluation questionnaire (FNE questionnaire; Watson & Friend, 1969) is a 30-item true-false self-report questionnaire that provides a measure of apprehension about others' evaluations, distress over negative evaluation, and the expectation of negative evaluation. Sample items include "I am often afraid that I may look ridiculous and make a fool of myself." The FNE questionnaire had high internal consistency (Cronbach's  $\alpha = .94$ ), good test-retest reliability ( $r = .78$ ) and good discriminant validity ( $p < .01$ ) when compared with a measure of social desirability (Crowne-Marlowe Scale; Crowne & Marlowe, 1964) on a sample of undergraduates (Watson & Friend, 1969).

**3. State Trait Anxiety Inventory.** The State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a 40-item self-report questionnaire assessing both current (state) and general (trait) anxiety. The STAI is commonly used in research and clinical settings and the internal consistency (Cronbach's alpha) of the measure among samples of college students is above .90 (Spielberger et al., 1983). In Experiment 1 only the trait version (STAI-T) of the measure was used (the 20 statements that evaluate the participant's general level of anxiety).

**4. Beck Depression Inventory II.** The revised Beck Depression Inventory II (BDI II; Beck, Steer, & Brown, 1996) is a 21-item self-report instrument for measuring the severity of depression in adults and adolescents aged 13 years and older during the past two weeks. Coles, Gibb, and Heimberg (2001) evaluated BDI with adults suffering from social anxiety disorder and concluded that the BDI is a valid tool for the assessment of depressive symptoms in social anxiety disorder with good internal consistency (Cronbach's alpha = .89) and reliability (intraclass coefficient = .91). The convergent validity with clinical evaluation of depression was .64 (Salaberria & Echeburua, 1998).

### *Materials*

**1. Pictures.** The digitized face stimuli (i.e., JACKFEE and JACNeuF<sup>2</sup>) showing positive (happy), neutral (no expression), and negative expressions developed by Matsumoto and Ekman (1988) were used. The negative facial expressions consisted of equal numbers of anger, disgust, and fear (all three types had similar intensity ratings, according to Matsumoto & Ekman, 1988). Also, the models included equal numbers of male and female Caucasian and Japanese individuals. Each picture was converted to black and white image and was further edited to fit an upright rectangle measuring 65 x 90 mm.

**2. Face Rating task.** A set of 72 facial expressions was displayed alone, one at a time. Each black and white face-picture was presented for 500 ms only at the centre of the pc monitor, in a random order for each individual. Next, the face disappeared and a rating scale appeared in the place of the picture. Participants were required to observe the expressions of the faces and judge whether they perceived the person seen as *critical of them* or not. Ratings were done on a five-point scale ranging from 1 (not critical at all) to 5 (very critical). Participants pressed the relevant button with the help of a mouse and the next face appeared shortly at the centre of the screen.

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<sup>2</sup> Japanese and Caucasian facial expressions of emotion (JACFEE) and neutrals (JACNeuF) (Matsumoto & Ekman, 1988).

**Procedure.** Participants were tested individually. On arrival they completed the FNE questionnaire, BDI II, and STAI-T and were taught to use the instantaneous mood scales with which they rated their mood. All participants were then informed that they have to give two speeches in front of camera (threat induction) and they re-rated their mood. Next, the lights were dimmed and they completed the face-rating task.

## Results

**Participants' characteristics.** Table 1 shows the mean scores on each measure for each social anxiety group. Independent samples *t*-tests were used to compare groups. The scores of the BDI and FNE questionnaire failed Levene's test for equality of variance and so *t*-tests assuming unequal variances were employed. Consistent with the selection process, the two groups differed significantly in score of the FNE questionnaire. In addition, the high social-anxiety group scored higher than the low social-anxiety group on STAI-T and BDI measures. The two groups did not differ in age or gender of the participants,  $\chi^2(1) = .26, ns$ .

