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Multimodal assessment of social anxiety among international students

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ABSTRACT

The present study examined Social Anxiety (SA) through the utilization of multiple measures and experimental paradigms. Participants were categorized using the Liebowitz Social Anxiety Scale (threshold: 30). The Facial Test assessed emotional facial recognition, and eye-tracking technology examined visual attention biases during emotion identification. The Social Cognitions Questionnaire was administered to investigate the relationship between biases and SA.

Results revealed no gender-based differences in SA, but Asian participants scored significantly higher on the anxiety scale compared to non-Asians, challenging assumptions about lower Asian social anxiety scores and highlighting cultural influences.

Emotion recognition showed no significant differences between SA and control groups. Gaze pattern analysis revealed that females focused more on eyes, aligning with gender-based emotion recognition differences.

Contrary to previous findings individuals with higher social anxiety scores did not show hypervigilance towards threatening stimuli but exhibited avoidance towards them, including delayed gaze, fewer and shorter fixations, and reduced gazes directed at the eyes.

Both the SA and the control group exhibited maladaptive schemas related to performance and visible signs of anxiety. Men and Asian participants showed higher belief in these schemas, challenging the notion of their lower susceptibility to social anxiety.

1. Social anxiety disorder

Social Anxiety Disorder (SAD) presently stands as the third most prevalent psychiatric disorder, following major depression and alcohol use disorder, and holds the foremost position among anxiety disorders (Kessler et al., 2012). Its impact is far-reaching, exerting adverse effects on various domains of life and diminishing overall mood and well-being (Clark & Beck, 2010). Recent findings suggest a rising trend in the prevalence of social anxiety, with particular emphasis on its disproportionate burden on younger individuals, particularly those aged between 18 and 24 years (Jefferies & Ungar, 2020).

1.1. Gender differences in SAD

The available research on social anxiety does not provide a clear consensus on whether a difference in prevalence exists between men and women. Clark and Beck (2010) note that unlike other anxiety disorders, the gender distribution of social anxiety is not heavily skewed towards women; approximately, three women are suffering from social anxiety for every two men. Similarly, Barnett and colleagues (2020) found no significant gender difference in the prevalence of social anxiety, aligning with the findings of several other studies (e.g. Bekker & van Mens-Verhulst, 2007; Pierce & Kirkpatrick, 1992).

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1.2. Demographics of SAD

The lifetime prevalence of social anxiety in Europe and the USA is estimated to be around 12 % (Stein et al., 2017). In contrast, data from a 2011 survey (McLean et al., 2011) reveals much lower prevalence rates in East Asian regions: 0.4 % in Taiwan, 0.2–0.6 % in Korea, 0.2 % in China, and 0.8 % in Japan. These regional differences do not necessarily imply that Asians experience lower levels of anxiety compared to their European or American counterparts. Several factors may contribute to these variations, including differences in social and cultural norms, such as individualist versus collectivist attitudes (Razidi et al., 2021). Moreover, as social anxiety often goes undiagnosed, it is plausible that a greater number of individuals are affected than reported in surveys (Jefferies & Ungar, 2020). Consequently, social anxiety seems to manifest in various countries globally, but its manifestations, symptomatology, and even the diagnostic threshold for the disorder may vary across different cultural contexts (Jefferies & Ungar, 2020; Stein et al., 2017).

1.3. Theoretical models of SAD

Although the cognitive processes underlying social anxiety are intricate, researchers generally concur that attentional bias may contribute to the persistent nature of the disorder. Prior literature suggests that social anxiety may be characterized by three types of disrupted attention processes: initial hypervigilance, delayed disengagement, and/or avoidance (Kleberg et al., 2021). However, it is noteworthy that the results of relevant studies are surprisingly inconsistent.

According to the meta-analysis by Bar-Haim et al. (2007) and the summary by Van Bockstaele et al. (2014), anxious individuals, when compared to non-clinical populations, typically perceive threatening stimuli (e.g., angry, disgusted, fearful facial expressions) faster than neutral stimuli. This was also evident when stimuli were presented below the threshold of perception, indicating the automatic operation of the biasing mechanism (Mogg et al., 1995).

However, an expanding body of literature (Koster et al., 2005) substantiates the observation that certain individuals experiencing anxiety tend to engage in avoidance behaviors. This observation aligns with clinical findings that emphasize the significant role of behavioral avoidance in both the development and maintenance of anxiety disorders. Numerous self-report studies examining social phobia and anxiety (Kivity & Huppert, 2016) behavioral investigations (Konvalova et al., 2021), as well as research utilizing eye-tracking technology (Chen et al., 2020; Clark & Beck, 2010; Moukheiber et al., 2010) provide supporting evidence that individuals with social anxiety demonstrate a pronounced inclination to avoid direct eye contact.

Nevertheless, it is plausible that attentional avoidance may arise as a consequence of hypervigilance or delayed disengagement, suggesting that this phenomenon may reinforce an already existing tendency. The vigilance-avoidance hypothesis (Kleberg et al., 2021) posits that attentional processes in anxiety disorders follow a biphasic temporal pattern, involving an initial state of vigilance towards threatening stimuli, followed by subsequent avoidance. This implies that anxious individuals, after initially directing vigilant attention towards threatening cues, subsequently withdraw their attention from such stimuli as a means to alleviate the anxiety provoked by aversive triggers. In this context, avoidance serves as a potentially maladaptive emotion regulation strategy.

The role of the eye region in attentional biases and its significance in perpetuating social anxiety is also well-documented. However, it is noteworthy that investigations into attentional biases associated with social anxiety have primarily focused on adult populations, examining the allocation of attention when presented with threatening faces and various control stimuli (Kleberg et al., 2021). There is a paucity of studies specifically exploring the interplay between gaze processing and

the distribution of attention in this context.

