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Visual attention patterns during online video-mediated interaction in socially anxious individuals

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ABSTRACT

Background and objectives: These days, a growing number of social interactions occur through video-mediated communication (VMC). However, little is known about how socially anxious individuals use this technology. Here, we examined the visual attention patterns of high and low socially anxious individuals during a live interaction with a study confederate using a typical online VMC setup.
Methods: High (n = 30) and low (n = 30) socially anxious participants completed a VMC-based social interaction task comprised of two parts: A one-on-one acquaintance interview followed by a one-on-one short presentation assignment. State anxiety was measured before and after the task, and gaze data was collected throughout.
Results: High socially anxious participants experienced elevated anxiety following the interaction task, whereas no elevation was observed for low socially anxious participants. Gaze data revealed that high socially anxious participants dwelled longer on the confederate's image during the acquaintance interview compared with the presentation task, and dwelled longer on non-face areas during the presentation relative to during the acquaintance interview. This task-related gaze pattern was not observed among low socially anxious participants.
Limitations: An analog sample was used in this study and future research should replicate its findings in a clinical sample. Future studies may also wish to counterbalance confederate's gender and task order across participants.
Conclusions: The results suggest that during VMC, socially anxious individuals observe their environment differently than non-socially anxious individuals, depending on the context of the interaction. This context-dependency might help explain mixed findings in previous studies. Further theoretical implications of these findings are discussed.

1. Introduction

Over the last decade, social interactions performed via online communication platforms have become massively common, with technological advances making video-mediated communication (VMC) widely available and extensively used (Kappas & Krämer, 2011). Today, online VMC is used not only for social purposes, such as interacting with family and friends, but also in professional contexts such as employment interviews (Chapman & Rowe, 2001; Huffcutt & Culbertson, 2011) and educational lectures (Gaudin & Chaliés, 2015). Furthermore, a growing rate of psychotherapy protocols for various psychiatric conditions are being delivered via VMC platforms (Andersson, 2016; Hedman, Ljótsson, & Lindefors, 2012). The use of VMC for social, occupational, and therapeutic purposes have become even more common with the outbreak of the Coronavirus pandemic (COVID-19), forcing many to resort to VMC platforms and avoid physical face-to-face encounters.

Although VMC simulates a face-to-face interaction, important differences between VMC and in-person interactions exist. Parkinson and Lea (2011) noted that the sensory information transferred via VMC platforms tends to be limited, including less accurate and impoverished visual and auditory information. Furthermore, it has been suggested that the lack of physical co-presence in VMC may reduce the user's sense of social presence and salience of the other person in the interaction (Croes, Antheunis, Schouten, & Krahmer, 2016), reducing rapport and motivation for self-disclosure (Manstead, Lea, & Goh, 2011). Finally, and most relevant for the present study, VMC platforms typically stream an image of one's self, potentially enhancing self-awareness during the interaction, a facet that is clearly absent from face-to-face interactions.

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The fact that VMC platforms typically screen a live self-image during interpersonal interactions is of particular interest in the context of social anxiety, as cognitive models posit that heightened self-focused attention plays a key role in the formation and maintenance of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997). Research using self-report questionnaires of self-focused attention has shown a positive correlation between self-focus and social anxiety (e.g., Hope & Heimberg, 1988; Monfries & Kafer, 1994; Saboonchi & Lundh, 1997; Smári, Clausen, Hardarson, & Arnarson, 1995). Recently, Vriends, Meral, Bargas-Avila, Stadler, and Bögels (2017) reported corresponding findings in gaze behavior during a VMC task. In their seminal study, gaze data from woman participants with sub-clinical and clinical social anxiety, collected during a date-like video conversation with an attractive male confederate were compared to the viewing patterns of non-anxious woman participants. Relative to non-anxious woman, woman with clinical social anxiety dwelled longer on their self-image throughout the conversation. Woman with sub-clinical social anxiety showed a similar pattern of dwelling on self only when receiving negative feedback from the male confederate.

While the study by Vriends et al. (2017) provides important insights into self-focused attention in social anxiety in VMC settings, several gaps still remain. Specifically, Vriends et al. (2017) classified gaze fixation data only as self-focused or other-focused based on the general location of each fixation on the computer screen (i.e., the half of the screen containing the participant's image and the half containing the confederate's image). This analysis discards attention allocation to non-facial areas of the display (see Fig. 1). Dwelling on non-facial areas may be particularly relevant to socially anxious participants, as dwelling on these areas during social interaction may reflect avoidance tendencies (Bögels & Mansell, 2004; Chen, Thomas, Clarke, Hickie, & Guastella, 2015; Kim et al., 2018). Furthermore, the use of a women-only sample conversing in a date-like setting with an attractive male confederate limits generalization of the findings to other VMC contexts and to male participants. In addition, although VMC is applied in wide variety of social contexts, the impact of context on gaze behavior during VMC was only scantly investigated so far, with most previous studies using either conversation or public speaking assignments thus focusing on a single type of social interaction (e.g., Chen, Clarke, MacLeod, Hickie, & Guastella, 2016; Chen et al., 2015; Howell, Zibulsky, Srivastav, & Weeks, 2016; Vriends et al., 2017). Importantly, social anxiety was found to differently affect performance in conversation and in speech contexts (Voncken & Bögels, 2008). And, it has been further suggested that changes in context may interact with anxiety to affect visual attention allocation patterns (Shechner & Bar-Haim, 2016).

