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

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 Edelmann (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 & Edelmann, 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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CHAPTER 2

A systematic review of visual avoidance of faces in socially anxious individuals: Influence of severity, type of social situation, and development

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ABSTRACT

Although visual avoidance of faces is a hallmark feature of social anxiety disorder (SAD) on clinical and theoretical grounds, empirical support is equivocal. This review aims to clarify under which conditions socially anxious individuals display visual avoidance of faces. Through a systematic search in Web of Science and PubMed up to March 2019 we identified 61 publications that met the inclusion criteria. We discuss the influence of three factors on the extent to which socially anxious individuals avoid looking at faces: (a) severity of social anxiety symptoms (diagnosed SAD versus High Social Anxiety levels in community samples [HSA] or related characteristics [Shyness, Fear of Negative Evaluation]), (b) three types of social situation (computer face-viewing tasks, speaking tasks, social interactions), and (c) development (age-group). Adults with SAD exhibit visual avoidance across all three types of social situations, whereas adults with HSA exhibit visual avoidance in speaking and interaction tasks but not in face-viewing tasks. The relatively few studies with children and adolescents suggest that visual avoidance emerges during adolescence. The findings are discussed in the context of cognitive-behavioral and skills-deficit models. Suggestions for future research include the need for developmental studies and more fine-grained analyses of specific areas of the face.

INTRODUCTION

Social anxiety disorder (SAD) is a prevalent, debilitating anxiety disorder, characterized by an intense fear or anxiety, as well as avoidance of social situations (American Psychiatric Association, 2013). Given the key features of SAD and the fact that faces convey cues about scrutiny and negative social evaluation, visual avoidance of faces may be a behavioral marker of social anxiety disorder. Relations with eye-contact have been proposed in theoretical models of SAD developed by clinicians. Firstly, cognitive models state that people with SAD interpret social situations in more threatening ways than people without SAD (e.g., Clark & Wells, 1995; Hofmann, 2007). Gaze avoidance then serves as a safety-seeking behavior aimed to avoid feared social outcomes without completely withdrawing from social situations. Secondly, social skills deficit models argue that persons with SAD are featured by actual skills deficits (see Levitan & Nardi, 2009 for a review). This model postulates that people with SAD have failed to acquire social skills, which leads to unpleasant social experiences and hence to social anxiety. In this view, people with SAD may not have learned to make appropriate eye-contact. In line with these clinical perspectives, inadequate eye-contact is a supporting feature of the diagnosis in the DSM (APA, 2013, p. 204). Indeed, both adults (Schneier, Rodebaugh, Blanco, Lewin, & Liebowitz, 2011) and children diagnosed with SAD (Kley, Tuschen-Caffier, & Heinrichs, 2012) report that they avoid eye-contact themselves.

Although avoidance is a hallmark feature of SAD on clinical and theoretical grounds, experimental findings have provoked a debate on whether visual attention towards facial stimuli is fundamentally reduced, normal, or even increased in socially anxious individuals. There have been three previous reviews of gaze behavior in social anxiety, but none of them focused primarily on avoidance. Bantin, Stevens, Gerlach, and Hermann (2016) systematically reviewed studies using facial dot-probe tasks to evaluate the hypothesis that socially anxious individuals show an attentional bias *toward* threatening facial stimuli (i.e., by looking more at them). Their review supports this hypothesis, and noted that the results are inconsistent with avoidance of threat in this particular task. Schulze, Renneberg, and Lobmaier (2013) primarily reviewed studies on gaze perception, concluding that patients with SAD are more inclined to think that others are looking at them. In addition, they noted that although patients with SAD showed a severe fear of eye contact, studies did not consistently show avoidance. They suggested that contradictory findings might be explained by a hypervigilance-avoidance model of attention. According to this two-stage model, anxious people are initially vigilant for threat, but subsequently avoid it (e.g., Mogg, Bradley, Miles, & Dixon, 2004). In the third review, Chen and Clarke (2017) evaluated the evidence for this model. They concluded that social anxiety is associated with a mixed visual

pattern involving vigilance (i.e., increased attention) as well as avoidance. However, they also concluded that the data were inconsistent with the proposed model, because the time-course from vigilance to avoidance could not consistently be identified from the reviewed studies. To date, it is still unresolved why "several studies observe vigilance, while several others observe avoidance" (Chen & Clarke, 2017, p. 59).

The present paper aims to evaluate whether socially anxious individuals avoid looking at eyes and faces. It extends previous reviews by considering studies that used various tasks and multiple measures of gaze behavior with eye-tracking and observer ratings. Based on the empirical literature, we identified three factors that may influence the relation between social anxiety and visual avoidance: level of social anxiety, type of social situation, and development.

Firstly, it is worth noting that social anxiety (SA) varies along a continuum from very low levels, through normal levels, to very high levels. Although people diagnosed with SAD often score at the high end of the continuum, high levels of social anxiety and SAD are not synonymous. A diagnosis of SAD also requires substantial interference with daily life (Spence & Rapee, 2016). Hence, there is a possibility that different degrees of interference result from different behavioral patterns (such as gaze patterns) in people diagnosed with SAD versus individuals with high social anxiety scores but no diagnosis. Previous reviews have distinguished between studies of these two groups, but only within a specific experimental context (Bantin et al., 2016; Chen & Clarke, 2017). The focus of these reviews did not allow for a comparison of gaze behavior across tasks within a particular level of social anxiety. In the present review, the level of social anxiety is the main organizing principle. We will discuss research on a) persons with diagnosed SAD, b) people with high self-reported levels of social anxiety but no diagnosis (High Social Anxiety; HSA), and c) people reporting characteristics associated with social anxiety: high fear of negative evaluation and shyness.

Secondly, studies have been conducted in very different social situations, ranging from face-viewing tasks of being presented with (emotional) faces on a computer screen, to naturalistic social situations, namely, structured and unstructured social situations of public speaking and social interaction (Levitan & Nardi, 2009; Voncken & Bögels, 2008). The DSM definition of SAD suggests that avoidance of eye-contact would occur *in situations in which one may be scrutinized by others*. The social skills deficit literature indicated that deficits are more often observed in unstructured situations than in predictable situations (Levitan & Nardi, 2009; Voncken & Bögels, 2008), although these findings are based on global performance ratings rather than specific gaze behavior. Chen and Clarke (2017) looked specifically at naturalistic social situations in their review and concluded that they provided evidence for visual

avoidance of faces. However, their review was restricted to eye-tracking studies and hence the conclusion of visual avoidance was based on only three studies. The present review includes eye-tracking studies that have appeared recently as well as older social interaction studies using observer ratings. To clarify the role of the social situation, we will distinguish between face-viewing tasks, public speaking and social interaction.

Thirdly, developmental differences have so far received little attention. Few studies have been done with non-adult samples and they have been combined with adult studies in previous reviews (Chen & Clarke, 2017; Schulze et al., 2013). The developmental literature indicates that adolescence is an important period for the development of social anxiety and avoidance behavior. Existing longitudinal data indicated that social fear levels become fairly stable across development (Miers, Blöte, De Rooij, Bokhorst, & Westenberg, 2013), but that socially anxious youth increasingly avoid social situations (Miers, Blöte, Heyne, & Westenberg, 2014). These findings suggest that avoidance of eye-contact might also increase with development in socially anxious individuals, particularly during adolescence. In contrast, results from social skills studies suggest that deficits are more often observed in children and adolescents than in adults with social anxiety (Levian & Nardi, 2009). The present study will explore whether and how visual avoidance of faces differs by age group.

In summary, while technological advances in eye-tracking systems have spurred a rapid accumulation of evidence from both fundamental and intervention studies, there is a growing need for clarification of the divergent findings. Hence, a comprehensive review might clarify to what extent socially anxious individuals display gaze avoidance and whether this tendency is influenced by severity of social anxiety, type of social situation, and development.

METHOD

Inclusion criteria

Based on the purposes of this review, the following eligibility criteria were used for the procedure of screening and selection: (1) the article must be available, peer-reviewed, full-text, and published in English, (2) the article must report original empirical results, (3) the article must investigate human participants, (4) the article uses a reliable tool to measure social anxiety symptoms (structured diagnostic interview, self-report and parent-report), (5) the study compares participants with different levels of social anxiety symptoms; studies investigating the effects of another variable in a single group of SAD patients are excluded, (6) the study provides information about effects

of social anxiety that are distinguishable from effects of other variables; the study is excluded if it investigates an interaction between social anxiety and a manipulated variable, and does not include or report the results for social anxiety in the control condition of the manipulated variable, and (7) the article reports results with respect to objective gaze behavior while the participant is presented with facial stimuli.

Literature sources and search strategy

The literature search of this systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The PRISMA diagram is displayed in Figure 1. Several alternative search terms were used that combined: (1) *social anxiety symptoms* and (2) *gaze behavior*. Titles and abstracts were set as search fields for articles prior to March 29, 2019. No language restriction was applied. Two electronic databases: Web of science (Web of Science Core Collection as well as MEDLINE) and PubMed were searched concurrently by using the following search phrase: *(*"Social anxiety" OR "social anxiety disorder" OR "social anxiety disorders" OR "social phobia" OR "social phobias" OR "shyness" OR "speech phobia") AND *(*"gaze behavior" OR "eye movements" OR "eye contact" OR "eye movement" OR "eye gaze" OR "eye tracking"). This resulted in a total of 468 records. After duplicates had been removed, the 343 remaining records were screened based on their titles and abstracts.

During the screening process, obviously irrelevant records (n=275) were subsequently excluded based on the following criteria: (1) The study was not published in English (n=7), (2) The study was not empirical (n=69). We excluded review, case reports, questionnaire studies, qualitative studies (e.g., thematic analysis), conference abstracts, etc. (3) The study did not investigate a human population (n=3), (4) The study did not measure social anxiety symptoms (e.g., trait and state anxiety, depression, Williams syndrome, separation anxiety, chronic pain disorder (... n=151), (5) The study did not compare participants with different levels of social anxiety (n=4), (6) The outcomes of the study were not comprised of gaze behavior variables (n=42). For example, studies which measured non-behavioral responses (e.g., neural or psychophysiological), subjective gaze perception/judgement, or reaction time (without any information about gaze behavior) were removed. These studies seemed to have been identified by our search terms because they used eye gaze as experimental stimuli rather than outcomes.

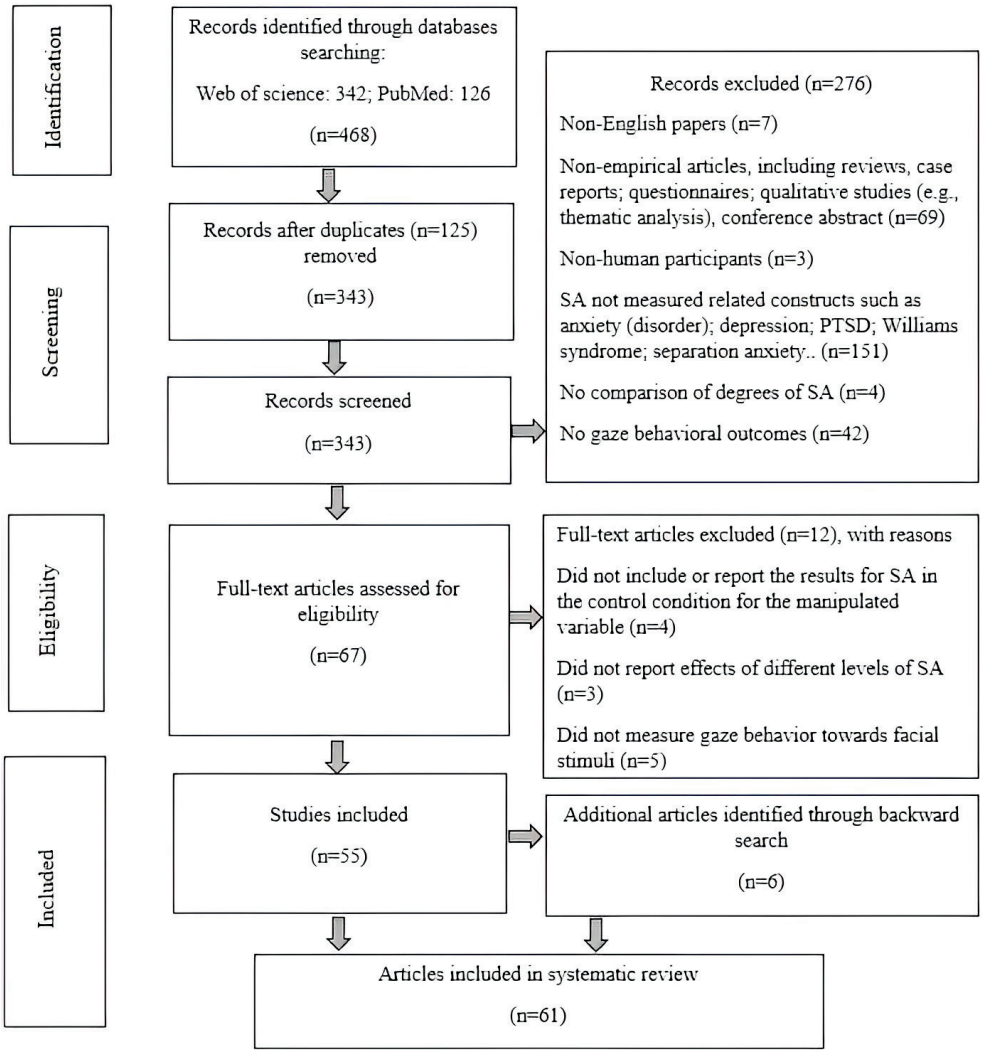

Figure 1. *Selection flow chart*

Afterwards, we further examined 67 remaining articles for eligibility. Twelve articles were excluded after examining the methods and results. They were excluded for the following reasons: (1) Three studies did not include or report the results for social anxiety in the control condition of the manipulated variable (Enter, Terburg, Harrewijn, Spinhoven, & Roelofs, 2016; Finch, Iverach, Menzies, & Jones, 2016; Van Dillen, Enter, Peters, van Dijk, & Rotteveel, 2017). (2) Four studies investigated the effects of other variables (alcohol, communication impairments, age of face) in a single group of participants with SAD. Therefore, these studies do not provide an

answer to the question of whether SAD affects gaze behavior (Battista, MacDonald, & Stewart, 2012; Capriola-Hall, Wieckowski, Ollendick, & White, 2018; Wieckowski, Capriola-Hall, Elias, Ollendick, & White, 2019). (3) Five studies were excluded because they did not measure gaze behavior towards facial stimuli. Specifically, two studies did not present clear facial stimuli, presenting either no faces (Baggett, Saab, & Carver, 1996) or degraded faces as distractors in search task (Ruth Doherty, Patai, Duta, Nobre, & Scerif, 2017). The other three studies did not measure eye gaze on facial stimuli (Haller et al., 2017; Stevens, Rist, & Gerlach, 2011; Terburg et al., 2016). The remaining 55 studies were included in this review.

Subsequently, we performed a backwards literature search, manually searching the references cited in the included articles. Five articles were identified based on the eligibility criteria mentioned above. One additional article was identified through a backwards search of those five articles. These six articles had not been identified in the main search, because gaze behavior was not the only outcome variable and more general key words were used, such as "behavioral assessment", "social skills" and "submissiveness". In total, 61 articles were included in the final sample.

Data extraction

The following variables were extracted from each included article and the findings are reported in Table 1. Basic information: first author surname and publication year. Participant information: sample size (N), mean age, and percentage of female participants. Social anxiety symptoms (i.e. social anxiety disorder, social anxiety, fear of negative evaluation, shyness). Instruments used for social anxiety assessment. Types of social situations (i.e. facial-viewing, public speaking and interaction). Gaze behavior variables (i.e., total fixation count, total dwell time). The main outcomes are presented in Table 1, more details are discussed below.

Synthesis of results

The included studies were primarily stratified by severity of social anxiety: individuals with a diagnosed social anxiety disorder (SAD), individuals with high levels of social anxiety in community samples (HSA), and people with characteristics related to social anxiety (fear of negative evaluation, shyness). Under each social anxiety level, studies were grouped by type of social situation to further explore the variability of gaze behavior within each level of social anxiety. Finally, the relatively few studies with youth samples were analyzed separately to examine developmental effects on visual avoidance of faces.

Type of participants

Of the 51 studies with adult participants, 22 included participants with SAD, 19 included participants with high levels of social anxiety from community samples and 10 included participants with characteristics related to social anxiety (high fear of negative evaluation in nine studies and shyness in one study). SAD was determined with a structured diagnostic interview in most studies. High SA, fear of negative evaluation and shyness were generally measured by self-report questionnaires. Of the ten studies with minors (including infancy, childhood, and adolescence), six included participants with SAD, two included participants with high levels of social anxiety from community samples, and two studies examined shyness. SAD was determined with a structured diagnostic interview, SA with self-report questionnaires, and shyness with parent- or self-report questionnaires.

Type of social situation

The studies also used three different types of situations: 41 used facial-viewing tasks, five used public speaking tasks and 15 used interaction tasks.

Facial-viewing tasks. In all facial-viewing task studies, eye-tracking technology was used to continuously register on which part of the stimuli the eyes were fixated. The facial-viewing tasks included passive viewing, preferential looking, visual search, emotion classification and face recognition.

In the passive viewing studies, participants were typically presented with static pictures of faces with emotional expressions for ten seconds. Some studies presented facial stimuli dynamically using video clips or virtual reality. In preferential looking studies, participants were simultaneously presented with two or more pictures of faces displaying different emotions (e.g., happy, angry, disgusted, neutral). A few studies compared gaze behavior to facial and non-facial stimuli. In emotion classification studies, participants were required to indicate which emotion was expressed by facial stimuli or face-body compounds. In the visual search tasks, participants were presented with circles of eight faces with different expressions (positive, negative and neutral). Their task was to decide whether the target face was different from the others. Finally, in face recognition tasks, participants were instructed to indicate whether the presented face was new or old.

Public speaking. Public speaking studies required participants to give a short speech (3 – 10 minutes), either in front of a live audience, a prerecorded audience or a virtual audience. The speech in front of the live audience was recorded on video and eye-contact was subsequently assessed by two raters. The other studies used eye-tracking technology.

Interaction. The interaction studies usually included having a conversation. In one study, participants sat facing each other, but were not instructed to talk. In another study, the participant talked while the confederate only listened. Most conversations were with one or more real-life conversation partner: confederates or someone the participant knew well. In few studies, the confederates were prerecorded or virtual interaction partners. In some other studies, the life conversation was channeled through an indirect communication set-up like Skype. The studies using VR or an indirect communication set-up were able to use eye-tracking technology. In the other studies eye-contact was assessed by raters.

RESULTS

Visual avoidance of faces in adults with social anxiety disorder

A majority of studies (16/22) on adult SAD patients found a gaze pattern consistent with avoidance of faces, and this was observed across all three types of social situations. Six studies did not observe greater avoidance in persons with SAD. The proportion of positive findings did not substantially vary across the three social situations. Firstly, 10 out of 14 studies with facial-viewing tasks observed visual avoidance. Avoidance of faces and the eye-region in particular was found in all passive viewing (Horley, Williams, Gonsalvez, & Gordon, 2003; Horley, Williams, Gonsalvez, & Gordon, 2004; Moukheiber et al., 2010; Moukheiber, Rautureau, Perez-Diaz, Jouvent, & Pelissolo, 2012; Staugaard & Rosenberg, 2011; Weeks, Howell, & Goldin, 2013), and in three (Byrow, Chen, & Peters, 2016; Chen, Clarke, MacLeod, & Guastella, 2012; Schofield, Inhoff, & Coles, 2013) out of five preferential looking studies (not in Gamble & Rapee, 2010; Lazarov, Abend, & Bar-Haim, 2016), as well as in one (Wermes, Lincoln, & Helbig-Lang, 2018b) of two visual search studies (not in Wermes, Lincoln, & Helbig-Lang, 2018a). One study using an emotion classification task (Boll, Bartholomaeus, Peter, Lupke, & GamLer, 2016) presented evidence against avoidance: increased dwell times to the eyes relative to the mouth in SAD patients. Secondly, the three public speaking studies all reported that participants with SAD showed significantly less visual attention to faces than healthy controls in video-based situations (Chen, Clarke, MacLeod, Hickie, & Guastella, 2016; Chen, Thomas, Clarke, Hickie, & Guastella, 2015) and in a virtual environment (Kim et al., 2018) when giving a speech. Thirdly, considering interaction paradigms, three (Baker & Edelmann, 2002; Langer, Lim, Fernandez, & Rodebaugh, 2017; Monti et al., 1984) out of five studies reported that SAD patients exhibited avoidance of eye contact during naturalistic interaction (except Hofmann, Gerlach, Wender, & Roth, 1997; Vriends, Meral, Bargas-Avila, Stadler, & Bögels, 2017). Notably, the results of

several studies indicated that SAD patients avoid looking at faces in general, regardless of emotional valence (Byrow et al., 2016; Chen et al., 2016; Chen et al., 2015; Horley et al., 2003, 2004; H. Kim et al., 2018; Weeks et al., 2013).

As was noted, six studies were not in line with an avoidance pattern. Four of these studies used facial-viewing tasks. One visual search study reported that SAD patients showed increased fixation counts on faces than healthy controls in anxiety-provoking conditions (no difference in control conditions), where specific task requirements that participants need to search for certain facial stimuli may account for the greater frequency for ensuring correctness (Wermes et al., 2018a). Discrepant results from other three studies may be explained by relatively short presentation times. Whereas most studies presented facial stimuli for about 10 seconds, Boll et al. (2016) presented faces for three seconds and found that participants with SAD tended to focus longer on the eye-regions. Lavarov et al. (2016) presented matrices of 16 faces containing neutral and disgusted expressions for 6 seconds and observed longer dwell time on disgusted faces in SAD patients and participants with high but subclinical levels of social anxiety. Gamble and Rapee (2012) showed paired faces for 5-s and found initial vigilance for negative faces in SAD persons, but no group-differences in the later stage. Interestingly, Staugaard and Rosenberg (2011) also found different results with different presentation times. With a 3-s presentation duration, Staugaard and Rosenberg (2011) found increased attention to threatening faces in patients with SAD compared to controls, but this attentional bias was no longer shown when stimulus presentation duration was prolonged. In a 10-second trial, participants with SAD fixated less on threat than controls. Therefore, individuals with SAD seem to direct their attention to threat-related social cues while viewing faces when presentation times are relatively short.

The last two studies that were not in line with the avoidance pattern used an interaction paradigm and found no difference between SAD patients and controls in visual attention to social partners (Hofmann et al., 1997; Vriends et al., 2017). The results may be influenced by the specific measures and conditions of these studies. In the study by Hofmann et al. (1997), eye-contact was scored by an observer. Although three other studies found significant differences between SAD patients and controls with this method (Baker & Edelmann, 2002; Langer et al., 2017; Monti et al., 1984), it may be less precise than eye-tracking. Vriends et al. (2017) used a particular experimental set-up to investigate self-focused attention. Participants were simultaneously presented with a video of their interaction partner and a life-recording of themselves. Accordingly, SAD participants spent more time looking at themselves than control participants, whereas there was no group difference in confederate-regions.

Specific conditions were also relevant in two other interaction studies. Baker and Edelmann (2002) found that individuals with SAD made significantly less eye contact while talking in comparison to a non-anxious group, whereas no difference was observed while they were listening. Langer and colleagues (2017) asked participants to invite a close friend or romantic partner to take part in a set of social tasks together. The tasks consisted of three 10-minute conversations, respectively primed for social support, social conflict and social support. Their results showed that participants with SAD only made less eye contact than controls when the conversation was primed for conflict; no gaze avoidance was found in supportive conversations.

In summary, most studies with SAD patients show that they avoid looking at faces regardless of the type of social situation. The exceptions to this pattern were mostly due to much shorter presentation times and specific methodological factors. In social interactions, SAD patients may show normal eye-contact in specific social conditions.

Visual avoidance of faces in individuals with high levels of social anxiety

In contrast with the consistent results of studies with SAD patients across the three types of social situations, the results of studies with HSA individuals from community samples are more variable. Across all three types of social situations, nine out of 19 studies report a positive result for HSA and visual avoidance. Positive findings were most consistently found in studies with public speaking and interaction tasks, whereas negative findings were overrepresented in studies using facial-viewing tasks.

Firstly, three out of 12 studies with facial-viewing tasks observed the avoidant pattern. Five preferential looking studies found evidence for attentional bias to threat (i.e. faces expressing (negative) emotions) in HSA participants (Buckner, Maner, & Schmidt, 2010; Çek, Sánchez, & Timpano, 2016; Fernandes et al., 2018; Lange et al., 2011; Schofield, Johnson, Inhoff, & Coles, 2012). Four other preferential looking studies and one passive viewing study found no difference in gaze pattern between high and low socially anxious participants (Berdica, Gerdes, Bublatzky, White, & Alpers, 2018; Gregory, Bolderston, & Antolin, 2019; Mühlberger, Wieser, & Pauli, 2008; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). The different outcomes do not seem to be related to presentation times in these studies. One preferential looking study provides partial support for visual avoidance of faces in HSA participants (Taylor, Kraines, Grant, & Wells, 2019). They found indirect correlations between social anxiety and visual avoidance of faces, mediated by excessive reassurance seeking. Two emotion classification studies presented participants with face-body compounds, and noted that HSA persons avoided looking at faces but attending to the body for making judgments about emotions (D. H. Kim & Lee, 2016; Kret, Stekelenburg, de Gelder, & Roelofs, 2017).

