



The widening of the gaze cone in patients with social anxiety disorder and its normalization after CBT



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ABSTRACT

Gaze plays a crucial role in social interactions. Social Anxiety Disorder (SAD), which is associated with severe impairment of social interactions, is thus likely to exhibit disturbances of gaze perception. We conducted two experiments with SAD-patients and healthy control participants using a virtual head whose gaze could be interactively manipulated. We determined the subjective area of mutual gaze, the so-called gaze cone, and measured it prior to and after a psychotherapeutic intervention (Exp. 1). Patients exhibited larger gaze cones than control subjects. Exp. 2 varied the emotional expression of the virtual head. These data were validated using a real person (professional actor) as stimulus. Excellent reliability indices were found for our gaze cone measure. After Cognitive Behavioral Therapy, group differences in gaze cone width had disappeared. Emotional expressions were observed to modulate the gaze cone's width. Especially an angry expression caused the gaze cone to widen, possibly mediated by increased arousal. Finally, wider gaze cones in SAD-patients could be demonstrated for virtual and for real human heads confirming the ecological validity of virtual heads. The findings are of relevance for a more fine-grained understanding of perceptual processes in patients with SAD.

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Introduction: the cone of gaze

Social anxiety disorder (SAD), also called social phobia, is characterized by strong anxiety of acting embarrassingly or showing shame-related symptoms induced by social interaction or performance situations (American Psychiatric Association, 2000). Not surprisingly, patients with SAD tend to avoid such situations altogether (DeLong & Pollack, 2008). SAD severely impairs performance in every-day situations (Barrera & Norton, 2009; Chen & Drummond, 2008), it is known to be long lasting (Stangier, Clark, & Ehlers, 2006) and frequently accompanied by comorbid disorders, such as depressive disorders (Beesdo et al., 2007), anxiety disorders and alcohol and substance abuse (DeLong & Pollack, 2008). In comparison with other anxiety disorders, SAD showed high persistence rates and high probability of relapse (Bruce et al., 2005). Epidemiological studies showed a wide range of prevalence rates, depending on sample characteristics and the diagnostic criteria that have been applied (Fehm, Beesdo, Jacobi, & Fiedler,

2008). In a German community sample, cumulative incidence rate by the age of 33 years was 11.6% (Beesdo et al., 2007), which is already close to the lifetime prevalence of 12.1% found in the national comorbidity survey (Kessler et al., 2005). Accordingly, SAD represents a frequent disorder with massive negative impact on patients' lives. We sought to gain deeper insights into its consequences by focusing on the cognitive-perceptual correlate of mutual gaze perception. A valid correlate that is easy to measure would be most valuable for diagnosis and treatment.

Gaze research has identified some changes of looking behavior in patients suffering from SAD, mainly the avoidance of eye contact in social interaction. The latter is often considered to be an important indicator of social anxiety (Hofmann, Gerlach, Wender, & Roth, 1997). Eves and Marks (1991) demonstrated such gaze aversion in socially anxious participants who had to speak in front of an audience. Other studies found comparable gaze avoidance in social anxiety (Garner, Mogg, & Bradley, 2006; Roelofs et al., 2010), whereas some studies failed to demonstrate differences of gazing behavior between SAD-patients and healthy controls (Hofmann et al., 1997; Schneier, Kent, Star, & Hirsch, 2009).

Clark and Wells' (1995) influential cognitive model of social phobia postulates that SAD-patients shift attention towards themselves, thereby monitoring their own bodily symptoms more closely, which is typically associated with negative self-related cognitions and heightened arousal (Zou, Hudson, & Rapee,

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2007). This shift of attention in combination with the activation of negative thoughts and the mentioned changes in gaze behavior make it appear likely that SAD-patients also misperceive the area of mutual gaze. Our work focuses on mutual gaze perception of patients suffering from SAD rather than on their active gazing behavior.

Gamer and Hecht (2007) developed a psychophysical paradigm to measure the width and direction of the area of mutual gaze as experienced by the person receiving the gaze (the *gaze cone* resp. *cone of gaze*). Subjects are confronted with a virtual head displayed on a monitor or a large screen. Their task is to interactively adjust the eyes of the virtual target head such that it seems to look straight in their eyes or such that the target head is gazing at the edge of the area that the subject would consider to establish mutual gaze. The edges define the subjective gaze cone. If the counterpart's gaze falls within this area the person feels looked at. This paradigm was then applied to SAD-patients (Gamer, Hecht, Seipp, & Hiller, 2011) to measure their potentially altered gaze perception. The gaze cone was found to be widened in SAD-patients compared to healthy control participants when a second head also looking at the subject was present. Gamer et al. (2011) thereby demonstrated that SAD-patients have a broader criterion for mutual gaze than do controls. In the realm of SAD, the gaze cone width therefore most likely represents a psychophysical measure for the "amplified feeling of being looked at" (Gamer et al., 2011; p. 757). We sought to test whether the gaze cone is generally widened in SAD-patients or whether the additional social pressure constituted by the second head is required. We varied the orientation of this second head and its gaze orientation twofold to explore whether its mere presence suffices to induce changes. We also asked whether the assessment of the gaze cone using a virtual head constitutes a reliable measure. And most importantly, we were interested to find out whether the observed abnormalities in the gaze cone in patients with SAD disappear or decrease with Cognitive Behavior Therapy (CBT). If so, a venue to use the gaze cone measure to monitor therapy success would open up.