Here we examined visual attention allocation of high and low socially anxious participants during an online VMC interaction task, comprised of two parts reflecting two different contexts: an interactive acquaintance interview with a confederate, and a short presentation participants had to prepare and deliver. The VMC display was divided into three distinct areas of interest (AOIs; see Fig. 1): a) Self AOI (the self-image of the participant); b) Confederate AOI (the image of the confederate); and c) Non-Face AOI (any other area on the screen not included in the Self or Confederate AOIs). Total dwell time and number of fixations on each of these AOIs were calculated for each context. Based on the self-focus hypothesis (Clark & Wells, 1995; Rapee & Heimberg, 1997) and previous experimental evidence (Pineles & Mineka, 2005; Vriends et al., 2017), we expected that relative to low socially anxious participants, high socially anxious participants would dwell longer on the Self AOI. We also predicted that the effect of task type (context) on attention allocation would be different between high and low socially anxious participants. As this is the first study to directly examine the interaction between context and anxiety during VMC, we did not have a directional hypothesis for this interaction.

2. Method

2.1. Participants

Participants were undergraduate students with high and low social anxiety. Two hundred eighty-four students were screened for social

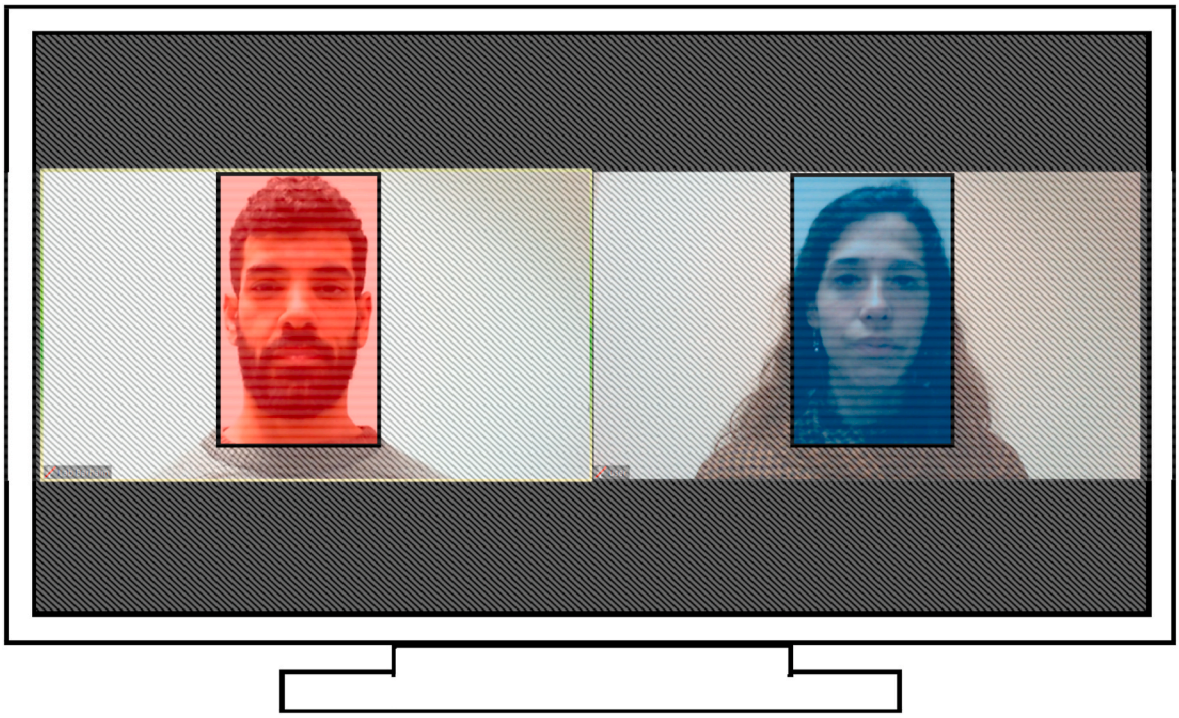

Fig. 1. "Zoom" web conferencing interface: screenshot taken from the social interaction task, with "Self" and "Confederate" areas of interest marked in red and blue, respectively. "Non-Face" area of interest, marked in diagonal gray stripes, was defined as any other area on the screen not included in the "Self" or "Confederate" areas of interest. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

anxiety using the Liebowitz Social Anxiety Scale (Liebowitz, 1987). Those with LSAS score ≥60 constituted the high social anxiety group (n = 30, 21 females, mean age = 23.10 years, SD = 2.37, range = 19–29). This LSAS score has been established as a reliable cutoff for generalized social anxiety disorder (Mennin et al., 2002; Rytwinski et al., 2009). The low social anxiety group consisted of participants with LSAS score ≤19 (n = 30, 21 females, mean age = 23.90, SD = 2.20, range = 20–32), reflecting the bottom of the sampling pool with minimal social anxiety. Participants received course credit for participation. Additional inclusion criterion was normal or corrected-to-normal vision. Individuals undergoing pharmacotherapy were not recruited for the study.

