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BRIEF REPORT

Social anxiety biases the evaluation of facial displays: Evidence from single face and multi-facial stimuli

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This study examined the contribution of social anxiety to the evaluation of emotional facial stimuli, while controlling for the gender of participants and stimuli. Participants ($n = 63$) completed two tasks: a single face evaluation task in which they had to evaluate angry versus neutral faces and, a facial crowd evaluation task in which they had to evaluate displays with a varying number of neutral and angry faces. In each task, participants had to evaluate the stimuli with respect to (a) the degree of disapproval expressed by the single face/crowd, and (b) the perceived difficulty of interacting with the face/crowd (emotional cost). Consistent with earlier studies, results showed that social anxiety modulated the evaluation of single faces for emotional cost, but not for disapproval ratings. In contrast, the evaluation of facial crowds was modulated by social anxiety on both ratings.

Keywords: Social anxiety; Emotional facial expression; Interpretation bias; Evaluation bias.

The fear of negative evaluation is at the heart of social anxiety (SA). According to cognitive models, SA is maintained by the tendency of socially anxious individuals (SAs) to evaluate social information, including emotional facial expressions (EFEs), more negatively than non-socially anxious

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individuals (nSA) do (e.g., Rapee & Heimberg, 1997).

Research examining decoding biases suggests that SAs are as accurate as nSA in identifying EFEs (e.g., Philippot & Douilliez, 2005; Schofield, Coles, & Gibb, 2007), but that they might differ in their sensitivity to angry signals in animated displays (Joormann & Gotlib, 2006; Montagne, Schutters, Westenberg, & van Honk, 2006). Although Joorman and Gotlib (2006) found that SAs are *more sensitive* to angry cues, Montagne et al. (2006) observed that SAs are *less sensitive* in recognising anger and disgust than controls.

Moreover, for many evaluative dimensions, SAs do not demonstrate an evaluation bias for EFEs (e.g., valence: Mohlman, Carmin, & Price, 2007; pleasantness: Heuer, Rinck, & Becker, 2007; perceived threat: Douilliez & Philippot, 2003). Two studies examined biases in evaluating the emotional cost of interacting with individuals displaying EFEs. Schofield et al. (2007) found that SAs overestimated the emotional cost of interacting with individuals expressing disgust, while Campbell et al. (2009) failed to demonstrate such a bias for angry and disgust faces.[1] These results suggest that, while SAs are not biased in their evaluation of valence or threat, they may be more extreme when evaluating the emotional cost of interacting with people expressing rejection.

The above-mentioned studies focused on the evaluation of single faces. However, in real life people often interact with multiple individuals simultaneously and such situations are the most feared by SAs (Latane, 1981). For instance, Gilboa-Schechtman, Presburger, Marom, and Hermesh (2005) observed that SAs evaluate facial crowds with a minority of disapproving faces more negatively than nSA. However, Lange, Keijsers, Becker, and Rinck (2008) failed to show a bias in the evaluation of friendliness of angry–neutral and happy–angry crowds in socially anxious women. These divergent results do not allow us to draw firm conclusions about whether SAs display a bias in the evaluation of facial crowds.

The goal of the present study was to investigate how SAs evaluate (a) neutral versus angry single faces and (b) facial crowds varying in the number of neutral and angry faces. We assessed two core evaluation dimensions for SAs: disapproval/threat/unfriendliness[2] and the emotional cost of interacting. For the former dimension, several adjectives were selected to capture broadly the negative evaluation that typically signals SA. The emotional cost of interacting has only been examined for single faces in previous studies (Campbell et al., 2009; Schofield et al., 2007). It is considered as a proxy of the difficulty to approach others, i.e., the conscious self-evaluation of the approach tendency.

Based on previous research, we did not expect an effect of SA on disapproval ratings for single faces. However, extending Schofield et al.'s (2007) findings, we hypothesised an effect of SA on emotional cost ratings. In contrast, we expected effects of SA for both ratings of facial crowds. Our rationale was that, when confronted with a crowd of EFEs varying in threat intensity, SAs selectively detect threatening EFEs, disregarding neutral ones, thereby displaying an anger superiority effect.

Finally, although studies on the evaluation of single faces generally used male and female faces, no studies with SAs have systematically examined the effect of gender on evaluation. Participants' gender is likely to be relevant: Rotter and Rotter (1988) reported an interaction between participant and stimulus genders in decoding EFEs in a normal sample. Further, SAs frequently report difficulties in interacting with opposite-gender partners. Therefore, we also

[1]It should be noted that the operationalisation of "cost of interacting" is slightly different in those two studies. In Schofield et al. (2007), participants had to evaluate "what it would be like to interact with" on a scale from "*very bad*" to "*very good*" for me. Campbell et al. (2009) asked their participants to evaluate how likely they were "to approach and engage the presented person in a social interaction".