Table 1. Characteristics of participants in each social anxiety group

Variable	Low social anxiety		High social anxiety		<i>t</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
	Experiment 1				
FNE questionnaire	4.78	2.86	25.04	4.25	19.52***
BDI II	5.56	3.94	16.32	9.92	5.01***
STAI-T	32.22	6.66	54.72	8.99	9.78***
Age (years)	21.70	4.66	20.40	2.71	1.19
	Experiment 2				
FNE questionnaire	8.26	3.32	26.80	2.06	23.01***
BDI II	8.65	5.98	15.60	8.07	3.36**
STAI-T	41.53	7.92	50.19	6.77	3.52**
Age (years)	21.61	1.50	20.80	.91	2.28*

*Note:* *n* = 23 and 25 for the low and high social anxiety group respectively, except in STAI-T (Experiment 2), *n* = 15 and 21 for low and high social anxiety groups, respectively, because some participants did not return the STAI-T at Experiment 2.

\* *p* < .05; \*\* *p* < .01; \*\*\* *p* < .001

**Mood ratings.** Mood ratings were entered into a two-way Time (before induction, after induction) x Social Anxiety (high, low) repeated-measures ANOVA. A significant main effect of social anxiety,  $F(1, 46) = 13.23, p = .001$ , partial  $\eta^2 = .22$ , indicated that the high social anxiety group reported greater anxiety before and after the threat induction. There was also a main effect of time,  $F(1, 46) = 13.80, p =$

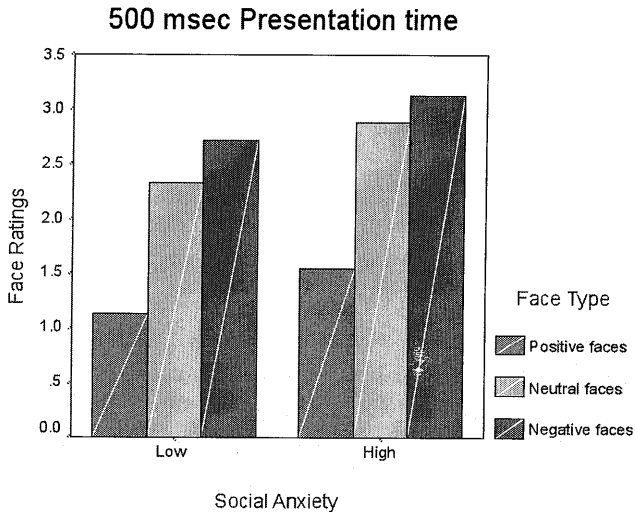


.001, partial  $\eta^2 = .23$ , but the interaction between social-anxiety group and time was nonsignificant,  $F(1, 46) = 3.29, p = .08$ . It appears that both social-anxiety groups increased their self-reported anxiety after the threat: before the threat, for low social-anxiety groups  $M = 89.3 (SD = 59.8)$  and for high social-anxiety groups  $M = 129.0 (SD = 52.9)$ ; after the threat, for low social-anxiety groups  $M = 101.7 (SD = 43.4)$ , and for high social-anxiety groups  $M = 165.2 (SD = 58.5)$ .

**Face rating biases.** The face-ratings from one participant could not be recorded due to technical difficulties and he was replaced by another participant with a similar score on FNE questionnaire. The data were analysed using a two-way Social Anxiety (high, low) x Face Type (positive, negative, neutral) ANOVA with the last variable as within-subjects factor. It had been predicted that high socially anxious subjects will rate the faces as more critical than the low anxious controls, and that this difference in ratings will be greater for the positive and neutral faces. Consistent with Hypothesis 1a, a significant main effect of social anxiety on face ratings emerged from the analysis,  $F(1, 46) = 11.17, p = .003$ , partial  $\eta^2 = .20$ , with the high socially anxious participants giving higher scores than individuals low in social anxiety to all three types of faces. Specifically for the positive, negative, and neutral faces, high social-anxiety individuals scored,  $M = 1.54 (SD = .47)$ ,  $M = 3.12 (SD = 1.04)$ , and  $M = 2.88 (SD = .71)$ , respectively, while low social-anxiety individuals scored  $M = 1.13 (SD = .13)$ ,  $M = 2.71 (SD = .87)$ , and  $M = 2.32 (SD = .65)$ , respectively. Thus, Hypothesis 1a was confirmed.

