



# Attentional mechanisms of social perception are biased in social phobia



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## ABSTRACT

Previous studies of social phobia have reported an increased vigilance to social threat cues but also an avoidance of socially relevant stimuli such as eye gaze. The primary aim of this study was to examine attentional mechanisms relevant for perceiving social cues by means of abnormalities in scanning of facial features in patients with social phobia. In two novel experimental paradigms, patients with social phobia and healthy controls matched on age, gender and education were compared regarding their gazing behavior towards facial cues. The first experiment was an emotion classification paradigm which allowed for differentiating reflexive attentional shifts from sustained attention towards diagnostically relevant facial features. In the second experiment, attentional orienting by gaze direction was assessed in a gaze-cueing paradigm in which non-predictive gaze cues shifted attention towards or away from subsequently presented targets. We found that patients as compared to controls reflexively oriented their attention more frequently towards the eyes of emotional faces in the emotion classification paradigm. This initial hypervigilance for the eye region was observed at very early attentional stages when faces were presented for 150 ms, and persisted when facial stimuli were shown for 3 s. Moreover, a delayed attentional orienting into the direction of eye gaze was observed in individuals with social phobia suggesting a differential time course of eye gaze processing in patients and controls. Our findings suggest that basic mechanisms of early attentional exploration of social cues are biased in social phobia and might contribute to the development and maintenance of the disorder.

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## 1. Introduction

Social phobia is an anxiety disorder characterized by an intense and persistent fear of social situations and negative evaluation by others often provoking a significant anxiety response and avoidance of social situations (World Health Organisation, 1992). Initial attendance to and subsequent avoidance of social threat stimuli have been suggested to contribute to the development and maintenance of social phobia (Amir, Foa, & Coles, 1998; Heinrichs & Hofmann, 2001). Empirical evidence is largely consistent with this proposal as hypervigilance for social threat cues, such as social threat words and emotional faces, was observed in several studies (Mogg, Philippot, & Bradley, 2004; Seefeldt, Krämer, Tuschen-Caffier, & Heinrichs, 2014; Spector, Pecknold, & Libman, 2003).

Moreover, the avoidance of disorder-relevant stimuli following the initial hypervigilance towards such cues has been demonstrated when the time course of attention was taken into account in social phobia and anxiety (Garner, Mogg, & Bradley, 2006; Schofield, Inhoff, & Coles, 2013; Wieser, Pauli, Weyers, Alpers, & Mühlberger, 2009), although evidence for avoidance of these stimuli is less consistent (e.g., Gamble & Rapee, 2010).

The eyes convey important information about the emotional state of conspecifics, their focus of attention and their intentions. Research in social phobia has therefore particularly focused on investigating the relationship between social anxiety and attention towards the eye region. Self-reports and behavioral studies in social phobia and anxiety revealed a marked tendency to avoid eye contact in social situations (Baker & Edelmann, 2002; Daly, 1978; Schneier, Rodebaugh, Blanco, Lewin, & Liebowitz, 2011). Studies employing eye-tracking technology and computerized faces have supported these findings by demonstrating a lower amount of fixations and dwell times on the eye region for patients suffering from social phobia (Horley, Williams, Gonsalvez, & Gordon, 2003; Horley,

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Williams, Gonsalvez, & Gordon, 2004; Moukheiber et al., 2010; Moukheiber, Rautureau, Perez-Diaz, Jouvent, & Pelissolo, 2012; Weeks, Howell, & Goldin, 2013). However, these studies employed relatively long stimulus presentation times (~10 s) and analyzed gazing behavior across the whole viewing period. As a result it remains unclear whether initial hypervigilance to the eye region as reported for other social threat cues might precede later avoidance. Moreover, increased rather than decreased attention towards the eyes of facial expressions has been reported in shy children and socially anxious individuals (Brunet, Heisz, Mondloch, Shore, & Schmidt, 2009; Wieser, Pauli, Alpers, & Mühlberger, 2009).

In the current study, we employed two novel eye-tracking paradigms to examine the gazing behavior of patients with social phobia compared to healthy controls in response to emotional facial expressions. In the first experiment, angry, fearful, happy and neutral faces were presented either briefly or for a longer duration and we manipulated whether participants initially fixated on the eye or the mouth region of facial expressions. Thus, contrary to previous experiments investigating attention to the eyes in patients with social phobia, our paradigm allowed for investigating early, reflexive shifts of attention towards the eyes or towards the mouth. It further enabled us to dissociate these reflexive aspects of visual orienting from sustained attention towards specific facial features. We expected that early, reflexive attentional shifts towards the eye region would be more pronounced in patients with social phobia as compared to controls. An avoidance of the eye region as reported in previous studies based on free-viewing conditions however (Horley et al., 2003, 2004; Moukheiber et al., 2010, 2012; Weeks et al., 2013), was expected to occur only subsequent to the initially increased attention towards the eyes in patients with social phobia.

