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## **Will you look at me? Social anxiety, naturalistic social situations, and wearable eye-trackers**

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# CHAPTER 1

General introduction





*Social relationships are fundamental for most people, and they are devoted to forming and maintaining social relationships throughout the life course. Both quality and quantity of social relationships have profound influence on physical and psychological health, even mortality. However, people experiencing higher levels of social anxiety have been facing widespread difficulties in this regard.*

## **SOCIAL ANXIETY (DISORDER) AND GAZE AVOIDANCE: CLINICAL THEORY**

1

Social anxiety disorder (SAD) is an often chronic mental disorder characterized by excessive fear and anxiety of being scrutinized and negatively evaluated by others that often leads to avoidance of feared social and performance situations (American Psychiatric Association, 2013). Social anxiety (SA) is a continuum varying from low to high levels. When reaching high levels on this continuum, people may be diagnosed with SAD if intense fear and concerns interfere with their lives (Rapee & Spence, 2004). SAD is one of the most commonly diagnosed psychiatric disorders, with a lifetime prevalence rate of 4-13% in Western societies (Bandelow & Michaelis, 2015; Kessler et al., 2005; 2012; Stein et al., 2017). Recent work shows that up to 36% of the young adult population from multiple Western and Asian countries can be considered at risk for SAD (Jefferies & Ungar, 2020). SAD is frequently comorbid with other mental disorders, such as eating disorders (Pallister & Waller, 2008; Swinbourne et al., 2012), mood disorders (Koyuncu et al., 2014; Ohayon & Schatzberg, 2010), substance and alcohol abuse disorders (Agosti et al., 2002; Grant et al., 2005). Further, SAD is associated with substantial functional impairments across work, school and social life domains (Aderka et al., 2012; Ruscio et al., 2008), contributing to poor quality of life (Alonso et al., 2004; Dryman et al., 2016) and high socioeconomic costs (Wittchen et al., 2011). Of importance, SAD is often both underrecognized and undertreated (Chapdelain et al., 2018; Jefferies & Ungar, 2020; Katzelnic et al., 2001; Keller et al., 2003). Taken together, the high prevalence and striking impairments underscore the need to deepen our understanding of SAD.

The core fear of socially anxious individuals lies in negative evaluation and rejection by others (APA, 2013). It appears sadly true that social anxiety is consistently associated with negative social outcomes. During social interactions, those people experiencing greater social anxiety are rated as: more anxious (Heerey & Kring, 2007; Thompson & Rapee, 2002), less warm and outgoing (Stangier et al., 2006), less likeable (Mein et al., 2016; Tissera et al., 2021; Voncken & Dijk, 2013), and less socially skilled (Bögels et al., 2002; Meleshko & Alden, 1993; Stevens et al., 2010). As one significant consequence, these people tend to have difficulties developing and

maintaining interpersonal relationships across various social domains (e.g., peer and romantic relationships) from a young age on (Alden & Taylor, 2004; Hur et al., 2019). Understanding the ways social anxiety shapes social outcomes is crucial to gain insight into development and maintenance processes of SAD.

One hallmark feature of social anxiety that may be at play is gaze avoidance. Theories based on clinical observation have posited that social anxiety is associated with eye contact avoidance. In line with this view, inadequate eye contact has been recognized in the diagnostic process as a supporting feature of SAD (APA, 2013). Avoidance of eye contact has been interpreted as safety behaviors, intending to avoid feared outcomes without completely withdrawing from social situations (Clark & Wells, 1995), a submissive temperament (Gilbert, 2001) and social skills deficits (Levitan & Nardi, 2009). Given that faces convey a wide range of social information, perceived threat in relation to facial cues has also been proposed as an explanation (Schulze et al., 2013; Weeks et al., 2019). Avoidance of eye contact is particularly problematic when engaging in social interactions; it may not only disturb social interaction and elicit negative consequences since gaze aversion can be interpreted as disinterested or dishonesty (Kleinke, 1986), but the avoidance may also deprive socially anxious individuals of important social information, impeding social learning processes in the long run.

