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

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CHAPTER 5

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

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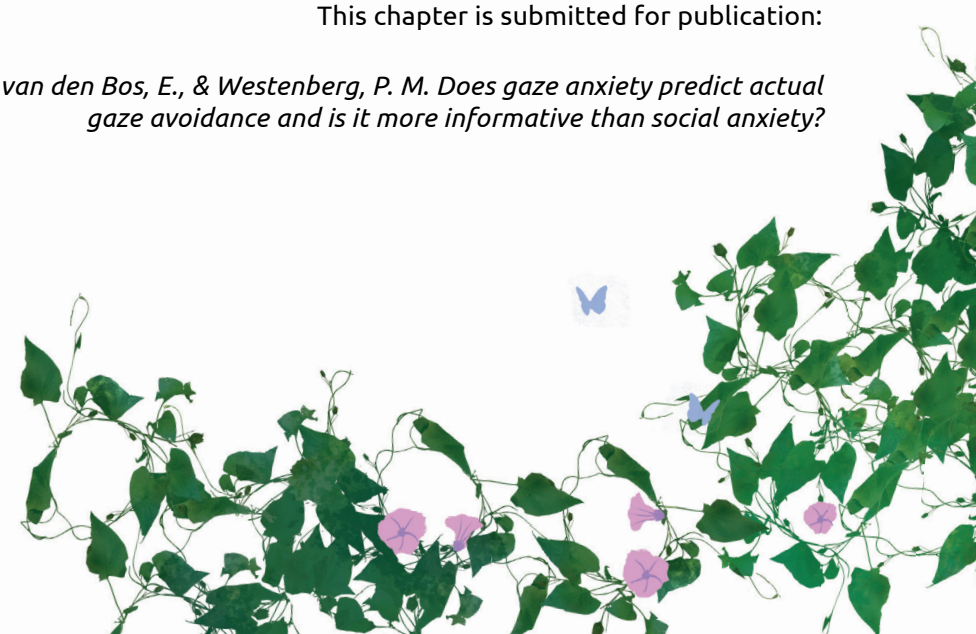

ABSTRACT

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.

REFERENCES

Aron, A., Melinat, E., Aron, E. N., Vallone, R. D., & Bator, R. J. (1997). The experimental generation of interpersonal closeness: A procedure and some preliminary findings. *Personality and Social Psychology Bulletin, 23*, 363–377. https://doi.org/10.1177/0146167297234003

Baker, S. R., & Edelmann, R. J. (2002). Is social phobia related to lack of social skills? Duration of skill-related behaviours and ratings of behavioural adequacy. *British Journal of Clinical Psychology*, *41*(3), 243–257. https://doi.org/10.1348/014466502760379118

Baker, S. L., Heinrichs, N., Kim, H. J., & Hofmann, S. G. (2002). The Liebowitz social anxiety scale as a self-report instrument: a preliminary psychometric analysis. *Behaviour Research and Therapy, 40*(6), 701-715. https://doi.org/10.1016/S0005-7967(01)00060-2

Buchan, J. N., Paré, M., & Munhall, K. G. (2008). The effect of varying talker identity and listening conditions on gaze behavior during audiovisual speech perception. *Brain Research,* 1242, 162-171. https://doi.org/10.1016/j.brainres.2008.06.083

Chen, J., van den Bos, E., L.M. Velthuizen, S., & Westenberg, P. M. (2021). Visual avoidance of faces in socially anxious individuals: The moderating effect of type of social situation. *Journal of Experimental Psychopathology, 12*(1), 204380872198962. https://doi.org/10.1177/2043808721989628

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

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. Liebowitz, D. Hope, & F. Schneier (Eds.). *Social phobia: Diagnosis, assessment, and treatment*. New York: Guilford.

Daly, S. (1978). Behavioural correlates of social anxiety. *British Journal of Social and Clinical Psychology*, *17*(2), 117–120.

Dechant, M., Trimpl, S., Wolff, C., Mühlberger, A., & Shiban, Y. (2017). Potential of virtual reality as a diagnostic tool for social anxiety: A pilot study. *Computers in Human Behavior*, *76*, 128–134. https://doi.org/10.1016/j.chb.2017.07.005

Derlega, V. J., Winstead, B. A., Wong, P. T., & Hunter, S. (1985). Gender effects in an initial encounter: A case where men exceed women in disclosure. *Journal of Social and Personal Relationships*, *2*(1), 25-44. https://doi.org/10.1177/0265407585021002

Domes, G., Marx, L., Spenthof, I., & Heinrichs, M. (2016). The German version of the Gaze Anxiety Rating Scale (GARS): reliability and validity. *PLOS ONE 11*(3): e0150807. http://doi.org/10.1371/journal. pone.0150807

Freeth, M, Foulsham, T, & Kingstone, A. (2013). What Affects Social Attention? Social Presence, Eye Contact and Autistic Traits. *PLOS ONE* 8(1): e53286. https://doi.org/10.1371/journal.pone.0053286.

Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz Social Anxiety Scale: a comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine, 31*(6), 1025-1035. https://doi:10.1017/S0033291701004056

Grossman, R. B., Zane, E., Mertens, J., & Mitchell, T. (2019). Facetime vs. Screentime: Gaze patterns to live and video social stimuli in adolescents with ASD. *Scientific Reports, 9*(1), 1-10. https://doi.org/10.1038/s41598-019-49039-7

Günther, V., Kropidlowski, A., Schmidt, F. M., Koelkebeck, K., Kersting, A., & Suslow, T. (2021). Attentional processes during emotional face perception in social anxiety disorder: A systematic

review and meta-analysis of eye-tracking findings. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *111*, 110353. https://doi.org/10.1016/j.pnpbp.2021.110353

Haensel, J. X., Danvers, M., Ishikawa, M., Itakura, S., Tucciarelli, R., Smith, T. J., & Senju, A. (2020). Culture modulates face scanning during dyadic social interactions. *Scientific Reports*, *10*(1), 1–11. https://doi.org/10.1038/s41598-020-58802-0

Haensel, J. X., Smith, T. J., & Senju, A. (2022). Cultural differences in mutual gaze during face-to-face interactions: A dual head-mounted eye-tracking study. *Visual Cognition, 30*(1-2), 100-115. https://doi.org/10.1080/13506285.2021.1928354

Hanley, M., Riby, D. M., Carty, C., Melaugh McAteer, A., Kennedy, A., & McPhillips, M. (2015). The use of eye-tracking to explore social difficulties in cognitively able students with autism spectrum disorder: A pilot investigation. *Autism, 19*(7), 868–873. https://doi.org/10.1177/1362361315580767

Hessels, R. S., Holleman, G. A., Cornelissen, T. H. W., Hooge, I. T. C., & Kemner, C. (2018). Eye contact takes two – autistic and social anxiety traits predict gaze behavior in dyadic interaction. *Journal of Experimental Psychopathology*, *9*(2). https://doi.org/10.5127/jep.062917

Hessels, R. S., Holleman, G. A., Kingstone, A., Hooge, I. T. C., & Kemner, C. (2019). Gaze allocation in face-to-face communication is affected primarily by task structure and social context, not stimulus-driven factors. *Cognition*, *184*, 28–43. https://doi.org/10.1016/j.cognition.2018.12.005

Hofmann, S. G. (2007). Cognitive factors that maintain social anxiety disorder: A comprehensive model and its treatment implications. *Cognitive Behaviour Therapy*, *36*(4), 193–209. https://doi.org/10.1080/16506070701421313

Howell, A. N., Zibulsky, D. A., Srivastav, A., & Weeks, J. W. (2016). Relations among Social Anxiety, Eye Contact Avoidance, State Anxiety, and Perception of Interaction Performance during a Live Conversation. *Cognitive Behaviour Therapy*, *45*(2), 111–122. https://doi.org/10.1080/16506073.2015.1111932

Judah, M. R., Hager, N. M., Nako, K., & Blanchette, D. (2019). Gaze Avoidance Explains the Association Between Anxiety Sensitivity Social Concerns and Social Anxiety. *International Journal of Cognitive Therapy*, *12*(3), 205–216. https://doi.org/10.1007/s41811-019-00050-w

Kashdan, T. B., Goodman, F. R., Machell, K. A., Kleiman, E. M., Monfort, S. S., Ciarrochi, J., & Nezlek, J. B. (2014). A contextual approach to experiential avoidance and social anxiety: Evidence from an experimental interaction and daily interactions of people with social anxiety disorder. *Emotion*, *14*(4), 769–781. https://doi.org/10.1037/a0035935

Kashdan, T. B., & Roberts, J. E. (2004). Social anxiety's impact on affect, curiosity, and social self-efficacy during a high self-focus social threat situation. *Cognitive Therapy and Research*, *28*(1), 119–141. https://doi.org/10.1023/B:COTR.0000016934.20981.68

Kashdan, T. B., & Roberts, J. E. (2006). Affective outcomes in superficial and intimate interactions: Roles of social anxiety and curiosity. *Journal of Research in Personality*, *40*(2), 140–167. https://doi.org/10.1016/j.jrp.2004.10.005

Kleinke, C. L. (1986). Gaze and eye contact: A research review. *Psychological Bulletin*, *100*(1), 78–100. https://doi.org/10.1037//0033-2909.100.1.78

Kley, H., Tuschen-Caffier, B., & Heinrichs, N. (2012). Safety behaviors, self-focused attention and negative thinking in children with social anxiety disorder, socially anxious and non-anxious children. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(1), 548–555. https://doi.org/10.1016/j.jbtep.2011.07.008

Langer, J. K., Rodebaugh, T. L., Menatti, A. R., Weeks, J. W., & Schneier, F. R. (2014). Psychometric properties of the gaze anxiety rating scale: convergent, discriminant, and factorial validity. *Cognitive Behaviour Therapy, 43*(1), 49-59. https://doi.org/10.1080/16506073.2013.804116.

