Social anxiety and detection of facial untrustworthiness: Spatio-temporal oculomotor profiles

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ARTICLE INFO

ABSTRACT

Cognitive models posit that social anxiety is associated with biased attention to and interpretation of ambiguous social cues as threatening. We investigated attentional bias (selective early fixation on the eye region) to account for the tendency to distrust ambiguous smiling faces with non-happy eyes (interpretative bias). Eye movements and fixations were recorded while observers viewed video-clips displaying dynamic facial expressions. Low (LSA) and high (HSA) socially anxious undergraduates with clinical levels of anxiety judged expressers' trust-worthiness. Social anxiety was unrelated to trustworthiness ratings for faces with congruent happy eyes and a smile, and for neutral expressions. However, social anxiety was associated with reduced trustworthiness rating for faces with an ambiguous smile, when the eyes slightly changed to neutrality, surprise, fear, or anger. Importantly, HSA observers looked earlier and longer at the eye region, whereas LSA observers preferentially looked at the smiling mouth region. This attentional bias in social anxiety generalizes to all the facial expressions, while the interpretative bias is specific for ambiguous faces. Such biases are adaptive, as they facilitate an early detection of expressive incongruences and the recognition of untrustworthy expressers (e.g., with fake smiles), with no false alarms when judging truly happy or neutral faces.

1. Introduction

Socially anxious individuals are particularly sensitive to negative evaluation, which makes them experience persistent and intense fear of social situations in which they may be scrutinized (American Psychiatric Association, 2013). Interpretation biases (i.e., judging ambiguous stimuli and situations as threatening) have been proposed to underlie the development and maintenance of social anxiety (see Amir and Bomyea, 2010; Steinman et al., 2014). There is evidence that ambiguous social stimuli are interpreted in a more negative (or less positive) manner by socially anxious than by non-anxious individuals (see Mobini et al., 2013; Morrison and Heimberg, 2013). Facial expressions are relevant social cues as they convey approval and liking, or disapproval and hostility, and they are often ambiguous (for example, due to low or subtle intensity, or co-occurrence with non-congruent cues, blends, etc.). Thus, they are amenable to different interpretations. It is therefore likely that the socially anxious person uses observed facial cues to infer potential negative evaluation or intentions from others.

Prior research on the explicit *recognition* (in expression categorization tasks) of *prototypical* facial expressions (e.g., anger, sadness, etc.) has generally found no differences as a function of social anxiety (see Staugaard, 2010). In contrast, there is some evidence that socially anxious individuals interpret *ambiguous* expressions in a more negative way (as angry: Bell et al., 2011; Gutiérrez-García and Calvo, 2017; Yoon et al., 2014; or disgusted or contemptuous: Gutiérrez-García and Calvo, 2017; Heuer et al., 2010), or in a less benign fashion (as less happy: Gutiérrez-García and Calvo, 2014, 2017), relative to non-anxious individuals (but see Button et al., 2013; Jusyte and Schönenberg, 2014). Further, for basic facial emotions, social anxiety is associated with enhanced sensitivity toward perceiving anger and disgust at *low intensities* (i.e., under high ambiguity), with no effect for other expressions (fear, sadness, surprise, and happiness), or for anger and disgust at higher intensities (i.e., low ambiguity; Gutiérrez-García and Calvo, 2017). The facilitated detection of anger and disgust, and the biased interpretation of ambiguous expressions as anger, disgust, or contempt, are understandable, as these expressions are related to negative evaluation and rejection, and fear of it constitutes a hallmark of social anxiety.

An implication is that, to avoid feared negative social evaluation or rejection, social anxiety might drive *untrustworthiness* judgments (as an interpretative process) of other people as soon as signs—even if

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ambiguous—of those expressions are detected. However, prior research on the relationship between social anxiety and un/trustworthiness judgments has obtained discrepant findings when *neutral* faces were used as stimuli. Meconi et al. (2014) found enhanced encoding of untrustworthy faces in social anxiety, but Cooper et al. (2014) reported non-significant effects. In contrast, with *emotional* faces as stimuli, social anxiety is related to (a) heightened distrust toward angry and disgusted expressions even at low intensities (Gutiérrez-García and Calvo, 2016a), and (b) reduced trustworthiness for smiling faces with neutral eyes, or when happy eyes subtly change toward non-happy (e.g., neutral, angry, etc.) (Gutiérrez-García and Calvo, 2016b).

The aim of the current study was to examine whether an attentional bias (i.e., selective and early gaze allocation to particular face regions) can account for such interpretative bias (i.e., untrustworthiness judgments of ambiguous expressions). We hypothesize that the tendency to distrust blended expressions with a smile but non-happy eyes by socially anxious individuals develops through a gaze bias toward looking earlier at non-happy eyes. In contrast, the visual attention of non-anxious individuals would be attracted more by the salient smiling mouth, thus making them judge such expressions as happy, given the diagnostic value of the smile for happiness categorization (Calder et al., 2000; Calvo et al., 2014); and, hence, as trustworthy, given the consistent relationship between perceived facial happiness and trustworthiness (Krumhuber et al., 2007; Quadflieg et al., 2013). We focused on smiling faces because of the inherent ambiguity of the smile, which can actually be associated with very different emotions apart from enjoyment and warmth, such as arrogance, dominance, sarcasm, contempt, nervousness, embarrassment, appeasement, or mere politeness (Ambadar et al., 2009; Niedenthal et al., 2010). Accordingly, faces with a smile are suitable to investigate interpretative bias in the form of reduced trustworthiness, since happy faces are generally rated as trustworthy but smiles can have multiple meanings (including negative ones, e.g., mockery).