Our task additionally allowed for determining whether the hypothesized preferential processing of the eye region in social phobia is restricted to specific emotions for which the eye region possesses a higher diagnostic relevance than the mouth region. This applies to fearful and angry, but not to happy faces for which the mouth region is diagnostically most relevant (Smith, Cottrell, Gosselin, & Schyns, 2005). Notably, in previous applications of this paradigm initial gaze shifting has been shown to vary as a function of these diagnostic facial features (Boll & Gamer, 2014; Gamer & Büchel, 2009; Scheller, Büchel, & Gamer, 2012). Thus, we expected that the supposed group differences regarding attention towards the eyes would interact with the type of emotional expression if patients with social phobia orient their gaze more frequently towards diagnostically relevant facial features such as the eyes of fearful faces and the mouth of happy faces.

The second experiment was a gaze-cueing paradigm, in which non-predictive gaze cues were supposed to trigger gaze-following and facilitate identification of targets appearing at the gazed-at location. It was hypothesized that enhanced reflexive attention towards the eyes and later avoidance of the eye region would result in differences in gaze-following and gaze-cueing effects between patients and controls.

## 2. Methods and materials

### 2.1. Participants

Based on the sample sizes of previous eye-tracking studies in social phobia (e.g., Horley et al., 2003, 2004; Moukheiber et al., 2010; Weeks et al., 2013) as well as our experience with the experimental paradigm, we aimed at recruiting a minimum of 20 participants for each group. Since eye-tracking measures between factor levels are substantially correlated ( $r > 0.70$  in our previous studies, e.g. Boll & Gamer, 2014), the power for detecting medium effects ( $f = 0.25$ ) in interactions between group and within-subject factors is larger than 0.90 (Faul, Erdfelder, Lang, & Buchner, 2007).

In total, 22 patients with social phobia and 22 healthy controls carefully matched with respect to age, gender and education participated in this study. Initially, 24 patients and 24 controls were recruited. One patient was excluded because of acute psychotic symptoms and another one because he was illiterate and unable to complete the questionnaires. Additionally, two control participants had to be replaced because they reached high values on the social anxiety questionnaires (see Section 3.1). Patients were recruited when seeking treatment from the psychotherapeutic outpatient clinic Falkenried in Hamburg, Germany. All of them had a primary diagnosis of social phobia (ICD-10; see Table 1 and Supplement for further details on the sample), which was established during an initial interview by a clinically trained psychologist who checked relevant ICD-10 criteria for social phobia as well as potential comorbid disorders. This interview was conducted in a similar manner (standardized operating procedures of the respective outpatient clinic) for all participants and diagnoses were verified in a second interview by the clinically trained psychologist who was responsible for organizing further treatment. Participants in the control group were recruited via advertisement and screened for any current or past psychiatric symptoms using the MINI-international neuropsychiatric interview (Sheehan et al., 1998). Four of the social phobia subjects were on medication, including three on selective serotonin reuptake inhibitors (escitalopram and citalopram), one on a serotonin-norepinephrine reuptake inhibitor (venlafaxine) and two of them were additionally treated with anticonvulsant drugs (pregabalin). All patients and controls had normal or corrected-to-normal vision and gave written informed consent as approved by the local ethics committee of the Medical Board in Hamburg, Germany.

### 2.2. Apparatus and procedure

Volunteers performed two eye-tracking tasks as described in the following. Questionnaires were completed in the break between the experiments. Eye movements were monitored using a video-based eye tracking system (EyeLink 1000, SR Research, Ontario, Canada) with a sampling rate of 1000 Hz. The Software Presentation (Neurobehavioral Systems, Albany, CA, USA) was used to present the stimuli on a 20" Samsung SyncMaster 204B display (40.64 × 30.48 cm) with a resolution of 1600 by 1200 pixels and a refresh rate of 60 Hz. Participants viewed the screen from a distance of 51 cm and the head location was fixed using a chin rest and a forehead bar. The physical size of the depicted faces in both experiments amounted to 9.7 × 13.9 cm which yielded a visual angle of 10.9 × 15.6°. To ensure that participants fixated the middle of the screen before the facial stimuli were presented, they were instructed to look at the fixation cross whenever it was shown on the screen in both experiments. When the fixation cross disappeared (e.g., when faces were shown), volunteers were free to look wherever they wanted to. In both paradigms, participants were verbally instructed before the start of the experiment and familiarized with the task in a short training session using a different set of stimuli.

All statistical tests were performed using the statistical programming language R ([www.r-project.org](http://www.r-project.org)). An a priori significance level of  $\alpha = 0.05$  was applied. A multivariate analysis approach as implemented in the *car* package was used for all repeated-measures analyses of variance (ANOVAs). Partial Cohen's  $f$  is reported as an effect size estimate (Cohen, 1988).

### 2.3. Measures

#### 2.3.1. Assessment of social anxiety

The level of social anxiety was assessed using German versions of the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel,

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