Independent samples *t*-tests for social anxiety were carried out separately for each face type. For the positive and neutral faces, the effect of social anxiety was significant,  $t(46) = 4.14, p < .01$ , Cohen's  $d = 1.22$ , and  $t(46) = 2.79, p < .01$ , Cohen's  $d = .82$ , respectively (see Figure 1). However, for the negative faces the effect of social anxiety was not found to be significant,  $t(46) = 1.50, ns$ . The findings confirmed Hypothesis 1b.

Last, a significant main effect of face type on participants' ratings,  $F(2, 92) = 79.63, p < .001$ , partial  $\eta^2 = .63$ , suggested that our participants interpreted the various face types (positive, negative and neutral) in a different way. Indeed, the participants perceived the negative faces as the most critical ones ( $M = 2.93, SD = .97$ ), the neutral faces as less critical towards them than the negative ones but more critical than positive faces ( $M = 2.62, SD = .73$ ), and, finally, the positive faces as almost not critical at all ( $M = 1.35, SD = .40$ ). This rating pattern was similar for high and low socially anxious participants (see Figure 1).



*Figure 1. Mean ratings of criticalness for each face type presented for 500 ms in high and low socially anxious participants.*

### *Discussion*

Individuals high in social anxiety rated all emotional facial expressions as appearing more critical compared to individuals low in social anxiety. The difference in interpretation biases between the two social anxiety groups was significant for positive and neutral faces. These results are consistent with the cognitive theories of social anxiety as well as with the findings reported by Winton et al. (1995). However, the Face Rating task used in Experiment 1 presented facial expressions only for 500 ms. Therefore, it was important to investigate the interpretation bias for faces using a different presentation time (200 ms).

## **EXPERIMENT 2**

This research started with the observation that manipulation of stimulus duration may influence the way socially anxious individuals perceive facial expressions. The assumption that socially anxious individuals were more likely to rate briefly presented facial expressions as negative in the absence of having abstracted more affective information from the expressions was confirmed in Experiment 1 by indicating that individuals high in social anxiety perceived all emotional facial expressions as appearing more critical compared to individuals low in social anxiety (Hypothesis 1a).

In such a case their processing of the facial expressions, probably, relies more on their pre-existing mental structures (e.g., negative self-schema) and less on external cues. In Experiment 2 Hypothesis 1a was further examined. The prediction was that there will be more pronounced differences between the two social anxiety groups in the interpretation of facial expressions if the latter are displayed for a shorter duration (200 ms). Thus, the hypothesis (Hypothesis 2) was that greater interpretation bias for emotional facial expressions between high and low socially anxious individuals would emerge with shorter than longer stimulus exposure durations, that is, when the faces are presented for 200 rather than for 500 ms, and that this would be particularly salient for the more ambiguous facial expressions (e.g., positive or neutral faces).

A second aim of Experiment 2 was to test the hypothesis (Hypothesis 3) that high socially anxious individuals, compared to the low socially anxious ones, will have a better recognition memory for emotional facial expressions due to their vigilance for emotional threat cues when the stimuli are presented for 200 ms (see Vassilopoulos, 2005).

### **Method**

**Participants.** Participants were 48 university students (Department of Primary Education, University of Patras, Greece). They were recruited from a larger sample of about 120 students who had filled in the FNE questionnaire (Watson & Friend, 1969). All students were attending a course in psychology and received partial course credits for their participation in the study. The FNE questionnaire was used to divide the participants into high ( $> 23$ ) and low ( $< 15$ ) social-anxiety groups (for the Greek norms for the FNE questionnaire see Vassilopoulos, 2004). The low social-anxiety group contained 23 participants (mean age = 21.61,  $SD = 1.50$ ; 4 males, 19 females) and the high social-anxiety group contained 25 females (mean age = 20.80,  $SD = .91$ ).