1.4. SAD and emotion recognition

It is intriguing to note that cognitive biases observed in social anxiety extend to emotion recognition processes. For instance, shifting attention from a neutral face to an angry face necessitates the prior recognition of emotions displayed on each face (Boll et al., 2016). Although emotion recognition mechanisms may underlie several well-established biases in social anxiety, the specific facial regions that socially anxious individuals concentrate on during emotion identification remain largely unexplored. Some studies with healthy subjects have demonstrated regular scanning patterns, with a particular focus on prominent internal facial features such as the eyes, nose, and mouth, as opposed to external features like hair, face contour, forehead, and ears. This pattern often results in scanning paths resembling an inverted triangle (Claudino et al., 2019).

In the context of emotion recognition, Vassallo et al. (2009) conducted a study on a non-clinical population and found that women exhibited greater accuracy in recognizing a variety of facial expressions (happy, sad, angry, fearful, surprised, and neutral) compared to men. A possible explanation for these gender differences is, that women directed their gaze more frequently to the eyes, whereas men tended to focus on the nose and mouth during facial exploration. This finding prompts the question of how such gender-based differences in gaze patterns manifest among individuals with higher social anxiety scores.

1.5. The current study

Based on the existing research on social anxiety, it is evident that the manifestation of symptoms and the diagnostic criteria for the disorder may vary across different cultural contexts. However, there remains a lack of consensus regarding a significant gender-based difference in the prevalence of social anxiety, as well as a dearth of agreement concerning the development of attentional biases in individuals exhibiting social phobic traits. Furthermore, studies on emotion recognition in non-clinical populations have revealed distinct differences in how women and men identify emotions, raising inquiries into how this discrepancy may be evident in individuals displaying social anxiety traits.

Addressing these inquiries can contribute to a deeper comprehension of the underlying etiology of social anxiety and foster the development of more effective treatments aimed at normalizing atypical attentional patterns. To this end, our study focuses on three core factors of cognitive biases among various variables: emotion recognition, attentional biases associated with gaze, and maladaptive schemas characterizing individuals with social anxiety. Next to the traditional pen and paper tests we have used innovative instrumental modalities to explore social anxiety. The overarching aim of our investigation is to explore, based on the gathered data: (1) whether there exists a significant gender-based disparity in social anxiety scores between men and women; (2) whether there exists a significant difference in social anxiety scores between individuals of Asian and non-Asian backgrounds. We chose the Asian and non-Asian differentiation because many of the participating psychologists and doctors (the authors) working with international students at the University of Debrecen had a personal experience contradicting the findings of the survey of (McLean et al., 2011), which found a low prevalence of SA in East Asian countries. Even though the students examined were selected randomly, the demographics at the university, with a significant Asian population makes this comparison possible. Most of the examined students were accepted to the University of Debrecen just a few months ago, also international students have all their classes separate from Hungarian students, so there is a low possibility of acculturation.

Additionally, we examine (3) how the general capacity to recognize emotional facial expressions varies among individuals with higher social anxiety scores; (4) how attentional biases concerning face perception,

particularly gaze-related biases, manifest in individuals with higher social anxiety scores; (5) the specific facial regions individuals with higher social anxiety scores focus on when decoding facial expressions reflecting emotions; (6) whether there is a disparity between men and women in their attentional focus in this regard; (7) how these identified biases relate to the three aspects of maladaptive schemas characteristic of individuals with social anxiety, namely negative beliefs about self, fear of failure in performance situations and fear of visible signs of anxiety, and fear of negative evaluation and attentional capture.

Hypothesis 1. We assume that women exhibiting higher levels of anxiety compared to men.

Hypothesis 2. We assume that individuals of Asian descent when compared to the non-Asian population, demonstrate significantly lower scores on the social anxiety questionnaire.

Hypothesis 3. We assume that individuals with higher social anxiety scores exhibit accurate recognition of emotions.

Hypothesis 4. We assume that there are differences in the facial regions that women and men prioritize when identifying emotions (Fig. 1).

Hypothesis 5. We assume that participants with higher social anxiety scores, if characterized by hypervigilance towards socially threatening stimuli, demonstrate faster gaze allocation to the eyes during the early stages of exposure compared to the control group (Fig. 2).

Hypothesis 6. We assume that individuals with higher social anxiety scores, if characterized by avoidance, demonstrate faster gaze disengagement from the eyes, and expected to have less frequent and shorter eye directed gazes, compared to the control group (Fig. 2).

Hypothesis 7. We assume that individuals with higher social anxiety scores, if characterized by delayed disengagement, prolong their gaze fixation on the eyes before redirecting their attention, and expected to have more frequent and longer eye directed gazes compared to the control group (Fig. 2).

2. Method

2.1. Participants

The participants in the study are foreign students studying at the University of Debrecen, Hungary. During their mandatory occupational health examination, they were given the opportunity to voluntarily participate in our research, to which their attention was drawn through personal contact. Before the study, the participants signed a consent form, which ensured the voluntary nature of their participation in the research.

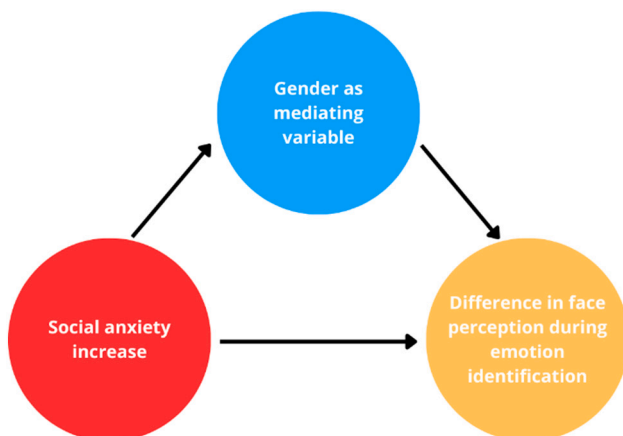


Fig. 1. Visualisation of Hypothesis 4.