We conducted two experiments. The first one measured the gaze cone prior to and after a specific CBT for patients with SAD (*SAD-Group*). A comparison group of healthy participants (*Control Group*) was likewise measured prior to and after a waiting period of identical length as the duration of CBT for the SAD-patients. In a second experiment we varied the target stimuli. A virtual head was compared to a real person with professional acting experience. We thereby aimed at examining the ecological validity of our findings. Can equivalent differences in gaze-perception in SAD-patients be observed when facing a real onlooker as compared to the virtual head that was used in our previous studies?

In addition, the second experiment varied the emotional expression of the target face whose eyes had to be adjusted. The misclassification of emotions in SAD-patients has been well documented. Coles, Heimberg, and Schofield (2008) for example found a tendency of participants with high levels of social anxiety to misinterpret facial expressions of schematic faces as threatening. They also tended to misclassify neutral facial expressions as showing anger (Bell et al., 2011). Foa, Gilboa-Schechtman, Amir, and Freshman (2000) demonstrated a better memory for emotional expressions in anxious compared to non-anxious participants, especially for negative emotions. Consistent with these findings, Gentili et al. (2008) found higher activation levels in brain areas of anxiety patients that process information about emotional expressions, and lower activation in areas processing other facial information. We therefore varied the emotional expression of the stimulus faces in Experiment 2 hypothesizing that highly activating emotional expressions, such as anger, might further widen the gaze cone.

Experiment 1

The aim of Experiment 1 was twofold. By comparing the values of the test prior to (Pre-Test) and after psychotherapy (Post-Test) in the *SAD-Group* we wanted to explore whether the enlarged gaze cones values decrease due to the psychotherapy, that is, if the gaze cone could serve as an instrument measuring changes in social-phobic psychopathology. The second aim was to determine whether our assessment of the gaze cone constitutes a reliable measure. We sought to answer that question by comparing the values of the experiment prior to (Pre-Test) and after a waiting period (Post-Test) in the *Control-Group*.

Having observed differences in the gaze cone's width between SAD-patients and healthy control participants, we sought to determine if our measure could achieve reliabilities comparable to common measures of social anxiety. Such scales are the Liebowitz Social Anxiety Scale (LSAS-CA; Liebowitz, 1987) or the Brief Social Phobia Scale (Davidson et al., 1991). Commonly used self-report measures are the Social Phobia Scale (SPS) and the Social Interaction Scale (SIAS; Mattick & Clarke, 1998), the Social Phobia and Anxiety Inventory (SPAI; Turner, Beidel, & Dancu, 1996) and the Social Phobia Inventory (SPIN; Connor et al., 2000). For all these measures, high retest reliabilities have been shown, for instance the German version of the SPS and SIAS (Stangier, Heidenreich, Berardi, Golbs, & Hoyer, 1999) has internal consistency values (Cronbachs α) of $\alpha = .89$ (SPS) and $\alpha = .93$ (SIAS) and retest-reliability values of $r = .91$ (SPS) and $r = .92$ (SIAS) (Rabung, Jaeger, Streeck, & Leichsenring, 2006; Stangier et al., 1999). As our gaze cone measure constitutes a different approach depending on basic perception, we would hope to achieve comparable or better retest-reliabilities.

Provided the gaze cone can be measured reliably, is psychotherapy able to reduce the abnormalities in the gaze cone attributes associated with SAD? Especially cognitive behavioral therapy (CBT) has proven to be effective in producing a significant decrease of symptoms in individual therapy (Stangier, Schramm, Heidenreich, Berger, & Clark, 2011) as well as in group therapy settings (Davidson et al., 2004; Heimberg et al., 1998), with an advantage of the individual therapy setting (Aderka, 2009; Stangier, Heidenreich, Peitz, Lauterbach, & Clark, 2003). Consequently, we hypothesized that CBT would also change perceptual abnormalities as reflected in altered gaze cone attributes in patients with SAD.

Method

Participants

41 volunteers participated, 18 SAD-patients recruited at the outpatient clinic of the University of Mainz prior to a standardized cognitive behavioral therapy (9 male, 9 female; Age: $M = 30$ years, $SD = 7.9$) and 23 healthy control participants recruited at the University of Mainz (9 male, 14 female; Age: $M = 28$ years, $SD = 7.9$). The Structured Clinical Interview (SCID; Wittchen, Zaudig, & Fydrich, 1997) according to DSM-IV standards (American Psychiatric Association, 2000) had been conducted by trained interviewers to diagnose SAD in the *SAD-Group* and to ensure mental health in the *Control Group*. Before taking part in the study, all participants gave informed consent and it was impressed on them that their participation was voluntarily allowing them to withdraw from the study at any time. All participants had normal or corrected to normal vision.

Apparatus

The participants placed their head on a chin rest while they were sitting on a height-adjustable chair. Their eye-level could thus

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