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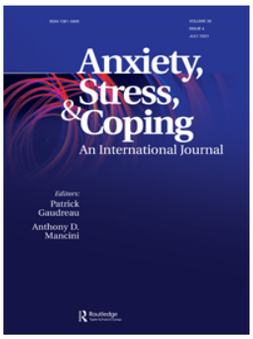

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Jiemiao Chen, Esther van den Bos, Julian D. Karch & P. Michiel Westenberg

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RESEARCH ARTICLE

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

Jiemiao Chen, Esther van den Bos, Julian D. Karch and P. Michiel Westenberg

Institute of Psychology, Leiden University, Leiden, The Netherlands

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.

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Eye-tracking; social anxiety; face gaze; face-to-face conversation; self-disclosure

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

CONTACT Jiemiao Chen j.chen@fsw.leidenuniv.nl
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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 (Hofmann, 2007; Piccirillo et al., 2016) and non-clinical samples (e.g., Gray et al., 2019; Judah et al., 2019; McManus et al., 2008). 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 et 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 et al. (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 et al. (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., Kang & Gratch, 2010; Miller & Dechant, 2021; Papsdorf & Alden, 1998; 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 and 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.

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 to 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 × 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 & Roberts, 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., 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 min). 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 m 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 m). 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

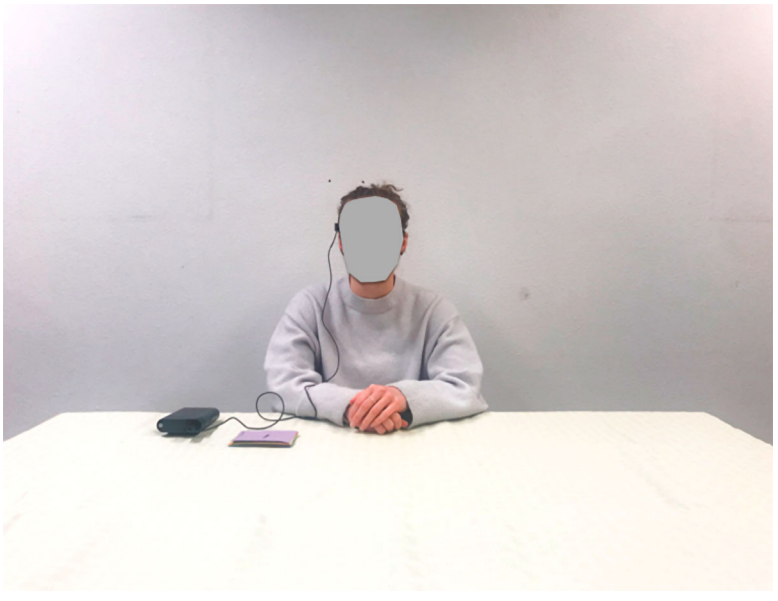

Figure 1. One of the reference images depicting the conversation task; the gray circle is the face AOI.

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 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) × 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.

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.

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

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, $F(2, 78) = 15.21$, $p < .001$, $\eta_p^2 = .28$. 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 ($M_{\text{block1}} = 170$ s, $M_{\text{block2}} = 195$ s, and $M_{\text{block3}} = 256$ s).

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) × 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, $F(3, 77) = 20.96$, $p < .001$, $\eta_p^2 = .449$, 90% CI [.294; .540], and a main effect of intimacy, Wilks's Lambda = .507, $F(3, 77) = 24.92$, $p < .001$, $\eta_p^2 = .493$, 90% CI [.341; .578]. There was an interaction between intimacy and conversational role, Wilks's Lambda = .793, $F(3, 77) = 6.72$, $p < .001$, $\eta_p^2 = .207$, 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, $F(1,79) = 44.65$, $p < .001$, $\eta_p^2 = .361$, 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, $F(1,79) = 73.88$, $p < .001$, $\eta_p^2 = .483$, 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, $F(1,79) = 18.91$, $p < .001$, $\eta_p^2 = .193$, 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, $F(1,79) = 5.41$, $p = .023$, $\eta_p^2 = .064$, 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, $F(1,79) = .107$, $p = .744$, $\eta_p^2 = .001$, 90% CI [.000; .040]. However, there was an interaction between intimacy and social anxiety, Wilks's Lambda = .951, $F(1,79) = 4.11$, $p = .046$, $\eta_p^2 = .049$, 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.

For the proportion of fixations on the face, the ANCOVA showed a main effect of conversational role, Wilks's Lambda = .644, $F(1,79) = 43.74$, $p < .001$, $\eta_p^2 = .356$, 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, $F(1,79) = 3.06$, $p = .084$, $\eta_p^2 = .037$, 90% CI [.00; .125] (low intimacy $M = .34$, high intimacy $M = .32$).