3. Measures

3.1. Social anxiety

Social anxiety was measured using the self-report version of the LSAS (Liebowitz, 1987). The LSAS describes 24 socially relevant situations. Each situation is rated in relation to the passing week on two scales ranging 0–3 describing level of fear and level of avoidance provoked by the described situation. The LSAS has strong psychometric properties, including high internal consistency, strong convergent and discriminative validity, and high test–retest reliability (e.g., Baker, Heinrichs, Kim, & Hofmann, 2002; Fresco et al., 2001; Richard G.; Heimberg et al., 1999). In the current sample Cronbach's alpha was .98.

3.2. State anxiety

State anxiety was measured using a computerized version of a visual analog scale for state anxiety (VAS-A). This scale consists of 100-mm horizontal line, with one edge marked as "calm" and the other edge as "anxious". Participants were asked to determine the location on the scale corresponding to how anxious they feel right now. The indicated location was then converted to a numerical value ranging 0 (calmest) to 30 (most anxious). The computerized VAS-A was found to have high convergent and discriminant validity (Abend, Dan, Maoz, Raz, & Bar-Haim, 2014).

3.3. Social interaction task

The social interaction task followed a standard protocol of an online video conversation between the participant and a male confederate using the Zoom platform (Zoom Video Communications, Inc., California, USA). The conversation interface displayed the participant and the confederate in two separate, equal-sized, side-by-side windows (Fig. 1). The task consisted of two sub-parts: a) an acquaintance structured interview (see Appendix); and b) a presentation task. During the acquaintance interview, participants were asked general biographical questions and questions about their current occupation. The confederate asked at least four out of ten listed questions during the interview. Each question was followed by a set of pre-specified follow-up questions that were applied only if participants failed to relate to the relevant content spontaneously. The confederate did not provide feedback and maintained a neutral business-like ambient. Total interview time was 4 min. In the presentation task, participants were asked to give a 4-min presentation about a specific topic. They were given 4 min to prepare and then delivered their presentation to the confederate. Two minutes into their presentation participants were politely stopped. During the presentation there was no verbal or other feedback from the confederate. The confederate was instructed to look directly into the camera throughout both tasks. It was thus ensured that gaze behavior of the confederate, potentially affecting the level of social anxiety and the gaze behavior of the participant (e.g., Hessels, Holleman, Cornelissen, Hooge, & Kemner, 2018; Schneier, Pomplun, Sy, & Hirsch, 2011; Schneier, Rodebaugh, Blanco, Lewin, & Liebowitz, 2011), was identical between groups and tasks. To ensure position and size matching between the confederate's and the participant's faces, the internet camera was adjusted before the task started in three axes (i.e., left-right, up-down, and forward-backward), and both the participant and the confederate were instructed to try and avoid gross head movements during the task. The first author reviewed recordings of the screen display to verify that both faces (participant and confederate) maintained their equivalent size and position on the screen throughout the tasks, and that the confederate maintained a continuous eye contact with the camera. These two conditions were maintained for all participants in all the tasks. The same person served as the confederate for all participants in both the interview and the presentation tasks. The confederate was blind to participants' group assignment.

Because familiarity has been shown to alter perceived threat and anxiety during social interaction (Beatty, 1988; McCroskey, 1984), we did not counterbalance the order (interview/presentation). Such counterbalancing could have created two very different interview and presentation outcomes due to distinct levels of personal disclosure during the interview sub-task and rapport with the confederate, potentially affecting levels of experienced familiarity and closeness.

3.4. Eye tracking measures

Eye tracking was recorded throughout the entire protocol. Fixations were defined as at least 100 ms of stable fixation within 1-degree visual angle. Three areas of Interest (AOIs) were defined (see Fig. 1): (a) "Self" AOI comprised of the participant's face; (b) "Confederate" AOI comprised of the confederate's face; and (c) "Non-Face" AOI comprised of any area of the screen other than the two abovementioned AOIs. Relative total dwell time was derived per AOI reflecting percent dwell time on the AOI out of total task time. To further elucidate the visual scanning patterns underlying potential group differences in dwell time, we calculated the number of fixations per minute on each AOI. Similar results for these two measures would indicate that changes in dwell time resulted from changes in the number of fixations on a certain AOI. In contrast, different patterns for these measures could suggest variation in fixation duration, potentially related to changes in hyperscanning gaze behavior (see: Horley, Williams, Gonsalvez, & Gordon, 2003, 2004).

3.5. Apparatus

Gaze data was recorded using a remote high-speed eye-tracker (RED 500) using SMI BeGaze native software (SensoMotoric Instruments, Inc., Teltow, Germany). Sampling rate was 500 Hz. Operating distance to the eye-tracking monitor was 70 cm. The stimuli were presented on a 22-inch Dell P2213 monitor with a screen resolution of 1680X1050 pixels. Video was broadcasted using two Microsoft LifeCam HD-3000 webcams placed on top of the two screens.