Taken together, the assumption of eye contact avoidance has led to this conceptual framework: people experiencing greater social anxiety are likely to avoid making eye contact, and this avoidance, in turn, may create or exacerbate social difficulties which may maintain or even increase the fear of social situations. However, at the start of the current dissertation project it appeared that the empirical findings regarding gaze avoidance in socially anxious individuals were not so straightforward: some studies demonstrated the expected relationship between social anxiety and gaze avoidance, whereas other studies did not establish this relationship.

## **SOCIAL ANXIETY AND GAZE AVOIDANCE: A HISTORICAL OVERVIEW**

Here, we provide a brief historical overview of studies on gaze avoidance in social anxiety that have followed three different approaches to measuring gaze. The first period was driven by testing clinical observations, using observer ratings. This approach requires researchers (or clinicians) to assess gaze behavior based on videotapes of social interactions involving socially anxious participants (e.g., Baker & Edelmann, 2002; Boice & Monti, 1982; Daly, 1978; Hofmann et al., 1997; Langer et al., 2017; Weeks

et al., 2011). For instance, in the study by Hofmann et al. (1997), gaze data were videotaped in naturalistic social situations such as talking with an experimenter and delivering a speech. The data then were coded by the rater via pressing a specific key on a computer keyboard to register the start and end times of a participant's gaze when it seems to be directed at another person's eyes. This study reported *no* indications of gaze avoidance in socially anxious participants. Conversely, Baker and Edelman (2002) recorded a getting-acquainted conversation and found that people with SAD displayed significantly less eye contact while talking compared to people without a disorder. Overall, the observational paradigm has yielded mixed findings: some studies found differences between socially anxious people and nonanxious controls (e.g., Baker & Edelman, 2002; Daly, 1978; Langer et al., 2017) but other observational studies did not find the expected association with social anxiety (e.g., Boice & Monti, 1982; Hofmann et al., 1997; Weeks et al., 2011). This inconsistency may in part be due to methodological limitations of the observational paradigm. Coding eye contact solely on the basis of a videotape has questionable validity, as it is hard for the rater to judge whether the participant is actually looking at the face of a conversation partner. In addition, the workload imposed on researchers is abundant because multiple activities are involved (e.g., observers training, coding process).

The second period is characterized by the increasing usage of eye-tracking technologies, and a growing number of studies has utilized picture-based eye-tracking paradigms to explore gaze behavior. In general, the means of eye-tracking allows for the acquisition of objective and fine-grained gaze data. Further, applied to pictures, the approach enables highly controlled and efficient investigation, facilitating replications and even cross-study comparisons. Participants are typically asked to look at facial stimuli (preselected by researchers) that are presented on a screen while their eye movements are registered using eye-trackers attached to the screen (e.g., Horley et al., 2003; 2004; Kret et al., 2017; Lazarov et al., 2016; Liang et al., 2017; Moukheiber et al., 2012; Schofield et al., 2012). One of the pioneering eye-tracking studies was conducted by Horley et al. (2003). In this study, participants were required to look at photographs of human faces displaying various expressions (e.g., sad, happy) and the presentation of each picture lasted for 10 seconds. The study found that people with SAD displayed visual avoidance of facial features (particularly the eyes) compared to non-SAD controls. At the same time, several other studies did not show the expected association (e.g., Gamble & Rapee, 2010; Lange et al., 2011; Seefeldt et al. 2014; Waechter et al., 2014). For example, Waechter et al. (2014) asked participants to look at a series of emotional faces (e.g., angry, happy), and no difference between people with high and low social anxiety was identified. Collectively, the picture-based eye-tracking paradigm has yielded an inconsistent pattern as well. Furthermore, unlike the previous observational studies, picture-based eye-tracking has been repeatedly criticized as being

too far from the real-world (e.g., Chen & Clarke, 2017; Howell et al., 2016; Schulze et al., 2013). The importance of examining gaze behavior in naturalistic settings has been emphasized because of the highly context-dependent nature of gaze (Hamilton, 2016; Hietanen, 2018; Risko et al., 2016). As an illustration of this point, increasing evidence demonstrates that people's gaze behavior is different when confronted with physically present others compared to video-based presentation of others (e.g., Freeth et al., 2013; Laidlaw et al., 2011; Rubo et al., 2020).