Secondly, public speaking tasks were used in two studies comparing participants with high and low levels of social anxiety. Both found that HSA participants avoided looking at faces with positive facial expressions (Lin, Hofmann, Qian, Kind, & Yu, 2016; Lowe et al., 2012). However, Lin et al. (2016) found that HSA participants looked more at faces with negative expressions than low socially anxious participants, which could be interpreted as an attentional bias to threat. Thirdly, four out of five interaction studies found that HSA participants looked less at the eyes or face of their interaction partner than low socially anxious participants (Dechant, Trimpl, Wolff, Mühlberger, & Shiban, 2017; Farabee, Ramsey, & Cole, 1993; Hessels, Holleman, Cornelissen, Hooge, & Kemner, 2018; Howell, Zibulsky, Srivastav, & Weeks, 2016). Only one study using a semi-structured role-play task found no difference (Weeks, Heimberg, & Heuer, 2011). The participants were all males, who had to join the conversation of a male and a female confederate in the context of a party. The participant had to compete with the male confederate for the attention of the female confederate. The obvious task demand to make eye-contact may have been sufficient to produce this behavior in socially anxious males in this study. Alternatively, the precision of measurement may have been limited, because eye-contact with the female confederate was rated from video recordings by observers.

In summary, in more naturalistic social tasks – public speaking and social interaction – HSA individuals showed fairly consistent avoidant pattern. In contrast, HSA persons show an inconsistent gaze patterns when confronted with facial-viewing tasks.

Visual avoidance of faces in adults with shyness or fear of negative evaluation

Studies investigating gaze behavior in people with characteristics related to social anxiety, such as shyness and fear of negative evaluation, have exclusively used face-viewing tasks. The findings were similar to what we found for individuals with HSA: only four out of 10 studies with facial-viewing tasks reported a positive result for visual avoidance of faces in passive viewing (Grisham, King, Makkar, & Felmingham, 2015; Wieser, Pauli, Grosseibl, Molzow, & Mühlberger, 2010) as well as preferential looking tasks used with FNE adults (Garner, Mogg, & Bradley, 2006), and a face recognition task with a shy sample (Wang, Hu, Short, & Fu, 2012). In contrast, three passive viewing studies (Calvo, Gutiérrez-García, & Fernández-Martín, 2018; Gutiérrez-García, Calvo, & Eysenck, 2018; Wieser, Pauli, Alpers, & Mühlberger, 2009) and one preferential looking study (Liang, Tsai, & Hsu, 2017) reported attentional bias to threat in participants scoring high on FNE. Finally, two studies on FNE samples using preferential looking tasks found no differences in gaze behavior (Singh, Capozzoli, Dodd, & Hope, 2015; Wieser, Pauli, Weyers, Alpers, & Mühlberger, 2009).

In two studies, avoidance only occurred in specific conditions. Garner et al. (2006) reported that visual avoidance of emotional faces in people with fear of negative evaluation was only true in an anxiety-provoking situation (i.e. when participants were informed that they had to give a speech after the viewing task). Wieser and colleagues (2010) noted that women with high fear of negative evaluation avoided eye-contact with a virtual male, but only in a very specific situation: when a male avatar looked at them directly while standing far away. Shuhama, Del-Ben, Loureiro, and Graeff (2008) argued that the distance to a threat is an important factor in the selection of defensive responses in humans and animals. Avoidance of eye-contact could be seen as hiding, which is a frequent response to distant threats.

In summary, studies using visual tasks to compare participants scoring high and low on shyness or fear of negative evaluation have produced mixed findings. In these participants, visual avoidance of faces may be observed most reliably when the facial-viewing task has to be performed in a context of a social-evaluative threat such as an anticipated speech task. Further research with other tasks is needed to clarify whether people with characteristics related to social anxiety show gaze behavior comparable to those with HSA and SAD in more naturalistic social situations.

Visual avoidance and social anxiety in children and adolescents

To examine developmental effects in the relatively few studies conducted with participants aged 0-18 years (n = 10) we have organized this section primarily by age-group. Overall, gaze avoidance was reported in only three out of ten studies.

One study has been conducted on infants aged 7 - 13 months with high and low levels of shyness (Matsuda, Okanoya, & Myowa-Yamakoshi, 2013). It reported a positive correlation between shyness and visual attention to eye regions. Six out of seven studies on children (generally aged 7 - 12) found no evidence for avoidance. Four studies did not find differences between SAD and healthy control groups in either preferential looking tasks (Schmidtendorf, Wiedau, Asbrand, Tuschen-Caffier, & Heinrichs, 2018; Seefeldt, Krämer, Tuschen-Caffier, & Heinrichs, 2014) or role-play tasks with peers (Alfano, Beidel, & Turner, 2006; Spence, Donovan, & Brechman-Toussaint, 1999). Two other studies demonstrated maintenance of visual attention on the eyes in a face recognition task used with shy children (Brunet, Heisz, Mondloch, Shore, & Schmidt, 2009) and a social interaction task used with HSA children (Morgan & Banerjee, 2006). Only one study identified an avoidant tendency in a passive viewing task (Keil et al., 2018). Children with SAD looked less at the eyes in the last two seconds of a 10-s presentation duration than healthy and mixed anxiety disorder control groups, but the difference was only significant for girls. Finally, three studies focused on adolescents. Two studies found that adolescents with SAD (Alfano, Beidel,

& Turner, 2008) and HSA high school students (Daly, 1978) made significantly less eye contact in a face-to-face interaction compared to a healthy control group and LSA students, respectively. In contrast, Alfano et al. (2006) found no difference between adolescents with and without SAD in role-play tasks.

In summary, although gaze behavior in youth has received relatively little empirical attention, the available findings suggest that age possibly moderates the association between gaze patterns and social anxiety. That is, the gaze avoidant pattern may become more prominent during adolescence, whereas greater visual attention to faces may be more typical during early developmental periods.

DISCUSSION

The current review has examined the influence of three factors (i.e. severity of social anxiety, type of social situation, and development) on the relation between social anxiety and visual avoidance of faces. Four key results were found. First, adults with SAD exhibit visual avoidance of faces across all social situations. Second, in HSA persons, avoidance of faces depended on the type of situation. This group displayed consistent avoidance in public speaking and social interaction situations, but mixed results were found with face-viewing tasks. Third, facial-viewing tasks showed relatively consistent avoidance of faces in people with SAD, but not in people with high social anxiety or related characteristics. Fourth, although developmental data are scarce, the relation between social anxiety and visual avoidance of faces seems to emerge in adolescence. Some studies with socially anxious infants and children showed increased attention to faces instead.

Adults with SAD

Regarding people with SAD, visual avoidance of faces was remarkably consistent across the different types of social situations. Of the few studies that were not in line with this pattern, three reported attentional bias to threat in facial-viewing tasks (Boll et al., 2016; Gamble & Rapee, 2010; Lavarov et al., 2016). This may be related to their relatively short presentation times: 3 - 6 seconds, whereas the presentation times in the other studies varied from ten seconds to minutes. These findings complement a review of dot-probe studies with presentation times of no more than 1250 ms, which found evidence for attentional bias to threat in socially anxious individuals, but not for avoidance (Bantin et al., 2016). Although Chen and Clarke (2017) pointed out that no presentation time is exclusively associated with either vigilance or avoidance, the pattern found for adults with SAD in the present study is in line with the general

hypothesis that initial vigilance for threat is followed by avoidance (Schulze et al., 2013).

Severity of social anxiety

Visual avoidance of faces was less consistently observed in high socially anxious people from a community sample and people with characteristics related to social anxiety (i.e., strong fear of negative evaluation and shyness). Moreover, the type of situation seems to matter. In people with HSA, avoidance was observed in both public speaking studies and all but one social interaction study. In the facial-viewing tasks, however, vigilance, avoidance and no difference were found in equal proportions. As noted by Clark and Chen (2017), these results seemed unrelated to presentation times. Our findings suggest that people with HSA (without DSM diagnosis) differ from people with diagnosed SAD in that they only show avoidance of faces in naturalistic social situations.

A similar pattern may be hypothesized for people with characteristics related to social anxiety. Although their results on visual tasks were as divergent as in the HSA group, two of the studies that found avoidance of faces seem to have used facial-viewing tasks with heightened social threat (Garner et al., 2006; Wieser et al., 2010). This suggest that avoidance may be more likely to occur in naturalistic social situations. However, this possibility remains to be tested. As people with high FNE or shyness have not been studied in such situations, it is as yet unclear whether and to what extent their gaze behavior differs from people with HSA or SAD.

Type of social situation

The finding that people with SAD consistently avoid looking at faces in each type of situation suggests that they may lack the ability to make appropriate eye-contact, which is in line with social skill deficits theory (Levitan & Nardi, 2009). Such consistence across public speaking and social interaction, however, seems not to support the proposed distinction between structured and unstructured social situations (Levitan & Nardi, 2009; Voncken & Bögels, 2008). For example, Voncken and Bogel (2008) reported that patients with SAD were featured by actual social skills deficits during conversations but not in speaking tasks. Additionally, two interaction studies indicated that people with SAD did not avoid looking at faces during a conversation in a supportive atmosphere (as opposed to one primed for conflict; Langer et al., 2017) and when they only had to listen instead of doing the talking (Baker & Edelmann, 2002). These situations seem to pose minimal risk of negative evaluation. This flexibility of the gaze pattern could be taken as evidence against a strong version of the social skills deficit hypothesis. It is more in line with explanations concerning safety behavior (see Piccirillo, Taylor Dryman, & Heimberg, 2016 for a review). Alden and Bieling

(1998) demonstrated that another safety behavior, avoidance of self-disclosure, was demonstrated by people with SAD when they expected a high chance of negative evaluation, but not when they expected a low chance of negative evaluation (i.e. high versus low social-evaluative threat).

The level of social-evaluative threat may also explain the pattern of results found for HSA adults, who tended to show avoidance in naturalistic social situations, but not in facial-viewing tasks. Public speaking tasks and conversations often require people to disclose some personal information to strangers and they usually involve (the suggestion of) being watched by real people. Myllyneva and Hietanen (2015) noted that participant's knowledge of being the target of another individual's attention caused significantly greater autonomic and brain reactions compared to situations where participants believed others could not see them. Consequently, these situations would significantly enhance levels of anxiety and fear in HSA persons, leading to visual avoidance. Therefore, visual avoidance may be a temporary result of anxiety-provoking situations, which is in line with explanations concerning safety behavior (Piccirillo et al., 2016).

The results of a study including both SAD and HSA groups suggest that adults with HSA may be more sensitive to the level of social-evaluative threat than SAD patients. Vriends et al. (2017) used a conversation task in which the behavior of the confederate was friendly in some phases and critical in others. Gaze behavior of participants with SAD differed from that of control participants throughout the conversation, whereas HSA participants differed from low anxious participants when the confederate was being critical or had to led the conversation. In SAD patients, the threshold for perceiving social-evaluative threat may be so low that they show safety behavior in all but the safest situations. Yet this does not explain why they avoid looking at faces in non-interactive visual tasks. A general avoidant tendency might result from negative reinforcement learning, when they perceive not being overtly rejected as a consequence of not making eye-contact. Further research is needed to answer this question.

Development

Our review of studies on infants and children provided little evidence for visual avoidance of faces in relation to social anxiety. Some studies even demonstrated that shy or socially anxious infants and children tend to maintain attention on the eye-region. In a social interaction study, this was partly interpreted as excessive reassurance seeking from the adult confederate (Morgan & Banerjee, 2006). These findings suggest that gaze avoidance is not a manifestation of social anxiety in the early years. Regarding adolescence, however, two out of three studies provided evidence that socially anxious individuals avoid looking at faces during social interaction. These findings suggest

that the tendency of socially anxious adults to avoid faces may emerge in adolescence, which would be in line with longitudinal (Miers et al., 2014) and cross-sectional data (Sumter, Bokhorst, & Westenberg, 2009) concerning the development of avoidant tendencies at a general behavior level. However, more research is needed to draw any final conclusions about the development of visual avoidance of faces in socially anxious people.

Limitations and future directions

The present review complements previous ones by including studies from various experimental paradigms and by distinguishing between different levels of social anxiety and different age groups. In addition to eye-tracking studies, the current review included some interaction studies that used observer ratings of eye-contact. Visual avoidance of faces by people with SAD was found in 74% of eye-tracking studies and 75% percent of studies using observer ratings. Although the estimate is based on a smaller number of studies for observer ratings, it gives an indication that these studies add valid information about a type of social interaction situation that is underrepresented in eye-tracking studies and has relatively high ecological validity. The type of social situation seems to be an important factor in visual avoidance of faces, in particular for HSA adults.

Despite its merits, some limitations of this review should be noted. First, the review was restricted to fixation-based eye movement data (i.e., dwell time and fixation counts). These eye movement parameters were selected because they have been widely and consistently measured in relevant studies. However, other gaze parameters may be informative as well. Besides time-course parameters such as initial attention, gaze aversion may offer insights for understanding gaze behavior in socially anxious individuals. For example, Walters and Hope (1998) recorded the frequency with which participants looked away from each other's faces in social interactions. Future research could consider alternative parameters to derive a full profile of gaze behaviors related to social anxiety.

Second, the current review could not distinguish between visual avoidance of faces and avoidance of eye-contact in particular. There are some indications that these phenomena may not be equivalent (e.g., Dechant et al., 2017). In the current literature, however, few studies have measured fixations on the eye-region specifically. As the development of eye-tracking technology continues, opportunities to do so may arise in future.

Third, comparatively little research has been done with infants, children and adolescents. As a consequence, the present review could not investigate the influence

of severity of social anxiety and type of social situation in these age groups and interpretations of the development of the relation between social anxiety and visual avoidance of faces are only tentative. More research on younger populations is needed.

Fourth, the present review focused on visual avoidance of faces, because of its clinical significance and the existence of recent reviews covering attentional bias to threat. Future research may go beyond establishing avoidance and address the question of what socially anxious people look at instead. For example, the results of two studies presenting participants with face-body compounds (D. H. Kim & Lee, 2016; Kret et al., 2017) suggest that HSA participants rely more on the body than on the face for making judgments about emotions. This might reflect a compensatory strategy that still allows socially anxious people to obtain important social information. This pattern has however not yet been studied in patients with SAD.

Finally, the current review only considered studies reported in English. Although few publications in other languages were available in the leading databases, the overrepresentation of participants from Western cultures may hamper generalization of research findings to other parts of the world.

Clinical implications

The findings discussed in this review may have some clinical implications. First, they indicate that visual avoidance of faces is a well-validated behavioral marker of adults with SAD across multiple types of social situations. This justifies listing inappropriate eye-contact as a supporting feature of the disorder in the DSM-5 (APA, 2013). However, our findings also suggest that different definitions of "inappropriate" may apply to adults and children. Whereas clinicians are most likely to observe avoidance of eye-contact in social interactions with adults, they may notice excessive eye-contact in socially anxious children.

Second, avoidance of eye-contact may warrant attention in treatment of SAD. It has been discussed as both a causal and a maintaining factor of the disorder. Spence and Rapee (2016) pointed out that withdrawn behavior, including avoidance of eye-contact, could trigger negative reactions from others. These negative social outcomes could cause fear (and further avoidance) of social situations. Furthermore, avoidance of eye-contact could maintain social anxiety, because it prevents socially anxious people from disconfirming their negative beliefs about an interaction partner's attitude towards them (Clarke & Wells, 1995). In view of these potential contributions to the disorder, it seems important to change the gaze behavior of socially anxious individuals. Cognitive behavioral treatment programs with a strong skills component,

such as SET (Beidel, Turner, & Morris, 2000) and SASS (Masia Warner, Colognori, & Lynch, 2018) already address this aim.

The finding that gaze avoidance may not occur in social interactions when patients feel safe, suggests that the problem may also be addressed by cognitive restructuring. More realistic thinking about the level of social-evaluative threat involved in an interaction may reduce the need to avoid eye-contact (and use other safety behaviors) in SAD patients. At least, these findings indicate that making appropriate eye contact is not impossible for them.

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Table 1. *Study characteristics*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Horley (2003)	15 GSP (38.27/47%) vs. 15 HC (38.4/47%)	SAD	SCID	face-viewing (passive viewing)	fixation duration & counts	SAD showed avoidance of faces as well as facial features (eyes, nose, mouth), whereas HC showed no effect
Horley (2004)	22 GSP (40.45/41%) vs. 22 HC (40/41%)	SAD	SCID	face-viewing (passive viewing)	fixation duration & counts	SAD showed avoidance of faces as well as eyes, whereas HC showed no effect
Moukheiber (2010)	26 SP (27.4/42%) vs.24 HC (26.9/42%)	SAD	MINI	face-viewing (passive viewing)	fixation duration & counts	SAD showed gaze avoidance
Moukheiber (2012)	26 SAD-FB (27.4/46%) vs. 26 SAD+FB (26.9/ 53%) vs. 24 HC (27.1/ 45%)	SAD	MINI	face-viewing (passive viewing)	fixation duration & counts	Gaze avoidance in SAD-FB when compared to SAD+FB and controls
Weeks (2013)	20 SAD (18.90/75%) vs. 15 NSAC (18.87/80%)	SAD	ADIS-IV-SP	face-viewing (passive viewing)	eye contact counts & duration	SAD showed global gaze avoidance to both positive and negative facial stimuli
Keil (2018)	31 SAD (11.85/48%) vs. 30 MAD (11.93/50%) vs. 32 HC (11.70/44%)	SAD	Kinder-DIPS	face-viewing (passive viewing)	eye contact duration	Groups did not differ in their dwell time to angry or neutral faces over the entire presentation time. Further, SAD girls and MAD girls spent less time on the eye regions compared to HC girls, no difference in boys.
Staugaard (2011)	8 SP (29.4/63%) vs.34 CP (26.2/53%)	SAD	ADIS-IV	face-viewing (passive viewing & preferential looking)	fixation duration & counts	SAD tended to show increased attention to briefly presented threatening faces. Whereas shorter fixation durations to the eyes of neutral, sad, disgust faces compared to HC in prolonged presentation tasks
Chen (2012)	32 SAD (23.52/31%) vs. 30 NAC (19.17/60%)	SAD	ADIS-IV	face-viewing (preferential looking)	fixation duration	SAD showed avoidance for all emotional stimuli, relative to NAC
Byrow (2016)	90 SAD (32.18/48%) vs. 23 NC (26.04/49%)	SAD	ADIS-IV	face-viewing (preferential looking)	fixation counts	SAD showed avoidance for all emotional stimuli, relative to NC
Schofield (2013)	19 SP (29.6/58%) vs. 20 NC (29.7/55%)	SAD	ADIS-IV-L	face-viewing (preferential looking)	fixation duration	SAD showed avoidance for all emotional stimuli, relative to NC

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Gamble (2010)	59 SP (33.15/49%) vs. 28 NP (36.36/43%)	SAD	ADIS-IV	face-viewing (preferential looking)	fixation counts	SAD looked more at angry faces (vigilance) only in the first 500ms of each 5000ms trail, no group difference in later presentation
Lazarov (2016)	20 SAD (35.15/60%) vs. 20 HSA (22.85/70%) vs. 20 LSA (22.05/70%)	SAD & SA	MINI & LSAS	face-viewing (preferential looking)	fixation duration	SAD and HSA looking longer at threated faces, relative to non-anxious group
Seefeld (2014)	30 SP (9.9/43%) vs. 42 HC(9.9/45%)	SAD	Kinder-DIPS	face-viewing (preferential looking)	fixation duration	No group differ over time. All children showed same pattern of attentional distribution over 3000 ms presentation.
Schmidtendorf (2018)	37 SAD(11.4/62.2%) vs. 42 HC (11.5/59.5%)	SAD	Kinder-DIPS	face-viewing (preferential looking)	fixation duration	There were no differences between groups
Wermes (2018b)	SAD: 36 without state anxiety (30.8/72%) & 31 with state anxiety (29.6/65%) vs. HC: 32 without (29.8/62%) & 30 with (29.8/70%)	SAD	SCID-I	face-viewing (visual search)	fixation duration	SAD showed avoidance for threatening faces, relative to HC
Wermes (2018a)	61 SAD: 30 without state anxiety (30.1/88%) & 30 with state anxiety (29.4/70%) vs. 60 HC: 30 without (30.1/63%) & 30 with (29.2/63%)	SAD	SCID-I	face-viewing (visual search)	fixation counts	Compared to HC, SAD showed increased fixation counts only in anxiety induction conditions. Whereas no difference in control conditions
Boll (2016)[a]	22 SP (32.18/45%) vs. 22 HC (31.91/45%)	SAD	ICD-10	face-viewing (emotion classification)	fixation duration	No evidence for a later avoidance of eye gaze during the entire 3 s stimulus presentation interval, SAD even exhibited more attention to the eyes relative to mouths
Chen (2015)	22 SAD (25.24/32%) vs. 19 CP (23.78/42%)	SAD	ADIS-IV	public speaking	fixation counts & duration	SAD showed a significantly increased attention towards background, suggesting avoidance of audience

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Chen (2016)	SAD (25.24/26%) vs. CP (23.78/62%)	SAD	ADIS-IV	public speaking	fixation duration	SAD showed less total fixation time at emotional faces, while no differences in neutral or non-face regions
Kim (2018)	79 SAD (23.5/49.4%) vs. 51 HC (24/47.1%)	SAD	unknown	public speaking	fixation counts	SAD showed a marginal significance less at screen containing audience compared to HC
Hofmann (1997)	50 (46.4/59%): 24 SP + PSA vs. 25 NP	speech phobia	SCID	interaction	eye contact counts & duration	No group differences in the three tasks
Baker (2002)	18 SP (42.3/78%) vs. 18 AD (48.3/89%) vs. 18 NC (50.9/83%)	SAD	SCID 1	interaction	eye contact counts & duration	SP showed avoidance of eye contact while talking phrase but not listening phrase, relative to NC
Langer (2017)	114 (39.06/71.9%): 65 GSAD vs. 49 NOSAD	SAD	SCID-IV	interaction	fixation duration	SAD made less eye contact during a conversation primed for conflict (not in supportive circumstances)
Monti (1984)	27 male college students vs. 37 patients	SAD	unknown	interaction	rating scale	significant less eye-contact in patients, relative to healthy samples.
Vriends (2017)	Expe 1: 25 HSA (23.27/100%) vs. 26 LSA (23.24/100%). Expe 2: 32 SAD (22.41/100%) vs. 30 NOSAD (23/100%)	SA & SAD	SPS & DIPS	interaction	fixation duration	No any group differences in confederate-regions
Alfano (2006)	50 SP (11.94/ 44%) vs. 30 NC (11.87/ 57%)	SAD	ADIS-C	interaction	eye contact counts	No difference between age or group
Alfano (2008)	21 SP (14.05/43%) vs. 42 HC : 21 IMAG (13.43/48%) vs. 21 controls (13.29/62%)	SAD	ADIS-C/P	interaction	eye contact counts	SP made less eye-contact than HC during a social interaction.
Spence (1999)	27 SP (10.93/56%) vs. 27 NC (11/56%)	SAD	ADIS-C-P	interaction	eye contact counts	No significant differences between SP and NC for eye-contact
Gregory (2018)	105 (19.91/84%): 27 HSA vs. 27 LSA	SA	LSAS	face-viewing (passive viewing)	fixation duration & counts	No group difference in terms of fixation number, fixation duration over the whole trail.

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Taylor (2019)	79 (19.79/57.5%)	SA	SIAS-6; SPS-6	face-viewing (passive viewing)	fixation duration	SA had an indirect effect on attention bias to disgust faces through increased reassurance seeking. Moreover, negative correlations between total fixation to sad and disgust faces, somehow indicating avoidance of threat
Bucker (2010)	46 (20.02/65%). 23 HSA vs. 23 LSA	SA	SIAS	face-viewing (preferential looking)	fixation duration	HSA tended to show disengagement difficulty from social threat
Cek (2016)	55 (19.13/45%)	SA	SIAS	face-viewing (preferential looking)	fixation duration	HSA tended to look at threatening faces
Schofield (2012)	42 (19.2/54.8%)	SA	SIAS	face-viewing (preferential looking)	fixation duration	Positive correlations between SA and attention to emotional faces over time, and difficulty disengagement from angry faces
Lange (2011)	43 (82.6%) : 22 SA (24.2) vs. 21 NAC (23.6)	SA	LSAS-A	face-viewing (preferential looking)	fixation duration & counts	SA tended to look at angry faces than NACs did.
Fernandes (2018)	19 HSA (21.11/89%) vs. 19 LSA (21.84/63%)	SA	AASPI	face-viewing (preferential looking)	fixation duration	No group difference in total dwell time, but HSA showed slower disengagement from happy faces in terms of time-course dwell time
Mulberger (2008)	26 (19-36/54%)	SA	SPAI	face-viewing (preferential looking)	fixation duration	No effects in terms of sustained attention
Waechter (2014)	40 LSA vs. 41 HSA	SA	SIAS	face-viewing (preferential looking)	fixation duration & counts	There were no significant differences
Berdica (2018)	70 (27.21/84%)	SA	SPIN	face-viewing (preferential looking)	fixation duration & counts	There were no any correlations between SA and eye movement indices
Kim (2016)	22 SA (22.05/50%) vs. 22 HC (20.64/50%)	SA	SADS & BFNE2	face-viewing (emotion classification)	fixation duration	SA looked less at faces and longer at body than HC
Kret (2017)	23 HSA (21.87/83%) vs. 23 LSA (22.29/43%)	SA	LSAS-A	face-viewing (emotion classification)	fixation duration	HSA tended to look at hand-regions compared to LSA
Lin (2017)	22 HSA (23.89/41%) vs. 22 LSA (22.75/59%)	SA	SIAS	public speaking	fixation counts & duration	HSA spent more time looking at negative audience and less time on positive ones, compared to LSA.