3.6. Procedure

Participants provided written informed consent and then tested in a quiet room. First, they indicated their current level of anxiety using the VAS-A. Then, eye-tracking calibration was performed using a 5-dot array to which participants sequentially fixated. Calibration was validated using the same procedure with the requirement that visual deviation scores were under 0.5° on the X and Y axes. Once calibration and validation were completed participants were asked to avoid head movements as much as possible. Then, the internet camera was adjusted to place participant's face in the middle of the frame and to match the size of the onscreen confederate's face (see *Social Interaction Task)*. Next, participants were told that they were going to be interviewed by another person (the confederate) via online video conversation, and were explained that the interview would start after they fixate their gaze on a centrally presented cross. After a 500 ms fixation on the central cross, the ZOOM interface appeared and 4 min of the structured conversation followed. Next, participants were instructed to prepare a presentation

about the following topic: 'Admission to academic studies: pros and cons of cancelling the SAT tests and relying on matriculation grades only'. At the end of the preparation time (4 min), another eye-tracking calibration was conducted, after which the ZOOM interface appeared again. Two minutes into their presentation participants were politely stopped and asked to report their current level of anxiety using the VAS-A. Then participants were debriefed, thanked, and dismissed.

3.7. Data analysis

To examine group differences in state anxiety, we conducted a mixed-model analysis of variance (ANOVA) with group (high social anxiety, low social anxiety) as a between-subjects factor and time (before and after the social interaction task) as a within-subject factor.

To examine group differences in gaze patterns, we performed a separate mixed-model ANOVA for each of the eye-tracking measures (i.e., relative total dwell time and number of fixations), with group (high social anxiety, low social anxiety) as a between-subjects factor, and AOI (Self, Confederate, Non-Face) and task (interview, presentation) as within-subject factors. Significant three-way interaction was followed-up with three separate group-by-task ANOVAs for each AOI. Significant main and two-way interaction effects were followed-up with Bonferroni corrected post-hoc comparisons. All statistical tests were 2-sided with $\alpha \leq 0.05$ as significance criterion. Power analysis conducted using G*Power3.1 (Erdfelder, Faul, Buchner, & Lang, 2009) indicated that with the current sample size, the power of detecting a medium size between-subjects effect ($d = 0.30$) was 0.85 ($\alpha = 0.05$).

4. Results

4.1. State anxiety

State anxiety values by group and time are presented in Table 1. A significant main effect of group, $F(1, 58) = 18.53$, $p < .01$, $\eta_p^2 = 0.24$, indicated that participants with high social anxiety reported overall higher levels of state anxiety compared to participants with low social anxiety. This main effect was qualified by a significant group-by-time interaction, $F(1, 58) = 5.70$, $p = .02$, $\eta_p^2 = 0.09$. Simple effects analyses revealed that among high socially anxious participants state anxiety increased from before to after the social interaction task, $p < .01$, whereas low socially anxious participants did not show a difference between the two time points, $p > .10$.

4.2. Dwell time per AOI

Relative dwell times by group, AOI, and task are presented in Table 1. Mauchly's test indicated that the assumption of sphericity was violated for effects involving the AOI variable. Therefore, degrees of freedom for the effects involving the AOI variable were corrected using Greenhouse-Geisser estimates of sphericity. A significant main effect of AOI, $F(1.78, 77.84) = 43.12$, $p < .01$, $\eta_p^2 = 0.43$, indicated that participants dwelled less on Self compared to Confederate and compared to Non-Face, all $ps < .01$. The difference between the Confederate AOI and the Non-Face AOI was not significant, $p > .10$. This main effect of AOI was qualified by a significant group-by-AOI-by-task interaction, $F(1.34, 77.84) = 4.79$, $p=<.05$, $\eta_p^2 = 0.08$.

Fig. 2 depicts the results of follow-up two-way ANOVAs conducted separately for each AOI. Analysis of dwell time on Self AOI revealed a main effect of task, $F(1, 58) = 4.34$, $p = .04$, $\eta_p^2 = 0.07$, with longer dwell time on Self during the presentation task relative to the interview task. The main effect of group and the interaction were non-significant, $p > .10$.

For Confederate AOI there was a significant main effect of task, with longer dwell time on Confederate during the interview task relative to the presentation task, $F(1, 58) = 20.68$, $p < .01$, $\eta_p^2 = 0.26$. This main effect was qualified by a significant group-by-task interaction, $F(1, 58) = 6.11$, $p = .02$, $\eta_p^2 = 0.09$. Simple effects analyses revealed that participants with high social anxiety dwelled longer on the confederate's face during the interview task compared to the presentation task, $p < .01$, whereas participants with low social anxiety did not show a difference in dwell time between tasks, $p > .10$.

Finally, for the Non-Face AOI, there was a significant main effect of task, $F(1, 58) = 13.16$, $p < .01$, $\eta_p^2 = 0.18$, indicating longer dwell time on the Non-Face AOI during the presentation task compared to the interview task. This main effect was also qualified by a significant group-by-task interaction, $F(1, 58) = 4.31$, $p = .04$, $\eta_p^2 = 0.07$. Again, simple effects analyses indicated a significant difference in dwell time between tasks only among the participants with high social anxiety who dwelled longer on the Non-Face AOI during the presentation task compared to the interview task, $p < .01$. Participants with low social anxiety did not show a difference in dwell time on the Non-Face AOI between tasks, $p > .10$.

Of note, between-group comparisons within AOIs and contexts did not yield significant findings (all $ps > .05$).

Table 1
Means and SDs of participants' state anxiety, relative dwell times and number of fixations, by group.