The third period in this research area has just started with the advent of wearable (or head-worn) eye-trackers. This technology holds the promise of combining the strengths of both previous approaches: high precision in naturalistic social interactions. Wearable eye-trackers offer a unique opportunity to register unguided gaze behavior in ongoing social activities (Pérez-Edgar et al., 2020). Compared to other types of eye-tracking, such devices enable maximum freedom of (head and body) movement (Valtakari et al., 2020), which allows more natural behavior during live, face-to-face social interactions. When I started my dissertation project in 2017, only a few studies had used (mobile) eye-tracking technology in naturalistic social situations representing situations feared by socially anxious individuals, such as public speaking tasks (Chen et al., 2015; 2016; Lin et al., 2016) and conversation with a stranger via webcam (Howell et al., 2016). For example, Chen et al. (2015) implemented a public speaking task wherein participants delivered a 4-minute speech in front of a pre-recorded audience while their eye movements were recorded by a remote eye-tracking set-up. The findings showed gaze avoidance in socially anxious individuals. It is important to note that none of these studies have established face-to-face social interactions with others. Despite their revolutionary potential, the usage of wearable eye-trackers has potential disadvantages, mainly including complex and time-intensive data processing (e.g., mapping eye movements onto a reference image) and less optimal accuracy and precision of eye-tracking data compared to screen-based eye-trackers (Hessels et al., 2020; Valtakari et al., 2020).

Taken together, the brief historical overview above indicates that the overall picture of empirical evidence on gaze avoidance in socially anxious individuals was puzzling in 2017, and called for a comprehensive review and additional empirical research to further clarify the relationship. This dissertation addresses three key questions: (1) Whether social anxiety is featured by gaze avoidance. (2) Under which conditions socially anxious individuals display gaze avoidance. (3) To what extent subjective experience of gaze avoidance corresponds with actual gaze behavior. This dissertation capitalizes on the combination of naturalistic social settings and wearable eye-tracking technology, so as to shed light on the nature of gaze behavior adopted by socially anxious individuals in naturalistic social interactions.



## OUTLINE OF THE DISSERTATION

The goal of this dissertation is to unravel whether social anxiety affects people's gaze behavior in naturalistic social situations, and to clarify the specific factors that may influence the relationship between social anxiety and gaze avoidance. This dissertation consists of a literature review (*Chapter 2*) and three empirical studies (*Chapters 3-5*). Based on mixed findings in the empirical literature, a literature review (*Chapter 2*) focusing on studies in which factors possibly influencing the relation between social anxiety and gaze avoidance is conducted as the first step. Building on the outcomes of the review suggesting that the influence of situational factors may be particularly strong in subclinical samples, the *Chapters 3 and 4* empirically investigate whether gaze behavior significantly differs between high and low socially anxious females, with a focus on the role of social situation. *Chapter 3* directly compares a passive face-viewing situation and a social-evaluative speaking situation. *Chapter 4* considers two aspects of a face-to-face conversation: conversational role and level of intimacy to investigate their effects on the relationship between social anxiety and gaze behavior. In addition to these objective eye-tracking measurements, *Chapter 5* evaluates the predictive validity of a self-report instrument of gaze avoidance (the Gaze Anxiety Rating Scale) and clarifies the relative contributions of social anxiety and gaze anxiety to actual gaze behavior in a naturalistic social interaction. Finally, *Chapter 6* summarizes the results of this dissertation, discusses clinical implications, and points at limitations and directions for further research.

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