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Lowe (2012)	16 stutter (36.7/18.8%) vs. 16 non-stutter (38.2/18.8%)	stutter	SPAI	public speaking	fixation counts & duration	Participants who stutter looked less time and less often to audience members on a television screen than controls
Dechant (2017)	18 HSA (20.44/83.3%) vs. 19 LSA (23.11/52.6%)	SA	LSAS	interaction	fixation duration	HSA looked shorter on faces than LSA
Hessels (2018)	96 (24.52/52%)	SA	SAS	interaction	fixation duration & counts	SAD traits was negatively correlated with total dwell time at the eyes
Howell (2016)	20 (19.15/100%)	SA	LSAS	interaction	fixation duration & counts	Trait social anxiety was inversely related to eye contact duration and frequency averaged across the 4-min interaction.
Farabee (1993)	20 HSA (unknown /100%) vs. 20 LSA (unknown/100%)	SA	social anxiety subscale of the Self-Consciousness Scale….	interaction	eye contact counts & duration	HSA looked less at the other participants both in terms of total gaze duration and average gaze duration, compared to LSA. Moreover, HSA tend to avoid looking at disagreeing confederate, while LSA tend to look at disagreeing people
Weeks (2011)	48 (20.27/0)	SA	SIAS-S	interaction	Eye contact duration	No difference in gaze avoidance indices
Daly (1978)	36 (seconds and third-year high school students/50%)	SA	SADS	interaction	eye contact duration	HSA tended to make less eye contact while talking, but no difference in listening phase between high and low SA groups
Morgan (2006)	28 HSA (12.8/57%) vs. 28 LSA (12.5/36%)	SA	SAS-A	interaction	eye contact counts	HSA made significantly more eye contact than LSA children, particularly on the negative scenarios
Matsuda (2013)	57 (9.8 month/60%)	shyness	CCTI	face-viewing (passive viewing)	fixation duration	Positive correlations between shyness and dwell time on eyes
Grisham (2015)	29 HSA (18.93/36%) vs. 28 LSA (20.68/23%)	FNE	BFNE	face-viewing (passive viewing)	fixation duration	HSA exhibited significantly shorter dwell time on faces (negative, neutral but not happy), compared to LSA

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Calvo (2018)	24 HSA (19-25/63%) vs. 24 LSA (19-25/63%)	FNE	BFNE	face-viewing (passive viewing)	fixation counts	HSA looked longer at the eye region than LSA, who looked longer at mouth regions
Gutierrez-Garcia (2018)	25 HSA (21.71/60%) vs. 24 LSA (22.12/63%)	FNE	BFNE	face-viewing (passive viewing)	fixation counts & duration	HSA looked longer at the eye region than LSA, who looked longer at mouth region
Wieser (2009)	45 (21.5/100%): 21 LSA vs. 17 MSA vs.18 HSA	FNE	BFNE	face-viewing (passive viewing)	fixation duration	HSA looked longer at eye regions than MSA and LSA, regardless of gaze directions during free viewing condition.
Wieser (2010)	19 HSA (21.9/100%) vs. 20 LSA (22.3/100%)	FNE	BFNE	face-viewing (passive viewing)	fixation duration	HFNE showed avoidance of eye contact only in specific virtual condition
Singh (2015)	91 (20.4/52.7%)	FNE	BFNE	face-viewing (preferential looking)	fixation duration & counts	No group difference in terms of run count, dwell time as well as dwell time bias with/ without state anxiety induction
Wieser (2009)	HFNE (20.7/100%) vs. LFNE (24.6/100%)	FNE	BFNE	face-viewing (preferential looking)	fixation duration	HFNE looked at the emotional faces longer during the first second of stimulus exposure, whereas the avoided these faces in the consecutive time interval from 1 to 1.5 s. However, this avoidance did not sustain. There were no significance during the following time intervals (3 s trail)
Garner (2006)	Exper 1: 16 LSA (20.8/94%) VS. 16 HSA (20.3/87%). Exper 2: 16 LSA (21.7/67%) vs.16 HSA (22.4/94%)	FNE	BFNE	face-viewing (preferential looking)	fixation duration	HFNE showed reduced maintenance of attention on emotional faces compared to LFNE ones, who looked longer at emotional than neutral faces only in a anxiety-induction condition
Liang (2017)	32 SA (18.66/75%) vs. 30 NA (19.27/73.3%)	FNE	BFNE	face-viewing (preferential looking)	fixation duration	SA tended to look at angry faces than the NA group
Wang (2010)	30 (20.17/60%)	shyness	CBSS	face-viewing (face recognition)	fixation duration	Negative correlations between shyness level and fixation proportion on eyes

Table 1. *Continued*

First Author (Year)	Participants N (M/FP)	Social Anxiety Symptoms	Social Anxiety Assessments	Type of Social Situations (specific tasks)	Gaze Behavioral Variables	Main Outcomes
Brunet (2009)	28 (11.14/50%)	shyness	CCTI	face-viewing (face recognition)	fixation counts & duration	Positive correlations between shyness and dwell time on eyes

Note. AASPI = Scale of Anxiety and Avoidance in Social Performance and Interaction; AD = anxiety disorder but not social phobia; ADIS-C = Anxiety Disorders Interview Schedule for Children for DSM-IV; ADIS-C-P = Anxiety Disorders Interview Schedule for Children - Parent Version; ADIS-IV = Anxiety Disorder Interview Schedule for adults; ADIS-IV-L = Anxiety Disorders Interview Schedule; ADIS-IV-SP = Anxiety Disorders Interview Schedule for DSM-IV; Social Phobia subsection; BFNE = Brief Fear of Negative Evaluation scale; BFNE2 = Brief Version of the Fear of Negative Evaluation 2; CBSS = Revised Cheek and Buss Shyness Scale; CCTI = Colorado Children Temperament Inventory; CP = control participants; DIPS = Diagnostisches Interview bei psychischen Störungen; FNE = fear of negative evaluation; FP = female percentage; GSAD = generalized social anxiety disorder; GSP = generalized social phobia; HC = healthy controls; HFNE = high levels of fear of negative evaluation; HSA = high social anxiety; ICD 10 = 10th revision of the International Statistical Classification of Diseases and Related Health Problems; Kinder-DIPS = Anxiety Disorders Interview Schedule for children; LFNE = low levels of fear of negative evaluation; LSA = low social anxiety; LSAS = Liebowitz Social Anxiety Scale; LSAS-A = LSAS anxiety subscale; M = mean age; MAD = mixed anxiety disorders; MINI = Mini International Neuro-psychiatric Interview; MSA = medium social anxiety; N = sample size; NA = non-anxious; NAC = non-anxious controls; NC = nonclinical controls; NP = non phobic; NOSAD = nonsocial anxiety disorder; NSAC = non socially anxious controls; SA = social anxiety; SAD = social anxiety disorder; SADS = Social Avoidance and Distress Scale; SAD-FB = social phobia and no fear of blushing; SAD + FB = social phobia and fear of blushing; SAS = Social Anxiety Scale; SAS-A = Social Anxiety Scale for Adolescents; SCID = Structured Clinical Interview for DSM-IV; SCID-I = Structured Clinical Interview for DSM-IV; SCID-IV = Structured Clinical Interview for Diagnostic and Statistical Manual-IV; SIAS = Social Interaction Anxiety Scale; SIAS-6; SPS-6 = Social interaction anxiety scale and social phobia scale – short forms; SIAS-S = Social Interaction Anxiety Scale-Straightforward Scale; SP = social phobia; SP+PSA = social phobia with public speaking anxiety; SPAI = Social Phobia Anxiety Inventory; SPAI = Social Phobia and Anxiety Inventory; SPS = Social Phobia Scale; SPIN = Social Phobia Inventory.

[a] This study conducted two experiments. We only extracted the eye gaze data from reported experiment 1 because it examined gaze behavior towards faces while not in the second experiment.

CHAPTER 3

Visual avoidance of faces in socially anxious individuals: The moderating effect of type of social situation

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ABSTRACT

Patients with social anxiety disorder appear to display aberrant gaze behavior across a variety of social situations. In contrast, the gaze behavior of high socially anxious (HSA) individuals from the community seems to depend on the type of situation and the aberration might be limited to gaze avoidance. This study investigated the differential effect of social situation – a face-viewing task and a public speaking task – on gaze behavior in HSA participants from a community sample. Participants' eye movements were tracked using a wearable eye-tracker. Two aspects of gaze behavior were measured: 1) Gaze avoidance was assessed by total fixation time, fixation counts and mean fixation time on faces; 2) Hypervigilance was assessed by scan path length and mean distance between fixations. The results confirmed a moderating effect of task on total (though not mean) fixation time on faces and fixation counts. Compared to low socially anxious participants, HSA participants looked less frequently (hence shorter) at the audience during the speech only. This indicates that visual avoidance in HSA individuals does not occur by default, but only when risks of (negative) social consequences are perceived. High and low socially anxious participants showed no difference in hypervigilance in either situation.

INTRODUCTION

Overwhelming fear or anxiety, as well as avoidance of social situations are diagnostic criteria of social anxiety disorder (SAD; American Psychiatric Association, 2013). Existing literature from theoretical and clinical perspectives claims that socially anxious individuals tend to avoid looking at faces and eyes (e.g., Clark & Wells, 1995). However, experimental research has produced inconsistent results, ranging from clear visual avoidance of faces to no avoidance whatsoever; indeed, some findings suggest *more* eye-gaze behavior by socially anxious individuals (for reviews see Bantin, Stevens, Gerlach, & Hermann, 2016; Chen & Clark, 2017; Schulze, Renneberg, & Lobmaier, 2013; Staugaard, 2010).

A recent systematic review (Chen, van den Bos, & Westenberg, 2020) concluded that the extent of visual avoidance of faces depends on severity of social anxiety symptoms as well as the type of social situation. Adults with SAD appear to display avoidance of faces in virtually any social situation, be it a face-viewing task on a computer screen or an actual social interaction. Socially anxious individuals from the general community do not exhibit consistent avoidance in face-viewing tasks, whereas they more consistently show this avoidance in social interaction and public speaking tasks. In other words they seem to adjust their eye-gaze behavior on the basis of the social context. The greater flexibility of avoidance in socially anxious persons from the community was found across various samples and studies (Chen et al., 2020). However, to our knowledge, it has not yet been demonstrated within the same sample and with the same procedure. Different eye gaze findings between studies may in part be due to the different samples and study designs. Therefore it is worthwhile to compare gaze behavior between distinct types of social situations within a particular sample from the community. This is the primary aim of this study.

In addition, indications of hypervigilance are examined. Three recent studies using a public speaking task have complemented fixation based measures (i.e., fixation time and fixation counts) with scan path length: the distance covered by the eyes during stimulus presentation. Chen, Thomas, Clarke, Hickie, and Guastella (2015) proposed that a longer visual scan path is an indication of hyperscanning, characterized by "saccades of greater amplitude, and attenuated fixations with regard to duration and quantity" (Chen et al., 2015, p. 668). Although attenuated fixations (on faces) would also be in line with avoidance, hyperscanning is interpreted as a sign of vigilance (Chen et al., 2015). Specifically, Chen et al. (2015) found that SAD patients showed longer scan paths during a public speaking task than control participants, although the relative contributions of the distance between fixations and the number and duration of fixations remained unclear. Wermes, Lincoln, and Helbig-Lang (2018) also found

longer scan path lengths for persons with SAD than for controls during visual search tasks when participants were anticipating a public speaking task (in control conditions without anticipatory threat, there was no difference). In contrast, Lowe et al. (2012) did not find a difference in scan path length during public speaking between high and low socially anxious participants (selected based on whether or not they suffered from stuttering, a risk factor for social anxiety). Taken together, these studies have provided some initial data on hyperscanning when multiple faces in the audience were present, and further suggested that hyperscanning may be dependent on the type of social situation (Wermes et al., 2018). Hence, as for avoidance, it would be helpful to clarify to what extent hypervigilance depends on the type of social situation.

Although most studies on gaze behavior in social anxiety have used face-viewing tasks (Chen et al., 2020), visual avoidance of faces has been demonstrated most consistently with public speaking tasks (e.g., Chen et al., 2015; Chen, Clarke, MacLeod, Hickie, & Guastella, 2016; Farabee, Ramsey, & Cole, 1993; Kim et al., 2018; Lowe et al., 2012, though see Hofman, Gerlach Wender, & Roth, 1997). The main difference between the two situations seems to be social-evaluative threat, that is the risk that "an important aspect of the self-identity is or could be negatively judged by others" (Dickerson & Kemeny, 2004, p. 358). According to Dickerson and Kemeny (2004), this is a key characteristic of public speaking situations. First, the situation requires exposing oneself (e.g., by disclosing personal information, sharing one's views or demonstrating one's ability to tell a coherent story). Second, the evaluative nature of the situation is usually highlighted by the (suggested) presence of an audience and/or recording the performance. In short, public speaking triggers fear of negative evaluation, which is central to social anxiety (APA, 2013).

Social-evaluative threat may lead to visual avoidance of faces in two ways. First, it prompts the use of safety behaviors, which aim to hide oneself in a (counterproductive) attempt to minimize the risk of negative social evaluation (Clark & Wells, 1995). Avoidance of eye-contact is considered as a safety behavior. Second, social-evaluative threat induces state anxiety. In public speaking situations, elevated state anxiety has been observed in the general population (e.g., Westenberg et al., 2009) and it is positively related with social anxiety (Crisan, Vulturar, Miclea, & Miu, 2016; Harrewijn, Van der Molen, & Westenberg, 2016). Although state anxiety is associated with increased attention to verbal threat cues (Heinrichs & Hofmann, 2001), there is some evidence that the combination of high trait and state anxiety is associated with consistent avoidance of faces with a negative expression (Singh, Capozzoli, Dodd, & Hope, 2015). This may be particularly relevant, because audience perception seems to be biased. High socially anxious speakers judged the attitude of a pre-recorded

audience to be more negative than low socially anxious speakers (Blöte, Miers, Heyne, Clark, & Westenberg, 2014; Perowne & Mansell, 2002).

The present study investigated the moderating effect of social situation on two aspects of gaze behavior in high and low socially anxious individuals from a community sample. Gaze avoidance was assessed in terms of fixation time and fixation counts; hypervigilance was assessed in terms of scan path length. We created two distinct situations - a face-viewing task and a public speaking task – using identical stimuli: a pre-recorded neutral audience, sitting in a classroom and facing the camera (i.e., a multiple-faces viewing paradigm). In the viewing task, the participant was instructed to simply look at the audience. Next, they were asked to rate the attitude of each audience member. In the public speaking task, participants were instructed to hold a speech in front of the same audience. Subsequently, they rated their overall impression of the audience. The current design allows for a direct comparison between two types of social situations while ruling out potential confounding by different general circumstances. Based on the conclusion of the review by Chen et al. (2020) that HSA persons may show consistent avoidance in social-evaluative public speaking situations but not in face-viewing situations, we expected to find an effect of social anxiety in the speech task and a smaller, or no effect in the viewing task. Based on the only previous study that investigated hypervigilance in a community sample (Lowe et al., 2012), we expected no difference in scan path length between HSA and LSA individuals.

METHODS

Participants

Eighty-eight female undergraduates (M = 20.75 years, SD = 2.19) of Leiden University with self-reported normal vision, were recruited for the study. The sample consisted of 45 Dutch students and 43 international students (including 9 Germans, 5 Italians, 5 Greeks, 3 British, 3 Americans, 2 Turkish, 2 Chinese, and 14 participants from other countries). Leiden University offers parallel psychology programs in Dutch and English. Dutch students can be enrolled in either program and they were allowed to do the study in either language: 27 participated in Dutch and 18 in English. International students always participated in the English version. Ten were native speakers of English. All non-native speakers enrolled in the English study program had passed an English proficiency test as an entry requirement. All participants were requested not to wear eye make-up on the day of testing. Participants gave written informed consent and were fully debriefed afterwards. They received either 2 credits

or €7.50 for participating in the experiment. The University's ethics committee for psychological research approved the study protocol.

Materials

Questionnaires

Each questionnaire was available in both Dutch and English. Twenty-seven participants completed the questionnaires in Dutch and 61 participants completed the questionnaires in English. In the latter group, the non-native speakers (n = 51) were asked to rate their fluency in English on a scale from 1 to 10, where "10" was defined as: "as fluent as your native language". Their mean rating was 8.02 (*SD* = 0.88).

Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987). The LSAS consists of 24 items, including 11 items about social interaction (e.g., "Meeting strangers") and 13 items about social performance (e.g., "Telephoning in public"). The instrument uses a 4-point Likert scale to rate both anxiety (0 = none, 3 = severe) and avoidance (0 = never, 3 = usually) in each of these situations. The LSAS demonstrates high internal consistency (α = .96; Heimberg et al., 1999). The internal consistency in this study is excellent for both language versions (α = .93 for Dutch, and α = .96 for English). The LSAS-Anxiety subscale also demonstrated good internal consistency (α = .92 and α = .94 for Dutch and English versions, respectively).

In line with other studies using the LSAS with community samples, where the LSAS-Anxiety subscale was used to make groups (e.g., Kret, Stekelenburg, de Gelder, & Roelofs, 2017; Lange, Heuer, Langner, Keijsers, Becker, & Rinck, 2011; Vrijsen, Lange, Becker, & Rinck, 2010), high and low social anxiety groups were created by doing a median split on the sum scores of LSAS Anxiety subscale. Cases scoring on the median were assigned to the low social anxiety group. Scatter plots are provided in the Supplementary materials.

Personal Report of Public Speaking Anxiety (PRPSA; McCroskey, 1970). The PRPSA is a 34-item instrument that assesses fear of public speaking. An adapted version (Blöte, Poungjit, Miers, van Beek, & Westenberg, 2015) consisting of 19 items (e.g., "My hands tremble when I am giving a speech", "While preparing for giving a speech, I feel tense and nervous") was used in this study. The PRPSA uses a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). The sum scores were used in this study; the possible range of scores is 19 - 95. The adapted version has a good internal consistency (α = .89, Blöte et al., 2015). In the current study, α = .93 and α = .94 for the Dutch and English versions, respectively.

Audience Perception List (APL; Blöte et al., 2014). The APL assesses how the participant perceives the audience. It consists of 4 questions: (1) Did you think the audience was interested? (2) Did you think the audience was friendly? (3) How pleasant was it to speak in front of this audience? (4) How at ease did you feel when giving a speech in front of this audience? The items were rated from "-2" to "+2". For example, Question 1 was scaled as follows: –2 = Uninterested, –1 = Somewhat uninterested, 0 = Neutral, 1 = Somewhat interested, and 2 = Interested. The score was recoded into a score from 1 to 5; thus, higher scores represent a more positive perception. Blöte et al. (2014) reported an internal consistency of α = .74. In this study, the internal consistency was α = .65 and α = .59 for the Dutch and English versions, respectively.

Stimuli and apparatus

The pre-recorded audience of the Leiden Public Speaking Task (Westenberg et al., 2009) was used in this study. The video was presented on a projection screen, depicting a natural scenario commencing with an empty classroom (about 20 seconds), and an audience (a female teacher and eight students) gradually walking into the scene and taking seats in different rows (about 20 seconds). Subsequently, the nine life-size audience members remain seated, facing the speaker. They behave naturally and display relatively neutral expressions all the time.

We utilized a Tobii Pro Glasses 2 wearable eye-tracker (Tobii Technology AB, Sweden) to record participants' gaze behavior towards the audience. The eye-tracker is equipped with 4 eye cameras which track people's eye movements in relation to the external environment they're watching. It records eye gaze at a sampling frequency of 100 Hz and a scene video at 25 Hz. An embedded microphone records the audio scene.

Procedure

After reading and signing consent forms, participants completed two self-report questionnaires, LSAS and PRPSA respectively. The study consisted of two tasks: the public speaking task and the face-viewing task. Participants were randomly assigned to one of two orders (i.e. first speaking and then viewing vs. first viewing and then speaking). Except for the order of the tasks, the procedure in this study was identical for all participants (see Figure 1). The public speaking task went as follows: participants were fitted with the eye-tracker and the eye-tracker was calibrated. Then participants were instructed to introduce themselves in front of a pre-recorded audience for one minute while gaze behavior was being recorded. They stood in front of the projection screen and watched the classroom as the audience members entered and took their seats. After 40 seconds, a beep indicated that they should start speaking. Exactly one minute later, a second beep indicated that they should stop. Following this, participants were seated and completed the APL (as in the study by Blöte et al., 2014), which

concluded the public speaking task. For the viewing task, participants were asked to stand and the eye-tracker was calibrated. Participants were informed that they would watch a video of an audience and that they would then have to rate the attitude of its members. The same video was used as during the speaking task to make the visual data from the two tasks comparable. After watching the introduction (40 seconds) and the first minute of the audience facing them, the participant remained standing in front of the screen and rated the behavior of each audience member on a 5-point scale from positive to negative. The video kept playing and each audience member was identified in turn by a number displayed over his or her head for 4 seconds. The participants marked their ratings on a form on a clipboard. After completing both tasks, all participants were de-briefed about the main purpose of each experimental part and then reimbursed.

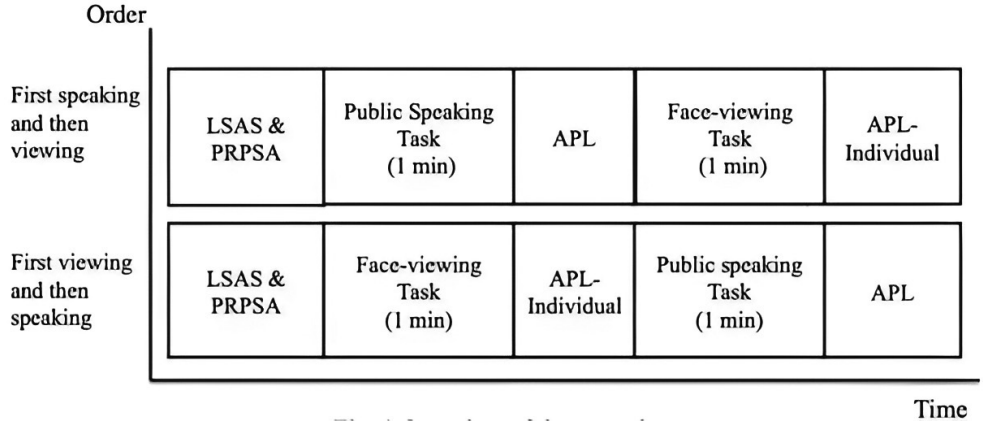

Figure 1. *Overview of the procedure*

Data preparation

Two one-minute segments of eye-tracking data were analyzed; one for each task. The beginning of the segment was aligned with the end of the introduction of the video of the audience (i.e., when it had played for 40 seconds). Pictures of the video being displayed on the screen were used as reference images. Areas of interest (AOIs) on the reference images were hand drawn shapes of each audience member's face. The hair was excluded, as this region does not contain social information. AOIs varied in size, because the audience members in the video were seated in three rows at varying distances from the camera (see Figure 2). Fixation counts and fixation time were cumulated across AOIs.

Figure 2. *A snapshot of the audience display presented in the two tasks; colored circles are AOIs*

Eye tracking data was processed using Tobii Real World Mapping software. An attentional filter was applied and participants' fixations were automatically mapped on designated reference images. Subsequently these mappings were checked by a human observer (J.C.). The software calculated fixation-based parameters: the total fixation time on faces in seconds and the number of fixations on faces. The mean fixation duration was computed by dividing the total fixation time on faces by the number of fixations on faces. In addition, raw data were exported to derive scan path length parameters for each task. Total scan path length in pixels was computed by taking the Euclidean distance between the X and Y coordinates of successive fixations on the scene video and summing them. The mean distance between fixations was computed as the total scan path length divided by the total number of fixations in the one-minute period. We calculated these eye-tracking outcomes for each segment from the two tasks.

Data analysis

To compare gaze behavior of high and low socially anxious participants in the two tasks, two mixed models multivariate analyses of variance (MANOVAs) were performed. The first MANOVA tested the visual avoidance hypothesis and

included the total fixation time on faces, the number of fixations on faces and the mean duration of fixations on faces in seconds as dependent variables. The second MANOVA tested the hypervigilance hypothesis and included total scan path length in pixels and mean distance between fixations in pixels as dependent variables. Task was a within-participants factor (viewing vs. speech) and social anxiety group was the main between-participants factor (High Social Anxiety (HSA) vs. Low Social Anxiety (LSA)). Order was included as a between-participants control variable (first speech vs. first viewing). If a MANOVA was significant, mixed models analyses of variance (ANOVAs) were performed as follow-up analysis. The multivariate approach (Wilks λ) was reported, because it does not assume sphericity. To assess the robustness of the effect of anxiety group, the analyses were repeated with cases scoring on the median assigned to the high social anxiety group and with the LSAS anxiety score as a continuous variable (see Supplementary Materials).

RESULTS

The analyses were based on data of 82 participants. While 88 participants completed the entire experiment, one participant was excluded because of missing data for the speaking task due to technical issues. Two participants were excluded because of insufficient quality of their eye-tracking data. Two other participants were excluded because of procedural errors during testing. One participant was excluded because she admitted to have poor eye-sight after the experiment. Four participants had missing values on the mean duration of fixations, because they did not fixate on any of the faces during the viewing task.

Preliminary analyses

Preliminary analyses explored whether significant relations existed among social anxiety (LSAS-Anxiety subscale), public speaking anxiety (PRPSA), and overall impressions of the audience (APL). Pearson correlation analyses demonstrated that social anxiety was significantly and positively related to public speaking anxiety (r = .64, p <. 001), and negatively to perception of the audience as a whole (r = -.23, p = .035).

Participant characteristics

The two orders of the tasks were represented equally among the two anxiety groups ($\chi^2(1)$ = 1.22, p = .269). Twenty-four participants in the low social anxiety (LSA) group and 17 participants in the high social anxiety (HSA) group started with the speaking task. The other participants started with the viewing task. Table 1 shows the characteristics of high and low socially anxious participants.