		High socially anxious	Low socially anxious	Total
State anxiety (VAS-A score)	Before interaction task	9.10 (7.96)	3.57 (6.47)	6.33 (7.71)
	After interaction task	12.30 (8.37)	3.23 (5.49)	7.77 (8.37)
	Total	10.70 (7.28)	3.40 (5.77)	7.05 (7.48)
Relative dwell time on Self AOI (%)	Interview	6.54 (14.34)	8.60 (14.60)	7.58 (14.38)
	Presentation	10.96 (22.89)	10.33 (17.28)	10.65 (20.11)
	Total	8.76 (17.90)	9.47 (15.34)	9.11 (16.53)
Relative dwell time on Confederate AOI (%)	Interview	57.41 (18.25)	50.08 (23.90)	53.75 (21.40)
	Presentation	35.34 (31.24)	43.56 (28.41)	39.45 (29.89)
	Total	46.38 (21.73)	46.82 (23.97)	46.60 (22.69)
Relative dwell time on Non-Face AOI (%)	Interview	36.03 (15.83)	41.32 (21.61)	38.68 (18.97)
	Presentation	53.70 (31.35)	46.12 (24.13)	49.91 (27.00)
	Total	44.87 (20.28)	43.72 (21.03)	44.29 (20.49)
Number of fixations on Self AOI (per minute)	Interview	10.68 (18.46)	16.68 (28.16)	13.68 (23.80)
	Presentation	18.92 (38.10)	19.10 (34.84)	19.01 (36.20)
	Total	14.80 (27.32)	17.89 (30.07)	16.35 (28.52)
Number of fixations on Confederate AOI (per minute)	Interview	88.77 (33.95)	73.94 (36.32)	81.35 (35.65)
	Presentation	62.13 (56.25)	70.85 (48.25)	66.49 (52.14)
	Total	75.45 (40.57)	72.40 (38.19)	73.92 (39.09)
Number of fixations on Non-Face AOI (per minute)	Interview	18.05 (14.89)	31.60 (29.80)	24.82 (24.33)
	Presentation	37.07 (46.18)	34.35 (30.87)	35.71 (38.97)
	Total	27.56 (28.93)	32.97 (27.85)	30.27 (28.29)

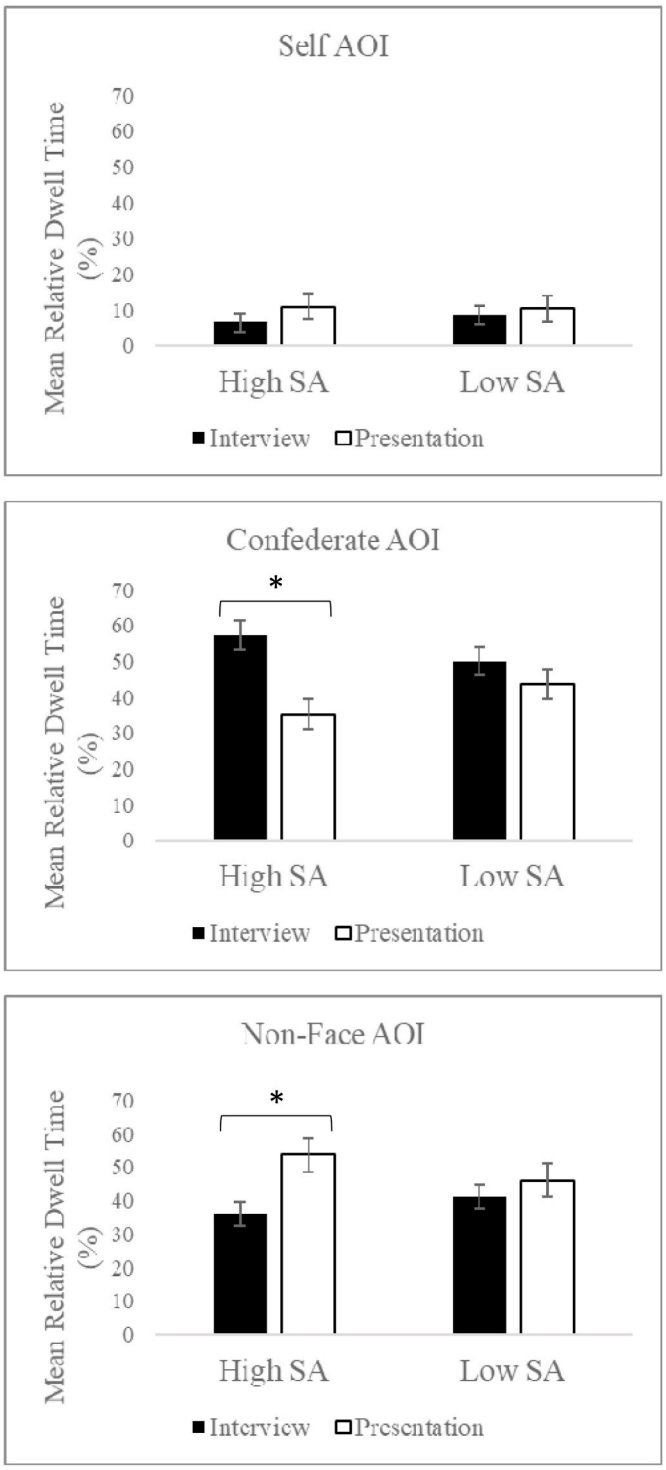

Fig. 2. Mean relative dwell times (%) by area of interest, group and task. Error bars denote standard error. Abbreviations: AOI, area of interest; SA, socially anxious.