Liebowitz, M. R. (1987). Social phobia. In D. F. Klein (Ed.), *Modern problems of pharmacopsychiatry* (Vol. 22, pp. 141-173). Basel: Karger. http://dx.doi.org/10.1159/000414022.

Mansour, H., & Kuhn, G. (2019). Studying "natural" eye movements in an "unnatural" social environment: The influence of social activity, framing, and sub-clinical traits on gaze aversion. *Quarterly Journal of Experimental Psychology, 72*(8), 1913–1925. https://doi.org/10.1177/1747021818819094

Mauss, I. B., Wilhelm, F. H., & Gross, J. J. (2004). Is there less to social anxiety than meets the eye? *Cognition and Emotion, 18*, 631-662. https://doi.org/10.1080/02699930341000112

Mehmood, F., Mahzoon, H., Yoshikawa, Y., & Ishiguro, H. (2021). Communication Apprehension and Eye Contact Anxiety in Video Conferences Involving Teleoperated Robot Avatars: A Subjective Evaluation Study. *Frontiers in Robotics and AI, 8,* 758177. https://doi.org/10.3389/frobt.2021.758177

Miers, A. C., Blöte, A. W., Sumter, S. R., Kallen, V. L., & Westenberg, P. M. (2010). Subjective and objective arousal correspondence and the role of self-monitoring processes in high and low socially anxious youth. *Journal of Experimental Psychopathology, 2*, 531-550. https://doi.org/10.5127/jep.019411

Olsen, A. (2012). Tobii I-VT fixation filter - Algorithm description. *White Paper* (Retrieved from http://www.tobii.com/eye-tracking-research/global/library/white-papers/the-tobii-i-vt-fixation-filter/).

Rubo, M., Huestegge, L., & Gamer, M. (2020). Social anxiety modulates visual exploration in real life–but not in the laboratory. *British Journal of Psychology, 111*(2), 233-245. https://doi.org/10.1111/bjop.12396

Schneier, F. R., Rodebaugh, T. L., Blanco, C., Lewin, H., & Liebowitz, M. R. (2011). Fear and avoidance of eye contact in social anxiety disorder. *Comprehensive Psychiatry*, *52*(1), 81–87. https://doi.org/10.1016/j.comppsych.2010.04.006

Spence, S. H., & Rapee, R. M. (2016). The etiology of social anxiety disorder: An evidence-based model. *Behaviour Research and Therapy*, *86*, 50–67. https://doi.org/10.1016/j.brat.2016.06.007

Trilla, I., Wnendt, H. & Dziobek, I. (2020). Conditional effects of gaze on automatic imitation: the role of autistic traits. *Scientific Reports, 10*(1), 1-12. https://doi.org/10.1038/s41598-020-72513-6

Tsang, T., Atagi, N., & Johnson, S. P. (2018). Selective attention to the mouth is associated with expressive language skills in monolingual and bilingual infants. *Journal of Experimental Child Psychology,* 169, 93-109. https://doi.org/10.1016/j.jecp.2018.01.002

Tyler, C., Light, S., Notthoff, A., & Cacciamani, L. (2021). Eye Gaze During Controversial Conversations Depends on Agreement and Conversational Role. *Journal of Nonverbal Behavior*, *45*(3), 351–366. https://doi.org/10.1007/s10919-021-00363-5.

Vatheuer, C. C., Vehlen, A., von Dawans, B., & Domes, G. (2021). Gaze behavior is associated with the cortisol response to acute psychosocial stress in the virtual TSST. *Journal of Neural Transmission, 128*(9), 1269-1278. https://doi.org/10.1007/s00702-021-02344-w

Vatikiotis-Bateson, E., Eigsti, I. M., Yano, S., & Munhall, K. G. (1998). Eye movement of perceivers during audiovisual speech perception. *Perception & Psychophysics, 60*(6), 926-940. https://doi.org/10.3758/BF03211929

von Dawans, B., Spenthof, I., Zimmer, P., & Domes, G. (2020). Acute psychosocial stress modulates the detection sensitivity for facial emotions. *Experimental Psychology, 67*(2), 140–149. https://doi.org/10.1027/1618-3169/a000473