The participants were categorized into two groups (individuals characterized by social anxiety traits and a control group) based on the Liebowitz Social Anxiety Scale. A total of 100 students participated in the study. We had to exclude 10 of them due to incomplete, or wrong filling out of questionnaires and 9 of them because of incomplete gaze data, which occurred because of too much head movement. The final sample consisted of 81 students, with 60 individuals characterized by social anxiety traits (SA) and 21 control subjects. Demographic data are summarized in Table 1.

Overall and broken down by gender, the level of social anxiety was significantly higher in the group of participants potentially characterized by social anxiety traits compared to the control group, Mann-Whitney U test $p < 0.001$, $W = 1260$. However, there was no significant difference observed in the distribution of anxiety levels between men and women - it appears that women do not score significantly higher on the anxiety scale. There were no significant group differences in terms of age, marital status, and educational attainment. Among the participants with higher social anxiety scores, 50 % were of Asian origin, while in the control group, this percentage was 29 %. Regarding ethnicity, we can see that Asians achieve significantly higher scores on the anxiety scale compared to non-Asians Mann-Whitney U test $p < 0.05$, $W = 1028.5$. However, the average score (56.08) in the Asian group reaches the fifty-point threshold, indicating the likelihood of mild social-anxiety traits.

2.2. Measures

2.2.1. Liebowitz Social Anxiety Scale (LSAS)

As mentioned briefly above, the grouping of participants was based on LSAS scores (Liebowitz, 1987). The purpose of the questionnaire is to assess the range of social interaction and performance situations that the person finds fearful, to assist in the diagnosis of Social Anxiety Disorder (SAD). The scale consists of 24 items, divided into two subscales. Thirteen questions refer to performance anxiety, while eleven pertain to social situations. Each of the 24 items is first rated on a Likert scale from 0 to 3 in terms of the fear experienced in the given situation, and then the same items are rated in terms of the level of avoidance in that situation. By combining the scores of the fear and avoidance sections, a maximum total score of 144 points is obtained. We used a cut-off value of 30, below which social anxiety is unlikely (Mennin et al., 2002; National Social Anxiety Center, 2016).

2.2.2. Facial test

During the study, participants took part in the Facial Test, which allowed us to measure their general ability for emotional facial recognition and their attention orientation. For the study, we selected a female and a male model from the FACES collection (Ebner et al., 2010) and presented the participants with 5 basic emotions (anger, disgust, fear, happy, sadness) and a neutral facial. Each model appeared an equal number of times for each emotion display. The participants were allowed to view each face for 5 s. This duration seemed ideal for measurements, as it takes approximately 170 ms to form a detailed structural representation of a face (Adolphs, 2002).

The applied free-viewing experimental paradigm consisted of 12 trials. The trials were followed by a list of emotions on a white background before the next picture appeared. The stimuli were presented on a 17" monitor. Participants sat approximately 60 cm away and were instructed to freely observe the stimuli and, without looking up, verbally state which emotion they perceived on the screen when the list appeared. The verbally stated emotions were recorded by an examiner sitting in the same room as the participant. No other instructions were given.

2.2.3. Eye-tracking study

To explore which facial areas individuals with social anxiety traits focus on when decoding facial expressions of emotions and to study the

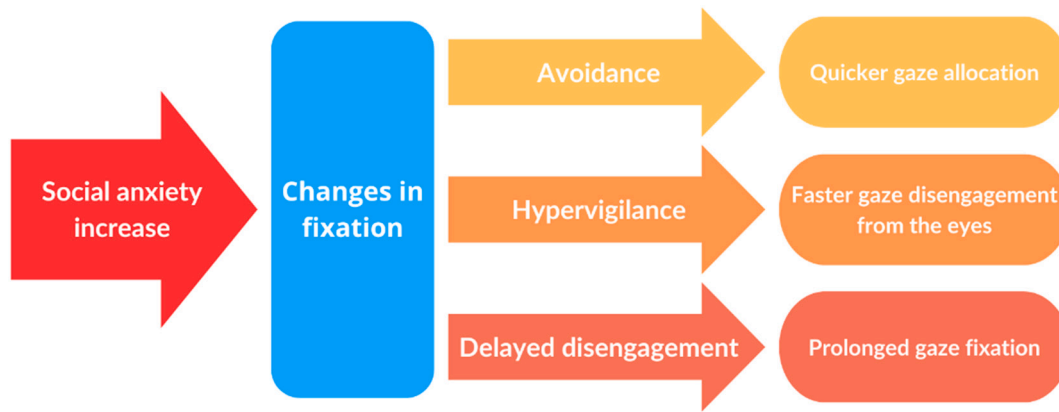


Fig. 2. Visualisation of hypotheses 5, 6 and 7.

Table 1
Demographic and clinical measures.

	SA (n = 60)		CONTROL (n = 21)		P	W
	M (SD)	MIN-MAX	M (SD)	MIN-MAX		
TOTAL						
Sex (% male)	48 %		62 %			
Age	23 (4,63)	18–37	23 (3,27)	18–30		
Marital status (% single)	68 %		67 %			
Highest level of education (% at least one diploma)	43 %		55 %			
Origin (% Asian)	50 %		29 %			
LSAS total score	59,48 (19,3)	30–117	17,48 (7,57)	1–29	<0,001	1260
Social Cognitions	2,42 (0,67)		1,93 (0,63)		<0,05	875,5
Social Cognitions - probability	43,7 % (21,8)		34,42 % (28,45)			
SEX						
	MALE (n = 42)		FEMALE (n = 39)			
LSAS total score	46,6 (23,67)	4–90	50,74 (26,78)	1–117	0,61	
Social Cognitions	2,37 (0,65)		2,21 (0,73)		0,24	
Social Cognitions - probability	46,82 % (22,93)		35,38 % (23,72)		0,02	573
ORIGIN						
	Asian (n = 36)		Not Asian (n = 44)			
LSAS total score	56,08 (25,69)	7–117	43,14 (23,26)	1–88	<0,05	1028,5
Social Cognitions	2,32 (0,68)		2,26 (0,71)		0,72	
Social Cognitions - probability	43,35 % (24,17)		39,59 % (24,03)		0,48	