4.3. Number of fixations

Number of fixations by group, AOI, and task are presented in Table 1. Overall, the patterns found for the number of fixations measure were similar to those found for relative dwell time (see Fig. 3). Mauchly's test indicated that the assumption of sphericity was violated for effects involving the AOI variable and degrees of freedom for these effects were corrected using Greenhouse-Geisser estimates of sphericity. A significant main effect of AOI, $F(1.79, 89.97) = 39.58$, $p < .01$, $\eta_p^2 = 0.41$, indicated that the number of fixations was smaller for Self compared to Non-Face and smaller for Non-Face compared to Confederate AOIs, all $ps < .01$. This main effect of AOI was qualified by a significant group-by-AOI-by-task interaction effect, $F(1.55, 89.97) = 4.45$, $p=<.05$, $\eta_p^2 = 0.07$.

The same pattern of interaction found for relative dwell time was observed for number of fixations. For Confederate AOI, a significant

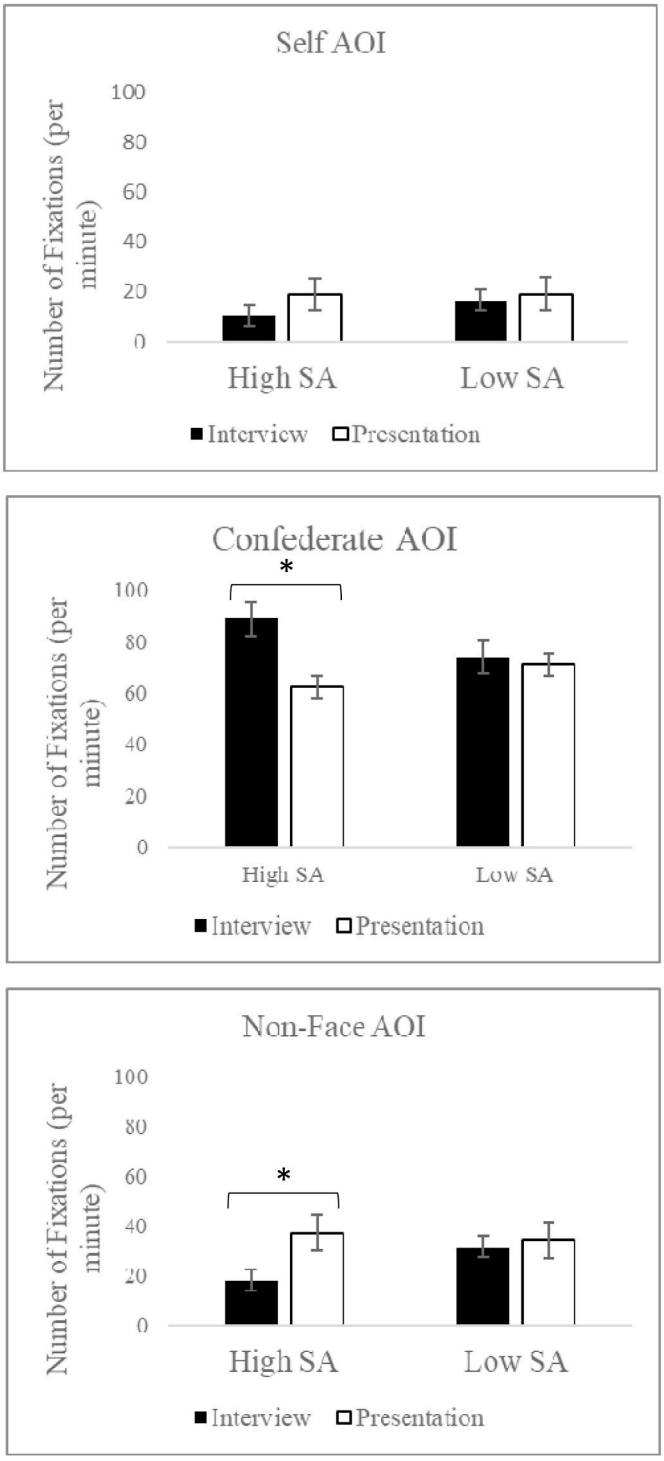

Fig. 3. Number of fixations (per minute) by area of interest, group and task. Error bars denote standard error. Abbreviations: AOI, area of interest; SA, socially anxious.

main effect of task ($F(1, 58) = 7.55$, $p < .01$, $\eta_p^2 = 0.11$) was qualified by a significant group-by-task interaction, $F(1, 58) = 4.74$, $p < .05$, $\eta_p^2 = 0.07$. Simple effects analyses indicated that participants with high social anxiety fixated more on the confederate's face during the interview task compared to the presentation task, $p < .01$, whereas participants with low social anxiety did not show a difference in number of fixations between two tasks, $p > .10$. For Non-Face AOI, a significant main effect of task ($F(1, 58) = 7.34$, $p < .01$, $\eta_p^2 = 0.11$) was qualified by a significant group-by-task interaction, $F(1, 58) = 4.10$, $p < .05$, $\eta_p^2 = 0.07$. Participants with high social anxiety fixated more on the Non-Face AOI during the presentation task compared to the interview task, $p < .01$, whereas participants with low social anxiety did not show a difference in number of fixations between two tasks, $p > .10$. Similar to the results reported for relative dwell time, between-group comparisons within AOIs and tasks did not yield significant differences in number of fixations (all $ps > .05$).