Table 1. *Sample characteristics for groups with high and low LSAS scores*

	HSA (n = 39)		LSA (n = 43)	
	M	**SD**	**M**	**SD**
Age	20.64	2.36	20.81	2.09
LSAS-Anxiety	34.23	9.72	12.56	6.15 ***
PRPSA	67.49	14.05	53.44	11.07 ***
APL	10.64	2.58	11.60	2.27

Note. HSA = high socially anxious participants; LSA = low socially anxious participants; LSAS-Anxiety = Liebowitz Social Anxiety Scale – Anxiety subscale; PRPSA = Personal Report Public Speaking Anxiety; APL = Audience Perception List. ***p <.001

Social anxiety and gaze behavior

The normality assumption was violated for the total fixation time on faces and the number of fixations on faces in both tasks, and for scan path length and the mean distance between fixations in the viewing task. To correct for skewness, a ln transformation was applied to the total fixation time on faces and a square root transformation was applied to the number of fixations on faces. After transformation, all variables met the assumption of normality. For scan path length and the mean distance between fixations in the viewing task, the violation of the normality assumption was due to outliers. In both variables, three extremely low and two extremely high values, were replaced by the lowest and highest value in the rest of the sample, respectively.[1] Means and standard deviations of the raw gaze behavior variables in the speech task and the viewing task for HSA and LSA groups are presented in Table 2.

Table 2. *Means of the raw gaze behavior variables in the speech task and the viewing task for HSA and LSA groups. Fixation times are in seconds. Standard deviations are in parentheses*

	HSA		LSA	
	Speaking	**Viewing**	**Speaking**	**Viewing**
Total fixation time on faces	6.5 (5.8)	10.5 (10.2)	10.1 (8.6)	9.3 (12.3)
Number of fixations on faces	20.46(16.3)	21.0 (18.4)	27.8(17.3)	17.8(19.2)
Mean fixation time on faces	.29 (.12)	.47 (.22)	.34 (.13)	.42 (.20)
Total Scan path length	66395 (25841)	50858 (27331)	71175 (23656)	54481 (21896)
Mean distance between fixations	503 (139)	479 (237)	503 (125)	483 (113)

Note. Fixation times are in seconds. Standard deviations are in parentheses.

Regarding the avoidance hypothesis, the results of the MANOVA indicated a main effect of task (*Wilks* λ = .595, $F(3,72) = 16.35$, $p < .001$, p*artial* η^2 = .405), as well

1 The analyses showed the same pattern of results when the extreme values were included.

as a significant interaction between anxiety group and task (*Wilks* λ = .898, $F(3,72)$ = 2.74, p = .050, p*artial* η^2 = .102). Three follow-up mixed-model ANOVAs were conducted on the dependent variables.

For the total fixation time on faces, the analysis showed a significant interaction between task and social anxiety group (*Wilks* λ = .925, $F(1,78)$ = 6.35, p = .014, p*artial* η^2 = .075). Independent samples t-tests showed that LSA participants spent more time fixating on the faces than HSA participants during the speech task ($t(80)$ =2.28, p = .025), whereas there was no difference in the viewing task. No other main effects or interactions were significant.

For the number of fixations on faces, the analysis showed a main effect of task (*Wilks* λ = .939, $F(1,78)$ = 5.07, p = .027, p*artial* η^2 = .061). Participants fixated more often on the faces of the audience members during the viewing task than during the speech task. Moreover, there was also a significant interaction between task and social anxiety group (*Wilks* λ = .9439, $F(1,78)$ = 4.75, p = .032, p*artial* η^2 = .057). Independent samples t-tests indicated that LSA participants fixated more often on the faces than HSA participants during the speech task ($t(80)$ = 2.15, p = .035), but there was no difference during the viewing task. No other main effects or interactions were significant.

For the mean duration of fixations on faces, the analysis showed a significant main effect of task (*Wilks* λ = .698, $F(1,74)$ = 32.06, $p < .001$, p*artial* η^2 = .302), but no other significant main effects or interactions. The mean duration of fixations on faces was longer in the viewing task than in the speech task. In summary, the results are in line with the hypothesis that socially anxious people avoid looking at faces in the audience during a speech task. The HSA group spent less time looking at the faces than the LSA group. The fixations were of similar duration, but less frequent in the HSA group.

Regarding the hypervigilance hypothesis, the MANOVA on scan path length parameters revealed a main effect of task (*Wilks* λ = .709, $F(2,77)$ = 15.82, $p < .001$, p*artial* η^2 = .291), but no interaction effects. A follow-up mixed-model ANOVA on scan path length also showed a main effect of task, *Wilks* λ = .747, $F(1, 78) = 26.48$, $p < .001$, *Partial* η^2 = .253. Participants exhibited longer scan path length while speaking than while viewing the audience (see Table 2). There were no main or interaction effects of social anxiety, indicating that social anxiety did not affect the total scan path length. The mixed-model ANOVA on the mean distance between fixations did not show any significant main or interaction effects. In summary, the results were in

line with the hypothesis that the HSA group would not show more indications of hypervigilance than the LSA group.

DISCUSSION

The present study investigated the influence of the type of social situation on the relation between gaze behavior and social anxiety in a community sample. While their eye movements were tracked using eye-tracking glasses, participants were asked to give a one-minute introduction of themselves in front of a neutral audience in one situation and to simply view the audience for the same period of time in the other situation. The results provided empirical evidence for the moderating effect of social situations. That is, in the public speaking task, HSA individuals looked less frequently and for a shorter amount of time at the faces of the audience than LSA individuals, whereas no difference was observed in the face-viewing task. Moreover, there was no indication of hypervigilance for HSA participants, because all participants exhibited increased scan path length when giving a speech in front of the audience compared to when they were simply watching them. Despite the modest internal consistency of the APL, the present study also replicated a finding by Blöte et al. (2014) that participants with higher levels of social anxiety had more negative impressions of the audience.

In line with our main prediction, HSA participants displayed visual avoidance of faces, indexed as significantly reduced fixation time and counts on faces of the audience. Avoidance took the form of fewer fixations on faces, but the mean duration of those fixations did not differ between LSA and HSA participants. Importantly, this avoidance was only found during the actual performance of the speech. Not only are such findings consistent with previous public speaking studies conducted with community samples (Lowe et al., 2002; Farabee et al., 1993), but they are also in line with studies reporting no effects of social anxiety in community samples during face-viewing (e.g., Berdica, Gerdes, Bublatzky, White, & Alpers, 2018; Gregory, Bolderston, & Antolin, 2019; Mühlberger, Wieser, & Pauli, 2008; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). The findings extend previous research by providing direct evidence, within the same sample, that visual avoidance of faces in HSA persons depends on the type of social situation.

The avoidance patterns in HSA participants was only found during the speech; this supports that visual avoidance of faces may be a result of social-evaluative threat. Furthermore, the current findings are in line with prior studies using face-viewing task, which did not find indications of avoidance (or other distinct gaze patterns) in people with elevated social anxiety symptoms (e.g., Berduca et al., 2018; Georgy et

al., 2018; Mühlberger et al., 2008; Waechter et al., 2014), even though some of them induced anticipatory state anxiety (e.g., by informing participants that they have to do a public speaking task after the completion of the face-viewing task). For example, Georgy et al. (2018) did not identify differences in eye-movement patterns when high and low socially anxious participants watched a two-minute video displaying natural social scenarios. Similarly, socially anxious individuals displayed a normal gaze pattern in a virtual environment, expecting that they would have to give a speech afterwards (Mühlberger et al., 2008). In viewing conditions, either with or without an anticipatory threat, participants do not have to expose themselves (as opposed to speech tasks) and hence HSA individuals are not tempted to use safety behaviors, because they hardly expect to be negatively evaluated. Therefore, our results seem to fit better with a safety behavior interpretation than the state anxiety interpretation. Nevertheless, it is possible that the avoidance tendency could be linked to substantial state anxiety triggered by a combination of a negative impression of the audience and an interaction of both high trait and high state anxiety in our public speaking tasks, indicating that the state anxiety explanation could not be clearly ruled out. Future research including measures of state anxiety is needed.

With respect to scan path length, the current study found a task effect, but no difference between HSA and LSA participants. There were also no differences in the mean distance between fixations. Participants exhibited longer overall scan path length in speech than in face-viewing situations. One possible reason concerns cognitive demands during speaking; people are likely to make gaze aversions when they think hard, because looking at someone's eye-region is too distracting when cognitive load is experienced (Doherty-Sneddon, Bruce, Bonner, Longbotham, & Doyle, 2002). Meanwhile, people have to monitor the audience's reactions while performing a speech that may lead to a sequence of looking away and looking back at the faces in the audience. Hence, people may display longer scan path length during a speech. Our results are not in line with the findings from clinical samples that SAD patients are hypervigilant in social situations (Chen et al., 2015; Horley, Williams, Gonsalvez, & Gordon, 2003; Horley, Williams, Gonsalvez, & Gordon, 2004; Wermes et al., 2018), but they are consistent with other studies with a community sample that reported no differences during public speaking (Lowe et al., 2012), as well as during a face-viewing task in which a natural social scenario was dynamically presented (Gregory et al., 2019). Collectively, it seems that the effect of severity of social anxiety symptoms is an important explanation: in naturalistic social-evaluative situations HSA people appear to display different scan patterns than patients with SAD.

The finding that the avoidance tendency varies across social situations in socially anxious individuals from a community sample may have implications for early

detection of social anxiety. Naturalistic situations with heightened social-evaluative threat may be more likely to offer the opportunity to identify individuals with high levels of social anxiety before they experience the profound impairment associated with social anxiety disorder than situations lacking such threat. In addition, assessing eye-gaze behavior in natural social-evaluative situations may be useful to monitor progress during therapeutic interventions with socially anxious individuals. Further research is needed to investigate whether assessment of eye-gaze behavior could be a useful tool for early detection and intervention for individuals with moderate to high levels of social anxiety.

The present study extended previous research by comparing two distinct types of social situations while presenting identical stimuli and provided direct evidence for moderating effects of this situational factor on the relation between social anxiety and visual avoidance of faces. However, some limitations should be noted. First, the two situations – public speaking and face-viewing – did not only differ in their levels of social-evaluative threat but also differ in their cognitive demands. Social-evaluative threat might still be the more likely explanation of social anxiety-related differences in gaze behavior. Nonetheless, this interpretation could be tested by manipulating social-evaluative threat in a more direct way (e.g., by manipulating the presence of observers). Moreover, state anxiety could be measured to clarify the contributions of state anxiety and safety behaviors in visual avoidance of faces. Second, our situation was not completely naturalistic, because we used a pre-recorded audience and participants knew that the audience members could not actually evaluate them. This could have lowered social-evaluative threat levels. However, research with the Leiden PST showed that speaking in front of this audience evoked considerable social-evaluative stress (Westenberg et al., 2009). In addition, an earlier study found minimal differences between virtual and real public speaking environments (Kothgassner et al., 2016). Third, existing studies indicate that decreased attention to (images of) faces in HSA adults may not be simply because these people attempt to entirely withdraw from faces. Instead, they tend to relocate attention to other parts of the body to obtain important social information (Kim & Lee, 2016; Kret et al., 2017). However, our stimulus material of people sitting in rows and behind tables was ill-suited to investigate gaze patterns on the body. Hence, future research could explore possible body biases in a set-up where more of the body is visible. Fourth, this study only included female emerging adults (average age of 21), which prevents generalization towards other populations. Previous research has indicated that gaze behavior may be influenced by development (Chen et al., 2020) and gender (e.g., Jun, Mareschal, Clifford, & Dadds, 2013). Specifically, in contrast to the avoidance tendency observed in adults, socially anxious children tend to maintain their attention on the eye-region (Morgan & Banergee, 2006). In addition, a study found that socially anxious males are more

likely to overestimate being looked at, but socially anxious female participants did not show this bias (Jun et al., 2013). In future research, these factors could be considered to obtain a full picture of gaze behavior in social anxiety.

CONCLUSIONS

Our study provides supporting evidence that visual avoidance of faces in HSA individuals depends on the nature of the social situation. Avoidance does not occur by default, but seems to occur only when risks of (negative) social consequences are perceived. Importantly, there was no sign of hypervigilance in HSA persons. Future studies may examine the role of social-evaluative threat more directly and explore whether socially anxious individuals look at other body parts of social partners (e.g., hands) while paying less attention to their faces.

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SUPPLEMENTARY MATERIALS

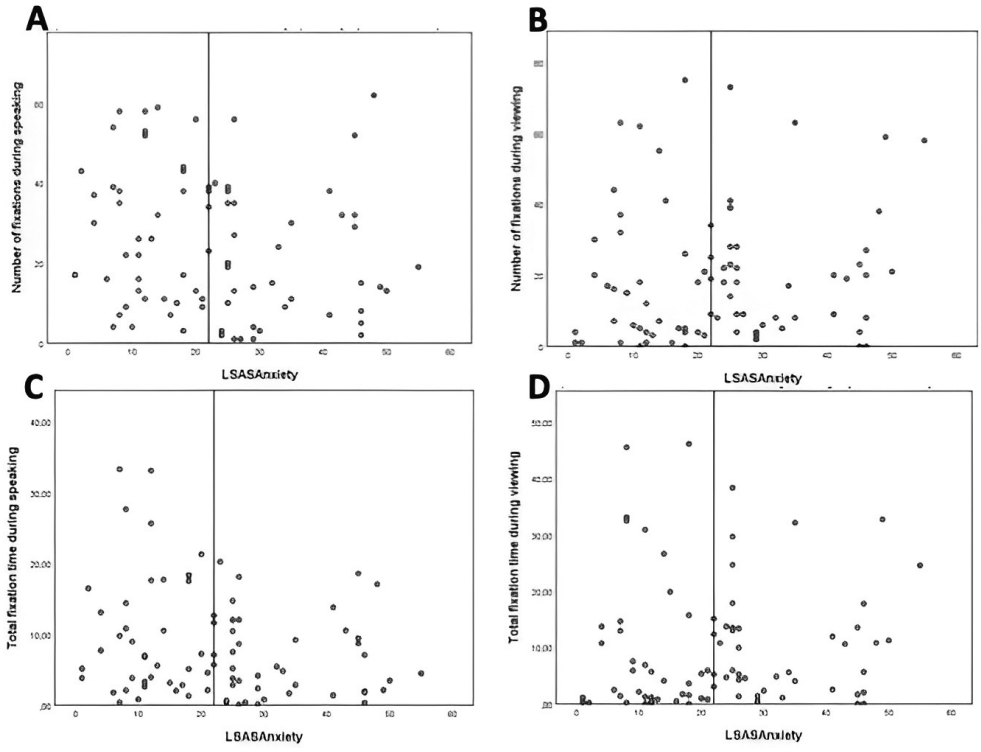

Figure 1. Scatter plots with median line of social anxiety and eye-tracking variables. (A) Number of fixations on all faces in the speaking task. (B) Number of fixations on all faces in the viewing task. (C) Total fixation time on all faces in the speaking task. (D) Total fixation time on all faces in the viewing task. Social anxiety was measured with the anxiety subscale of the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987).

Additional MANOVAs

In order to examine the robustness of the effect of social anxiety, the MANOVA's were repeated with cases scoring on the median assigned to the other group and with the square root transformed LSAS-Anxiety score as a covariate.

Alternative assignment of cases scoring on the median

Regarding the avoidance hypothesis, the mixed-model MANOVA with the number of fixations on all faces, the total duration of fixations on all faces and the mean duration of fixations on all faces as dependent variables showed a main effect of task (*Wilks* λ = .599, $F(3,72) = 16.07$, $p < .001$, p*artial* $\eta^2 = .401$), as well as a significant interaction

between anxiety group and task (*Wilks* λ = .875, $F(3,72) = 3.41$, $p = .022$, p*artial* η^2 = .125). Regarding the hypervigilance hypothesis, the MANOVA with total scan path length and mean distance between fixations as dependent variables showed a main effect of task (*Wilks* λ = .706, $F(2,77) = 16.00$, $p < .001$, p*artial* η^2 = .294), but no interaction effects.

Therefore, there was no impact of the assignment of the cases that score on the median on the pattern of the results.

LSAS-anxiety as a continuous variable

Regarding the avoidance hypothesis, the mixed-model MANOVA with the number of fixations on all faces, the total duration of fixations on all faces and the mean duration of fixations on all faces as dependent variables showed a main effect of task (*Wilks* λ = .865, $F(3,73) = 3.80$, $p = .014$, p*artial* η^2 = .135), as well as a marginal significant interaction between anxiety and task (*Wilks* λ = .911, $F(3,73) = 2.38$, $p = .077$, p*artial* η^2 = .089). In summary, although the interaction is only marginally significant, the analysis with LSAS anxiety as a continuous variable shows the same pattern of results.

Regarding the hypervigilance hypothesis, the MANOVA with total scan path length and mean distance between fixations as dependent variables did not show any significant main or interaction effects.

CHAPTER 4

Social anxiety is related to reduced face gaze during a naturalistic social interaction

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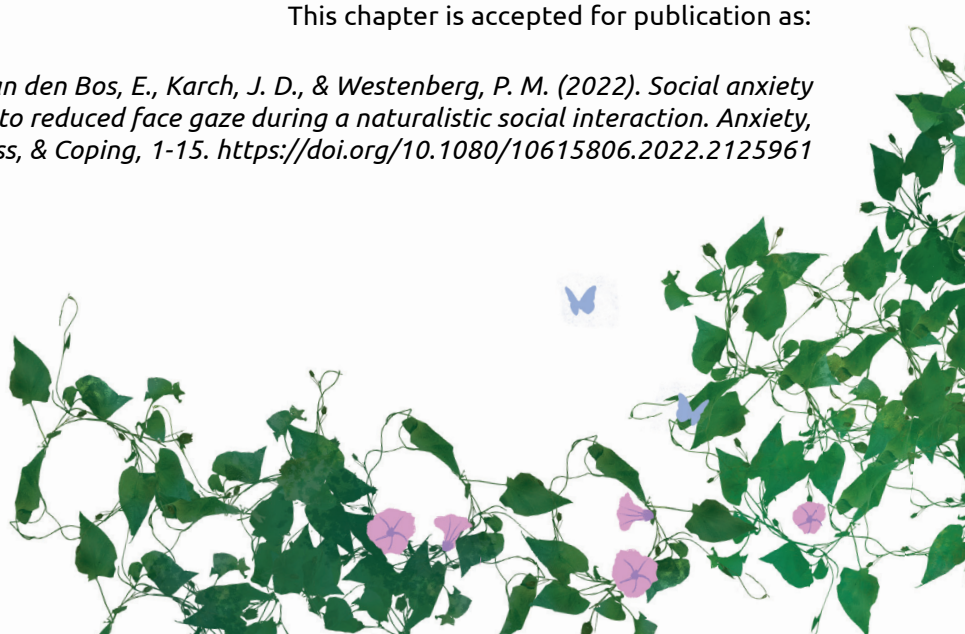

ABSTRACT

Background: Social anxiety has long been related to reduced eye contact, and this feature is seen as a causal and a maintaining factor of social anxiety disorder. The present research adds to the literature by investigating the relationship between social anxiety and visual avoidance of faces in a reciprocal face-to-face conversation, while taking into account two aspects of conversations as potential moderating factors: conversational role and level of intimacy.

Method: Eighty-five female students (17 – 25 years) completed the Leibowitz Social Anxiety Scale and had a face-to-face getting-acquainted conversation with a female confederate. We alternated conversational role (talking versus listening) and manipulated intimacy of the topics (low versus high). Participants' gaze behavior was registered with Tobii eye-tracking glasses. Three dependent measures were extracted regarding fixations on the face of the confederate: total duration, proportion of fixations, and mean duration.

Results: The results revealed that higher levels of social anxiety were associated with reduced face gaze on all three measures. The relation with total fixation duration was stronger for low intimate topics. The relation with mean fixation duration was stronger during listening than during speaking.

Conclusion: The results highlight the importance of studying gaze behavior in a naturalistic social interaction.

INTRODUCTION

Social anxiety disorder (SAD) is 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). Both adults and children with SAD report that they avoid eye contact in their social lives (Kley et al., 2012; Schneier et al., 2011). Likewise, inadequate eye contact has been recognized in the diagnostic process as a supporting feature of the disorder (APA, 2013, p. 204). According to cognitive theories, avoidance of eye contact by people with SAD serves as a safety-seeking strategy, aimed at avoiding feared social outcomes without completely withdrawing from social situations (e.g., Clark & Wells, 1995). Moreover, this visual avoidance is thought to possibly play an etiological and maintaining role in social anxiety and in SAD. For example, Spence and Rapee (2016) suggested that avoidance of eye contact may be a risk factor for the development of social anxiety and SAD. Avoidance of eye contact is likely to result in poor social performance, which may trigger negative responses from others, for instance being perceived as more anxious and less likeable (Gray et al., 2019; Leigh et al., 2021). These negative experiences, in turn, may heighten anxiety. Besides, the use of safety behaviors, including eye contact avoidance, is considered as the most critical attribute that maintains social anxiety in patients (Hofmannn, 2007; Piccirillo et al., 2016) and non-clinical samples (e.g., Gray et al., 2019; McManus et al., 2008; Judah et al., 2019). Such behaviors prevent socially anxious individuals from disconfirming their beliefs as to feared social situations (Clark & Wells, 1995).

Previous empirical research provides support that visual avoidance of faces is a behavioral marker of SAD across a variety of facial expressions and situations (for reviews see Chen et al., 2020; Günther et al., 2021). However, it should be noted that the evidence largely stems from studies where facial stimuli were presented on a screen, such as face-viewing tasks and public speaking tasks in front of a pre-recorded audience. The implications for causal theories of SAD hinge on the assumption that the avoidance occurs *in actual social interactions*. Some initial evidence was provided by two studies implementing a live video connection between two people and finding reduced eye gaze in individuals with greater social anxiety when interacting with another person (Hessels et al., 2018; Howell et al., 2016). To our knowledge, only three eye-tracking studies have examined the relationship between social anxiety and visual avoidance of faces *in a face-to-face setting*, and the evidence is mixed (Haensel et al., 2020; Konovalova et al., 2021; Rösler at al., 2021).

Two face-to-face interaction studies reported that social anxiety was not associated with face gaze behavior. Konovalova et al. (2021) instructed participants to stay in a

room with a confederate who was occupied filling out a questionnaire. The confederate was instructed not to initiate conversations. There were no correlations between social anxiety and the number and duration of fixations on the head of the confederate. Rösler and colleagues (2021) registered participants' gaze behavior towards the face of a confederate while they were in a waiting room and confronted with a sequence of events: the confederate was first occupied in completing a questionnaire, then he received a phone call, and finally he initiated interaction with the participant. Participants showed increasing fixations on the confederate's face across the experiment regardless of their level of social anxiety. The authors suggested that avoidance may not occur in relatively safe situations, but be specific to threatening contexts.

The findings from the third study seem in line with this suggestion. Haensel and colleagues (2020) found that a significant negative association between social anxiety and fixation time on the face of the conversation partner was only evident at an early stage of a naturalistic interaction and only when participants were asked to introduce themselves (not when listening to the confederate's introduction). Moreover, after a guessing game intended to facilitate the interaction, the effect of social anxiety disappeared even when participants had to share a personal story. In addition, findings from observational studies implementing face-to-face conversations also suggest that visual avoidance of faces is restricted to less safe situations. Two studies reported that reduced eye contact in socially anxious individuals occurred when they were speaking, but not when they were listening (Baker & Edelmann; 2002; Daly, 1978).

Taken together, these studies suggest that socially anxious people specifically avoid gazing at someone's face during a face-to-face interaction requiring self-disclosure to a stranger. Self-disclosure, or revealing information about the self to others (Jourard, 1971), increases the potential for scrutiny and to be negatively evaluated. In some studies involving initial encounters (Baker & Edelmann, 2002; Daly; 1978; Haensel et al., 2020), the act of talking to strangers may have posed a risky situation for being negatively evaluated. Likewise, in the study by Langer et al. (2017), the demand to discuss a conflict may have signaled a risk of negative evaluation. In the other two studies this risk may have been rather low: the likelihood of having to engage in a conversation was basically absent in the study by Konovalova et al. (2021), and in the Rösler et al. (2021) study the confederate initiated a conversation about an impersonal topic (research participation). Altogether, two aspects of conversations seem crucially related to self-disclosure: conversational role (talking versus listening), and level of intimacy (topics low versus high on intimacy). Both factors may influence the perceived risk of negative evaluation, and the latter is a core concern of socially anxious individuals.

A wealth of research has demonstrated that self-disclosure is difficult for socially anxious individuals. They tend to talk less and not to reveal much information about themselves, both in initial encounters (e.g., Miller et al., 2021; Papsdorf & Alden, 1998; Kang & Gratch, 2010; Stevens et al., 2010) and in close relationships (e.g., Cuming & Rapee, 2010; Montesi et al., 2013; Sparrevohn & Rapee, 2009). Also, individuals higher in social anxiety showed prolonged physiological arousal compared to those lower in social anxiety when they conversed face-to-face with a same-sex stranger and were expected to share personal information (Ketay et al., 2019). Therefore, a demand for self-disclosure (e.g., intimate conversation topics) is likely to exacerbate the face gaze avoidance in high socially anxious individuals in social interactions. Yet, this hypothesis remains to be tested.