**Measures.** Participants completed the same measures used in Experiment 1.

#### **Materials**

**1. Pictures.** The digitized face stimuli (i.e., JACKFEE and JACNeuF) showing positive (happy), neutral (no expression), and negative expressions developed by Matsumoto and Ekman (1988) were used as in Experiment 1.

**2. Face Rating task.** The face Rating task was identical to that of Experiment 1, with the only exceptions that the total number of positive, negative and neutral facial expressions was reduced to 54 (18 pictures of each category) instead of 72 pictures, and the presentation time for each facial expression was 200 ms instead of 500 ms used in Experiment 1. The number of pictures was reduced due to the memory task that followed afterwards.

**3. Recognition Memory task.** A total of 36 faces were presented in a random order, one at a time, on the screen. Equal numbers of positive, neutral and negative faces were presented. Half of these had been presented in the face-rating task and half were new. Each individual depicted in the pictures was presented for recognition only once. The participants were asked to say "Yes" if they recognized the picture and "No" if they did not while the experimenter was writing down their answers. They were instructed to respond as soon as they had made their decision.

**Procedure.** Participants were tested individually. On arrival they completed the FNE questionnaire and BDI II and were taught to use the instantaneous mood scales with which they rated their mood. All participants were then informed that they have to give a speech in front of camera (threat induction) and they re-rated their mood. Next, the lights were dimmed and all participants completed the face-rating task, followed by the recognition memory task.

Participants returned the STAI-T completed within one week after the experiment.

## Results

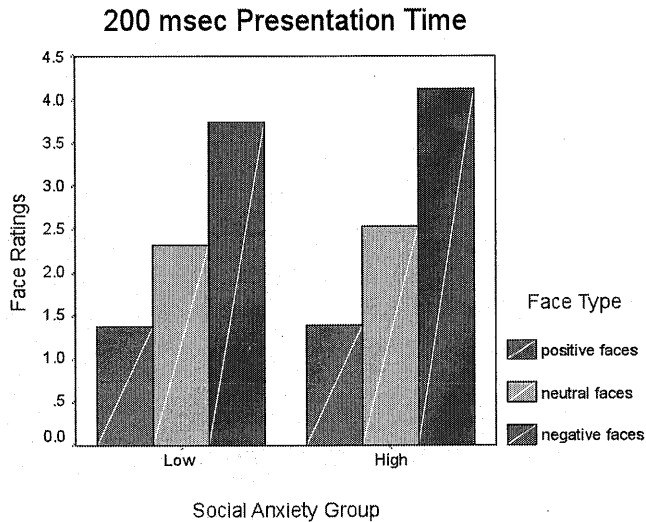
**Participants' characteristics and mood ratings.** Table 1 shows the mean scores on each measure for each social anxiety group. Independent samples *t*-tests were used to compare groups. Scores on FNE questionnaire failed Levene's test for equality of variance and so *t*-tests assuming unequal variances were employed. The selection criteria guaranteed that the groups would differ in the scores on FNE questionnaire. In addition, the high social-anxiety group scored higher than the low social-anxiety group on STAI-T and BDI measures. The groups also differed in age and in the balance of sexes,  $\chi^2(1) = 4.74, p < .05$ .

A two-way (Time x Social Anxiety) repeated measures ANOVA on mood ratings was conducted. Again, a significant main effect of social anxiety,  $F(1, 45) = 5.40, p < .05$ , partial  $\eta^2 = .11$ , and a significant main effect of time,  $F(1, 45) = 6.81, p < .05$ , partial  $\eta^2 = .13$ , but there was no interaction between them,  $F(1, 45) = .69, ns$ . It appears that both social-anxiety groups increased their self-reported anxiety after the threat: before the threat, for low social-anxiety groups,  $M = 105.7 (SD = 65.2)$ , and for high social-anxiety groups,  $M = 143.4 (SD = 60.6)$ ; after the threat, for low social-anxiety groups,  $M = 112.9 (SD = 59.0)$ , and for high social-anxiety groups,  $M = 157.0 (SD = 61.5)$ .