5. Discussion

The present study examined gaze patterns of high and low socially anxious participants in relation to live video images of "Self", "Confederate", and "Non-Face" areas in a typical VMC setting. Two types of social interaction were analyzed – acquaintance interview and presentation delivery. Results indicate that participants with high social anxiety experienced elevated anxiety following the social interaction tasks, whereas anxiety levels were unaffected among participants with low social anxiety. This suggests that despite the limited sensory characteristics of VMC and lack of direct contact with the interviewer, video-mediated social interactions are experienced as stressful by socially anxious individuals.

Regardless of social anxiety level or task type, participants dwelled very little on their self-image compared to other areas of the screen. Moreover, and contrary to our expectation, participants with high social anxiety did not dwell longer than low socially anxious participants on the self AOI. These results seem to be inconsistent with cognitive models of social anxiety assuming enhanced self-focused attention in socially anxious individuals (Clark & Wells, 1995; Rapee & Heimberg, 1997), and with studies reporting positive correlations between self-reported self-focus and social anxiety (Hope & Heimberg, 1988; Monfries & Kafer, 1994; Saboonchi & Lundh, 1997; Smári et al., 1995). It is possible that the present task failed to reveal group differences in self-focused attention because such differences might emerge only under certain circumstances not met in the current design. For instance, Vriends et al. (2017) found that during a date-like VMC interaction woman participants with subclinical social anxiety dwelled longer on their self-images compared to participants with low social anxiety only when the male confederate was reacting in a critical manner. In the present study no evaluative feedback was provided. These discrepancies in results highlight the possibility that context may play a crucial role in self-focused attentional allocation patterns.

Alternatively, this inconsistency between the current results and those of previous studies might suggest that the self-image video in VMC settings does not reflect the same theoretical concept of self-reported self-focused attention (Carver & Scheier, 1981; Fenigstein, Scheier, & Buss, 1975). It is possible that the live image of one's own face, as presented in VMC settings, is qualitatively different than an inner subjective self-representation. Indeed, mental self-representation was suggested to be quite different than an actual video stream of one's own face, with the former being influenced to a greater extent by factors such as long-term memory (e.g., recollection of general appearance, former experience in similar situations), internal cues (e.g., anxious symptoms) and external feedback (Rapee & Heimberg, 1997). Therefore, self-focused attention in the classic sense might be inaccurately represented by an external visual self-image. In this regard, it is also worth noting that the display of self-image may not only serve as a means of measuring self-focused attention, but could also be used to manipulate the extent to which participants are aware of their behavior during a VMC interaction. It has been demonstrated that the introduction of a mirror or video self-images may increase self-consciousness and self-focused attention (Carver, 1975; Carver & Scheier, 1978; Ingram, Cruet, Johnson, & Wisnicki, 1988; also see: Bögels, Alberts, & De Jong, 1996). Future studies may wish to examine potential effects of self-image saliency (e.g., the relative size of such image) on VMC behavior.

In contrast with previous studies reporting differences in gaze behavior of high and low socially anxious individuals within a particular type of social interaction (for a review see: Chen & Clarke, 2017), direct comparisons between high and low socially anxious participants within tasks were not significant in our study. Importantly however, the groups did differ in the effects different contexts had on gaze dwelling on the Confederate and Non-face AOIs. Results showed that participants with high social anxiety dwelled longer on the Confederate AOI during the interview task, relative to the presentation task, and longer on non-face areas during the presentation task, relative to the interview task. This pattern resulted from differences in the number of fixations on each AOI, reflecting differences in attentional maintenance rather than differences in hyperscanning behavior (see: Horley et al., 2003, 2004). These viewing patterns, not evident in low socially anxious participants, suggests that only high socially anxious participants were sensitive to the specific context of the studied interactions. This context-dependency of attentional allocation patterns in participants with high social anxiety might help explain mixed findings in previous studies, with some reporting that socially anxious individuals dwell less on social stimuli (e.g., Chen et al., 2015; Kim et al., 2018; Weeks, Howell, & Goldin, 2013), and others implicating increased dwell time on threat faces in social anxiety (Armstrong & Olatunji, 2012; Lazarov, Abend, & Bar-Haim, 2016; Richards, Benson, Donnelly, & Hadwin, 2014). The current results suggest that contextual factors may come into play and influence the manifestation of different attentional allocation patterns among socially anxious individuals. It is possible, for example, that during the interview task the confederate, still unfamiliar and holding an active role in the conversation, was perceived by the socially anxious participants as posing a greater threat. Such an elevated threat perception might have yielded heightened threat monitoring, leading high socially anxious participants to fixate more and dwell longer on the confederate. In contrast, during the presentation task, the confederate may have been perceived as more passive and therefore required less monitoring, which may have led to relatively reduced fixations and dwelling on the confederate's face.