A secondary aim focused on the role of different types of non-happy eyes. More specifically, we were interested in how different non-happy eye expressions (angry, fearful, surprised, and neutral) in faces with a smile modulate the proposed attentional bias. Although the smile makes a critical contribution to the *semantic categorization* of faces as happy, the eyes become important for the *affective processing* of a smile as genuine (Calvo et al., 2012; Johnston et al., 2010; McLellan et al., 2010). Presumably, the eyes can finely express more affective nuances than the straight smiling mouth (which otherwise can be voluntarily controlled to a greater extent), and the eyes can thus convey the expresser's current feelings and intentions better than the mouth. These feelings may involuntarily "leak" as micro-expressions through the eye region, even though a smiling mouth is intentionally exhibited. Further, the perceived authenticity of facial happiness and the genuineness of a smile are related to perceived trustworthiness (Krumhuber et al., 2007; Quadflieg et al., 2013) and predict trust behavior (Centorrino et al., 2015). Accordingly, perceived trustworthiness should be particularly sensitive to expressive changes in the eyes. We thus explored whether a bias toward selective early gazing at the eyes is modulated by type of non-happy eyes (or, rather, generalizes to all expressions) in social anxiety.

To investigate the above issues, we presented 2-s video-clips displaying dynamic facial expressions to high social anxiety (HSA) and low social anxiety (LSA) participants, who judged the expressers' trustworthiness while their eye fixations were recorded. Eye-tracking measures assessed the face region to which gaze was selectively directed and the gaze time course. The face stimuli involved (a) *prototypical* expressions (happy: neutral eyes and mouth unfolding to happy eyes and a smile; or non-happy: happy eyes and a smile unfolding to neutral) and (b) *blended* expressions with a constant smiling mouth but eyes changing from happy to non-happy (angry, fearful, surprised, or neutral). For blended expressions, *slight* changes (50% of intensity) appeared in the *eyes*. Such expressions represent fake smiles in social

encounters where the smiler is not genuinely happy, but rather may have internal negative feelings, motives, or intentions (e.g., arrogance, sarcasm, or contempt, for angry eyes; or nervousness, embarrassment, or appeasement, for fearful eyes; or merely politeness, for surprised or neutral eyes; Calvo et al., 2013). A 50% intensity of non-happy eye expressions was chosen to make the change realistic in a face with a smiling mouth. Higher intensities are unlikely to occur in social interaction, and would thus seem odd or unnatural.

2. Method

2.1. Participants

The Brief Fear of Negative Evaluation (BFNE) scale (Leary, 1983), the Social Interaction Anxiety Scale (SIAS) and Social Phobia Scales (SPS; Mattick and Clarke, 1998) were administered to the 236 students in classrooms, using anonymous codes. Twenty-four psychology undergraduates with high scores (HSA; $\geq$ 40) and 24 with low scores (LSA; < 30) on the BFNE scale were selected, with 15 females and 9 males in each group, aged 20–25 years. The HSA group had significantly higher scores than the LSA group on all three anxiety measures (BFNE, SIAS, and SPS; Table 1). With this sample size, the power for detecting medium effect sizes ($f = 0.25$) in interactions between group (two groups) and within-subject (six measurements) factors is larger than 0.90, at $\alpha = 0.05$, with a .5 correlation, and non-sphericity correction *épsilon* = 1. Written informed consent was obtained from the participants. The study was approved by the local ethics committee and conducted in accordance with the WMA Declaration of Helsinki 2008.

2.2. Social anxiety assessment

The 12-item BFNE scale assessing fear of negative evaluation by others (Leary, 1983) was the primary measure of social anxiety. Responses range from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). The BFNE is well-validated (Spanish version by Gallego et al., 2007), with high factorial and construct validity in undergraduate (Rodebaugh et al., 2004) and clinical samples (*M* scores = 47 in social phobia patients, Weeks et al., 2005; and *M* = 43 in clinically-diagnosed social phobic undergraduates, Gallego et al., 2007). The mean HSA BFNE scores (*M* = 46.33) in the current study are thus comparable to those of clinical social phobia.

The SIAS and the SPS (Mattick and Clarke, 1998) assess fear of social interaction and fear of being observed, respectively. Each questionnaire is a 20-item measure using a scale ranging from 0 (*not at all characteristic of me*) to 4 (*extremely characteristic of me*), with participants indicating the extent to which the statement applies to them. Spanish versions have been validated in large undergraduate samples (Olivares et al., 2001). Researchers use scores greater than 33 on the SIAS or 23 on the SPS to indicate social phobia (Brown et al., 1997). The mean SIAS (*M* = 35.33) and SPS (*M* = 30.33) scores in the current study thus indicated the HSA group was highly symptomatic.

Table 1
Participant characteristics.

	Low social anxiety		High social anxiety		Differences
	M	*SD*	*M*	*SD*	*Statistics*
Age	22.12	1.26	21.71	1.33	$t(46) = 1.09$, $p = 0.28$, *ns*
BFNE	22.25	4.58	46.33	5.02	$t(46) = 17.36$, $p < 0.0001$
SIAS	13.92	3.83	35.33	9.77	$t(46) = 9.99$, $p < 0.0001$
SPS	11.62	3.45	30.33	8.93	$t(46) = 9.57$, $p < 0.0001$

Note. BFNE: Brief Fear of Negative Evaluation Scale. SIAS: Social Interaction Anxiety Scale. SPS: Social Phobia Scale.