[2]This dimension is called "disapproval rating" in the remainder of the text.

examined whether the gender of the participant and the stimulus may play a role in the evaluation of EFE.

METHOD

Participants

Participants were 63 undergraduates (45 women; mean age: 20.49, $SD = 2.04$) who received a lottery ticket for their participation. SA was assessed with the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987; $M = 47.02$, $SD = 19.57$). Participants also completed the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996; $M = 10.03$, $SD = 8.66$).

Material

Seventy-two pairs of single-face pictures displaying either a neutral or an angry expression of 72 individuals (half were women) were used. Seventy pairs were obtained from the Karolinska Directed Emotional Faces (Lundqvist, Flykt, & Öhman, 1998) and two pairs were obtained from the Japanese and Caucasian Facial Expressions of Emotion Faces (Matsumoto & Ekman, 1993–2004). Pictures were resized to 5.01×5.01 cm, in an 8-bit greyscale. Each of the 144 faces was displayed once in the single face evaluation task (SFET).

For the facial crowd evaluation task (FCET), 72 matrices of 9 (3×3) EFEs were constructed. Matrices varied as a function of the ratio of angry versus neutral faces (this factor will be called "threat intensity" hereafter) and of the expresser's gender—each matrix contained only same-gender expressers. There were 9 levels of intensity from 0 (crowd comprising no angry faces and 9 neutral faces) to 8 (crowd comprising 8 angry faces and one neutral face). Four sets were constructed for each gender-intensity combination. Stimulus size was 15.03×15.03 cm.

Procedure

Participants completed the FCET and SFET in E-Prime 1.1 (Schneider, Eschman, & Zuccolotto, 2002). Task order was counterbalanced across participants. In both tasks, each trial started with a fixation cross displayed for a random duration varying from 1200 to 1700 ms. Next, the stimulus was displayed for 300 ms. Following stimulus offset, the disapproval scale appeared in the centre of the screen until a response was provided, followed by the emotional cost scale.

SFET. Participants were asked to evaluate how disapproving/approving the target face was (disapproval rating) using a scale from -3 (*completely disapproving, unfriendly, threatening*) to $+3$ (*completely approving, friendly, reassuring*). Finally, they were asked to evaluate how difficult it would be to interact with this individual (emotional cost rating) using a scale from -3 (*very difficult*) to $+3$ (*very easy*). There were three practice trials and 144 experimental trials.

FCET. Similar to the SFET, participants were requested to provide disapproval and emotional cost ratings. There were three practice and 72 experimental trials.

Afterwards, participants completed the LSAS and the BDI-II, and were debriefed.

Statistical analyses

Similarly to recent studies (e.g., Schofield et al., 2007), we used hierarchical linear modelling (HLM) that accounts for intra- and inter-individual variances simultaneously. Participants constituted level-1 units with within-subject factors (stimulus gender and valence for SFET; stimulus gender and linear and quadratic trends in threat intensity for FCET) as predictors, and participants' characteristics (gender, SA) were level-2 units (for description of HLM, see Raudenbush & Bryk, 2002). We used HLM 6 (Raudenbush,

Bryk, Cheong, Congdon, & duToit, 2004). We analysed the data separately for the FCET and SFET, and for each dependent measure.

RESULTS

Disapproval ratings[3]

In the SFET (Table 1), results showed an interaction between SA, participant gender, and face valence, $t(59) = -2.12$, $p < .05$. Following this interaction, we ran separate analyses for men and women. The effect involving SA was not significant for female or male participants. This pattern of results does not support a significant moderation by SA of disapproval ratings for single faces.

In the FCET (Table 2), disapproval ratings increased as a function of SA, $t(59) = 4.38$, $p < .001$. The linear effect of threat intensity, $t(59) = 9.31$, $p < .001$, indicating more disapproval as threat intensity increased, was moderated by SA, $t(59) = 2.76$, $p < .01$, in that the linear impact of threat intensity was more marked at higher SA levels. This interaction was qualified by a three-way interaction with participant gender, $t(59) = -2.00$, $p = .05$. For females, disapproval ratings increased as a function of SA, $t(43) = 3.63$, $p < .001$, without any interaction with intensity. For males, the effect of SA, $t(16) = 5.81$, $p < .001$, was qualified by an interaction with linear threat intensity, $t(16) = 4.03$, $p = .001$, and quadratic threat intensity, $t(16) = 2.43$, $p < .05$. Thus, in female participants, SA increased disapproval judgements of crowds irrespective of their intensity, whereas for males, the impact of SA was greater for more intensely angry crowds.