It should be noted that none of the existing gaze behavior studies have manipulated *both* aspects of conversations related to self-disclosure (conversational role and level of intimacy). Prior work has examined the two factors independently. Eye-tracking research has consistently shown that people exhibited more face gaze when listening than speaking, meanwhile the nature of the topic has been ignored (e.g., Freeth et al., 2013; Haensel et al., 2020). In contrast, a few observational studies have found that people displayed reduced eye contact when answering intimate questions compared to when answering impersonal questions, but participants in those studies were only required to speak; not to listen (e.g., Carr & Dabbs, 1974; Exline et al., 1965). Moreover, replication in eye-tracking studies is needed. It is therefore unclear to what extent these aspects contribute to the threat of a situation in which socially anxious individuals avoid looking at another person's face.

The current study aimed to clarify the relationship between social anxiety and visual avoidance of faces in actual social interactions by examining the effects of conversational role and level of intimacy. Using a face-to-face getting-acquainted conversation, two independent manipulations were employed: 1) conversational role (speaking versus listening) and 2) level of intimacy (conversation topics: low versus high intimacy). Three face gaze measures were used as dependent variables: total duration of fixations on the face of the confederate, proportion of fixations on the face of the confederate and mean duration of a fixation on the face of the confederate. The following hypotheses were addressed.

Hypothesis 1: All participants, regardless of social anxiety level, would show decreased face gaze when it was their turn to speak (e.g., Freeth et al., 2013; Haensel et al., 2020). **Hypothesis 2:** All participants, regardless of social anxiety level, would show decreased face gaze when the conversation topics were more intimate (e.g., Carr & Dabbs, 1974; Exline et al., 1965). **Hypothesis 3:** Participants with elevated social

anxiety would generally display decreased gaze to the face of the confederate across the conversation (e.g., Hessels et al., 2018; Howell et al., 2016). **Hypothesis 4:** The face gaze avoidance adopted by high socially anxious participants would only occur during speaking (Baker & Edelmann, 2002; Daly, 1978; Haensel et al., 2020). **Hypothesis 5:** Given that high reciprocal self-disclosure is likely to evoke more anxiety in people higher in social anxiety (e.g., Ketay et al., 2019), the effects of intimacy of topics would be stronger for high socially anxious individuals.

METHOD

Participants

Participants were selected on the basis of their scores on the self-report version of the Liebowitz Social Anxiety Scale (LSAS-SR; Liebowitz, 1987), which was a part of an online survey concerning anxiety profiles. Participants with scores on the LSAS-SR below 30 were categorized as low socially anxious (LSA), participants with scores between 30 and 59 were categorized as medium socially anxious (MSA) and participants with scores above 59 were categorized as high socially anxious (HSA; Liebowitz, 1987). Stratified sampling from these groups was employed in order to obtain a uniform distribution of participants with different levels of social anxiety. A total number of 458 undergraduate students aged between 17 to 25 years completed this survey (87.74% female). Female students (HSA = 110, MSA = 202, LSA = 96) were invited via email to take part. The final sample consisted of 85 participants (HSA = 28, MSA = 27, LSA = 30) with a mean age of 20.64 years (SD = 2.24 years) [1].

This study aimed to investigate same-sex interactions, because initial opposite-sex encounters, in particular involving intimate self-disclosure, may be associated with a more specific dating context (e.g., Derlega et al., 1985). Because of the demographic of the local student population, the current study was restricted to females. All participants have self-reported normal or corrected-to-normal vision. Participants gave written informed consent and were fully debriefed afterwards. They received either two credits or €6.50 for participating in the experiment. The University's ethics committee for psychological research approved the study protocol.

1 The low response rate was largely due to regulations to prevent the spread of Covid-19. The data were collected between March2020 and April2021. From March to July 2020 no lab sessions could be scheduled with participants who had completed the pre-screening as part of an online survey, because all labs were closed. When the labs reopened, people were still encouraged to minimize social contact and education remained completely online. This reduced students' willingness to participate in lab sessions at the university.

Materials

Liebowitz Social Anxiety Scale-Self Report (LSAS-SR; Fresco et al., 2001; Liebowitz, 1987)

The level of social anxiety of each participant was assessed using the LSAS-SR questionnaire. The LSAS-SR consists of 24 items, including 11 items about social interaction (e.g., "Meeting strangers") and 13 items about social performance (e.g., "Telephoning in public"). The instrument uses a 4-point Likert scale to rate both anxiety (0 = none, 3 = severe) and avoidance (0 = never, 3 = usually) in each of these situations. This study used participants' total score on the LSAS-SR. In the current sample of 85, Cronbach's alpha of the LSAS-SR was .96 at pre-screening and .97 at the day of testing. The total scores of the first and second administration of the LSAS-SR were highly correlated (r = .88, p < .001). The time interval between the two administrations of the LSAS-SR ranged from 2 - 184 days.

Apparatus

We utilized two Tobii Pro Glasses 2 wearable eye-trackers (Tobii Technology AB, Sweden) to simultaneously record both the participant's and the confederate's eye movements during the conversation. Only the participant's eye movements were analyzed. Each eye-tracker is equipped with 4 eye cameras which track people's eye movements in relation to the external environment they are watching, and with one scene camera to video-record the scene in front of the wearer (field of view 90° 16:9, visual angle 82° horizontally and 52° vertically, resolution 1920 X 1080 pixels). It records eye gaze at a sampling frequency of 100 Hz and a scene video at 25 Hz. An embedded microphone records the audio scene. Each eye-tracker was controlled by Tobii Glasses controller software installed on a tablet computer through a wireless connection. The software was used for recording and calibrating.

Conversation task

An adapted version of the relationship-building task (adapted from Kashdan et al., 2004; 2006; 2014)[2] was used in this study. Prior to testing, participants were informed that a fellow student who was involved in the research project (i.e., confederate) would be conversing with them. The participant and the confederate took turns in answering questions and listening to each other's answers. Each turn started with the speaker reading out the question she had to answer. Participants were instructed to make each answer as long as possible (e.g., "we would like you to talk as much as possible, and try to make each answer last at least 1 minute") and to minimize interactions beyond

2 In the original version, participants were randomly assigned to either closeness-generating conversations (intimate topics) or small-talk conversations (general topics). In this study, we combined the two types of conversation into one continuous conversation.

listening to the other's answers and answering the questions on their own cards (e.g., no follow-up questions) during the conversation. They also were aware that they could take time to think before answering, and that the content of their answers would not be analyzed.

The conversation included 18 questions (see Supplementary Material), which were selected from Aron et al. (1997) and adjusted to suit the local circumstances. These questions were individually presented on 18 topic cards made of colored construction paper. Two sets of 9 cards were placed in front of the participant and the confederate respectively. The order of the questions was fixed. For each conversation partner, the first and last block of 3 questions were less personal questions (e.g., "Do you think left-handed people are more creative than right-handed people? Why?" and "What book have you read recently? Tell your partner about it"). The questions in the middle block were more personal (e.g., "What is the greatest accomplishment in your life?" and "Share with your partner an embarrassing moment in your life"). The confederates were instructed to start the conversation in order to set an example.

Confederates

Three female confederates, of similar ages to the participants (two undergraduate honors students and one master's student), were involved in the study. They were informed about the manipulation (more vs. less intimate topics), but they were blind to the social anxiety level of each participant. Confederates were trained to behave in a natural and friendly way toward participants throughout the conversation and they were trained to answer each question consistently across participants in terms of content as well as length (at least 1 minute). They were instructed to keep their clothes and hair-style as consistent and simple as possible throughout the study to prevent potential distractions (e.g., simple black T-shirt and ponytail). The confederates were not acquainted with any of the participants.

Procedure

All participants were requested not to wear eye make-up on the day of testing (none of them did it). They were asked to fill out the LSAS-SR online before visiting the lab (to minimize the time participants spent in the lab, in line with COVID-19 regulations). Along with the LSAS-SR, they were also asked to report their native language and to rate their fluency in English to evaluate possible language effects (the scale varied from "1" to "10", where "10" was defined as "as fluent as your native language").

The conversation task took place in a room with stable light conditions and attenuated sound. A table was placed in the middle of the room, with two comfortable chairs at either side opposite from each other, approximately 1.8 meters apart. The background

behind the confederate was a blank white wall. After giving informed consent, participants were fitted with the eye-tracker, and the one-point calibration procedure was conducted, in which participants were instructed to fixate on the central black dot of the calibration card that was pasted on a white wall (at 1.5 meters). Meanwhile, the confederate put on the eye-tracker in a separate room. It was calibrated with the help of the experimenter when she came into the lab (following the same calibration procedure as the participants). The confederate was introduced and sat across the table from the participant. Next, the participant and confederate were introduced to the conversation task and started the task after receiving the start signal. On completion of the final question, the experimenter re-entered the room and the confederate left. Participants were asked to take off the eye-tracker. Finally, they were debriefed and compensated.

Data preparation

Eye-tracking data was recorded throughout the entire conversation task. However, only the segments where the questions were being answered were analyzed. For example, small-talk beyond the answer segments and thinking phases before giving answers were excluded. Therefore, each participant's data was composed of the 18 answer segments.

The area of interest (AOI) – face – was manually drawn on reference images of the confederates (see Figure 1) by using the Areas of Interest tool of the Tobii pro Lab (analyzer edition, version 1.98). The face AOI corresponded to a visual angle of 5.7° horizontally and approximately 7° vertically. Eye-tracking data was processed using Tobii pro Lab. We used the Tobii I-VT (Velocity-Threshold Identification) Attention gaze filter, which has been designed for the use of eye-tracking glasses in dynamic situations. The attention filter identifies fixations using a velocity threshold of 100°/s and a minimum fixation duration of 60 milliseconds (ms). Adjacent fixations are merged when the time between fixations is no more than 75 ms and the distance between fixations is no more than 0.5°, based on the average data from both eyes (Olsen, 2012). The fixations that had been registered relative to the scene video were automatically mapped onto the reference images. The result of the automatic mapping procedure was then checked by a human observer (J.C.), by visually comparing the mapped fixations on the reference images with the fixations on the scene video. The observer manually corrected the mapping whenever automatic mapping led to inaccurate classification of a fixation as on or outside of the AOI.

Figure 1. *One of the reference images depicting the conversation task; the gray circle is the face AOI*

The following parameters were exported: (1) total fixation count in each segment. (2) Total duration of each segment in seconds. (3) Total fixation count on the face of the confederate in each segment. (4) Total fixation duration on the face of the confederate in each segment in seconds. Three eye-tracking measures were calculated in this study: (1) The total fixation duration on the face of the confederate, which was the sum of all fixations on the face over the course of a speech turn. (2) The proportion of fixations on the face of the confederate, which was computed by dividing the fixation counts on the face by the total fixation counts. (3) The mean fixation duration on the face, which was computed by dividing the total fixation time on the face by the number of fixations on the face.

Data analysis

Data were analyzed using Statistical Package for the Social Science (SPSS), version 25.0.

In preliminary analyses, we explored: 1) Whether the three confederates influenced the participants' face gaze behavior. This was tested using three separate one-way analyses of variance (ANOVAs) with total fixation duration on the face, proportion of fixations on the face as well as mean fixation duration on the face as the dependent variables. 2) Whether the length of self-disclosure (participants' answer segments) was influenced by conversational block and social anxiety. This was tested using a repeated-measures analysis with conversational block as the within-subjects factor and LSAS-SR score as the covariate. The total duration of speaking was added as the dependent variable.

To clarify how face gaze behavior was influenced by social anxiety, conversational role and intimacy of topic, a 2 (conversational role: speaker vs. listener) x 2 (intimacy: high vs. low) multivariate analyses of covariance (MANCOVA) with LSAS-SR score on the day of testing as the covariate was performed. If the MANCOVA was significant, repeated-measures ANCOVAs were conducted as follow-up analyses. LSAS-SR score was entered as a covariate. Conversational role and intimacy were included as the within-subjects factors. The total fixation duration on the face, proportion of fixations on the face, and mean fixation duration on the face were the dependent variables. To quantify the precision of our estimates, we reported 90% confidence intervals on the partial eta-squared effect size (c.f. Colegrave & Ruxton, 2003; Levine & Ensom, 2001).

RESULTS

Four participants' data were excluded for the following reasons: One participant was excluded because the connection between one eye-tracker and its paired tablet was lost during testing. Two participants were excluded because of poor quality of eye-tracking data (gaze samples < 50%; *Mrest* = 83%, SD = 12%). One participant was excluded because she had received training to maintain eye contact during conversations to alleviate her symptoms of attention deficit/hyperactivity disorder. Therefore, 81 participants' data were used for the current analyses. The participants' total score on the LSAS-SR ranged from 4 – 95 (M = 41.23, SD = 23.23). The participants' mean rating of their proficiency in English was 8.16 (SD = 1.36, range: 5 – 10). Descriptive statistics for face gaze data are shown in Table 1.

Table 1. *Descriptive statistics for segment duration and face gaze measures*

Conversational Role	Listening		Speaking	
Intimacy Level	**Low**	**High**	**Low**	**High**
		Segment duration in seconds		
M (SD)	455 (98)	261 (59)	426 (131)	195 (82)
Skewness	.22	-.04	.43	1.02
Kurtosis	-.87	-.92	.79	1.29
		Total fixation duration on face in seconds		
M (SD)	217 (127)	122 (72)	76 (54)	33 (24)
Skewness	.17	.30	1.06	.99
Kurtosis	-.42	-.44	1.00	.41
		Proportion of fixations on the face		
M (SD)	.49 (.27)	.48 (.26)	.18 (.10)	.17 (.10)
Skewness	.21	.09	.36	.45
Kurtosis	-.67	-.79	-.31	-.53
		Mean fixation duration on face in seconds		
M (SD)	1.17 (.72)	1.24 (.85)	.60 (.32)	.61 (.32)
Skewness	.88	1.18	1.43	1.19
Kurtosis	.24	1.14	2.18	1.57
		Natural logarithm of mean fixation duration on face in seconds		
M (SD)	.72 (.32)	.75 (.35)	.45 (.18)	.46 (.19)
Skewness	.20	.44	.86	.64
Kurtosis	-.43	-.42	1.00	.46

Preliminary analyses

Confederate

The results from the three one-way ANOVAs, $F(2,78) > .141$, $p > .422$, indicated that none of the three face gaze variables differed significantly between the confederates. Therefore, it could be concluded that the three confederates did not differentially influence face gaze behavior of the participants in the conversation task.

Length of self-disclosure

Conversational block ANCOVA was performed with the total duration of participants' answers to the three questions in each block. For two extreme outliers in block 2 (> 3 SD), winsorized values were used. There was no main effect or interaction with social anxiety, $p > .270$. A main effect of block was found, Wilks's Lambda = .719, $F(2, 78) = 15.21$, $p < .001$, $n^2_p = .28$. Pairwise comparisons using Bonferroni correction showed that the total duration of block 3 was significantly different from block 1 and

block 2 (both $p \leq .002$). Participants overall increased the duration of their answers throughout the conversation (M_{block1} = 170 seconds, M_{block2} = 195 seconds, and M_{block3} = 256 seconds).

Face gaze and social anxiety

We used winsorized values for extreme outliers (> 3 SD: three in the total fixation duration on the face, two in the proportion of fixations on the face, and one in the mean fixation duration on the face). The normality assumption was violated for the mean fixation duration on the face; thus a ln transformation was applied to this variable. See Table 1 for the resulting skewness and kurtosis values per condition.

A 2 (conversational role) x 2 (level of intimacy) MANCOVA was performed with the face gaze measures as the dependent variables. There was a main effect of conversational role, Wilks's Lambda = .551, $F(3, 77) = 20.96$, $p < .001$, $n^2_p = .449$, 90% CI [.294; .540], and a main effect of intimacy, Wilks's Lambda = .507, $F(3, 77) = 24.92$, $p < .001$, $n^2_p = .493$, 90% CI [.341; .578]. There was an interaction between intimacy and conversational role, Wilks's Lambda = .793, $F(3, 77)= 6.72$, $p < .001$, $n^2_p = .207$, 90% CI [.067; .310]. Three follow-up ANCOVAs were conducted on the dependent variables.

For the total fixation duration on the face, the ANCOVA showed a main effect of conversational role, Wilks's Lambda = .639, $F(1,79)= 44.65$, $p < .001$, $n^2_p = .361$, 90% CI [.222; .473], indicating that participants overall spent less time fixating on the face of the confederate during speaking (M = 54.55) compared to during listening (M = 169.42). This is in line with hypothesis 1. There was a main effect of intimacy, Wilks's Lambda = .517, $F(1,79) = 73.88$, $p < .001$, $n^2_p = .483$, 90% CI [.348; .580], indicating that participants overall spent shorter time fixating on the face of the confederate in high intimate conditions (M = 77.40) compared to low intimate conditions (M = 146.57). This is in line with hypothesis 2. Also, there was an interaction effect between conversational role and intimacy, Wilks's Lambda = .807, $F(1,79)= 18.91$, $p < .001$, $n^2_p = .193$, 90% CI [.077; .313]. This was not hypothesized. Means are provided in Table 1. Paired-samples t-tests showed that all means were significantly different ($p < .001$).

As was expected, a significant relation with social anxiety was found, $F(1,79) = 5.41$, $p = .023$, $n^2_p = .064$, 90% CI [.005; .164]. Pearson correlation revealed that social anxiety was significantly negatively correlated with total fixation duration on the face during the conversation, $r(81) = -.255$, $p = .021$, which was in accordance with hypothesis 3. In contrast to hypothesis 4, there was no significant interaction between conversational role and social anxiety, $F(1,79) = .107$, $p = .744$, $n^2_p = .001$, 90% CI

[.000; .040]. However, there was an interaction between intimacy and social anxiety, Wilks's Lambda = .951, $F(1,79) = 4.11$, $p = .046$, $n^2_p = .049$, 90% CI [.001; .144]. Figure 2 shows that the relation between social anxiety and total fixation duration on the face is stronger in the low intimacy condition than in the high intimacy condition, which is in contrast to hypothesis 5.

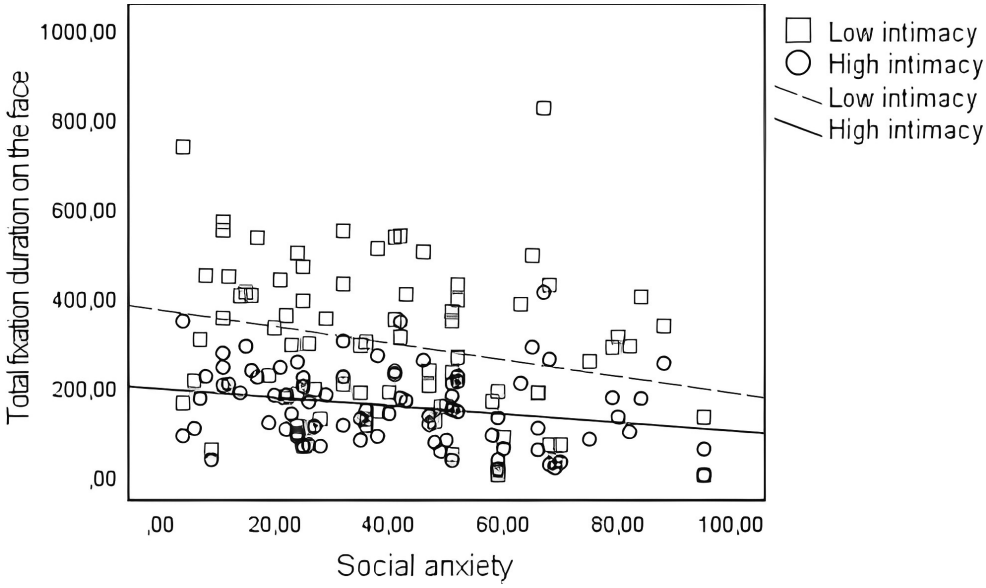

Figure 2. *Scatterplot showing the relation between social anxiety and total fixation duration on the face in seconds for low and high intimacy conditions*

For the proportion of fixations on the face, the ANCOVA showed a main effect of conversational role, Wilks's Lambda = .644, $F(1,79) = 43.74$, $p < .001$, $n^2_p = .356$, 90% CI [.217; .469], indicating that participants overall fixated on the face of the confederate more often during listening ($M = .48$) compared to during speaking ($M = .18$). This is in line with hypothesis 1. Hypothesis 2 was not supported, although there was a trend for a main effect of intimacy, Wilks's Lambda = .963, $F(1,79) = 3.06$, $p = .084$, $n^2_p = .037$, 90% CI [.00; .125] (low intimacy $M = .34$, high intimacy $M = .32$). Moreover, there was a main effect of social anxiety, $F(1,79) = 4.32$, $p = .041$, $n^2_p = .052$, 90% CI [.001; .147]. In line with hypothesis 3, Pearson correlation showed that social anxiety was significantly negatively correlated with proportion of fixations on the face, $r(81) = -.233$, $p = .037$. In contrast with hypotheses 4 and 5, neither interaction between conversational role and social anxiety, $F(1,79) = .134$, $p = .715$, $n^2_p = .002$, 90% CI [.000; .043], nor interaction between intimacy and social anxiety was significant, $F(1,79) = 1.00$, $p = .084$, $n^2_p = .013$, 90% CI [.000; .080].

For the mean fixation duration on the face, the ANCOVA showed a main effect of conversational role, Wilks's Lambda = .610, $F(1,79)= 50.40$, $p < .001$, $n^2_p = .390$, 90% CI [.250; .498], indicating that a participant's fixation on the face of the confederate was on average longer during listening ($M = .73$) than during speaking ($M = .47$). This is in line with hypothesis 1. There was no main effect of intimacy, $F(1,79)= .003$, $p = .958$, $n^2_p = .00$, 90% CI [.000; .002], which is in contrast with hypotheses 2. As predicted, there was a main effect of social anxiety, $F(1,79) = 5.20$, $p = .025$, $n^2_p = .062$, 90% CI [.004; .161]. The Pearson correlation showed that the relation was negative, $r(81) = -.277$, $p = .012$. This is in line with hypothesis 3. Furthermore, there was an interaction between conversational role and social anxiety, Wilks's Lambda = .951, $F(1,79)= 4.07$, $p = .047$, $n^2_p = .049$, 90% CI [.000; .143]. Figure 3 shows that the relation between social anxiety and mean fixation duration on the face is stronger when listening than when speaking, which is in contrast with hypothesis 4. In contrast with hypothesis 5, there was no interaction effect between intimacy and social anxiety, $F(1,79)= 4.37$, $p = .510$, $n^2_p = .006$, 90% CI [.001; .148].

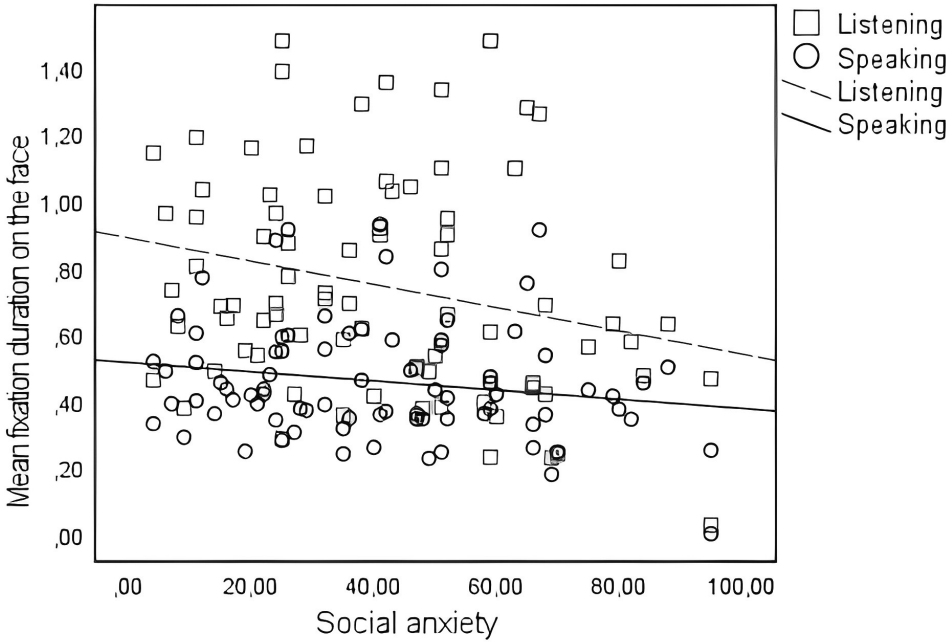

Figure 3. *Scatterplot showing the relation between social anxiety and (ln transformed) mean fixation duration on the face in seconds during listening and speaking*

DISCUSSION

The present research expanded on the existing literature by investigating the relationship between social anxiety and visual avoidance of faces in a face-to-face conversation requiring self-disclosure, while taking into account two aspects of conversations that previous research had implicated as potential moderating factors: conversational role and level of intimacy. Importantly, the two situational factors were independently manipulated to confirm and clarify these effects. Moreover, participants were selected to represent a wide range of social anxiety scores. The main findings can be summarized as follows: (1) All participants, regardless of social anxiety, looked shorter and less frequently at the face of the confederate during speaking than during listening. (2) Similarly, participants overall spent less time fixating on the face of the confederate in high intimacy conditions compared to low intimacy conditions. (3) Social anxiety was associated with reduced face gaze during the conversation. (4) The negative relation between social anxiety and the mean duration of a fixation on the face was stronger during listening than during speaking. (5) The negative relation between social anxiety and the total fixation duration on the face was stronger in low intimacy conditions than in high intimacy conditions. Taken together, our results shed light on effects of two situational factors, illuminating a picture of how social anxiety and its interactions with the two factors influence face gaze behavior in a face-to-face initial encounter.