Note, SA = Social Anxiety; LSAS = Liebowitz Social Anxiety Scale, P = p-value, W = Mann-Whitney rank sum.

three types of attentional bias that may characterize individuals with social anxiety traits, the eye movements of each participant were recorded using an eye-tracking device (Tobii Pro Fusion 120 Hz). Areas of interest (AOI) were predefined for each face using the oval AOI tool available on the Tobii Pro Fusion device (Fig. 3). In the current study, we focused solely on visual attention directed towards the eyes and mouth regions. Participants first viewed emotions presented by the male model and then those presented by the female model.

2.2.4. Social cognitions questionnaire (SCQ)

Finally, to investigate the relationship between biases and the three aspects of social anxiety, participants were asked to complete the Social Cognitions Questionnaire, which was supplemented with demographic questions. The SCQ consists of 22 items that assess fear related to social anxiety (e.g., “People will reject me,” “People will stare at me”), which allows for the differentiation of three aspects of social anxiety: negative beliefs about the self, fear of failure in performance situations and fear of visible signs of anxiety, and fear of negative judgement and raising attention. Participants are required to rate two questions for each item on a Likert scale: first, how frequently they experienced the thought during the past week, and second, how much they believed in these schemas. The reliability levels of the SCQ scales and subscales are high.

2.2.5. Analytic strategy

The questionnaires and instrumental measures applied in the study were not used for diagnostic purposes. They are not suitable for the

diagnosis of social anxiety disorder with this research setup.

Based on the above, the measured dependent variables in the study were as follows: (1) time to first fixation, (2) duration of first fixation, (3) total fixation time on AOIs, (4) total number of fixations on AOIs, (5) visit duration on AOIs, (6) total number of visits on AOIs, (7) accuracy of emotion recognition, and (8) social cognitions.

Descriptive statistics were used to analyse eye movement data. We used the Shapiro-Wilk and Kolmogorov-Smirnov tests to determine the distribution of our examined population. Because the studied population was not normally distributed, non-parametric Mann-Whitney U and Kruskal-Wallis tests were used to determine differences between the studied groups. All statistical analyses were performed using the R statistical program (R Core Team, 2021).

3. Results

When analyzing the LSAS scores we have found, that regardless of categorization no significant difference in anxiety levels between men and women can be observed (Mann-Whitney U test female vs. male: p = 0.61; Asian female vs. Asian male: p = 0.49; SA female vs. SA male: p = 0.73; SA Asian male vs. SA Asian female: p = 0.35 - see Table 2).

The inclusion of participants from diverse ethnic backgrounds in our sample provided an opportunity to explore the association between ethnicity and levels of social anxiety. The study comprised thirty-six Asian individuals and forty-four non-Asians. Our findings revealed that Asians achieved significantly higher scores on the anxiety scale



Fig. 3. Areas of Interest (AOI) determined during the study for the male and female models.

Table 2
Gender differences in SA.

SEX	MALE (n = 42)	MIN-MAX	FEMALE (n = 39)	MIN-MAX	P
LSAS total score	46,6 (23,67)	4–90	50,74 (26,78)	1–117	0,61
Social Cognitions	2,37 (0,65)		2,21 (0,73)		0,24
Social Cognitions - probability	46,82 % (22,93)		35,38 % (23,72)		0,02
	SA male (n = 29)		SA female (n = 31)		573
LSAS total score	59,24 (16,06)	33–90	59,7 (22,18)	30–117	0,73
Social Cognitions	2,54 (0,58)		2,31 (0,73)		0,16
Social Cognitions - probability	48,15 % (19,02)		39,6 % (23,68)		0,09
ORIGIN	Asian (n = 36)		Not Asian (n = 44)		
	Asian male (n = 15)		Asian female (n = 21)		
LSAS total score	50,67 (25,65)	7–90	59,95 (25,63)	14–117	0,49
Social Cognitions	2,43 (0,54)		2,24 (0,77)		
Social Cognitions - probability	49,03 % (19,62)		39,29 % (26,68)		
	SA Asian male (n = 10)		SA Asian female (n = 20)		
LSAS total score	65,6 (16,65)	36–90	62,25 (15,65)	30–117	0,35
Social Cognitions	2,52 (0,45)		2,31 (0,74)		0,36
Social Cognitions - probability	48 % (13,51)		41,2 (25,84)		0,24

Note, LSAS = Liebowitz Social Anxiety Scale, SA = Social Anxiety, P = p-value, W = Mann-Whitney rank sum.

compared to non-Asians, Mann-Whitney U test $p < 0.05$; $W = 1028.5$. However, it is important to note that the average anxiety score obtained by the Asian group (56.08) fell within the mild range and did not surpass the threshold of sixty points, associated with moderate social anxiety traits (Liebowitz, 1987). A significant difference in anxiety levels was also observed between Asian and non-Asian women (Mann-Whitney U test $p = 0.03$; $W = 251.5$), indicating that Asian women exhibit statistically significantly higher anxiety levels than their non-Asian counterparts.

Regarding the association between emotion recognition and the scores on the social anxiety questionnaire, no significant correlation was observed for the male model's pictures. An exception can be seen with the recognition of fear, where 69 % of the SA group recognized the emotion correctly, while only 45 % of the control group could do the same. For the female model, both the higher social anxiety scorers and the control group exhibited lower proportions of correctly recognized threatening and sad emotions as seen in Figs. 4 and 5.