**Face rating biases.** The data were analysed using a two-way Social Anxiety (high, low) x Face Type (positive, negative, neutral) ANOVA with the last variable as within

subjects factor. Contrary to Hypotheses 1a and 1b, no main effect of social-anxiety group,  $F(1, 46) = 3.26, ns$ , or interaction of social-anxiety group with face type,  $F(2, 92) = 1.08, ns$ , was found.

As in Experiment 1, there was only a significant main effect of face type,  $F(2, 92) = 218.22, p < .001$ , partial  $\eta^2 = .83$ . Participants rated the negative faces as more critical ( $M = 3.94, SD = .71$ ) than the neutral faces ( $M = 2.43, SD = .65$ ) and the neutral faces as more critical than the positive faces ( $M = 1.39, SD = .50$ ) (see Figure 2)



*Figure 2. Mean ratings of criticalness for each face type presented for 200 ms in high and low socially anxious participants.*

The difference in face ratings between the 200 and 500 ms presentation time condition was investigated by comparing the data of Experiment 2 to those of the Experiment 1 on the face pictures that were common in the two experiments. Considering that the same set of positive, negative and neutral facial expressions and same rating scale had been used in both experiments, it was appropriate to compare the scores from the 200 ms face rating task to the scores from the 500 ms Face Rating task. A three-way Social Anxiety (high, low) x Presentation Time (200 ms, 500 ms) x Face Type (positive, neutral, negative) ANOVA was carried out on the data, where face type was entered as a within subjects factor. The main effect of social anxiety was found to be significant,  $F(1, 92) = 12.69, p = .001$ , partial  $\eta^2 = .12$ , indicating that high socially anxious individuals rated the faces as appearing more critical towards them relative to the low socially anxious individuals. Obviously, this effect is due to the data

from the English participants of Experiment 1 that were included in the analysis. Contrary to Hypothesis 2, no three-way interaction,  $F(2, 184) = .63, ns$ , or interaction of social-anxiety group with presentation time,  $F(1, 92) = 1.71, ns$ , was found.

In addition, a significant main effect of face type,  $F(2, 184) = 281.37, p < .001$ , partial  $\eta^2 = .75$ , and a main effect of presentation time,  $F(1, 92) = 6.58, p < .01$ , partial  $\eta^2 = .07$ , were both qualified by a significant interaction between face type and presentation time,  $F(2, 184) = 17.41, p < .001$ , partial  $\eta^2 = .16$ . Follow up independent samples  $t$ -tests for each face type separately showed that the negative faces presented for 500 ms were rated as less critical by both low and high socially anxious participants, than when they were presented for 200 ms,  $t(94) = 4.73, p < .001$ , Cohen's  $d = .98$  (see Figure 3). For the positive and neutral facial expressions there was no significant difference between the two presentation time conditions,  $t(94) = .32, ns$ , and  $t(94) = 1.36, ns$ , respectively.

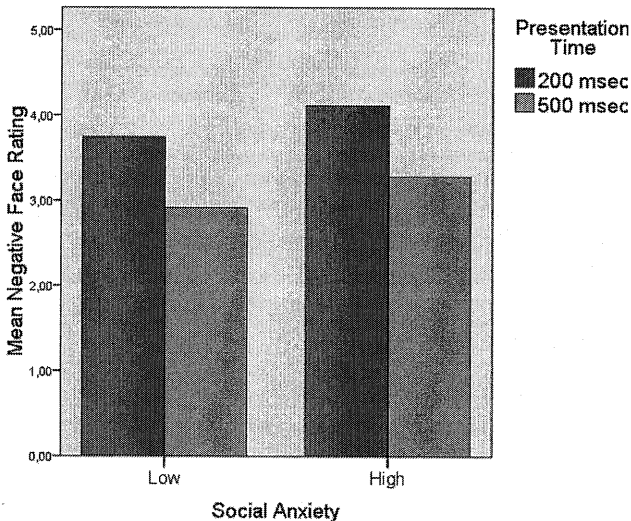


Figure 3. Mean ratings of criticalness for negative faces presented for 200 and 500 ms in each social anxiety group.