The finding that participants overall displayed decreased face gaze during speaking compared to during listening is in line with our hypothesis 1. The difference was present on all three measures of face gaze: the total fixation duration on the face, the proportion of fixations on the face and the mean duration of a fixation on the face. Moreover, it coincides with prior conversation studies with non-socially anxious participants (e.g., Haensel et al., 2020; Hessels et al., 2019; Roger et al., 2018). Although differences between speaking and listening have consistently been observed, the absolute face gaze rate varies across studies. For example, Tyler et al. (2021) reported that participants looked at the confederate 22.7% of the time while speaking and 41.6% while listening. Freeth et al. (2013) found face gaze rates of approximately 28% while talking and 61% while listening. Haensel et al. (2020) reported considerably higher face gaze rates ranging from 31 – 64% while speaking and from 80 – 91% while listening across situations and cultural groups. Methodological, cultural, situational and personal characteristics may underlie these differences. Face gaze rates in the present study -18% while speaking and 48% while listening- were on the lower end, but they were influenced by the participant's social anxiety and to a lesser extent by intimacy of the topic.

In line with our second hypothesis, shorter face gaze was observed when participants were discussing high intimate topics compared to less personal topics. This finding replicates previous observational studies on intimacy of topics in the general population (Carr & Dabbs, 1974; Exline et al., 1965). The reduced total fixation duration for intimate topics seems due to participants fixating less frequently on the face of the confederate, because intimacy had no effect on the mean duration of a fixation on the face. Furthermore, although we had no hypotheses about the interplay between conversational role and intimacy, a significant interaction was found. Specifically, participants' total fixation duration on the face was shortest when it was their turn to speak *and* the topic was personal. Taken together, this is the first eye-tracking study to examine how the two situational factors work together during a face-to-face conversation and provides evidence that gaze to the face of a conversation partner depends on the combination of these factors.

In line with our third hypothesis, social anxiety was significantly associated with reduced face gaze throughout the conversation on all three measures. This is also concordant with previous studies establishing a video interaction between participants (Hessels et al., 2018; Howell et al., 2016). However, it contrasts with two previous eye-tracking studies in a face-to-face context (Konovalova et al., 2021; Rösler et al., 2021). These discrepant results may be explained by the nature of the interaction. The study by Konovalova et al., (2021) did not require any conversation and the study by Rösler et al. (2021) only involved a short conversation about research participation. Moreover, in both studies participants were led to believe that the other person was accidentally present. In these situations requiring minimal interaction, participants in general seemed to avoid gazing at the other person's face. Hence, the lack of a relation with social anxiety could be due to a floor effect. The present study found a relation with social anxiety by creating a situation in which the participant and the confederate were expected to take turns in disclosing (more or less) personal information for more than 20 minutes. In this situation, socially anxious individuals may have permanently perceived a risk of negative evaluation, leading to high levels of visual avoidance of the face. Thus, our study indicates that people higher in social anxiety avoid looking at another's face in actual social interactions that require reciprocal self-disclosure.

Contrary to our fourth hypothesis, social anxiety was not specifically associated with decreased face gaze during speaking. There was no interaction between social anxiety and conversational role for the total fixation duration and the proportion of fixations. These findings are in line with results from Haensel et al. (2020) for British/Irish participants, but in contrast with their results for Japanese participants and findings from face-to-face conversation studies using observer ratings (Baker & Edelmann, 2002; Daly, 1978). For the mean duration of a fixation on the face, the effect was

even in the opposite direction: the negative relation with social anxiety was stronger when participants were listening. This finding may be due to the larger variance of the mean fixation duration during listening and is in need of replication. Nevertheless, shorter fixations on the face during listening may be particularly detrimental to the social outcomes socially anxious people may receive, because of the importance of increased attention to others when listening to show attentiveness and interest (Gobel et al., 2015; Risko et al., 2016). Future research on reduced face gaze and its social consequences across different situations and populations may elucidate our understanding of how social anxiety may shape social outcomes.

Contrary to our fifth hypothesis, social anxiety was not specifically associated with decreased face gaze for intimate topics. The interaction was not significant for the proportion of fixations or the mean duration of a fixation on the face. For the total fixation duration, the interaction was significant, but in the opposite direction: participants higher in social anxiety spent less time looking at the face of their conversation partner when talking about low intimate topics. Although we hypothesized that talking about intimate topics would be particularly threatening to individuals with high levels of social anxiety, it may be the case that this was threatening to all participants, particularly at a time when social interactions with strangers were scarce, because of the COVID-19 pandemic. The relationship may be stronger for low intimate topics, because participants with higher levels of social anxiety perceived a risk of negative evaluation, whereas participants with lower levels of social anxiety did not. Unfortunately, this study did not include a measure of state anxiety.

Intriguingly, our exploratory analysis showed that social anxiety was not related to absolute speaking time. In the literature, talking less is also considered an important safety behavior that socially anxious people resort to in social interaction (e.g., Gray et al., 2019). For example, Stevens et al. (2010) found that talking time was the most powerful predictor of social performance when comparing SAD patients and non-patients in a social interaction. In that study, however, confederates were trained to say no more than three sentences at a time. In the present study, participants and confederates were instructed to talk about the assigned topic for at least one minute and the confederate set an example by doing so. Participants seemed to follow this example regardless of their level of social anxiety. Overall, they increased the duration of their answers in the course of the conversation. Variations in safety behavior (including face gaze avoidance) appear to be strongly related to situational factors. Therefore, adding complexity to social interactions will be helpful in determining the conditions of occurrence of important safety behaviors used by socially anxious individuals in future research.

Implications of the current study should be considered. First, this study provides evidence that face gaze avoidance could be a reliable indicator for the identification and assessment of socially anxious individuals who may be at a risk for SAD and further validates clinicians' impressions of eye contact avoidance in patients. Increasing and maintaining eye gaze as targets of social skills training and restructuring dysfunctional cognitions related to eye contact may be beneficial. Second, our findings suggesting that demands for reciprocal self-disclosure reduce face gaze in people with higher levels of social anxiety may have implications for exposure exercises. That is, encouraging socially anxious people to engage in reciprocal self-disclosure may be a feasible way to create opportunities for exposure.

Several limitations of our study warrant comment. First, our interaction paradigm is limited to a conversation to get acquainted between two strangers. Eye gaze performs different social functions across situations (Kleinke, 1986), which implies that the conclusions may not generalize to different social situations. Second, the current study only involved female emerging adults. Further research involving different groups such as males or other age groups is needed. Third, it should also be noted that the data collection of this study has taken place during the COVID-19 outbreak and was impacted in multiple ways. For example, the combination of drastic reductions in in-person social interactions and worries about a potential infection by the virus when re-engaging in actual social interactions, may have evoked heightened anxiety in participants regardless of their level of social anxiety. Fourth, further work incorporating measures of state anxiety can generate greater understanding of social anxiety and face gaze patterns in social interactions across various conditions. Fifth, our screening procedure did not include a question about having received attentional training. As such trainings are attended by participants from a general population, it may be advisable to include such a screening question in future studies. Finally, calibration of the eye-tracker should be done on multiple points to increase precision.

In conclusion, our results show that face gaze during a conversation varies with one's conversational role and intimacy of the topics discussed. Furthermore, our findings strengthen the notion of reduced face gaze by people with higher levels of social anxiety within actual social interactions. One's level of social anxiety may have a stronger influence on the duration of a glance at another's face during listening than during speaking. Likewise, social anxiety may have a stronger influence on the total time one looks at another's face when topics of low intimacy are discussed. Adding variety to social interactions as well as clarifying the consequences of reduced face gaze across situations would be valuable directions for future research.

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SUPPLEMENTARY MATERIALS

Question list

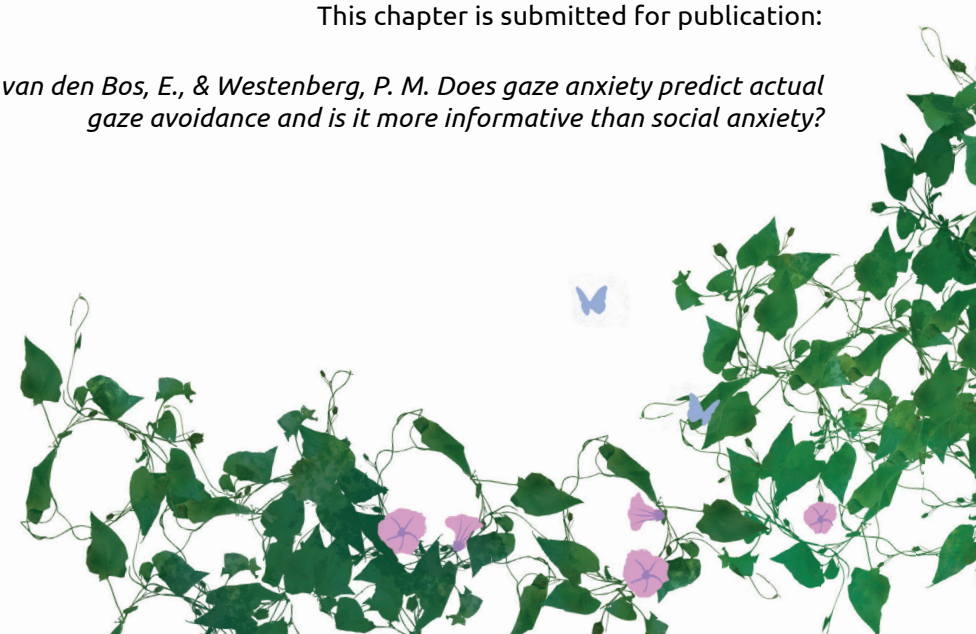
1. What was the best gift you ever received and why?
2. What is your favorite holiday (e.g. Christmas)? Why?
3. What was your impression of Leiden the first time you ever came here?
4. Where are you from? Name all of the places you have lived.
5. What are the advantages and disadvantages of artificial Christmas trees?
6. Do you think left-handed people are more creative than right-handed people?
7. Is there something that you have dreamed of doing for a long time? Why haven't you done it?
8. What is the greatest accomplishment of your life?
9. Share with your partner an embarrassing moment in your life.
10. When did you last cry in front of another person? When did you last cry alone?
11. If you were going to become a close friend with your partner, please share what would be important for her to know.
12. Tell your partner something that you already like about her.
13. What is your favorite holiday (e.g. Christmas)? Why?
14. How often do you get your hair cut? Where do you go? Have you ever had a really bad haircut experience?
15. What is a book you've read recently? Tell your partner about it.
16. What is the best movie you've watched recently? Tell your partner about it.
17. If you had to move from Leiden where you would live, and what would you miss the most about Leiden?
18. What foreign country would you like to visit? What attracts you to this place?

CHAPTER 5

Does gaze anxiety predict actual gaze avoidance and is it more informative than social anxiety?

This chapter is submitted for publication:

Chen, J., van den Bos, E., & Westenberg, P. M. Does gaze anxiety predict actual gaze avoidance and is it more informative than social anxiety?



ABSTRACT

In recent years, eye-tracking studies have provided converging evidence that socially anxious individuals avoid looking at other people's faces in social situations. In addition to these objective measures, the Gaze Anxiety Rating Scale (GARS) has increasingly been used as a self-report measure of gaze avoidance. However, extant results concerning its predictive validity were inconsistent. Moreover, no study has considered social anxiety and gaze anxiety together to examine their relative contributions to actual gaze behavior. To address these two questions, eye-tracking data collected from 85 female students during the initial six minutes of a face-to-face conversation with a female confederate were analyzed. Gaze anxiety and social anxiety were measured via the GARS and the Leibowitz Social Anxiety Scale. The results revealed that gaze anxiety was associated with reduced face gaze while speaking. Social anxiety was not only associated with decreased face gaze during speaking, but also across the initial conversation. Moreover, there was no evidence that gaze anxiety made an additional contribution to social anxiety in predicting face gaze behavior. The findings indicate that, in a community sample, gaze anxiety does predict actual gaze behavior during a face-to-face initial encounter, but social anxiety is a stronger predictor.

INTRODUCTION

Eye contact is vital in social interactions, but socially anxious people seem to avoid it. Social anxiety is typically conceptualized as fear of negative evaluation and rejection by others (Clark & Wells, 1995; Hofmann, 2007; Spence & Rapee, 2016). According to cognitive models, eye contact avoidance is an important safety-seeking strategy that is adopted by socially anxious individuals in an attempt to regulate anxiety and prevent negative social outcomes within social situations (e.g., Clark & Wells, 1995). Empirical research corroborates this claim. For example, two recent systematic reviews (Chen et al., 2020; Günther et al., 2021) conclude that socially anxious individuals avoid looking at facial stimuli (particularly at the eyes) across a variety of situations. Among these studies, measurements of gaze avoidance can be broadly grouped into objective and subjective approaches. Compared to objective approaches such as eye-tracking, self-report measures have the advantages of low costs and easy administration in empirical research and clinical practice. However, people may not always be aware of their own behavior. For example, self-report measures of sweating and heart rate only show modest correlations with physiological data (Mauss et al., 2004; Miers et al., 2010). Hence, it is important to demonstrate the predictive validity of self-report measures.

The Gaze Anxiety Rating Scale (GARS) – a self-report instrument relating to gaze avoidance – has been used in a broad range of settings over the past years (e.g., Mansour & Kuhn, 2019; Mehmood et al., 2021; Judah et al. 2019; Trilla et al., 2020; Vatheuer et al., 2021; von Dawans et al., 2020). The GARS was developed by Schneier et al. (2011) to measure the degree of gaze anxiety, which refers to fear and avoidance of making eye contact across various social situations (Schneier et al., 2011). The GARS has good internal consistency and test-retest reliability (Domes et al., 2016; Schneier et al., 2011). Additionally, correlational patterns with social anxiety, other anxieties, personality constructs and depression provide evidence for convergent and discriminant validity (Domes et al., 2016; Langer et al., 2014; Schneier et al., 2011). However, despite the growing use of the GARS (e.g., Mehmood et al., 2021; Vatheuer et al., 2021), the predictive validity of the scale has not been firmly established.

To the best of our knowledge, only two studies have examined the links between self-reported gaze anxiety and actual gaze avoidance (Mansour & Kuhn, 2019; Vatheuer et al., 2021). In a virtual environment, Vatheuer et al. (2021) implemented a stress induction (the Trier Social Stress Test) consisting of a speech task and an arithmetic task and found that higher gaze anxiety was correlated with greater cortisol stress responses in a subgroup of participants. However, no correlations between gaze anxiety and measures of gazing at virtual judges were found. In contrast, Mansour

and Kuhn (2019) established a video connection between two people and identified a significant negative association between gaze anxiety and fixation time on the face of a conversation partner (though not with fixation time on the eye region). Therefore, the extant results as to the predictive validity of the GARS were inconsistent. Moreover, replications in *face-to-face interactions* are needed, because there is evidence that people's gaze behavior varies with the physical presence or absence of an interaction partner (e.g., Grossman et al., 2019; Freeth et al., 2013; Rubo et al. 2020).

Furthermore, it is as yet unclear whether actual gaze avoidance is specifically related to gaze anxiety or to social anxiety more broadly. From the introduction of the GARS, gaze anxiety has been considered an important feature of social anxiety and moderate to high correlations have been demonstrated in both clinical (Domes et al., 2016; Schneier et al., 2011) and community samples (Judah et al., 2019; Langer et al., 2014). Nevertheless, gaze anxiety is treated as an independent construct that may be useful to identify a subgroup of individuals with social anxiety for whom eye contact is particularly problematic (Schneier et al., 2011), and that may also be relevant to other disorders that impact social functioning (Domes et al., 2016; Schneier et al., 2011). Because gaze avoidance is likely to contribute to social difficulties (Langer et al., 2014), self-reported gaze anxiety may be a useful screening tool for a broad range of social problems. However, the relative contributions of social anxiety and gaze anxiety to actual gaze avoidance have not been investigated yet.

The present study aimed to address two research questions: (1) Whether gaze anxiety is related to gaze avoidance during a face-to-face conversation and (2) Whether gaze anxiety makes an additional contribution to social anxiety in predicting actual gaze behavior during the conversation. To answer these questions, we used data from a real-life conversation study in which participants and a same-sex confederate took turns in answering questions (Chen et al., in press). On the basis of the study by Mansour and Kuhn (2019), it was hypothesized that increased gaze anxiety would be related to gaze avoidance, operationalized as decreased gaze towards the face of the confederate, during the conversation. The second research question was exploratory.

METHODS

The study comprised two parts: an online survey and a face-to-face conversation task in the lab.

Participants

A total of 458 participants aged between 17 to 25 years (*M* = 19.85 years, *SD* = 2.09, 87.74% female) completed the online survey. Participants were recruited from the university community and received either one research credit or €3.50 upon completion. For the conversation task, participants were selected on the basis of their scores on the self-report version of the Liebowitz Social Anxiety Scale (LSAS-SR; Fresco et al., 2001). Participants with scores on the LSAS-SR below 30 were categorized as low socially anxious (LSA), participants with scores between 30 and 59 were categorized as medium socially anxious (MSA) and participants with scores above 59 were categorized as high socially anxious (HSA; Liebowitz, 1987). Stratified sampling from these groups was employed in order to obtain a uniform distribution of participants with different levels of social anxiety. Female students (HSA = 110, MSA = 27, LSA = 96) were invited via email to take part. The final sample consisted of 85 participants (HSA = 28, MSA = 27, LSA = 30) with a mean age of 20.64 years (SD = 2.24 years)[1].

This study aimed to investigate same-sex interactions, because initial opposite-sex encounters, in particular involving intimate self-disclosure, may be associated with a more specific dating context (e.g., Derlega et al., 1985). Because of the demographics of the local student population, the current study was restricted to females. All participants have self-reported normal or corrected-to-normal vision. Participants gave written informed consent and were fully debriefed afterwards. They received either two credits or €6.50 for participating in the experiment. The University's ethics committee for psychological research approved the study protocol.

Materials

Gaze Anxiety Rating Scale (GARS; Schenier et al., 2011)

The GARS is a 17-item self-report questionnaire used to assess fear and avoidance of making eye contact in various social situations (e.g., "Being introduced", "Feeling close to someone you love"). Each item is rated both on anxiety (0 = no anxiety, 3 = a lot of anxiety) and avoidance (0 = no avoidance, 3 = avoid a lot). In the survey sample of 458, Cronbach's alpha of the GARS was .95. In the current sample of 85, Cronbach's alpha of the GARS was .96 (.92 for the anxiety subscale and .92 for the avoidance subscale).

1 The low response rate was largely due to regulations to prevent the spread of Covid-19. The data were collected between March2020 and April2021. From March to July 2020 no lab sessions could be scheduled with participants who had completed the pre-screening as part of an online survey, because all labs were closed. When the labs reopened, people were still encouraged to minimize social contact and education remained completely online. This reduced students' willingness to participate in lab sessions at the university.

Liebowitz Social Anxiety Scale-Self Report (LSAS-SR; Fresco et al., 2001; Liebowitz, 1987)

The level of social anxiety of each participant was assessed using the LSAS-SR questionnaire. The LSAS-SR consists of 24 items, including 11 items about social interaction (e.g., "Meeting strangers") and 13 items about social performance (e.g., "Telephoning in public"). The instrument uses a 4-point Likert scale to rate both anxiety (0 = none, 3 = severe) and avoidance (0 = never, 3 = usually) in each of these situations. The LSAS-SR was administered twice: during the survey and on the day of the lab session, but the present study only used the scores from the survey that included both LSAS-SR and GARS. In the survey sample of 458, Cronbach's alpha of the LSAS-SR was .95. In the current sample of 85, Cronbach's alpha of the LSAS-SR was .96. The total scores of the first and second administration of the LSAS-SR were highly correlated (r = .88, p < .001).

Apparatus

We utilized two Tobii Pro Glasses 2 wearable eye-trackers (Tobii Technology AB, Sweden) to simultaneously record both the participant's and the confederate's eye movements during the conversation. Only the participant's eye movements were analyzed. Each eye-tracker is equipped with 4 eye cameras which track people's eye movements in relation to the external environment they are watching, and with one scene camera to video-record the scene in front of the wearer (field of view 90° 16:9, visual angle: 82° horizontally and 52° vertically, resolution 1920 X 1080 pixels). It records eye gaze at a sampling frequency of 100 Hz and a scene video at 25 Hz. Each eye-tracker was controlled by Tobii Glasses controller software installed on a tablet computer through a wireless connection. The software was used for recording and calibrating.

Conversation task

An adapted version of the relationship-building task (adapted from Kashdan et al., 2004; 2006; 2014)[2] was used in this study. Prior to testing, participants were informed that a fellow student who was involved in the research project (i.e., confederate) would be conversing with them. The participant and the confederate took turns in answering questions and listening to each other's answers. Each turn started with the speaker reading out the question she had to answer. Participants were instructed to make each answer as long as possible (e.g., "we would like you to talk as much as possible, and try to make each answer last at least 1 minute") and to minimize interactions beyond listening to the other's answers and answering the questions on their own cards (e.g.,

2 In the original version, participants were randomly assigned to either closeness-generating conversations (intimate topics) or small-talk conversations (general topics). In this study, we combined the two types of conversation into one continuous conversation.

no follow-up questions) during the conversation. They also were aware that they could take time to think before answering, and that the content of their answers would not be analyzed.

The total conversation included 18 questions, which were selected from Aron et al. (1997) and adjusted to suit the local circumstances. These questions were individually presented on 18 topic cards made of colored construction paper. Two sets of 9 cards were placed in front of the participant and the confederate respectively. The order of the questions was fixed. For each conversation partner, the first and last block of 3 questions were less personal questions (e.g., "Do you think left-handed people are more creative than right-handed people? Why?" and "What book have you read recently? Tell your partner about it"). The questions in the middle block were more personal (e.g., "What is the greatest accomplishment in your life?" and "Share with your partner an embarrassing moment in your life"). The confederates were instructed to start the conversation in order to set an example.

Confederates

Three female confederates, of similar ages to the participants (two undergraduate honors students and one master's student), were involved in the study. They were blind to the anxiety levels of each participant. Confederates were trained to behave in a natural and friendly way toward participants throughout the conversation and they were trained to answer each question consistently across participants in terms of content as well as length (at least 1 minute). They were instructed to keep their clothes and hair-style as consistent and simple as possible throughout the study to prevent potential distractions (e.g., simple black T-shirt and ponytail). The confederates were not acquainted with any of the participants.

Procedure

Regarding the online survey, participants completed a battery of questionnaires that included the LSAS-SR and GARS. The survey administration was through Qualtrics survey platform (Provo, Utah, USA). The time interval between the survey and the conversation task ranged from 2 – 184 days (median = 47). On the day of the conversation task, participants filled out the LSAS-SR again. All participants were requested not to wear eye make-up on the day of testing (none of them did it).

The conversation task took place in a room with stable light conditions and attenuated sound. A table was placed in the middle of the room, with two comfortable chairs at either side opposite from each other, approximately 1.8 meters apart. The background behind the confederate was a blank white wall. After giving informed consent, participants were fitted with the eye-tracker, and the one-point calibration procedure

was conducted, in which participants were instructed to fixate on the central black dot of the calibration card that was pasted on a white wall (at 1.5 meters). Meanwhile, the confederate put on the eye-tracker in a separate room. It was calibrated with the help of the experimenter when she came into the lab (following the same calibration procedure as the participants). The confederate was introduced and sat across the table from the participant. Next, the participant and confederate were introduced to the conversation task and started the task after receiving the start signal. On completion of the final question, the experimenter re-entered the room and the confederate left. Participants were asked to take off the eye-tracker. Finally, they were debriefed and compensated.

Data preparation

The entire conversation task was comprised of 3 blocks of questions: the first and last blocks consisted of 6 questions of relatively low intimacy and the second block consisted of 6 questions of relatively high intimacy (Chen et al., in press). The present study used the eye-tracking data from the first block (M = 387 seconds, SD = 99), when the participant and confederate did not know each other yet and the questions were relatively neutral. This was done because answering intimate questions helps to build a relationship (Kashdan et al., 2004; 2006; 2014) and a reduction in face gaze has been observed when two strangers became more acquainted with each other (Haensel et al., 2020; 2022).

The area of interest (AOI) – face – was manually drawn on reference images of the confederates by using the Areas of Interest tool of the Tobii pro Lab (analyzer edition, version 1.98). The face AOI corresponded to a visual angle of 5.7° horizontally and approximately 7° vertically. Eye-tracking data was processed using Tobii pro Lab. We used the Tobii I-VT (Velocity-Threshold Identification) Attention gaze filter, which has been designed for the use of eye-tracking glasses in dynamic situations. The attention filter identifies fixations using a velocity threshold of 100°/s and a minimum fixation duration of 60 milliseconds (ms). Adjacent fixations are merged when the time between fixations is no more than 75 ms and the distance between fixations is no more than 0.5°, based on the average data from both eyes (Olsen, 2012). The fixations that had been registered relative to the scene video were automatically mapped onto the reference images. The result of the automatic mapping procedure was then checked by a human observer (J.C.), by visually comparing the mapped fixations on the reference images with the fixations on the scene video. The observer manually corrected the mapping whenever automatic mapping led to inaccurate classification of a fixation as on or outside of the AOI.

The following parameters were exported: (1) total fixation count in each segment. (2) Total fixation count on the face of the confederate in each segment. (3) Total fixation duration on the face of the confederate in each segment in seconds. Two eye-tracking measures were calculated in this study: The total fixation duration on the face of the confederate, which was the sum of all fixations on the face over the course of a speech turn. (2) The proportion of fixations on the face of the confederate, which was computed by dividing the fixation counts on the face by the total fixation counts. These face gaze measures were calculated not only for the total initial conversation (i.e. the first block of six questions), but also separately for the phases in which the participant was speaking and listening. This was done because there is considerable evidence that people in general tend to look more at the face of another person while listening than while speaking (e.g., Freeth et al., 2013; Haensel et al., 2020; 2022; Hessels et al; 2019; Tyler et al., 2021). Therefore, six face gaze measures were used in this study.

