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Face value: Eye movements and the evaluation of facial crowds in social anxiety

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ABSTRACT

Scientific evidence is equivocal on whether Social Anxiety Disorder (SAD) is characterized by a biased negative evaluation of (grouped) facial expressions, even though it is assumed that such a bias plays a crucial role in the maintenance of the disorder. To shed light on the underlying mechanisms of face evaluation in social anxiety, the eye movements of 22 highly socially anxious (SAs) and 21 non-anxious controls (NACs) were recorded while they rated the degree of friendliness of neutral-angry and smiling-angry face combinations. While the Crowd Rating Task data showed no significant differences between SAs and NACs, the resultant eye-movement patterns revealed that SAs, compared to NACs, looked away faster when the face first fixated was angry. Additionally, in SAs the proportion of fixated angry faces was significantly higher than for other expressions. Independent of social anxiety, these fixated angry faces were the best predictor of subsequent affect ratings for either group. Angry faces influence attentional processes such as eye movements in SAs and by doing so reflect biased evaluations. As these processes do not correlate with explicit ratings of faces, however, it remains unclear at what point implicit attentional behaviors lead to anxiety-prone behaviors and the maintenance of SAD. The relevance of these findings is discussed in the light of the current theories.

1. Face value

1.1. Eye movements and the evaluation of facial crowds in social anxiety

Negative evaluation by others lies at the core of what individuals suffering from social anxiety disorder (SAD) fear the most (compare: 'Social Phobia' in: American Psychiatric Association, 2000). Results from experimental research have repeatedly suggested that distortions in information processing expedite the maintenance of this disorder (Beck & Clark, 1997; Clark & Wells, 1995; Foa, Franklin, Perry, & Herbert, 1996; Heinrichs & Hofmann, 2001; Hirsch & Clark, 2004; Rapee & Heimberg, 1997; Stopa & Clark, 1993). Negative biases in interpretation and evaluation of social situations (negative interpretation biases) in SAD are frequently found using text vignettes that describe ambiguous social scenarios (Amir, Foa, & Coles, 1998; Brendle & Wenzel, 2004; Hirsch & Clark, 2004; Huppert, Foa, Furr, Filip, & Mathews, 2003; Stopa & Clark, 2000; Voncken, Bögels, & de Vries, 2003). Evidence is less persuasive from tasks that directly or indirectly reflect evaluations of facial expressions. This is surprising as facial expressions are frequently ambiguous, but nevertheless very important social cues that could potentially convey negative evaluation or be at least interpreted in a threat-confirming way by socially anxious individuals (SAs) in contrast to non-anxious controls (NACs).

Abrams (1999) reported some evidence for differential processing of faces in SAs. In his study, participants high in social anxiety showed a recognition bias for negative facial expressions. Consequently, he concluded that negative faces are evaluated/interpreted as more threatening by SAs than by NACs. Gilboa-Schechtman, Presburger, Marom, and Hermesh (2005) utilized grouped faces (crowds) to enhance ambiguity and thus susceptibility for biased interpretations. They could show that patients with generalized SAD (Social Phobia) have a tendency to evaluate moderately disapproving crowds more negatively than non-clinical controls do. Individuals with social anxiety and comorbid depression evaluated extremely disapproving crowds more negatively. Winton, Clark, and Edelmann (1995) reported a tendency of SAs to rate facial expressions as more negative (Experiment 2), but did *not* find an enhanced ability in socially anxious participants for detecting negative emotions (Experiment 1). Mohlman, Camin, and Price (2007), on the other hand, found that SAs were more accurate in categorizing angry faces and had a tendency to categorize neutral faces as angry. Hunter, Bruckner, and Schmidt (2009) found SAs to be more accurate in categorizing all facial expressions, not just angry ones. In more recent studies, it was found that social anxiety

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was related to problems with disengaging attention from disgusted faces (Buckner, Maner, & Schmidt, 2010), and with disruptions in attentional control when having to inhibit reflexive eye-movements to all kinds of facial expressions, not just threatening ones (Wieser, Pauli, & Mühlberger, 2009).

No support for processing biases for facial expressions in SA came from studies by Douilliez and Philippot (2003), Philippot and Douilliez (2005), nor Merckelbach, Van Hout, Van den Hout, and Mersch (1989). Finally, our own previous work (Lange, Keijsers, Becker, & Rinck, 2008), did not substantiate any relation between social anxiety and ratings of the friendliness of emotional crowds either, nor did we find any attentional disruption in response to angry, neutral or smiling faces (Lange, Heuer, Reinecke, Becker, & Rinck, 2008). However, differences occurred in an Approach-Avoidance Task (Lange, Keijsers et al., 2008), in which participants had to either pull or push crowds consisting of different ratios of neutral/angry and smiling/angry faces by means of a joystick. Here, SAs displayed increased avoidance tendencies in response to an increasing number of angry faces in a neutral crowd as well as ungraded avoidance of smiling-angry crowds irrespective of the smiling-angry ratio. This is partially in line with research by Campbell, Sareen, Stein et al. (2009). They reported a tendency of SAs to rate smiling faces as less approachable.