**The role of depression and general anxiety.** It was investigated whether interpretation bias for facial expressions was related to levels of depression and trait anxiety. First, participants' ratings of all face types were added together to a single variable that denoted perceived criticalness. Pearson correlations between this variable and each of the trait measures were calculated. Over both presentation times, a significant positive correlation,  $r(95) = .38, p < .001$  for the BDI and  $r(84) =$

.45,  $p < .001$  for the STAI-T emerged. The correlations were calculated once more with the second trait variable partialled out in each case. None of the correlations was significant, indicating that the variables may have a joint effect rather than a unique effect on interpretation bias. Finally, the correlations were calculated for each facial expression separately. As expected, it emerged that both trait variables were significantly correlated with all types of facial expressions, and that the correlation coefficients were increased for the positive and neutral facial expressions: for BDI,  $r(95) = .30$ ,  $r(95) = .21$ , and  $r(95) = .30$ , for the positive, negative, and neutral faces respectively; for STAI-T,  $r(95) = .37$ ,  $r(95) = .24$ , and  $r(95) = .37$ , for the positive, negative, and neutral faces respectively.

**Recognition memory and signal detection analysis.** It had been hypothesized that the high social-anxiety group might have a better memory for faces due to their vigilance for emotional threat cues at 200 ms presentation time (Hypothesis 3). Chance performance in correctly identifying old versus new faces would be 50%. A one-sample  $t$ -test was performed comparing the average correct identifications for facial expressions against chance performance (test value = .50). Results indicated that participants performed slightly, but significantly, better than chance ( $M = 55\%$  correct identifications,  $SD = 13.6\%$ ,  $t(47) = 2.46$ ,  $p = .019$ , Cohen's  $d = .71$ ).

The utility of signal detection theory is that it provides corrected measures of hit and false alarm rates, considering the independent contribution of each for a target class of stimuli. In these analyses, a correct identification of a face that had been presented in the face-rating task was considered a 'hit' and an incorrect identification of a face was considered a 'false alarm'. The raw hit and false alarm rates were then converted to standardised units and entered into two general formulas provided by MacMillan and Creelman (1991), to produce measures of sensitivity ( $d'$ ) and response bias ( $c$ ). An index of the ability to discriminate between two classes of stimuli (sensitivity) was determined by the formula:

$$d' = z(\text{hit rate}) - z(\text{false alarm rate}) \quad (1)$$

When sensitivity is high, individuals are able to correctly identify faces that have been previously presented in the face-rating task and are much less likely to make a mistake. The two-way Social Anxiety (low, high) x Face Type (positive, neutral, negative) ANOVA with  $d'$  scores as dependent variable did not provide support for Hypothesis 3,  $F(1, 46) = .003$ ,  $ns$ , indicating that the differential effects of social anxiety on attention were not mirrored by differences in recognition memory. There was only a main effect of face type,  $F(2, 92) = 6.32$ ,  $p < .004$ , partial  $\eta^2 = .12$ , and no interaction of face type with social anxiety. Inspection of the means for each face

expression separately indicates that participants were better at discriminating old from new negative facial expressions. A measure of response bias ( $c$ ) was also calculated in a similar manner using the formula:

$$c = -0.5[z(\text{hit rate}) + z(\text{false alarm rate})] \quad (2)$$

The values of the response bias measure, criterion  $c$ , typically range from -1 to +1 and represent the tendency of individuals to respond in a certain manner or predisposition to favour one response over another. A  $c$  of 0 would reflect the absence of response bias. Positive values of  $c$  reflect a conservative criterion in which hit and false alarm rates are minimized; whereas, negative values represent a liberal criterion in which hits and false alarms are maximized. The  $c$  scores were also submitted to the same analysis but there were no significant main effects or interactions. Table 2 shows the signal detection analysis data.