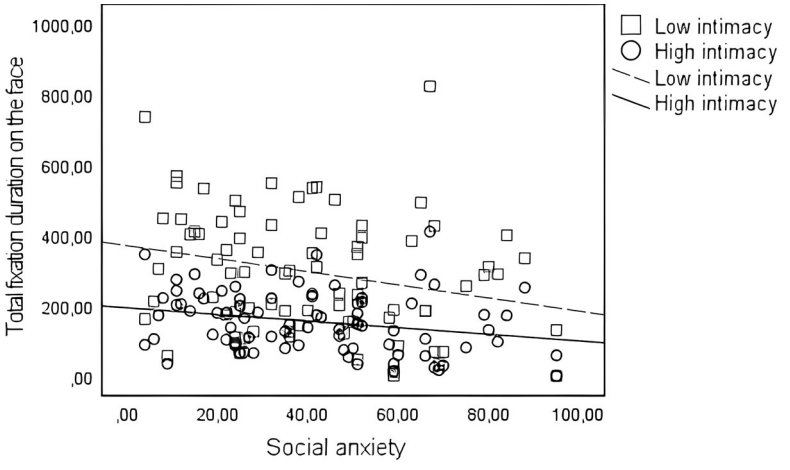

Figure 2. Scatterplot showing the relation between social anxiety and total fixation duration on the face in seconds for low and high intimacy conditions.

Moreover, there was a main effect of social anxiety, $F(1,79) = 4.32$, $p = .041$, $\eta_p^2 = .052$, 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, $F(1,79) = .134$, $p = .715$, $\eta_p^2 = .002$, 90% CI [.000; .043], nor interaction between intimacy and social anxiety was significant, $F(1,79) = 1.00$, $p = .084$, $\eta_p^2 = .013$, 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, $F(1,79) = 50.40$, $p < .001$, $\eta_p^2 = .390$, 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, $F(1,79) = .003$, $p = .958$, $\eta_p^2 = .00$, 90% CI [.000; .002], which is in contrast with hypotheses 2. As predicted, there was a main effect of social anxiety, $F(1,79) = 5.20$, $p = .025$, $\eta_p^2 = .062$, 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, $F(1,79) = 4.07$, $p = .047$, $\eta_p^2 = .049$, 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, $F(1,79) = 4.37$, $p = .510$, $\eta_p^2 = .006$, 90% CI [.001; .148].

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

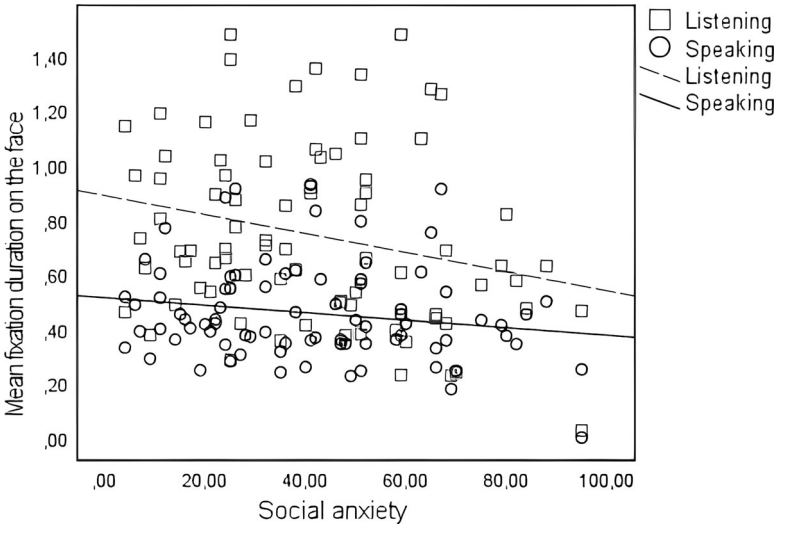

Figure 3. Scatterplot showing the relation between social anxiety and (ln transformed) mean fixation duration on the face in seconds during listening and speaking.

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; Rogers 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 min. 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.

Notes

1. The low response rate was largely due to regulations to prevent the spread of Covid-19. The data were collected between March 2020 and April 2021. 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.
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.

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Data availability statement

The data that support the findings of this study are available upon request (for scientific purposes) in Dataverse.

CRediT authorship contribution statement

Jiemiao Chen: Conceptualization, Investigation, Data curation, Formal analysis, Writing – original draft. **Esther van den Bos:** Conceptualization, Methodology, Formal analysis, Supervision, Writing – review & Editing. **Julian D. Karch:** Formal analysis, Writing – review & Editing. **P. Michiel Westenberg:** Conceptualization, Methodology, Supervision, Project administration, Writing – review & Editing.

ORCID

Julian D. Karch http://orcid.org/0000-0002-1625-2822
P. Michiel Westenberg http://orcid.org/0000-0001-9138-7703

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