There was also an interaction between SA and crowd gender, $t(59) = 2.26$, $p < .05$, qualified by a three-way interaction between SA, participant gender and crowd gender, $t(59) = -2.67$, $p < .05$. For male participants, the correlation between SA and disapproval ratings of female faces was significant, $r = .68$, $p < .005$, whereas the correlation between SA and disapproval ratings of male faces was not significant, $r = .18$, $p = .47$. For female participants, the correlation between SA and disapproval ratings of male crowds was significant, $r = .33$, $p < .05$, whereas the correlation between SA and disapproval ratings of female crowds was not significant, $r = .28$, $p = .07$. In sum, this interaction indicates that the more participants were socially anxious, the more they judged a facial crowd of the *opposite* gender as being disapproving.

Emotional cost ratings

As expected, we found that in SFET (see Table 1), SA was associated with greater emotional cost of an anticipated social interaction, $t(59) = 3.97$, $p < .001$. Interestingly, this effect was not moderated by the emotionality of the face, suggesting that, in the single face condition, SA enhances emotional cost for angry as well as neutral facial expressions.

These findings were replicated in the FCET. The emotional cost of interacting increased as a function of SA, $t(59) = 5.44$, $p < .001$. There was also a linear effect of intensity, $t(59) = 8.22$, $p < .001$, showing that emotional cost increased as the threat intensity of a crowd increased. Moreover, this linear effect was moderated by SA, $t(59) = 2.51$, $p < .05$, indicating that the positive linear impact of threat intensity was more marked at higher levels of SA. There was a three-way interaction between SA, participant gender, and quadratic threat intensity, $t(59) = -2.82$, $p < .01$. For female participants, emotional cost increased as a function of SA, $t(43) = 3.63$, $p = .001$. For male participants, we found an effect of SA, $t(16) = 4.38$, $p < .001$, qualified by an interaction with quadratic threat intensity, $t(16) = 5.63$, $p < .001$, confirming the fact that the quadratic impact of threat intensity was more marked at higher levels of SA. In other words, as was the case for disapproval judgement, SA increased the cost of interacting among female

[3]In order to facilitate the interpretation of results for the evaluation of disapproval and the emotional cost of interacting, these scales were reversed: the higher the score, the higher the disapproval or the emotional cost of interacting.

Table 1. *Summary of SFET results for disapproval and emotional cost ratings*

	Dependent variable	
	Disapproval ratings	*Emotional cost ratings*
Predictor	*Coefficient (SE)*	*Coefficient (SE)*
Level 2		
Intercept	0.566 (0.047)***	0.544 (0.059)***
Participant gender	−0.063 (0.045)	−0.034 (0.064)
Social anxiety	0.004 (0.002)	0.011 (0.003)***
Social anxiety × Participant gender	−0.000 (0.002)	0.002 (0.003)
Level 1		
Face gender		
Intercept	−0.116 (0.014)***	−0.128 (0.015)***
Participant gender	−0.051 (0.015)***	−0.046 (0.016)*
Social anxiety	0.001 (0.001)	0.001 (0.001)
Social anxiety × Participant gender	−0.001 (0.001)	−0.000 (0.001)
Face valence		
Intercept	1.012 (0.050)***	0.948 (0.055)***
Participant gender	0.084 (0.048)	0.074 (0.056)
Social anxiety	0.002 (0.003)	0.002 (0.003)
Social anxiety × Participant gender	−0.006 (0.003)*	−0.005 (0.003)

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

participants. In contrast, among male participants, this effect was moderated by the anger intensity of the crowd: The effect increased as a function of threat intensity, and this increase was more marked at higher level of intensity.

There was also an interaction between SA and crowd gender, $t(59) = 2.49$, $p < .05$. This interaction was moderated by a marginal three-way interaction between SA, participant gender and crowd gender, $t(59) = -1.96$, $p = .05$. For male participants, the correlation between SA and female face crowd ratings was significant, $r = .69$, $p < .005$, indicating that the more socially anxious male participants were, the more costly they evaluated interactions with female crowds to be, whereas the correlation between SA and emotional cost ratings of male faces was $r = .44$, $p = .06$. For female participants, the correlations between SA and emotional cost ratings of both male and female crowds were significant, respectively, $r = .52$, $p < .001$, and $r = .46$, $p < .002$, indicating that the more socially anxious female participants were, the more costly they evaluated interactions with crowds, irrespective of crowd gender. The correlation pattern suggests that SA is related to emotional cost ratings with facial crowds although the magnitude of the correlation varies as a function of participant and crowd genders.

