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## The effects of social pressure and emotional expression on the cone of gaze in patients with social anxiety disorder



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### ABSTRACT

**Background and objectives:** Patients with social anxiety disorder suffer from pronounced fears in social situations. As gaze perception is crucial in these situations, we examined which factors influence the range of gaze directions where mutual gaze is experienced (the cone of gaze).

**Methods:** The social stimulus was modified by changing the number of people (heads) present and the emotional expression of their faces. Participants completed a psychophysical task, in which they had to adjust the eyes of a virtual head to gaze at the edge of the range where mutual eye-contact was experienced.

**Results:** The number of heads affected the width of the gaze cone: the more heads, the wider the gaze cone. The emotional expression of the virtual head had no consistent effect on the width of the gaze cone, it did however affect the emotional state of the participants. Angry expressions produced the highest arousal values. Highest valence emerged from happy faces, lowest valence from angry faces.

**Conclusion:** These results suggest that the widening of the gaze cone in social anxiety disorder is not primarily mediated by their altered emotional reactivity. Implications for gaze assessment and gaze training in therapeutic contexts are discussed.

**Limitations:** Due to interindividual variability, enlarged gaze cones are not necessarily indicative of social anxiety disorder, they merely constitute a correlate at the group level.

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## 1. Introduction

Gaze plays a crucial role in human interaction. The aim of the work described in this article was to examine which social factors influence the perception of gaze and in particular the region of mutual gaze. Patients suffering from social anxiety disorder experience an amplified feeling of being looked at, amounting to an extension of the region taken to constitute mutual gaze (the gaze cone's width; Gamer & Hecht, 2007; Gamer, Hecht, Seipp, & Hiller, 2011; Harbort, Witthöft, Spiegel, Nick, & Hecht, 2013). Here, we investigated possible contributing factors, such as social pressure and the emotion conveyed by the gazing person. Before reporting two experiments, we introduce current findings about the relations between gaze and social anxiety disorder.

### 1.1. Gaze in social interaction

The information transmitted by gaze direction cues facilitates adequate communication to a large extent (Baron-Cohen, 1995; Gibson & Pick, 1963). Thus, it comes as no surprise that the estimation accuracy of gaze perception is generally high (Gale & Monk, 2000; Symons, Lee, Cedrone, & Nishimura, 2004). We have no trouble detecting where the attention of another person is focused, and we are able to tell the gaze direction of others even when they do not look at us directly (Gibson & Pick, 1963). Accordingly, Gamer and Hecht (2007) found that eye visibility had no effect on the width of the so called "gaze cone" (i.e., the area where mutual gaze is experienced).

The metaphor of a cone captures the fact that the range of eye-orientations conveying mutual gaze grows with the onlooker's distance. In order to fully assess the gaze cone, Gamer and Hecht (2007) devised two tasks. The "centering task" gauges the direction of the gaze cone. In the "decentering task" participants are instructed to adjust the onlooker's gaze to the very limit where they cease to feel looked at, which allows one to determine its left and

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rightward thresholds and thereby calculate the cone's width, indicating the readiness to feel looked at (see Task and Design section also). The width of the cone remained invariant under manipulations such as the onlooker's head orientation, the observer distance, and the presence of a second head. Harbort et al. (2013) demonstrated excellent reliability indices for the gaze cone measure with an internal consistency of ( $\alpha = 0.99$ ) and a retest reliability score of  $r = 0.745$ . Furthermore, they demonstrated that the widening of the gaze cone in social anxiety disorder occurred both using a virtual head and a real person as a stimulus.

## 1.2. Social anxiety disorder

Social anxiety disorder is a rather common mental disorder. One-year prevalence estimates range from 3.2% (Narrow, Rae, Robins, & Regier, 2002) up to 6% (Wittchen & Fehm, 2001, 2003). The lifetime risk is about 7–13%. Without adequate psychotherapeutic treatment, the risk of chronic persistence is higher than for other anxiety disorders (Wittchen & Fehm, 2001). It is thus important to investigate correlates of social anxiety disorder that might further the development of new techniques for diagnosis and therapy. We suggest that the width of the gaze cone might constitute such a promising correlate.

The cognitive behavioral models of social anxiety proposed by Clark and Wells (1995) and Rapee and Heimberg (1997; Heimberg, Brozovich, & Rapee, 2010) represent the two most important explanatory approaches to account for the pathogenesis of severe social anxiety. Whereas both models agree on the central role of dysfunctional representations of the self and the perpetuating role of an attentional bias toward negative self-related cognitions and mental images, the Rapee and Heimberg model further proposes an attentional bias toward external social threat related cues in the environment and difficulties to disengage attention from these cues, which operate in combination with an internal self-focused attentional bias to maintain social anxiety (e.g., Schultz & Heimberg, 2008). Thus, abnormalities in the allocation of visual attention to potential external threat cues in patients with social anxiety disorder as, for example, assessed in the gaze cone paradigm, would be more in line with the theoretical predictions of the Rapee and Heimberg model compared to the Clark and Wells model, which rather exclusively focuses on a biased attention allocation to internal threat cues (i.e., negative self-related cognitions and biased mental images of the self in social situations) and predicts the avoidance of external threat cues.