In the context of visual attention, a Mann-Whitney U test suggested notable differences in the gaze patterns directed towards the eyes and mouth, both in general and within the group exhibiting higher scores on the social anxiety questionnaire, as seen in Table 3. Specifically, female participants demonstrated a greater focus on the region of the eyes compared to the mouth. Moreover, the frequency of attention directed to the eyes was found to be influenced by the gender of the participants.

Based on the results regarding the direction of the first fixation, both

the participants with higher scores on the social anxiety questionnaire and the control group first directed their gaze to the eyes when presented with threatening stimuli. However, both individuals with higher social anxiety scores and the control group exhibit clear hypervigilance towards the region of the eyes compared to the region of the mouth, regardless of the type of the emotion.

In individuals with higher social anxiety scores, a prolonged duration was observed until the first fixation on the eyes, compared to the control group. This finding suggests a tendency towards avoiding gaze contact with threatening stimuli. Moreover, the classification of social anxiety scores into mild and moderate categories further accentuated this difference, see Table 4. For the categorization we used the cutoffs used by the National Social Anxiety Center, a score of 30 to 49 for the mild and a score of 50 to 64 for the moderate groups (National Social Anxiety Center, 2016). Participants in the moderate group displayed quicker gaze disengagement from the eye region in comparison to those in the mild or control groups.

Furthermore, supporting the avoidance hypothesis (Hypothesis 6), several other significant independent variables provided additional evidence. Individuals with higher scores on the social anxiety questionnaire exhibited fewer and shorter fixations on the eyes during the entire exposure, as well as a reduced number and duration of gazes directed at the eyes throughout the exposure period as seen in Table 5.

In the social cognitions questionnaire, which measures how frequently the participants experienced different negative thoughts,

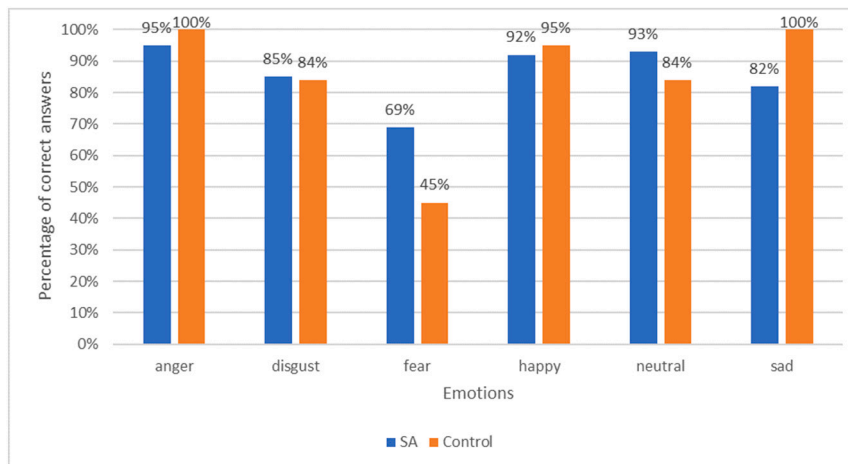


Fig. 4. Percentage of correctly identified emotions of the male model in SA and Control groups.

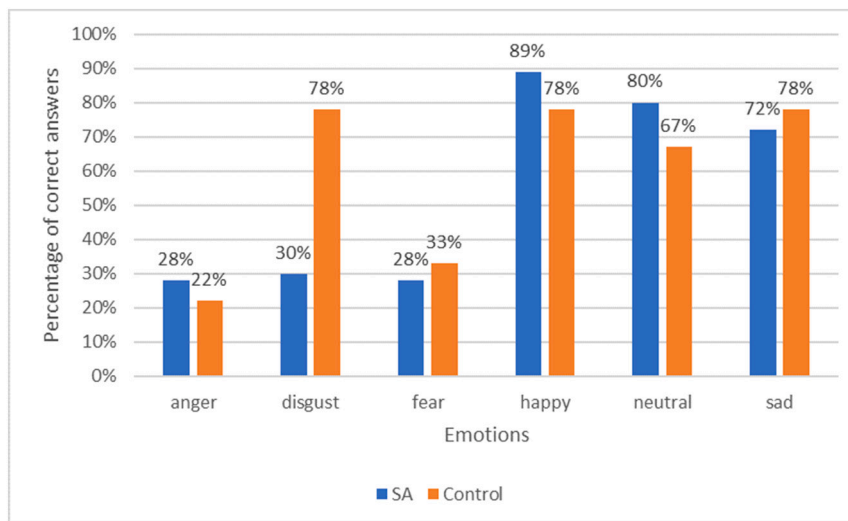


Fig. 5. Percentage of correctly identified emotions of the female model in SA and Control groups.

referred to as schemas, during the past week and how much they believed in the thoughts, the results revealed a notable prevalence of maladaptive schemas associated with performance situations and visible signs of anxiety in both individuals with higher social anxiety scores and the control group. It is evident that individuals with higher social anxiety scores, as expected, reported elevated values for both the frequency of schemas and their belief in their validity.

When examining the results by gender, a significant dominance of maladaptive schemas related to performance situations and visible signs of anxiety was evident in both men and women, as seen on Fig. 7. However, intriguingly, men consistently exhibited higher belief in their schemas compared to women.

Based on the data examined by ethnicity (see Fig. 8), it can be generally stated that compared to the non-Asian group, both the frequency of maladaptive schemas and the belief in their accuracy are higher among Asian participants, although the difference is not as significant as it is based on gender.

4. Discussion

No significant difference in anxiety levels between men and women was observed. Consequently, our findings do not align with prior research that emphasized gender-based disparities in anxiety levels. This

prompts the question of whether any historical discrepancies in anxiety levels between men and women were genuinely indicative of inherent differences or merely a reflection of socialization effects.