DISCUSSION

Disapproval ratings

In line with previous work (e.g., Douilliez & Philippot, 2003), the present findings suggest that SA does not affect the explicit evaluation of the disapproval expressed in single angry and neutral faces. This was not the case for stimuli involving multiple EFEs. SAs became more sensitive to the disapproval of the crowd as the proportion of angry faces increased. Two other studies also investigated the evaluation of facial crowds in SA. Lange et al. (2008) found an impact of SA in terms of action tendencies (see discussion below) but not in friendliness ratings. This latter scale, however, is less ecologically valid than disapproval ratings, as SAs are

Table 2. *Summary of FCET results for disapproval and emotional cost ratings*

	Dependent variable	
	Disapproval ratings	*Emotional cost ratings*
Predictor	*Coefficient (SE)*	*Coefficient (SE)*
Level 2		
Intercept	0.242 (0.061)***	0.0230 (0.060)***
Participant gender	−0.173 (0.057)**	−0.066 (0.057)
Social anxiety	0.010 (0.002)***	0.015 (0.003)***
Social anxiety × Participant gender	0.000 (0.002)	0.002 (0.003)
Level 1		
Crowd gender		
Intercept	−0.115 (0.026)***	−0.104 (0.023)***
Participant gender	−0.097 (0.025)**	−0.075 (0.022)**
Social anxiety	0.003 (0.001)*	0.001 (0.002)*
Social anxiety × Participant gender	−0.004 (0.001)*	−0.001 (0.002)†
Crowd intensity$_{linear}$		
Intercept	0.114 (0.012)***	0.110 (0.013)***
Participant gender	−0.016 (0.013)	−0.011 (0.014)
Social anxiety	0.001 (0.000)**	0.001 (0.000)*
Social anxiety × Participant gender	−0.001 (0.000)	−0.001 (0.000)
Crowd intensity$_{quadratic}$		
Intercept	0.006 (0.001)***	0.006 (0.001)***
Participant gender	−0.001 (0.001)	−0.001 (0.001)
Social anxiety	0.000 (0.000)	0.000 (0.000)
Social anxiety × Participant gender	−0.000 (0.000)	−0.000 (0.000)**

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

especially afraid of *negative* social judgement. In contrast, Gilboa-Schechtman et al. (2005) observed differences between social phobics and controls when evaluating the perceived disapproval of facial crowds. That effect is slightly different from the present findings in that their SA effect appeared only for moderately disapproving crowds. Several methodological differences offer a potential explanation for this difference. In Gilboa-Schechtman et al.'s (2005) study, crowds were comprised of angry, neutral as well as happy expressions, fewer angry expressions were used, and stimulus presentation time was longer (2,500 ms). Moreover, participants were socially phobics and/or depressed patients. Taken together, the present results suggest that SA influences the perception of disapproval in a facial crowd.

The present data support the notion that SA differentially affects EFEs processing depending on whether the EFE is to be found in a single display or in a crowd. When confronted with simple unambiguous EFEs, SAs provide disapproval evaluations that are similar to nSA. In contrast, crowds are complex stimuli, often containing conflicting information. When confronted with such information, SAs might more rapidly detect (Gilboa-Schechtman, Foa, & Amir, 1999) and give more weight to disapproval cues that are relevant to their concerns. These results support the notion that "the presence of angry faces in a neutral crowd appears to trigger an increase in the threat evaluation in SAs" (Lange et al., 2008, p. 941). However, single EFEs could also be ambiguous. A recent study by Gilboa-Schechtman, Foa, Vaknin, Marom, and Hermesh (2008)

showed that biases in the decoding of a single face emerge under a condition of ambiguity that was created by morphing. Future studies may further explore this role of ambiguity in the evaluation of disapproval and the emotional cost of interacting with single faces.

An alternative explanation for the difference between evaluations of single faces versus facial crowds is that SAs may be more reactive when confronted with several individuals as opposed to one. A crowd would thus elevate the state anxiety of SAs more than a single individual would, resulting in an evaluation bias for the former but not the latter. It is interesting to note that the only study to demonstrate a decoding bias for single static faces in SAs had induced a state of SA prior to the task (Mohlman et al., 2007).