*Table 2. Sensitivity ( $d'$ ) and response bias ( $c$ ) indexes as a function of social-anxiety group and type of face in the Recognition Memory task*

Index	Low social anxiety	High social anxiety
	Positive expression	
$d'$	.17 (.68)	.17 (.57)
$c$	-.05 (.52)	.01 (.34)
	Negative expression	
$d'$	.52 (.75)	.56 (.84)
$c$	-.04 (.48)	-.07 (.41)
	Neutral expression	
$d'$	.99 (.67)	.35 (.87)
$c$	.01 (.56)	.11 (.45)

## *Discussion*

When a different presentation time (200 ms) was used, high socially anxious individuals did not significantly differ from those low in social anxiety in the way they perceived facial expressions. Additionally, when the data from Experiment 2 were compared to those of Experiment 1, no significant interaction between social anxiety and stimulus presentation time emerged. Therefore, Hypotheses 1a and 2 were not confirmed. However, there was a significant interaction between face type and stimulus presentation time. Follow up analyses indicated that both anxiety groups perceived negative faces as appearing less critical to them at 500 ms than at 200 ms. This finding suggests that high and low socially anxious individuals are able to rate



other people's faces as less negative, if they have a chance to observe them in more detail. Moreover, high levels of trait anxiety and depression were associated with increased negative ratings of facial expressions. Therefore, the results suggest that general vulnerability to negative affect is related to interpretation biases for faces. Finally, the recognition memory test did not provide support for the hypothesis that the high social-anxiety group might have a better memory for faces presented for 200 ms (Hypothesis 3).

## GENERAL DISCUSSION

The main aim of the study was to explore interpretation bias for faces by using two exposure durations for the facial stimuli: 200 and 500 ms. A major reason for studying faces was to increase the ecological validity of interpretation bias investigations. The findings of Experiments 1 and 2 were as follows: In Experiment 1 high socially anxious individuals rated all faces as appearing more critical of them, compared with the low social anxiety group. This finding is consistent with the results of the Winton et al.'s study (1995) and supports the existence of a bias in the information processing of facial expressions in social anxiety. In Experiment 2, when the faces were displayed for 200 ms, there was no significant difference in face ratings between the social anxiety groups. Moreover, at 500 ms presentation time, high socially anxious individuals rated positive and neutral facial expressions as more critical compared with the low socially anxious individuals. It was also found that both anxiety groups interpreted the negative faces as less negative at 500 ms than at 200 ms. Finally, high levels of trait anxiety and depression were associated with more negative ratings of facial expressions.

It had been predicted (Hypothesis 2) that the difference in interpretation bias between the social anxiety groups would be greater at 200 than at 500 ms condition. The study did not lead to findings consistent with Hypothesis 2. In contrast, the two groups differed in interpretation bias only when the faces were presented for 500 ms. In which way could these results be accounted for? There are two possible explanations. First, it is possible that interpretive bias in social anxiety does not occur rapidly and automatically, but rather that it involves subsequent strategic processes. This explanation is in line with the stage-based information processing accounts reported in the Introduction section (Beck & Clark, 1997). Indeed, several studies investigating interpretive bias in trait anxiety (Calvo & Castillo, 1997; Calvo, Eysenck, & Castillo, 1997; Richards & French, 1992) provided convincing support for the notion that interpretive bias depends on strategic processes occurring some time after the presentation of stimuli. Alternatively, the current findings appear to suggest that

when low socially anxious participants are instructed to behave like socially anxious individuals in social-evaluative situations, that is, to selectively attend to social cues such as faces briefly presented for 200 ms and make inferences on the basis of such limited information, they are also prone to the same interpretation bias, just as high socially anxious participants do. However, when the availability of social stimuli is prolonged up to 500 ms presentation time, low socially anxious individuals are able to correct their interpretation bias and make less negative evaluations. Further research is needed on this point.