Data analysis

Data were analyzed using Statistical Package for the Social Science (SPSS), version 27.0.

First, preliminary analyses were conducted to verify whether the current sample that was selected based on level of social anxiety adequately resembled the larger survey sample in terms of range of gaze anxiety. The strength of the correlations between social anxiety (total score of the LSAS-SR) and gaze anxiety (total score of the GARS) in the current sample and the total survey sample were compared using Fisher r-to-z tests. Second, to answer the question whether gaze anxiety is related to gaze avoidance, bivariate Pearson correlation analyses were conducted with gaze anxiety (GARS total score) and the six face gaze measures (total duration and proportion of fixations on the face of the confederate across the initial conversation, during speaking and during listening). Bivariate Pearson correlations were also computed for social anxiety (LSAS-SR total score) and the face gaze measures. Finally, to determine whether gaze anxiety makes an additional contribution to social anxiety in predicting face gaze, we performed two-step hierarchical multiple regression analyses, entering the LSAS-SR total score in the first step and the GARS total score in the second step (enter method). The six face gaze measures were the dependent variables.

RESULTS

Preliminary analyses

Table 1 presents the descriptive statistics and correlations for GARS and LSAS-SR from the two samples. The range and distribution of the two measures were similar across the two samples. In addition, gaze anxiety was highly and positively associated with social anxiety in both samples. Fisher's *r* to *z* transformations indicated that the magnitudes of the correlation between gaze anxiety and social anxiety were not significantly different, z = .05, p = .48. As such, we concluded that the conversation task sample was representative of the total survey sample

Table 1. *Descriptive statistics and correlations for GARS and LSAS-SR in the total survey sample and the conversation task sample*

Sample	GARS		LSAS-SR		Pearson *r*
	M (SD)	**Range**	***M (SD)***	**Range**	
Total survey sample (n = 458)	27.02 (15.69)	0-85	45.76 (22.5)	0-104	.80**
Current sample (n = 85)	29.2 (18.44)	0-85	45.6 (24.45)	8-102	.80**

Note. GARS = Gaze Anxiety Rating Scale; LSAS-SR = Liebowitz Social Anxiety Scale-Self Report. ** p < .01

Four participants' data were excluded from the following main analyses for the following reasons: One participant was excluded because the connection between one eye-tracker and its paired tablet was lost during testing. Two participants were excluded because of poor quality of eye-tracking data (gaze samples < 50%; *Mrest* = 83%, *SD* = 12%). One participant was excluded because she had received training to maintain eye contact during conversations to alleviate her symptoms of attention deficit/hyperactivity disorder. Therefore, 81 participants' data were used for the analyses.

In inspecting the data, three extreme outliers (> 3 SD: two in the total fixation duration on the face during speaking, one in the proportion of fixations on the face during speaking) were detected and winsorized. Based on visual inspection of histograms and normal P-P plots of standardized residuals, it was concluded that the normality assumption was met, except for the total fixation duration on the face during speaking. Thus, a square root transformation was applied to this measure. After transformation, the P-P plot indicated normally distributed residuals.

Does gaze anxiety predict actual gaze avoidance?

Table 2 presents the correlations among our variables of interest. Gaze anxiety was significantly and negatively associated with total fixation duration on the face and proportion of fixations on the face during speaking phases only. Social anxiety was significantly and negatively associated with total fixation duration on the face and proportion of fixations on the face during speaking as well as during the total 6-min initial conversation. No significant correlations were found in the listening phase.

Table 2. *Bivariate correlations between GARS/LSAS-SR scores and face gaze measures*

	Fixation duration on the face			Proportion of fixations on the face		
	Total	Speaking[1]	Listening	Total	Speaking	Listening
GARS-Total	-.18	-.25*	-.13	-.20	-.30**	-.14
GARS-Anxiety	-.19	-.26*	-.15	-.21	-.32**	-.16
GARS-Avoidance	-.16	-.24*	-.10	-.17	-.27*	-.10
LSAS-SR	-.26*	-.41**	-.18	-.24*	-.36**	-.19

Note. GARS Total = total score of the Gaze Anxiety Rating Scale; GARS-Anxiety = total score of the Gaze Anxiety Rating Scale-Anxiety subscale; GARS-Avoidance = total score of the Gaze Anxiety Rating Scale-Avoidance subscale; LSAS-SR = Liebowitz Social Anxiety Scale-Self Report. [1] The total fixation duration on the face while the participant was speaking was square-root transformed. * $p < .05$; ** $p < .01$.

Relative contributions of gaze anxiety and social anxiety

Given that LSAS-SR and GARS were highly correlated ($r(81) = .796$, $p < .001$), we examined the possibility of collinearity. The variance inflation factor was 2.731 and Tolerance was .366, indicating that multiple regression analysis is acceptable.

Initial conversation (total)

Table 3 presents the results of the hierarchical regression analyses predicting face gaze during the 6-minute initial conversation (regardless of who was speaking) from social anxiety and gaze anxiety. For both face gaze measures, model 1 with the LSAS-SR was significant (fixation duration on the face, $F(1,80) = 5.49$, $p = .022$; proportion of fixations on the face: $F(1,80) = 4.83$, $p = .031$). Participants higher in social anxiety spent shorter time fixating and fixated less frequently on the face of the confederate. Model 2 with the LSAS-SR and the GARS was not significant, so GARS did not explain any additional variance.

Table 3. *Hierarchical regression analyses predicting face gaze across the initial conversation from social anxiety and gaze anxiety*

Step	Predictor	*β*	*t*	R^2	R^2 *change*
		Total fixation duration on the face			
1				.07*	
	LSAS-SR	-.26	-2.34*		
2				.07	.00
	LSAS-SR	-.31	-1.71		
	GARS	.07	.37		
		Proportion of fixations on the face			
1				.06*	
	LSAS-SR	-.24	-2.20*		
2				.06	.00
	LSAS-SR	-.23	-1.28		
	GARS	-.01	-.05		

* $p < .05$; ** $P < .01$

Speaking phases

Table 4 presents the results of the hierarchical regression analyses predicting face gaze during the speaking phase from social anxiety and gaze anxiety. For both face gaze measures, model 1 with the LSAS-SR was significant (fixation duration on the face, $F(1,80) = 15.97$, $p < .001$; proportion of fixations on the face: $F(1,80) = 11.51$, $p = .001$). Participants higher in social anxiety spent shorter time fixating and fixated less frequently on the face of the confederate during speaking. Model 2 with the LSAS-SR and the GARS was significant (fixation duration on the face: $F(2,80) = 8.70$, $p < .001$; proportion of fixations on the face: $F(2,80) = 5.72$, $p = .005$), however, adding gaze anxiety did not explain any additional variance.

Table 4. *Hierarchical regression analyses predicting face gaze during speaking from social anxiety and gaze anxiety*

Step	Predictor	*β*	*t*	R^2	R^2 change
		Square-root transformed fixation duration on the face			
1				.17**	
	LSAS-SR	-.41	-4.0**		
2				.18**	.01
	LSAS-SR	-.57	-3.35**		
	GARS	.20	1.17		
		Proportion of fixations on the face			
1				.13**	
	LSAS-SR	-.36	-3.39**		
2				.13**	.00
	LSAS-SR	-.32	-1.82		
	GARS	-.05	-.274		

* $p < .05$; ** $p < .01$

Listening phases

For the listening phases, none of the regression models were significant (total fixation duration on the face, model 1: $F(1,80) = 2.75$, $p = .101$; model 2: $F(2,80) = 1.39$, $p = .256$; proportion of fixations on the face, model 1: $F(1,80) = 2.97$, $p = .09$; model 2: $F(2,80) = 1.50$, $p = .23$).

DISCUSSION

The present study examined the relationship between self-reported gaze anxiety and actual gaze avoidance during an early stage of a face-to-face conversation between two strangers, while taking into account the role of social anxiety. The results revealed that gaze anxiety was significantly associated with reduced face gaze during speaking phases. Likewise, social anxiety was associated with decreased face gaze during speaking but also across the approximately 6-minute initial conversation. Moreover, the hierarchical regression analyses showed that gaze anxiety did not make an additional contribution to social anxiety in predicting face gaze behavior. Altogether, our findings suggest that gaze anxiety does predict actual gaze behavior during a face-to-face initial encounter, but social anxiety is a stronger predictor.

The current study found that individuals with greater gaze anxiety fixated less frequently and for a shorter amount of time on the face of the confederate compared to people with lower gaze anxiety while speaking. In addition to Mansour and Kuhn's (2019) work involving a video-mediated conversation between two people, this is the second study to provide evidence for predictive validity of the GARS, particularly in a real-life social setting. This finding contrasts with another study using a speech task (Vatheuer et al., 2021). Sex difference might be one explanation. Vatheuer et al. (2021) included a male sample, whereas the present study involved a female sample and participants in Mansour and Kuhn's (2019) study were predominately female (88%). As such, females with gaze anxiety might be more likely to display gaze avoidance patterns than males. Alternatively, the type of social situation might account for this discrepancy. Mansour and Kuhn (2019) and the present study used a conversation task, whereas Vatheuer et al. (2021) studied eye contact in a performance situation. Social norms for making eye contact may be more stringent for conversations than for performance situations. Therefore, having a conversation with others may induce more gaze avoidance among people with elevated gaze anxiety. Further research is needed to directly compare males and females to clarify gender effects.

It is worth noting that the negative correlation between gaze anxiety and face gaze avoidance was only observed during speaking, which is in line with the stronger

negative correlation during speaking than during listening in Mansour and Kuhn's (2019) study. These findings converge to indicate that greater gaze anxiety may not be generally associated with gaze avoidance throughout social interactions. Intriguingly, the lack of significant findings for listening phases aligns with previous studies of initial encounters using eye-tracking (Haensel et al., 2020) as well as observer ratings (Baker & Edelmann, 2002; Daly, 1978), wherein negative correlations between social anxiety and face (or eye) gaze were only observed during speaking but not during listening. One possible explanation is that listening is less anxiety-provoking than speaking for socially anxious people, because it does not require self-disclosure (Kleinke, 1986) – an element that implies a risk of being evaluated by others. Alternatively, listening to others' talking could elicit similar face gaze behavior across people with varying levels of social (and gaze) anxiety, because attending to faces helps to understand what is being said (e.g., Buchan et al., 2007; Tsang et al., 2018; Vatikiotis-Bateson et al., 1998). Moreover, if high socially anxious individuals specifically avoided looking at the eyes, but also – for the sake of information seeking - paid more attention to the mouth of their conversation partner while listening, these tendencies would have cancelled each other out, because the present study did not distinguish between different regions of the face. Selective gaze to the mouth, for example, has been demonstrated in individuals with autism spectrum disorder in a face-to-face conversation (Hanley et al., 2015). Future work on distinguishing between facial regions in face-to-face interactions is therefore needed to elucidate our understanding of gaze patterns that are adopted by socially anxious individuals.

Regarding the second research question, the present study showed that social anxiety significantly accounted for variance in the measures of face gaze, however, there was no evidence that gaze anxiety made an additional contribution. It thus indicates that, in the general population, gaze avoidance may be more a matter of degree of social anxiety than of gaze anxiety. Our results (see also Chen et al., in press) fit with extant evidence for the relevance of social anxiety to actual gaze avoidance in social interactions (e.g., Haensel et al., 2020; Hessels et al., 2018; Howell et al., 2016). On the other hand, the absence of an additional contribution by gaze anxiety suggests that the GARS may not be the most sensitive screening measure to index actual gaze avoidance in a community sample. It has been noted that gaze avoidance may be a risk factor for a large range of social difficulties (Langer et al., 2014). Overall, our results suggest that social anxiety is a more important predictor of actual gaze avoidance (and, by extension, social problems) than gaze anxiety.

Several potential limitations of the current study should be acknowledged. First, as noted above, face gaze was studied instead of eye gaze, because the interpersonal distance mandated by COVID-19 regulations prevented reliable identification of eye

gaze. Second, the self-report data, including LSAS-SR and GARS, were not collected on the same day as the eye-tracking data, which in all likelihood reduced the strength of the correlations. Similar reductions can be expected for correlations with LSAS-SR and GARS, because comparable test-retest reliability has been reported for the two instruments: GARS: r = .99 for 8-weeks (Schneier et al., 2011); r = .72 for 4-months (Domes et al., 2016); LSAS-SR: r = .83 for 12-weeks (Baker et al., 2002). Third, the participant selection procedure based on the LSAS-SR might have produced a better distribution of social anxiety level than of gaze anxiety level. However, our sample showed the same range of gaze anxiety as did the total survey sample. The preliminary analyses demonstrated that the two samples did not differ on correlations between social anxiety and gaze anxiety. Fourth, the current study used data from a community sample of female undergraduates, thus we cannot rule out that the GARS may perform better in predicting gaze avoidance in a population of SAD patients (or males). Replications in clinical populations are therefore needed.

In conclusion, this study provides some support for predictive validity of the GARS and extends the findings to a real-life social situation. The results indicate that anxiety-related gaze avoidance is more prominent during speaking than during listening. However, the results also reveal that, in a community sample, social anxiety is a better predictor of gaze avoidance than gaze anxiety. Hence, self-reported social anxiety may be more useful in screening for social difficulties in this population. Replication in a clinical sample is needed to assess whether self-reported gaze anxiety can be used to identify SAD patients for whom eye contact is particularly problematic.

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CHAPTER 6

Main findings and general discussion

The main goal of this dissertation was to shed light on the nature of gaze behavior adopted by socially anxious individuals in social interactions. To ensure precision of measurement in naturalistic social situations – including public speaking situations and face-to-face conversations – we took advantage of state-of-the-art wearable eye-trackers (Tobii Pro Glasses 2) to investigate gaze behavior in socially anxious individuals. Specifically, this dissertation sought to address three 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. The main findings pertaining to the three questions are summarized below.

MAIN FINDINGS

Is social anxiety associated with gaze avoidance?

The results from the review (*Chapter 2*) suggest that there is not a simple 'yes or no' answer to this main question, and that the relation depends on three factors: severity of social anxiety, type of social situation, and development. In particular, gaze avoidance is consistently observed in adults with SAD across various experimental paradigms, whereas, in adults with high levels of social anxiety but no diagnosis (HSA), comparatively consistent evidence for gaze avoidance is observed in social-*evaluative* situations. Based on these findings, the following experimental studies (*Chapters 3-5*) focused on nonclinical samples, and provide additional evidence for face gaze avoidance by HSA people in social-evaluative situations. Altogether, the results of this dissertation point to both robustness and complexity of the relationship between social anxiety and gaze avoidance.

What situational factors influence gaze behavior?

As concluded in *Chapter 2*, adults with SAD exhibit gaze avoidance across three types of situations: face-viewing tasks, speaking tasks and social interactions, whereas HSA adults display gaze avoidance in speaking and interaction tasks but not in face-viewing tasks; however, up till this point direct empirical evidence for such situational specificity was lacking. *Chapter 3* fills this gap by comparing a face-viewing task and a public speaking task - using identical stimuli - within the same sample, and provides support for the assumption that decreased fixation on faces of the audience in HSA individuals was evident during the speaking task and *not* during the face-viewing task. In order to further demonstrate that gaze avoidance occurs in naturalistic social-evaluative situations for HSA people, we extended the video-based speech context to live, face-to-face getting-acquainted interactions (*Chapters 4 and 5*). In particular,

Chapter 4 developed a conversation wherein a participant and a confederate took turns sharing more or less personal information. The findings corroborate that, in naturalistic social-evaluative situations that require reciprocal self-disclosure, face gaze avoidance does occur in HSA individuals.

Correspondence between perceived and actual gaze avoidance?

The third question is answered in *Chapter 5*. We evaluated whether perceived gaze anxiety is associated with actual gaze avoidance as well as the relative contributions of gaze anxiety and social anxiety to gaze avoidance. The results reveal that gaze anxiety is significantly associated with reduced face gaze during speaking phases (not listening phases) in a conversation. Moreover, gaze anxiety does not make an additional contribution to social anxiety in predicting face gaze behavior. Altogether, our findings suggest that gaze anxiety does predict actual gaze behavior during a face-to-face initial encounter, but social anxiety is a stronger predictor.

GENERAL DISCUSSION

Face gaze avoidance: HSA and real-life interactions

One of the most important findings from this dissertation is that individuals with high levels of social anxiety generally displayed face gaze avoidance in naturalistic social situations. The findings are consistent with longstanding clinical observations (American Psychiatric Association, 2013) and theoretical models (e.g., Clark & Wells, 1995; Hofmann, 2007), but also concordant with other recent eye-tracking studies conducted in naturalistic settings (Chen et al., 2015; Dechant et al., 2017; Haensel et al., 2020; Hessels et al., 2018; Howell et al., 2016; Kim et al., 2018; Rubo et al., 2020). Therefore, this dissertation contributes to the literature by strengthening the notion that gaze avoidance is a behavioral maker of social anxiety, as well as by demonstrating that such avoidance occurs in real-life social interactions.

The results that face gaze avoidance was observed in HSA people converge with other studies that involved nonclinical samples (Dechant et al., 2017; Haensel et al., 2020; Hessels et al., 2018; Howell et al., 2016; Rubo et al., 2020). It suggests that face gaze avoidance already exists in those experiencing greater social anxiety from the general population. Our results thus support the continuum model of social anxiety rather than categorical differences between patients and non-patient populations. On the other hand, what differentiates people with HSA and SAD, based on the findings from *Chapters 2 and 3*, appears to be whether they exhibit gaze avoidance in face-viewing tasks. People with SAD tend to display gaze avoidance while being asked

to look at a facial picture (*Chapter 2*) whereas people with HSA do not (*Chapters 2 and 3*). One possible explanation is that SAD gives rise to problems with flexible gaze patterns in response to changing social situations, which in turn may lead to overall avoidance of faces. In contrast, flexibility in people with HSA is possibly less impaired than in patients, resulting in situation-dependent rather than overall avoidance when confronted with faces. Intriguingly, the experimental work in this dissertation highlights flexibility of gaze behavior in HSA people, which is discussed in the **Naturalistic situations** section below.

Moreover, results from *Chapters 4 and 5* showing that face gaze avoidance in socially anxious individuals occurred in live, face-to-face interactions with another person are in line with a recent study by Haensel et al. (2020), in which Japanese (not British/Irish) participants with elevated social anxiety showed decreased face gaze while introducing themselves to their conversation partner. The results converge to indicate that face gaze avoidance as a behavioral maker of social anxiety could be translated to real-life interactions, and thus it means that adverse effects of eye contact avoidance are likely to occur in everyday social life for this population. As such, gaze avoidance may be a risk factor for maintaining and even exacerbating social anxiety symptoms ultimately moving towards clinically significant symptoms (Clark & Wells, 1995; Rapee & Spence, 2004).

Naturalistic situations: Mechanism underlying gaze avoidance in social anxiety

The studies included in this dissertation clearly illustrate that situational factors play an important role in the relation between social anxiety and gaze avoidance. Gaze avoidance was observed in some situations but not others. First of all, people higher in social anxiety displayed gaze avoidance in naturalistic social situations, including public speaking tasks and social interactions with others (*Chapters 3 to 5*), but not in face-viewing situations (*Chapter 3*). The absence of gaze avoidance in face-viewing tasks (*Chapter 3*) mirrors results from a number of studies using face-viewing paradigms where non-clinical socially anxious samples were involved (see *Chapter 2* for a discussion). Secondly, when engaging in actual social interactions, gaze avoidance was found across a 20-minute conversation requiring reciprocal self-disclosure (*Chapter 4*), and in the early stage of the conversation when socially anxious people were speaking (but not when they were listening, *Chapter 5*).

These results suggest that HSA individuals do not invariably avoid looking at facial stimuli; these people are sensitive to certain situational components, thereby leading to flexible gaze behavior. Indeed, recent work has also captured such context-related flexibility of gaze behavior in non-patient samples (Dechant et al., 2017; Haensel

et al., 2020; Rubo et al., 2020; Vriends et al., 2017). For example, using video-mediated conversations with a confederate, Vriends et al. (2017) demonstrated that high socially anxious individuals exhibited significantly increased gaze towards themselves (i.e. self-focused attention) when the confederate was critical of them and decreased gaze towards themselves when they were actively involved in asking questions compared to low socially anxious individuals. While no difference was observed when the confederate initiated a conversation about general topics nor when the confederate interacted with the participant in a friendly way. Moreover, Dechant et al. (2017) reported that socially anxious people specifically avoided gazing at the eyes of avatars they interacted with when they had to make a request but not when they answered arithmetic questions. Additionally, partly in line with the findings of *Chapter 5*, Haensel et al. (2020) found that greater social anxiety was associated with reduced face gaze only at early stages of a face-to-face conversation and only when the participant was talking to the confederate (cf. *Chapter 5*).

Taken together with the current findings, the observed flexibility suggests that merely being looked at by other people may not be sufficient for gaze avoidance. Rather, the risk of being (negatively) evaluated or rejected as perceived by HSA people seems to be the key factor to elicit gaze avoidance. This may also explain why the findings in this dissertation (*Chapters 4 and 5*) were (slightly) different from those of Haensel et al. (2020). In the study by Haensel et al. (2020), the association between social anxiety and face gaze disappeared as the conversation progressed. In the present studies, face gaze avoidance was not only observed in an initial stage (*Chapter 5*) but also across the approximately 20-minutue conversation (*Chapter 4*). This could be explained by the constant risk of negative evaluation posed by the reciprocal self-disclosure task. Therefore, in line with accounts of social anxiety highlighting fear and avoidance of scrutiny by others as key features (e.g., APA, 2013; Rapee & Heimberg, 1997), results from our studies underscore that a perceived risk of evaluation or rejection has more influence on gaze behavior of HSA individuals than merely being observed.

Furthermore, our studies indicate that a demand for self-disclosure – i.e. revealing personal information to other people (Jourard, 1971) – could be a key element contributing to the perceived risk of negative evaluation, thereby resulting in face gaze avoidance for people with HSA. In line with this idea, socially anxious individuals have been shown to decrease their self-disclosure levels during social interactions when they are expecting to be liked (Voncken et al., 2020). As such, increasing demands on HSA people to reveal themselves to others is likely to place them at an increased perceived risk of receiving negative evaluation or rejection. Further, it is worth noting that our studies suggest that both immediate self-disclosure demands (e.g., speech tasks, *Chapter 3*), and social interactions where (reciprocal) self-disclosure is

explicitly expected (e.g., initial encounters involving high intimate topics, *Chapter 4*), seem to similarly lead to gaze avoidance in HSA individuals. This may provide design recommendations for creating naturalistic settings investigating gaze behavior in social anxiety.

In addition, our results showed nuanced differences in gaze behavior modulated by conversational role and intimacy within social interactions (*Chapter 4*). For example, during the prolonged conversation with a live conversation partner about low and high intimate topics, HSA people apparently perceived a higher risk of negative evaluation for low intimate topics than low socially anxious (LSA) people. Both people with high and low social anxiety appeared to perceive risk of negative evaluation with high intimate topics. LSA people may have experienced a higher level of anxiety than usual while sharing highly personal information, because having a live, face-to-face interaction with others was rare for all participants under the circumstance of COVID-19 pandemic. These results therefore emphasize the importance of establishing naturalistic situations to study gaze behavior in social anxiety, while taking real-world complexity and richness of social tasks into account.

Face gaze avoidance: Gaze anxiety, but social anxiety is a better predictor

Chapter 5 provided initial evidence that self-reported gaze anxiety, using the Gaze Anxiety Rating Scale (GARS), can partially predict actual gaze avoidance. Of note, the results indicate that gaze anxiety is of limited correspondence with actual gaze behavior. The limited correspondence may be due to people not being fully aware of their own gaze behavior. It makes sense given that gaze to faces is highly context-dependent and interactive by nature (Hamilton, 2016; Hessels, 2020). Also, because making eye contact is prescribed by (implicit) social norms, it is likely that people only have a general impression of whether or not they adhere to this norm in everyday life. Future research could clarify the extent to which the general impression fits with specific social situations.

It is worth noting that social anxiety, compared to gaze anxiety, is a better predictor of actual gaze avoidance (*Chapter 5*). This finding seems in line with the view that gaze anxiety is an important symptom of social anxiety (e.g., Domes et al., 2016; Judah et al., 2019), suggesting that gaze avoidance is a feature that applies to people who are socially anxious individuals in general rather than to a subgroup of socially anxious people who specifically have problems making eye contact. Given that our sample was not drawn from a clinical population, replications are needed to investigate the possibility that the GARS fits in better with SAD patients. In addition, we could not rule out the alternative possibility that the relation between gaze anxiety and gaze avoidance may be specific to certain social situations, since the association between

gaze anxiety and gaze avoidance found in *Chapter 5* was only evident while taking not while listening. Further research using naturalistic social contexts therefore is needed to clarify the relationship.

Clinical implications

First, the results from this dissertation suggest that face gaze avoidance could be a quantitative and reliable indicator for the early detection of socially anxious individuals who may be at risk for developing SAD. Further, although our findings offer a promising starting point for investigation into gaze behavior in a naturalistic manner via using wearable eye-trackers, using eye-tracking for clinical purposes cannot yet be conclusively recommended as the current studies did not involve a clinical population. Few efforts have been made to seek for possibilities to apply eye-tracking as a screening tool, such as for autism spectrum disorder (e.g., Frazier et al., 2018; Kou et al., 2019). However, until the present, to the best of our knowledge, only one study attempted to use eye-tracking (in a virtual environment) as a screening tool for social anxiety (Dechant et al., 2017). This study yielded encouraging support for the application of eye-tracking to distinguish between high and low socially anxious individuals, but still, no clinical samples were involved. There is a clear need for further research, since several important questions remain to be clarified, such as: to what extent face gaze avoidance is shared by HSA and SAD, which combinations of eye-tracking paradigms (e.g., stimuli and social contexts) and gaze measures (e.g., fixations, scan patterns) is the most predictive of HSA and/or SAD. Of note, we acknowledge that social anxiety (disorder) is more than problems with making eye contact, and hence this SAD risk marker may assist clinical practice, but surely should be used in conjunction with other diagnostic techniques.