On this basis, we reject the first hypothesis: the assumption that women are significantly more anxious than men is not supported. In other words, there is no significant difference between men and women regarding social anxiety scores.

While the present study did not allow for direct comparison with a European or American sample, our data suggests that social anxiety levels in (East) Asian regions are not necessarily lower. The observed differences in anxiety scores between Asian and non-Asian participants highlight the importance of considering cultural and ethnic factors when examining social anxiety traits. Further research is warranted to gain a more comprehensive understanding of the nuanced relationship between ethnicity and social anxiety levels in diverse populations.

Based on the above summary, we reject our second hypothesis: the assumption that Asians, compared to the non-Asian population, achieve significantly lower scores on the social anxiety questionnaire, is not supported.

As emphasized by other experts, data suggesting lower levels of anxiety among Asians do not necessarily mean that the population of Asian regions is less anxious, but rather that they might show it less (Razidi et al., 2021). Social anxiety can be found in most countries

Table 3
Eye-tracking data on threatening faces (anger, disgust, fear) comparing male and female participants.

	Threatening faces (anger, disgust, fear)			
	M (SD)	M (SD)	P	W
Eye (Male vs. Female)				
Total fixation count in AOI	8,75 (4,67)	9,24 (3,07)	0,09	
Total duration of fixation in AOI	2,37 (1,25)	2,65 (0,77)	<0,001	5422,5
Number of Visit in AOI	3,46 (2,19)	3,18 (1,28)	0,48	
Total duration of Visit in AOI	2,69 (1,35)	2,97 (0,86)	0,005	5702,5
Mouth (Male vs. Female)				
Total fixation count in AOI	2,19 (1,82)	1,74 (1,48)	0,09	
Total duration of fixation in AOI	0,65 (0,58)	0,55 (0,47)	0,34	
Number of Visit in AOI	1,66 (1,22)	1,55 (1,26)	0,41	
Total duration of Visit in AOI	0,67 (0,61)	0,56 (0,48)	0,29	
Eye (SA Male vs. SA Female)				
Total fixation count in AOI	8,21 (3,14)	9,34 (3,37)	0,101	
Total duration of fixation in AOI	2,19 (0,87)	2,63 (0,78)	0,001	5317
Number of Visit in AOI	3,3 (1,19)	3,09 (1,27)	0,55	
Total duration of Visit in AOI	2,52 (0,98)	2,98 (0,87)	0,006	5561
Mouth (SA Male vs. SA Female)				
Total fixation count in AOI	2,1 (1,86)	1,69 (1,52)	0,08	
Total duration of fixation in AOI	0,63 (0,53)	0,53 (0,49)	0,31	
Number of Visit in AOI	1,66 (1,19)	1,49 (1,29)	0,39	
Total duration of Visit in AOI	0,65 (0,55)	0,54 (0,5)	0,26	

Note, SA = Social Anxiety; AOI = Area of interest, P = p-value, W = Mann-Whitney rank sum.

worldwide, but social concerns, symptom presentation, and even the threshold for diagnosing the disorder can differ across cultures (Rapee & Spence, 2004). In future research, it may be worth examining cultural factors such as individualism/collectivism, evaluation of social norms, gender roles, and gender identification that may contribute to differences in social anxiety.

We have found no significant correlation between social anxiety scores and emotion recognition. Intriguingly for the female model, both groups exhibited lower proportions of correctly recognized threatening and sad emotions. A possible explanation for these phenomena may stem from dialect studies (Elfenbein & Ambady, 2002), which indicate that individuals tend to more accurately recognize facial expressions of people from their own nationality compared to those from other national groups. In the context of our study, where the models depicted are of European origin while only a few of the participants are, it is plausible that a cultural difference might account for this result, particularly in the case of the female face. However, upon disaggregating the data by gender and examining it in terms of participants' origin, similar results were obtained, suggesting that the test battery may not be adequately calibrated.

Given these considerations, further investigation is warranted to delve into the reasons underlying the accuracy of emotion recognition and its potential relationship with social anxiety scores. Considering

Table 4
Eye-tracking data about the time to first fixation.

	M (SD)	M (SD)	P	W
Eye (SA Mild vs. Control)				
Threatening faces (anger, disgust, fear)	0,26 (0,28)	0,26 (0,24)	0,54	
Happy face	0,35 (0,31)	0,35 (0,22)	0,477	
Neutral face	0,23 (0,17)	0,31 (0,44)	0,488	
Sad face	0,44 (0,8)	0,4 (0,47)	0,969	
Eye vs. Mouth (SA Mild)				
Threatening faces (anger, disgust, fear)	0,26 (0,28)	1,11 (0,81)	<0,001	268
Happy face	0,35 (0,31)	0,89 (0,67)	<0,001	94
Neutral face	0,23 (0,17)	1,13 (1,19)	<0,001	59,5
Sad face	0,44 (0,8)	1,39 (1,1)	<0,001	49
Eye vs. Mouth (SA Moderate)				
Threatening faces (anger, disgust, fear)	0,35 (0,5)	1,19 (1,01)	<0,001	1456
Happy face	0,34 (0,46)	0,92 (0,92)	<0,001	287
Neutral face	0,27 (0,36)	1,31 (1,22)	<0,001	192,5
Sad face	0,36 (0,64)	1,2 (0,92)	<0,001	110
Eye vs. Mouth (Control)				
Threatening faces (anger, disgust, fear)	0,26 (0,24)	1,21 (1,21)	p < 0,001	221
Happy face	0,35 (0,22)	0,92 (0,81)	p = 0,03	99,5
Neutral face	0,31 (0,44)	1,38 (1,00)	p < 0,001	21
Sad face	0,4 (0,47)	1,56 (1,15)	p < 0,001	34

Note, SA = Social Anxiety, P = p-value, W = Mann-Whitney rank sum.

these findings, we focused on the results obtained for the male model for the purposes of our hypothesis.