As mentioned above, both high and low socially anxious participants rated the negative faces presented for 500 ms as less critical than in 200 ms. It has been suggested that the tendency to avoid threat cues presented for 500 ms observed in high socially anxious individuals (Chen, Ehlers, Clark, & Mansell, 2002; Mansell et al., 1999; Vassilopoulos, 2005) would prevent them from learning that the stimulus is less harmful (Mogg, Bradley, Bono, & Painter, 1997). Similarly, Wells and Papageorgiou (1998) found that instructing social phobics to observe other people closely during an anxiety-provoking social situation led to a reduction in anxiety and belief in feared catastrophes. Therefore, the results of the present study are consistent and suggest that when high and low socially anxious individuals are instructed to observe in more detail other people's faces and abstract more affective information from their expressions, they are able to rate them as less negative. The results also support the effectiveness of treatment interventions based on the cognitive-behavioural approach, where socially anxious individuals are generally instructed to abandon maladaptive self-focus and redirect their attention to the external social environment in order to realise that they come across people better than they think (for a discussion see Clark & Wells, 1995).

A recognition memory test was included to assess whether attentional vigilance to emotional cues leads to better memory for these cues briefly presented for 200 ms. Overall, memory performance was only slightly above chance, making it difficult to assess the hypothesis. However, with this proviso, there was no evidence that high socially anxious individuals had better memory for emotional faces.

In general, the results of the present study are consistent with cognitive models implicating information processing biases in the maintenance of social phobia. Our findings lend support to the presence of an interpretation bias for emotional facial expressions in socially anxious individuals. However, this bias was observed at 500 ms rather than 200 ms stimulus exposure duration suggesting that controlled, strategic processes may be involved, as Beck and Clark (1997) have suggested. Additionally, the findings suggest that by attending more to other people's negative facial expressions, both anxiety groups are able to perceive them as less critical.

### *Limitations of the present study*

The two experiments reported here have several limitations which need to be addressed in future research. First, individuals from two different countries, England and Greece, participated in Experiment 1 and Experiment 2, respectively. Therefore, it is possible that the differences in information processing of facial expressions found between the two experiments might be due to intercultural differences rather than due to the manipulation of stimulus display time. Indeed there is already experimental evidence suggesting that considerable cultural variation exists in the perception and interpretation of the meaning of facial expressions (Masuda et al., 2008). However, the groups in the two experiments were matched on trait variables and were both drawn from a university student population. In addition, more recent research using a variety of sophisticated techniques and controls has consistently showed that the general interpretation of certain emotional expressions is culturally universal (Haidt & Keltner, 1999).

Second, in Experiment 2 the total number of facial expressions used in the face-rating task was reduced due to the memory task that followed afterwards. Therefore, we cannot rule out the possibility that the nonsignificant differences found in Experiment 2 might have resulted from the reduced number of stimuli presented. However, all the key findings remained significant when the analyses of Experiment 1 were repeated with only the facial stimuli that were common in the two experiments. Additionally, the same experimental material was used and the same procedure was followed in both experiments. An ideal study would have either randomly assigned participants to either 200 or 500 ms condition, or presented the tasks in a within-subject design. The present study had the advantage of eliminating the carry-over effects of a within-subject design.

Third, the research was based on analogue populations. It is therefore not clear to what degree the present results can be generalised to clinically diagnosed social phobics. However, it is generally expected that social phobics show similar cognitive biases to those shown by the high social anxiety group (Stopa & Clark, 2001). Future studies should attempt to replicate the results in clinical samples.

Fourth, both experiments relied exclusively on self-report, such that demand effects could account for the differences between groups. However, participants were strongly encouraged to respond candidly and honestly, stressing that the anonymity and confidentiality of their responses was guaranteed. Nevertheless, future studies should employ indirect or non-self-report measures. A final limitation is that both experiments used a predominantly female sample. Therefore, the generalizability of these results to men also remains to be established in future studies.

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