When investigating fast, automatic processes, instead of explicit evaluative ones, evidence from tasks demanding visual search of facial arrays for a particular expression have been very helpful. They have strengthened the notion that facial threat is processed pre-attentively. These findings, however, cannot be conclusively integrated into our understanding of SAD. Öhman, Lundqvist, and Esteves (2001) for example, have shown that angry schematic faces are *generally* detected faster ("pop-out") in both neutral and smiling crowds, whereas neutral and smiling faces are not preferentially detected when embedded in angry crowds (Fox et al., 2000; Tipples, Atkinson, & Young, 2002; Williams, Moss, Bradshaw, & Mattingley, 2005). Calvo, Avero, and Lunqvist (2006) recorded eye movements during a visual search task. The reported "anger-superiority effect" (faster processing of angry faces) could not be explained by a higher proportion of initial fixations on an angry face; instead, angry faces were detected more accurately even though they were fixated upon less often and for a shorter time than other faces. Gilboa-Schechtman, Foa, and Amir (1999) found more rapid detection of angry faces compared to smiling faces in neutral crowds; this finding was even more pronounced in participants diagnosed with SAD. Juth, Lundqvist, Karlsson, and Öhman (2005) however, found that *real* smiling faces were detected more accurately and more quickly than angry or fearful targets irrespective of degree of social anxiety, whereas SAs detected *schematic* angry faces more reliably, when the social fear was experimentally enhanced.

In an extensive and recent review of the literature, Staugaard (2010) has summarized the status quo of research concerning processing of threatening faces in social anxiety. In line with the brief overview given above, he concluded that the most consistent results with regard to processing biases come from the dot-probe task and from measurements of visual attention, but only when presentation times are shorter than 500 ms. Besides that, results are very much dependent on task demands. Moreover, the specificity of the biases remains unclear because facial expressions of anger, criticism, disgust, contempt were not differentiated, but pooled under the term 'threatening'.

Besides methodological reasons, the inconsistencies in the reported findings and the dissociation between explicit and implicit ratings may also be explained partially by neurological hardwiring that is thought to underlie and facilitate rapid face processing (Haxby, Hoffman, & Gobbini, 2000; Herrmann, Ehlis, Mühlberger, & Fallgatter, 2005; Vuilleumier, 2002, 2005). LeDoux (1996), for example, suggested that the processing of threat cues travels via two different neurological pathways: a subcortical route for rough, quick stimulus evaluation and response initiation, and a cortical and slow one for thorough evaluation of a stimulus and, if necessary, inhibition/correction of erroneously initiated responses. It is proposed that discrimination of danger-relevant stimuli, such as angry faces, predominantly takes place pre-attentively and is evolutionarily beneficial (LeDoux, 1996; Öhman, 1993; Öhman & Soares, 1993). With facial expressions reliably communicating social rejection or sympathy, it is conceivable that in the etiology of social anxiety in a patient, preferential processing of particular faces may have become automatized. Consequently, measures of conscious recognition and evaluation of facial expressions may not tap into possible processing biases in SAD. Automatic attentional processes such as eye-movements and quick automatic evaluations, as well as associated responses or behavior may be initiated or executed very early, leaving patients unaware of these operations when asked for explicit evaluations of face stimuli. On the other hand, if conscious processing is to counteract erroneous early processing, some kind of interaction between the two should be evident.

In sum, the interplay between automatic, supposedly subconscious processes and the more strategic conscious evaluation processes is only poorly understood. While there seems conclusive evidence that (angry) faces undergo *some* kind of preferential subconscious processing in SAs, it remains unclear whether and how such a processing bias distorts the subjective supposedly conscious rating of particular facial expressions in SA and not in NACs. Therefore, with the present study, we further explored the relationship between (preferential) attentional processing, subjective ratings of affect in response to faces, and social anxiety. We expected that possible relationships between subconscious and conscious processing should become most evident when combined in a single task. Therefore, we recorded eye-movements, while participants had to rate displays of facial stimuli. As crowds of faces are generally more ambiguous than individual faces, are more susceptible to interpretations (Douilliez, Philippot, Yzerbyt, & Gilboa-Schechtman, submitted for publication), and can consequently be more threatening to SAs, we employed the crowds to enhance possible evaluative differences reflected in direct evaluations and/or eye-movements (Gilboa-Schechtman et al., 2005). We manipulated the degree of threat by varying the ratio between neutral and angry, as well as smiling and angry faces (compare: Lange, Keijsers et al., 2008). In addition, these stimuli enabled us to present competing emotional stimuli so that attentional biases (measured here via eye tracking) with regard to certain stimulus categories could be assessed. In order to account for the possible dissociation between fast and slow processes, stimulus duration was manipulated as well. Consequently, visual processing patterns for particular faces, face combinations, and participant groups can be compared, different facets of biased attentional processing can be detected, and these can be correlated with explicit subjective ratings of the stimuli (Calvo, Avero, & Lundqvist, 2006).

First, as (emotional) expressions have been found to evoke differential attentional processing in individuals with elevated degrees of social anxiety, we examined whether (different aspects of) eye movements differed between SAs and NACs when viewing facial crowds (e.g., Calvo et al., 2006). Second, we explored how facial crowds would be rated with respect to perceived friendliness as the ratio of angry faces in a neutral crowd or angry faces in a smiling crowd varied (Lange, Keijsers et al., 2008). We wanted to know whether these ratings would differ between SAs and NACs. The evaluations were expected to become increasingly negative as the number of angry faces increased in either a neutral or a smiling crowd. In line with earlier research, we expected more negative ratings on moderately negative crowds in SAs than in NACs (Gilboa-Schechtman et al.,