Based on the results obtained for the male model, the third hypothesis is retained: those with a higher score on the social anxiety questionnaire correctly recognize emotions.

When examining visual attention, we found, that female participants demonstrated a greater focus on the region of the eyes compared to the mouth as seen on Fig. 6. This finding aligns with the proposition presented in the theoretical overview, where it was suggested that men tend to concentrate more on the mouth, while women tend to prioritize the eyes during emotion recognition (Vassallo et al., 2009). The observed gender-based disparities in gaze allocation are indicative of differential visual processing strategies employed by individuals, and they may have implications for how emotions are perceived and recognized in social interactions.

Based on all these findings, we retain the fourth hypothesis: there is a difference in which facial areas women and men look at during emotion identification.

We found that both the participants with higher scores on the social anxiety questionnaire and the control group first directed their gaze to the eyes when presented with threatening stimuli. These results are in line with existing theories that emphasize the significance of both the eyes and mouth in emotion decoding. This suggests that the eyes possess inherent attention-grabbing and visual salience qualities for individuals, irrespective of their social anxiety levels.

Based on these findings, we reject the fifth hypothesis: according to the available data, individuals with higher social anxiety scores do not show hypervigilance towards threatening stimuli compared to the control group.

Table 5
Eye-tracking data on different levels of SA vs. Control.

	Threatening faces (anger, disgust, fear)				
	M (SD)	M (SD)	χ^2	P	
Eye (SA total vs. Control)					
Time to first fixation	0,32 (0,49)	0,26 (0,24)	0,0099	0,75	
First fixation duration	0,24 (0,25)	0,23 (0,1)	1263	0,26	
Total fixation count in AOI	8,79 (3,22)	9,57 (5,3)	0,0025	0,96	
Total duration of fixation in AOI	2,42 (0,84)	2,77 (1,46)	1636	0,2	
Number of Visit in AOI	3,19 (1,24)	3,73 (2,77)	0,924	0,34	
Total duration of Visit in AOI	2,76 (0,94)	3,05 (1,54)	0,79	0,37	
Eye (SA Mild vs. Moderate vs. Control)					
Time to first fixation	M (SD)	M (SD)	M(SD)	χ^2	P
Time to first fixation	0,26 (0,28)	0,35 (0,5)	0,26 (0,24)	0,52	0,77
First fixation duration	0,29 (0,37)	0,21 (0,13)	0,23 (0,1)	3975	0,14
Total fixation count in AOI	8,91 (2,97)	8,73 (3,37)	9,57 (5,3)	0,453	0,8
Total duration of fixation in AOI	2,56 (0,7)	2,33 (0,90)	2,77 (1,46)	3,85	0,15
Number of Visit in AOI	3,3 (1,21)	3,12 (1,25)	3,73 (2,77)	1348	0,51
Total duration of Visit in AOI	2,86 (0,76)	2,69 (1,02)	3,05 (1,54)	1714	0,42

Note, SA = Social Anxiety; AOI = Area of interest, P = p-value.

This conclusion aligns with the results of [Konovalova et al.'s research \(2021\)](#), who, contrary to previous laboratory studies, did not find evidence of social anxiety-related hypervigilance. The researchers suggest that this may indicate that hypervigilance is an artifact of experimental paradigms and may not manifest in real-life environments.

According to evolutionary models, when perceiving threat as a close danger, humans direct their gaze to the eye region of the face to detect the source of threat ([Moukheiber et al., 2010](#)). Based on the outcomes of our study, hypervigilant attention directed towards the eye region, as opposed to the mouth, did not exhibit significant variations based on the emotional content of the presented stimuli.

According to our data individuals with higher social anxiety score, when faced with faces threatening emotions tend to prolong the first fixation on- and display a quicker gaze disengagement form the region of the eyes. Although the differences between the groups were not statistically significant based on the results, this finding partially supports the avoidance hypothesis ([Hypothesis 6](#)) and contradicts the delayed disengagement hypothesis ([Hypothesis 7](#)).

Based on all this, we tentatively retain the sixth hypothesis, but we reject the seventh hypothesis: according to the available data, individuals with higher social anxiety scores tend to exhibit avoidance towards threatening stimuli.

The present finding is consistent with prior research indicating that social anxiety tends to result in gaze avoidance ([Kleberg et al., 2021](#)). However, it is worth noting that this avoidance may be more

pronounced during actual social interactions rather than when participants are merely observing computerized facial stimuli. Additionally, the level of avoidance may be influenced by the duration of exposure to emotional faces, as highlighted by [Konovalova et al. \(2021\)](#), who investigated attentional biases in social anxiety using gaze measurements within a novel eye-tracking paradigm in a real social context. Their study suggests that avoidance, rather than hypervigilance, predominates in an unstructured social environment, particularly among individuals exhibiting higher levels of social anxiety.

With the social cognitions questionnaire our primary objective was to examine how maladaptive schemas manifested within our sample. Individuals with higher social anxiety scores, men and Asian participants had a higher frequency and belief in schemas and their validity.

According to the cognitive approach that explains social anxiety, individuals' thoughts about themselves and the world around them play a significant role in the development and maintenance of the disorder ([Clark & Beck, 2010](#)). People with this disorder often ruminate in social situations (and often even before), driven by maladaptive self-schemas. As a consequence of the automatic activation of these schemas, the attention of individuals with social anxiety is shifted towards external and internal cues of social threat, and they exhibit heightened self-focused attention during social interactions, leaving very little attention for positive external information.