Importantly, future research would need to determine whether the attentional patterns found in the current study are unique to VMC or may generalize to other interpersonal settings. One may argue that performing the same interview and presentation tasks in an actual face-to-face setting would yield similar results. Particularly when considering the fact that the primary element distinguishing VMC from face-to-face interaction (i.e., a streaming video image of the self), attracted very little visual attention. Furthermore, unlike the dwell patterns on the "Confederate" and "Non-face" AOIs, visual attention to the Self AOI did not yield a group-by-task interaction effect. Future studies may use recent technological advances that afford a comparison of gaze patterns during VMC and during actual face-to-face interaction, to address this open question.

The current findings tentatively offer some clinically relevant implications. First, it has been suggested that using online communication platforms as an alternative to face-to-face interactions may relieve some aspects of anxiety, particularly among socially anxious patients (Prizant-Passal, Shechner, & Aderka, 2016; Schouten, Valkenburg, & Peter, 2007). The current results suggest that VMC in fact provoke notable anxiety among socially anxious individuals, calling for further examination of the conditions under which online communication platforms could effectively minimize the anxiety associated with social interaction. Second, the biases in gaze patterns of high socially anxious

individuals reported in the current study may affect their performance during social interactions (e.g., Baker & Edelmann, 2002; Daly, 1978; Lewin, McNeil, & Lipson, 1996; Thompson & Rapee, 2002). For example, reduced attention to audience faces during a presentation may hinder the access to valuable nonverbal feedback (Clark & McManus, 2002; Woody, 1996). Future studies may wish to examine whether between-tasks differences in gaze behavior of socially anxious individuals are accompanied by differences in performance, and whether manipulating gaze behavior could improve performance during such tasks.

Some limitations of the current study should be noted. First, the study focused on participants with high and low social anxiety. Although the LSAS scores of the high social anxiety group were quite high (M = 75.74, SD = 12.02), and well within the clinical range (Mennin et al., 2002; Rytwinski et al., 2009), future studies may wish to replicate the present results among patients with clinically diagnosed social anxiety disorder, especially as prior evidence suggests that the gaze patterns during VMC may be different in clinical and sub-clinical populations (Vriends et al., 2017). Second, all participants in the current study (i.e., males and females) were interacting with a male confederate. Assuming that the perceived attractiveness of the confederate may affect participants' behavior (Vriends et al., 2017), future studies may wish to counterbalance confederate's gender for both male and female participants. Third, anxiety levels were measured only at baseline and at the end of the entire social interaction task. As a result, it was not possible to determine whether changes in high socially anxious participants' state anxiety were at the basis of the reported context-dependent changes in viewing patterns. Future studies may wish to address this shortcoming by evaluating state anxiety separately for each context (i.e., pre- and post-interview, and pre- and post-presentation). Finally, since tasks order was the same for all participants, the difference in context may be confounded with a difference in familiarity with the confederate. Future studies may wish to counterbalance task order across participants, while somehow addressing the differential familiarity concern (e.g., by applying a long familiarization process before the experimental procedure begins, or by using different confederates to run the two tasks).

In conclusion, the present study provides preliminary insights regarding the way socially anxious individuals allocate their visual attention to self and other images, as well as to non-face areas, during online VMC. The results suggest that when interacting via video-mediated platforms, socially anxious individuals observe their environment differently than non-socially anxious individuals, depending on the context of the interaction. Such differences could affect the quality and accuracy of the social information accrued by anxious individuals during such interactions, and consequently influence their ability to develop effective adaptations. Given the growing use of VMC for social, professional, and therapeutic purposes, better understanding of the uniqueness of VMC compared to actual face-to-face communication, and of possible aberrations in gaze patterns during VMC, may have important implications for socially anxious individuals' personal and occupational functioning.

Declaration of competing interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

CRediT authorship contribution statement

Omer Azriel: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Visualization, Project administration. **Amit Lazarov:** Methodology, Validation, Formal analysis, Writing - review & editing. **Adva Segal:** Validation, Formal analysis, Writing - review & editing. **Yair Bar-Haim:** Validation, Resources, Writing - review & editing, Supervision.

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Appendix

Interview protocol

Hello, my name is ___ and I am going to ask you a few questions now.

a. Can you please tell me what do you study here at the university?
   a. Why did you choose to study ___?
   b. Please tell me about two courses you take, which are the most interesting in your opinion.
   c. Why do you find these courses interesting?
   d. Please tell me about two courses you take, which are the least interesting in your opinion.
   e. Why do you find these courses less interesting?
b. Please tell me about your main hobby.
   a. What makes you enjoy it?
   b. How many times do you do this per week?
   c. Since when have you been doing this?
c. What was your favorite subject during high school?
   a. What made you like this subject?
d. What was your least favorite subject during high school?
   a. What made you dislike this subject?
   b. How did you manage to study this subject in spite the fact you didn't like it?
e. Please tell me about a famous character you would like to meet.
   a. What makes you want to meet him/her?
   b. What would you like to speak with him/her about?
f. If you had the chance to choose, where would you like to live the most?
   a. What makes you want to live there?
   b. Do you think that it's going to happen one day?
g. Please tell me about an event from your past that you would like to experience again.
   a. What makes you want to re-experience it?
h. Can you tell me about a movie or a book that you like?
   a. What are the reasons you like it?
i. Can you tell me what your favorite food is?
   a. What makes you like it so much?
j. What kind of job would you like to have ten years from now?
   a. What makes this job appealing for you?
   b. Do you know anyone who's got this job?

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