Within the literature that focuses on a possible link between social anxiety disorder and gaze patterns, we discern two general approaches. The first focuses on altered gaze patterns within the active behavior of social anxiety disorder patients. Studies conducted within this approach found a significant correlation between the severity of social anxiety and gaze avoidance (Moukheiber et al., 2010; Schneier, Rodebaugh, Blanco, Lewin, & Liebowitz, 2011). Avoidance has been found for entire facial features (reduced foveal fixations), especially of the eyes (Garner, Mogg, & Bradley, 2006; Horley, Williams, Gonsalvez, & Gordon, 2003). Horley, Williams, Gonsalvez, and Gordon (2004) demonstrated that this avoidance behavior is especially evident for angry faces. These findings are in line with the Clark and Wells (1995) model suggesting avoidance of external social threat.

The second approach focuses on potential differences in the social anxiety disorder patient's perception of another's gaze (the onlooker's gaze), thus it is concerned with the feeling of being looked at. For example, Roelofs et al. (2010) found that people with high social anxiety were faster in avoiding angry or happy faces as compared with people with low social anxiety in an approach-avoidance task. Interestingly, this result emerged for the angry

faces only if they displayed a conspicuous direct gaze but not if they exhibited an averted gaze. It has to be acknowledged, however, that the existing empirical evidence regarding gaze avoidance in social interactions in patients with social anxiety disorder is rather inconclusive (Weeks, Heimberg, & Heuer, 2011; Schulze, Renneberg, & Lobmaier, 2013).

Regarding the size of the gaze cone in social situations, we found that the cone is generally widened in patients with social anxiety disorder (Harbort, Witthöft, Spiegel, Nick, & Hecht, 2013), and that this effect is particularly strong when social pressure (by means of another head directed toward the subject) is increased (Gamer et al., 2011). Furthermore, the degree of gaze cone enlargement was shown to be correlated with the severity of social anxiety disorder. These findings are, at first glance, more compatible with the predictions of the Rapee and Heimberg model suggesting sustained vigilance for external social threat cues. In this sense, wider gaze cones might represent an indicator of an external threat monitoring process according to the Rapee and Heimberg (1997) model. This threat monitoring process serves to detect and avoid possible social threats (e.g., signs of negative evaluations by others) and might operate in a hyper-vigilant state in case of social anxiety disorder. However, a wider gaze cone could also be the result of an avoidance reaction toward social threat cues as suggested by Clark and Wells. As a consequence of avoidance, information accumulation could be impaired leading to a less detailed processing of socially relevant information, which is based more on internal anxiety relevant schemata and 'emotional reasoning' than on external sensory stimulus properties. Consequently, a larger gaze cone might be the product of such noisy processing of external socially relevant information.

The present work aims to further explore gaze perception in social anxiety disorder with two primary goals. Firstly, if social anxiety disorder leads to a widened gaze cone, then increasing the degree of social pressure might moderate this effect (i.e., should widen the cone even more). In Experiment 1, we varied social pressure by adding other heads and presenting them in 3D. Secondly, we assumed that negative expressed emotion should widen the gaze cone, in particular for people with social anxiety disorder. This prediction would be compatible with the recent finding that observers are more accurate when determining the gaze direction of faces with neutral emotional expression, as opposed to happy, angry, or fearful expressions (Lobmaier, Hartmann, Volz, & Mast, 2013). In Experiment 2, we therefore varied the emotional expression of the virtual heads.

## 2. Material and method of experiment 1: Does social pressure influence the width of the gaze cone?

People with social anxiety disorder have more anxiety during public speeches than people without social anxiety (Hofmann, Gerlach, Wender, & Roth, 1997). Cornwell, Johnson, Berardi, and Grillon (2006) confirmed that anxiety can be caused both by speaking and anticipation of speaking in front of an audience, even if the audience is virtual. Furthermore, social anxiety disorder patients are more accurate in detecting positive (for example smile) and negative (for example raised eyebrows) signs of behavior from the audience, with the latter being detected with particular ease (Veljaca & Rapee, 1998). We hypothesize that increasing the number of people who also look at the patients should augment the perceived risk that humiliating or embarrassing events could happen and thereby increase their level of anxiety. This in turn should widen the cone of gaze.

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