Second, targeting gaze avoidance in (early) interventions could be beneficial. Prior work indicates that high socially anxious people feel the most anxious when they are being required to make less eye contact during social interactions (Langer et al., 2013). Demonstrating this undesirable outcome in an intervention may be a straightforward way for enabling these people to remedy this apparently unhelpful gaze pattern. In addition, our findings that socially anxious individuals show gaze avoidance in situations demanding self-disclosure may carry implications for exposure exercises. For instance, encouraging socially anxious individuals to reveal more information about themselves could help create more challenging exposure exercises. In addition, asking for self-disclosure by SAD patients may be useful to treatments targeting fear of negative evaluation in SAD. For example, in an attempt to improve efficacy of virtual reality exposure therapy in reducing such fear, Kampmann (2018) proposed to add facial expressions and/or dialogues that deliver explicit negative evaluation.

Our results complement these recommendations by indicating that incorporating demands for self-disclosure into exposure exercises could also be beneficial.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The limitations and strengths of the dissertation clearly call for future research to move the field forward. Here, we discuss three promising research lines that may contribute to better understanding of gaze behavior in social anxiety.

The first is the line focusing on improving and extending wearable eye-tracking based interaction paradigms. There are several branches to pursue. (a) Measuring *eye* gaze instead of face gaze could be more theoretically relevant, although individuals seem to perceive direct gaze on their faces as eye contact in general (Rogers et al., 2019). Of note, calibration performed with multiple points and a short interpersonal distance are needed to achieve sufficient precision to measure eye gaze. (b) Although confederates' eye movements were registered during the interactions, we were not able to incorporate it in the present studies due to time constraints. Given (mutual) eye contact is a two-way phenomenon, analyzing dual eye-tracking data enables to consider the influence of both interaction partner's gaze. Further, dual eye-tracking paradigms allow to investigate when and how mutual eye contact starts, continues, and is broken across time. These subtle processes in relation to eye contact could be important to modulate or alter social consequences, such as perceived likability and social skills of socially anxious individuals by interaction partners. Collectively, these details can enrich the picture of social anxiety and gaze behavior by adding extra layers to the aggregate fixation based-gaze measures that are commonly used. (c) The interactive situations we used are restricted to initial conversations with same-sex peers. In order to gain a better understanding of how social anxiety shapes gaze behavior in the real-world, future investigations may extend to situations that capture more variety of social situations (e.g., romantic relationship initiation, group conversation), richness of social tasks (e.g., playing games, cooperation and competition), and variants in interaction partners (e.g., close friends, family members). (d) The final branch could be to test and refine our tentative hypothesis that perceived risk of negative evaluation acts as the main driver for gaze avoidance in socially anxious individuals. The main question - the extent to which this risk elicits gaze avoidance in socially anxious individuals - could be a useful starting point.

The second line is to focus on demographic characteristics as well as longitudinal changes in relation to gaze behavior. (a) Our studies exclusively involve female emerging adults mostly from Western countries. Future studies evaluating effects of

age, gender as well as cultural background may assist clarify the extent to which these factors modulate gaze avoidance in socially anxious individuals. For instance, findings from Haensel et al. (2020) suggest that social anxiety has impact on Japanese but not British/Irish people' face gaze behavior in a face-to-face conversation. (b) It is important to note that studies from developmental perspectives are still sparse. Our review (*Chapter 2*) suggests that adolescence is a key stage for the emergence of gaze avoidance, but it has not yet been empirically confirmed. Furthermore, it still remains unclear whether individuals showing gaze avoidance are indeed more vulnerable to developing SAD later on. Longitudinal research is needed to examine the predictive validity of gaze avoidance, which may thus prove important for early detection and intervention.

The direction of the third line lies in increasing involvement of socially anxious individuals in the research processes. Gaze patterns in social anxiety have almost exclusively been examined using objective and quantitative approaches. Information generated from the perspectives of socially anxious people themselves should be valuable to understand when and how avoidant gaze patterns have developed, and which unintended consequences are experienced. Also, qualitative data that capture more detail and complexity regarding gaze behavior in socially anxious individuals can help develop effective (self-report) techniques for detection and intervention. Therefore, qualitative research, such as interview-based approaches, enables in-depth investigation of day-to-day experience and seems a promising line of research.

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CHAPTER 7

Nederlandse samenvatting

ALGEMENE INLEIDING

Sociale relaties zijn essentieel voor de meeste mensen, maar mensen die meer sociale angst ervaren hebben vaak moeite met het ontwikkelen en onderhouden van interpersoonlijke relaties. Sociale angst is angst voor negatieve beoordeling en afwijzing door anderen (Clark & Wells, 1995; Hofmann, 2007; Spence & Rapee, 2016). Sociale angst is een continuüm variërend van laag tot hoog niveau. Mensen met hoge niveaus van sociale angst kunnen worden gediagnosticeerd met een sociale angststoornis (social anxiety disorder, SAD), als er sprake is van intense angst en vermijding die hun leven verstoren (Rapee & Spence, 2004). SAD wordt in verband gebracht met substantiële functionele beperkingen in werk-, school- en sociale domeinen (Aderka et al., 2012; Ruscio et al., 2008), wat bijdraagt aan een slechte levenskwaliteit (Alonso et al., 2004; Dryman et al., 2016). Uit een recent onderzoek blijkt dat maar liefst 36% van de jongvolwassen bevolking uit meerdere westerse en Aziatische landen risico op SAD loopt (Jefferies & Ungar, 2020). Al met al onderstrepen de hoge prevalentie en impact de noodzaak om de kennis van SAD te verdiepen.

Sociale angst wordt consequent geassocieerd met negatieve sociale uitkomsten tijdens sociale interacties. Mensen die meer sociale angst ervaren worden bijvoorbeeld beoordeeld als minder sympathiek (e.g., Mein et al., 2016) en minder sociaal vaardig (e.g., Stevens et al., 2010). Een kenmerk van sociale angst dat mogelijk bijdraagt aan negatieve uitkomsten, is het vermijden van oogcontact. Theoretische modellen van sociale angst op basis van klinische observaties veronderstellen dat sociale angst geassocieerd is met het vermijden van oogcontact. In de literatuur over sociale angst wordt het vermijden van oogcontact geïnterpreteerd als een gedrag dat voortkomt uit (1) een behoefte aan veiligheid, bedoeld om de gevreesde uitkomsten te vermijden zonder zich volledig terug te trekken uit sociale situaties (Clark & Wells, 1995), (2) een onderdanig temperament: de neiging om zich te schikken naar de wensen of de bevelen van anderen (Gilbert, 2001) en (3) tekorten aan sociale vaardigheden (Levitan & Nardi, 2009). Bij het aangaan van sociale interacties is het vermijden van oogcontact problematisch; het kan niet alleen negatieve gevolgen hebben omdat het kan worden geïnterpreteerd als ongeïnteresseerd of oneerlijk (Kleinke, 1986), maar het vermijden kan sociaal angstige personen ook belangrijke sociale informatie ontnemen, waardoor sociale leerprocessen op de lange termijn worden belemmerd.

Alles bij elkaar genomen zullen mensen met een grotere sociale angst waarschijnlijk oogcontact vermijden, en het vermijden van oogcontact kan op zijn beurt sociale moeilijkheden creëren of verergeren die de angst voor sociale situaties in stand kunnen houden of zelfs vergroten. Aan het begin van dit promotieonderzoek bleek echter dat de empirische bevindingen met betrekking tot het vermijden van oogcontact bij

sociaal angstige personen niet zo eenduidig waren: sommige onderzoeken toonden de verwachte relatie aan tussen sociale angst en het vermijden van oogcontact, terwijl andere onderzoeken deze relatie niet aantoonden. Deze wisselende uitkomsten vroegen om een uitgebreide literatuurstudie en aanvullend empirisch onderzoek om de relatie tussen sociale angst en het vermijden van het oogcontact te verduidelijken.

Het proefschrift probeert drie belangrijke vragen te beantwoorden: (1) Of sociale angst gekenmerkt wordt door het vermijden van oogcontact (***Hoofdstukken 2 tot en met 5***). (2) Onder welke omstandigheden het vermijden van oogcontact waargenomen kan worden bij sociaal angstige personen (***Hoofdstukken 2 tot en met 5***). (3) In hoeverre de subjectieve ervaring van het vermijden van oogcontact overeenkomt met feitelijk kijkgedrag (***Hoofdstuk 5***). Dit proefschrift gebruikt de combinatie van levensechte sociale situaties en ultramoderne draagbare eye-trackers (Tobii Pro Glasses 2) om licht te werpen op de aard van het kijkgedrag van sociaal angstige individuen in sociale interacties.

SAMENVATTING VAN BEVINDINGEN

De eerste stap, naar aanleiding van de tegenstrijdige bevindingen in de bestaande empirische literatuur, was een systematisch literatuuroverzicht van onderzoeken naar de relatie tussen sociale angst en het vermijden van oogcontact (***Hoofdstuk 2***). Met een zoekopdracht in twee elektronische databases (Web of Science and PubMed) tot maart 2019 werden 61 publicaties geïdentificeerd die voldeden aan de inclusiecriteria. Dit overzichtsartikel bespreekt de bevindingen van deze onderzoeken aan de hand van drie factoren die mogelijk invloed hebben op de mate waarin sociaal angstige individuen vermijden om naar gezichten te kijken: (a) Ernst van symptomen van sociale angst (gediagnosticeerde SAD versus personen met een hoge mate van sociale angst (HSA) of aan sociale angst gerelateerde kenmerken [verlegenheid, angst voor negatieve beoordeling]); (b) Type sociale situaties (taken om naar de gezichten te kijken, spreektaken en sociale interacties); (c) Ontwikkeling (leeftijdsgroepen, inclusief jonge kinderen, schoolkinderen, adolescenten en volwassenen). Het overzichtsartikel biedt ondersteuning voor het effect van de drie factoren. Er werden vier belangrijke resultaten gevonden. (1) Volwassenen met SAD vermijden het kijken naar gezichten in alle sociale situaties. (2) Het vermijden van gezichten bij HSA-volwassenen hing af van het type sociale situatie. Dat wil zeggen dat ze consistente vermijding vertoonden in situaties zoals spreken in het openbaar en sociale interactie, maar er werden gemengde resultaten gevonden bij de taken om naar gezichten te kijken waarbij deelnemers doorgaans werd gevraagd om foto's van gezichten te bekijken die op een computerscherm werden gepresenteerd. (3) Taken om naar gezichten te kijken

toonden een relatief consistente vermijding van gezichten bij mensen met SAD, maar niet bij mensen met HSA of SA-gerelateerde kenmerken (verlegenheid, angst voor negatieve beoordeling). (4) Hoewel onderzoeken over ontwikkeling schaars zijn, lijkt de relatie tussen sociale angst en het vermijden van oogcontact naar voren te komen in de adolescentie. Sommige onderzoeken met sociaal angstige (jonge) kinderen toonden daarentegen juist meer aandacht voor gezichten.

Voortbouwend op de uitkomsten van het literatuuronderzoek (***Hoofdstuk 2***) waarin wordt gesuggereerd dat de invloed van situationele factoren bijzonder sterk kan zijn bij mensen met HSA, voerden we twee experimenten uit met verschillende sociale situaties om te onderzoeken of het kijkgedrag significant verschilt tussen hoog en laag sociaal angstige vrouwen (***Hoofdstukken 3 en 4***).

Hoofdstuk 3 presenteert het onderzoek naar het onderscheidende effect van twee soorten sociale situaties - een passieve taak om naar gezichten te kijken en een spreektaak voor een publiek - op kijkgedrag bij deelnemers met een hoge en een lage sociale angst. Achtentachtig vrouwelijke studenten (gemiddelde leeftijd 20,75 jaar) namen deel aan het experiment. Bij de spreektaak kregen de deelnemers de opdracht om zichzelf gedurende 1 minuut voor te stellen aan het publiek (dat vooraf opgenomen was en bestond uit een lerares en acht leerlingen). Bij de taak om naar gezichten te kijken kregen deelnemers de instructie om gewoon 1 minuut lang naar hetzelfde publiek te kijken. Alle deelnemers vulden een zelfrapportage vragenlijst in (de Liebowitz Social Anxiety Scale-Self Report; LSAS-SR; Liebowitz, 1987) om het niveau van sociale angst te meten. Tijdens de twee taken werden hun oogbewegingen geregistreerd met de Tobii Pro Glasses 2. Er werden twee patronen gemeten met betrekking tot oogcontact: (1) Het vermijden van oogcontact werd beoordeeld aan de hand van de totale fixatietijd (de totale tijd in seconden dat de blik op gezichten gericht is), fixatietellingen (het aantal keren dat de blik op een gezicht gericht is) en gemiddelde fixatietijd (gemiddelde duur in seconden van een blik op een gezicht). (2) Hyper waakzaamheid werd beoordeeld aan de hand van de lengte van het scanpad (de afstand die de ogen afleggen tijdens de presentatie van gezichtsbeelden) en de gemiddelde afstand tussen fixaties. Hyper waakzaamheid wordt meestal gekenmerkt door meer oogbewegingen en minder en kortere fixaties op gezichten, wat vaak wordt geïnterpreteerd als een teken van waakzaamheid in vergelijking met vermijding. Dit onderzoek biedt ondersteuning voor het onderscheidende effect van de sociale situaties. Dat wil zeggen, in vergelijking met laag sociaal angstige deelnemers keken HSA-deelnemers alleen tijdens de spreektaak minder naar de gezichten in het publiek (niet tijdens de taak om naar gezichten te kijken). Bovendien was er geen bewijs voor hyperwaakzaamheid voor HSA-deelnemers, omdat alle deelnemers een langere totale

lengte van het scanpad vertoonden wanneer ze een toespraak hielden voor het publiek in vergelijking met wanneer ze gewoon naar hen keken.

Om het onderzoek naar de invloed van sociale situaties uit te breiden van een interactie met mensen op een scherm (tijdens de spreektaak) naar live, face-to-face sociale interacties, bestudeerden we oogcontact tijdens een kennismakingsgesprek tussen twee personen in een face-to-face omgeving (***Hoofdstuk 4***). Tijdens het gesprek deelden een deelnemer en een gesprekspartner van hetzelfde geslacht om de beurt meer of minder persoonlijke informatie. Naast levensechte sociale interactie, bood dit protocol de mogelijkheid om twee contextuele factoren te onderzoeken die inherent zijn aan het voeren van een gesprek: rol in het gesprek (spreken versus luisteren) en niveau van intimiteit van het gespreksonderwerp (persoonlijke versus algemene onderwerpen). Vijfentachtig vrouwelijke studenten (leeftijd 17 - 25 jaar) namen deel aan het experiment. Sociale angst werd beoordeeld door de LSAS-SR en oogbewegingen werden geregistreerd met de Tobii Pro Glasses 2. De duur van de fixaties en de proportie fixaties op het gezicht van de gesprekspartner werden gebruikt als metingen voor oogcontact. Als resultaat toonden de eye-tracking-analyses aan dat (1) alle deelnemers, ongeacht sociale angst, tijdens het spreken minder naar het gezicht van de gesprekspartner keken dan tijdens het luisteren. (2) Evenzo keken deelnemers over het algemeen minder naar het gezicht van de gesprekspartner wanneer ze zeer intieme onderwerpen bespraken in vergelijking met minder persoonlijke onderwerpen. (3) Sociale angst ging gepaard met minder kijken naar het gezicht van de gesprekspartner tijdens het gesprek. Al met al bevestigt het onderzoek de effecten van de twee situationele factoren (rol in het gesprek en intimiteit) en sociale angst op kijkgedrag tijdens natuurlijke sociale interacties.

In ***Hoofdstuk 5*** rapporteren we in hoeverre de subjectieve ervaring van de angst voor en de vermijding van oogcontact overeenkomt met objectieve eye-tracking metingen. Daarnaast was het de vraag of zelf-gerapporteerde angst voor oogcontact (een angst die specifiek betrekking heeft op het maken van oogcontact) een betere voorspeller is van de daadwerkelijke vermijding van de blik van een ander dan sociale angst. Daartoe werden eye-tracking-gegevens van 85 vrouwelijke studenten tijdens de eerste 6 minuten van een persoonlijk gesprek geëxtraheerd (uit ***Hoofdstuk 4***). Angst voor oogcontact en sociale angst werden respectievelijk gemeten via de Gaze Anxiety Rating Scale (GARS; Schneier et al., 2011) en de LSAS-SR. Het onderzoek toonde aan dat angst voor oogcontact significant geassocieerd was met minder kijken naar het gezicht tijdens het spreken. Sociale angst was eveneens geassocieerd met minder kijken naar het gezicht tijdens het spreken, maar ook tijdens de hele eerste gespreksfase van ongeveer 6 minuten. Bovendien toonden de analyses aan dat angst voor oogcontact geen extra bijdrage leverde naast sociale angst bij het voorspellen van het kijken naar

het gezicht van de gesprekspartner. Al met al suggereren deze bevindingen dat de subjectieve angst voor oogcontact het daadwerkelijke kijkgedrag tijdens een face-to-face eerste ontmoeting voorspelt, maar dat sociale angst de sterkere voorspeller is van het daadwerkelijke kijkgedrag.

ALGEMENE DISCUSSIE EN IMPLICATIES

Levensechte sociale interacties en de vermijding van kijken naar gezichten

Een van de belangrijkste bevindingen uit dit proefschrift is dat personen met een hoge mate van sociale angst (HSA) het vermijden om naar gezichten te kijken in levensechte sociale situaties. Dit proefschrift draagt bij aan de bestaande kennis door meer bewijs te leveren voor het idee dat vermijding van het kijken naar gezichten een gedragskenmerk is van sociale angst, en door aan te tonen dat dergelijke vermijding met name voorkomt in levensechte sociale interacties.

De bevindingen dat vermijding van het kijken naar gezichten werd waargenomen bij HSA-mensen, suggereren dat een dergelijke vermijding al bestaat bij degenen die een grotere sociale angst ervaren van de algemene bevolking. Onze resultaten ondersteunen dus het continuümmodel van sociale angst in plaats van categorische verschillen tussen patiënten met SAD en niet-patiënten. Aan de andere kant, wat mensen met HSA en SAD onderscheidt, gebaseerd op de bevindingen uit ***Hoofdstukken 2 en 3***, lijkt te zijn of ze de vermijding van het kijken naar gezichten ook vertonen bij passieve taken om naar (afbeeldingen van) gezichten te kijken. Mensen met SAD hebben de neiging om te vermijden om naar gezichten te kijken wanneer hen gevraagd wordt om naar een foto van een gezicht te kijken (***Hoofdstuk 2***), terwijl mensen met HSA dat niet doen (***Hoofdstukken 2 en 3***). Een mogelijke verklaring is dat SAD resulteert in problemen om met flexibele kijkpatronen te reageren op veranderende sociale situaties, wat op zijn beurt kan leiden tot algehele vermijding van gezichten. In tegenstelling tot SAD is de flexibiliteit bij mensen met HSA mogelijk minder beperkt dan bij patiënten, wat resulteert in situatieafhankelijke vermijding wanneer ze geconfronteerd worden met gezichten, in plaats van in algemene vermijding. Bovendien geven de bevindingen dat vermijding van het kijken naar gezichten voorkomt in levensechte interacties aan dat deze vermijding beschouwd kan worden als een gedragskenmerk van sociale angst in het echte leven. Dit betekent dat nadelige effecten van het vermijden van oogcontact waarschijnlijk zullen optreden in het dagelijkse sociale leven voor mensen die een hoge mate van sociale angst ervaren. Als zodanig kan het vermijden van oogcontact een risicofactor zijn voor het in stand houden en zelfs verergeren van symptomen van

sociale angst die uiteindelijk leiden tot klinisch significante symptomen (Clark & Wells, 1995).

Een mechanisme voor het vermijden van oogcontact bij hoge sociale angst

Het proefschrift illustreert duidelijk dat situationele factoren een belangrijke rol spelen in de relatie tussen sociale angst en het vermijden van oogcontact. Het vermijden van oogcontact werd waargenomen in bepaalde sociale situaties, maar niet in andere situaties. Ten eerste vertoonden HSA-mensen de ontwijking van gezichten in levensechte sociale situaties, waaronder spreektaken en sociale interacties met anderen (***Hoofdstukken 3 tot 5***), maar niet in situaties waarin gezichten werden bekeken (***Hoofdstuk 3***). Ten tweede, bij het aangaan van daadwerkelijke interacties, werd het vermijden van oogcontact gevonden tijdens een gesprek van 20 minuten waarbij wederzijdse zelfonthulling nodig was (informatie over zichzelf aan anderen onthullen, ***Hoofdstuk 4***), en in de vroege fase van het gesprek wanneer sociaal angstige personen aan het woord waren (maar niet als ze luisterden, ***Hoofdstuk 5***).

Deze resultaten suggereren dat HSA-individuen niet altijd vermijden om naar gezichten te kijken; deze mensen zijn gevoelig voor bepaalde situationele componenten, wat leidt tot flexibel kijkgedrag. In die zin suggereert een dergelijke context-gerelateerde flexibiliteit dat alleen bekeken worden door andere mensen misschien niet voldoende is om oogcontact te vermijden. Integendeel, het door HSA-mensen waargenomen risico om (negatief) geëvalueerd of afgewezen te worden, lijkt de belangrijkste factor te zijn om het vermijden van oogcontact op te wekken. Bovendien geven onze onderzoeken aan dat de vraag naar zelfonthulling (het onthullen van persoonlijke informatie aan andere mensen; Jourard, 1971) een sleutelelement zou kunnen zijn dat bijdraagt aan het waargenomen risico op een negatieve beoordeling, wat resulteert in vermijding van het kijken naar gezichten voor mensen met HSA. Bovendien toonden onze resultaten genuanceerde verschillen in kijkgedrag, beïnvloed door rollen in het gesprek en intimiteit binnen sociale interacties (***Hoofdstuk 4***). Deze resultaten benadrukken daarom het belang van het creëren van levensechte situaties om kijkgedrag bij sociale angst te bestuderen, rekening houdend met de complexiteit en rijkdom van sociale taken in de echte wereld.

Vermijding van het kijken naar gezichten: Angst voor oogcontact, maar sociale angst is een betere voorspeller

Hoofdstuk 5 leverde het eerste bewijs dat zelfgerapporteerde angst voor oogcontact, met behulp van de Gaze Anxiety Rating Scale (GARS), tot op zekere hoogte het daadwerkelijke vermijden van oogcontact kan voorspellen. Bovendien is het

opmerkelijk dat sociale angst, in vergelijking met angst voor oogcontact, een betere voorspeller is van het daadwerkelijke vermijden van oogcontact (***Hoofdstuk 5***). Dit suggereert dat het vermijden van oogcontact een kenmerk is dat van toepassing is op sociaal angstige individuen in het algemeen, en niet op een subgroep van sociaal angstige mensen die specifiek problemen hebben met het maken van oogcontact. Aangezien onze steekproef niet afkomstig is uit een klinische populatie, zijn replicaties nodig om de mogelijkheid te onderzoeken dat de GARS een extra bijdrage levert aan het voorspellen van het kijkgedrag van SAD-patiënten.

Klinische implicaties

Ten eerste suggereren de resultaten van dit proefschrift dat vermijding van het kijken naar gezichten een waarneembare en betrouwbare indicator zou kunnen zijn voor de vroege detectie van personen die mogelijk risico lopen op SAD. Ten tweede kan het vermijden van oogcontact een nuttig aangrijpingspunt zijn voor (vroege) interventies. Eerder onderzoek geeft aan dat HSA-mensen zich het meest angstig voelen wanneer ze de instructie krijgen om minder oogcontact te maken tijdens een sociale interactie (Langer et al., 2013). Een interventie die HSA-mensen laat ervaren dat minder oogcontact meer angstgevoelens oproept, kan een eenvoudige manier zijn om deze mensen af te helpen van hun vermijding van oogcontact. Ten slotte kunnen onze bevindingen dat sociaal angstige individuen het vermijden van oogcontact vertonen in situaties die zelfonthulling vereisen, implicaties hebben voor blootstellingsoefeningen. Het zou nuttig kunnen zijn om verschillende gradaties van zelfonthulling op te nemen in oefeningen om sociaal angstige mensen bloot te stellen aan sociale situaties.

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APPENDICES

List of publications

Curriculum vitae

Acknowledgements

LIST OF PUBLICATIONS

Chen, J., van den Bos, E., & Westenberg, P. M. (2020). A systematic review of visual avoidance of faces in socially anxious individuals: Influence of severity, type of social situation, and development. *Journal of Anxiety Disorders, 70,* 102193. https://doi.org/10.1016/j.janxdis.2020.102193

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CURRICULUM VITAE

Jiemiao Chen was born in Emeishan, China in August, 1992. She received her high school diploma from No.2 middle school of Emei in 2010. After graduation she obtained her bachelor's degree in Education at Xianyang Normal University in 2014. In 2017, she obtained her master's degree in Education at East China Normal University. In 2017 she received a 4 - year scholarship from China Scholarship Council to support her PhD project in the Institute of Psychology at Leiden University under the supervision of Prof. dr. Michiel Westenberg and Dr. Esther van den Bos. Her research focused on gaze behaviour in socially anxious individuals. In November 2022, Jiemiao started working as a postdoctoral researcher at Leiden University. She will continue her collaboration with Prof. dr. Michiel Westenberg and Dr. Esther van den Bos to extend her PhD research to children and adolescents.

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