Emotional cost ratings

Schofield et al. (2007) showed that SAs overestimate the emotional cost of interacting with disgusted individuals even though they did not exhibit decoding biases of the same expressions. The present study replicates and extends this finding in several ways. Whereas no effect was observed for disapproval ratings, SA increased the emotional cost of interacting with single faces, regardless of whether these faces expressed a neutral or an angry expression. This discrepancy between the perceived disapproval and emotional cost dimensions could be explained by the fact that the difficulty of interacting with another is closer to the action tendency that is affected by SA (Heuer et al., 2007). It is interesting to note that neither our study nor Heuer et al.'s study found a moderating effect of face valence. In other words, it appears that SAs believe that interacting with another person is emotionally taxing, regardless of the emotional state of the expected interlocutor.

A similar effect of SA was observed in the FCET: The perceived emotional cost of interacting increased as a function of SA. However, in contrast to the single face condition, the impact of the number of angry faces in the crowd on the emotional cost of interacting increased with SA. Lange et al. (2008), in their Approach Avoidance Task, also observed that the avoidance of neutral–angry crowds tended to increase with the number of angry faces in SAs but not in nSA.

A note on participant and stimulus gender

This study considered participant and stimulus genders, and revealed that their interaction was qualified by SA for both disapproval and emotional cost dimensions in a facial crowd. As expected, the more participants were socially anxious, the more they judged a facial crowd of the opposite gender as disapproving. However, the pattern of results was less clear for the emotional cost ratings. SA appears to be related to a higher emotional cost of interacting with crowds regardless of the gender of the crowd or the participant.

Participant gender appears to moderate the relationship between SA and the intensity of facial crowds. Indeed, female participants were not affected by the crowd's threat intensity: The more socially anxious they were, the more they judged crowds to be disapproving and costly to interact with. In contrast, for male participants, both the linear and quadratic impacts of crowd intensity were more pronounced at higher levels of SA for the disapproval ratings. For emotional cost ratings, the quadratic impact of threat intensity was more marked at higher levels of SA.

Limitations and future directions

Although the results of the current study clarify how SAs evaluate facial stimuli, there are several limitations that should be considered. First, the present study views SA as a continuum (e.g., Rapee & Heimberg, 1997) and therefore focused on the whole range of SA. It has yet to be tested whether our findings may be replicated in clinical populations. Second, the current study only explored neutral and angry expressions. Our results need to be generalised to other negative (e.g., contempt, disgust) as well as positive (e.g., joy; see Campbell et al., 2009) expressions that may be relevant for the understanding of disapproval and emotional cost ratings in SA. Third,

the present design cannot exclude the possibility that the difference in disapproval evaluation between the single face and facial crowd conditions may be explained by an elevation of anxiety due to being confronted with a crowd of EFEs. In future research, state anxiety could be manipulated or measured in order to control its effect on judgement. Finally, we cannot exclude that the absence of significant findings was partly the result of an insufficient statistical power due to our small sample size.

In conclusion, the present findings add to previous studies indicating that SA does not bias the interpretation of simple and non-conflicting stimuli such as single faces. They are also congruent with previous data showing that SA increases the cost of interacting with others. In contrast, when people are confronted with conflicting information, as is often the case in facial crowds, SA is associated with increased sensitivity to threat intensity when judging the disapproval and the emotional cost.

The discrepancy between single and multiple facial displays may be accounted for by several, not necessarily incompatible, explanations. First, the greater ease of SAs in detecting angry faces compared to nSA (Gilboa-Schechtman et al., 1999) may lead them to assign more weight to angry faces in their judgement. Second, the intensity of a single face may not be sufficient to activate a disapproval evaluation whereas the intensity of facial crowds may be (a "dose effect"). At the same time, however, single angry faces are more threatening than single neutral faces and can thus be considered a greater "dose" than the latter. The fact that our data revealed no clear difference between single angry and neutral faces clearly questions this alternative explanation.

Further research is needed using eye-movement recording during the evaluation task in order to better understand how selection and interpretation processes relate to each other when people process facial crowds. This kind of research allows for an examination of the extent to which attentional indexes (e.g., first fixation, number of angry faces fixed, and fixation duration on angry faces) can predict facial crowd evaluation.

Finally, the current study underlines the importance of integrating both participant and stimuli genders in research designs. Some discrepancies between studies may be explained by the gender composition of the participant sample and materials (e.g., Lange et al., 2008, used only female participants). It should be noted that socially anxious men displayed a negative interpretation towards complex stimuli that was more sensitive to threat intensity than that in women.

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