However, the specific cause of this prevalence remains uncertain, as it is unclear whether the observed group effect is solely responsible for

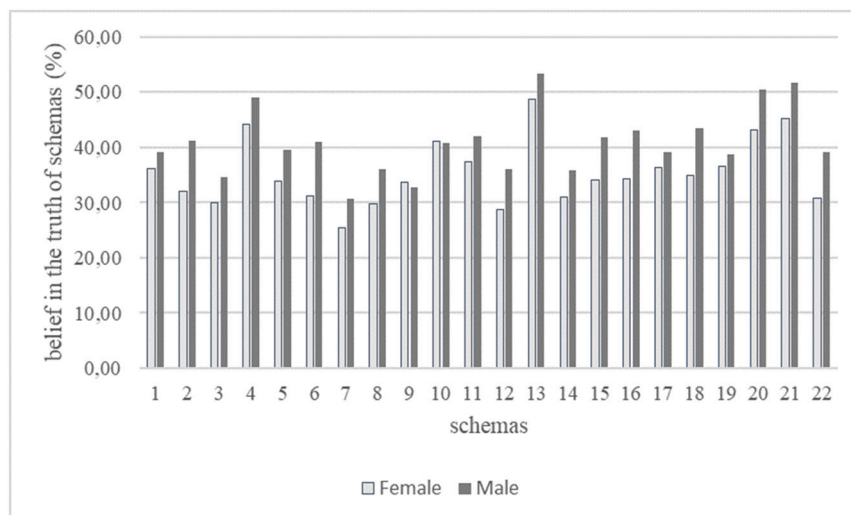


Fig. 7. Gender distribution in belief in the truth of scemas.

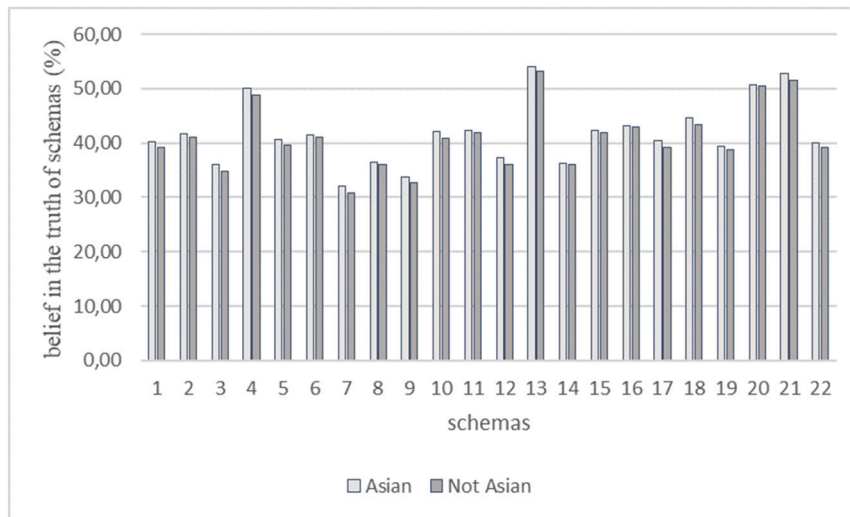


Fig. 8. Difference in Asian and not Asian populations in the belief in the truth of schemas.

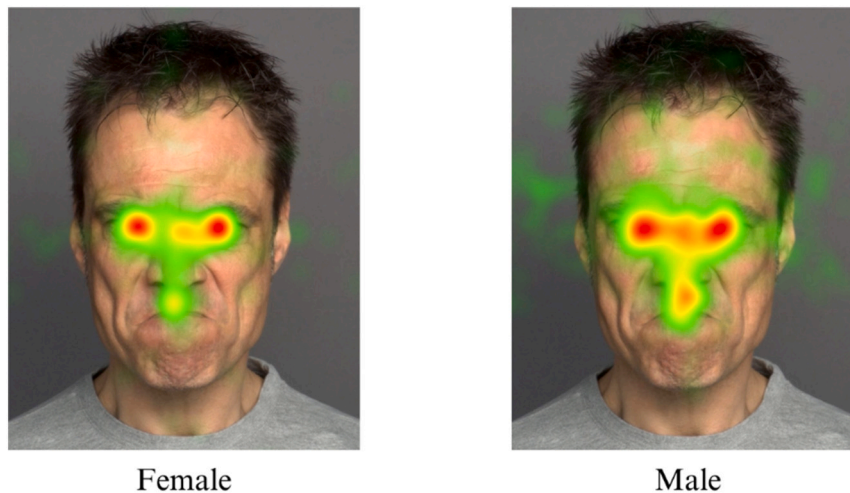


Fig. 6. Heat maps visualizing gaze data samples in men and women looking at a threatening face (anger).

these findings. One possibility is that the participants' unique life situations, such as being foreign students in a foreign country and attending a university where they face external expectations, could be influential factors in this context. Further investigations are warranted to gain a comprehensive understanding of these dynamics.

This finding is thought-provoking, particularly given that our results did not align with the common perception from literature that women tend to experience higher levels of anxiety than men. These outcomes may serve as a catalyst for future research that delves more deeply into maladaptive schemas, seeking to gain a nuanced understanding of the potential underlying reasons for the purported gender differences in this context.

Upon reviewing the existing literature, it becomes evident that both men and individuals of Asian descent are generally perceived as being less prone to experiencing social anxiety (Clark & Beck, 2010; McLean et al., 2011). However, our study's findings present contrasting results, indicating higher values for both men and Asians concerning the frequency of maladaptive schemas and the level of belief in their accuracy. This discrepancy suggests that cultural and socialization influences may play a substantial role in shaping the symptomatic expression of social anxiety, even influencing the diagnostic threshold of the disorder.

5. Conclusion

Despite the complex nature of the cognitive processes underlying social anxiety, there is a consensus among researchers regarding the potential role of attentional biases in perpetuating the disorder. However, intriguingly, studies have yielded conflicting findings concerning the nature of these biases. To address this gap in knowledge, our research focused on investigating visual attentional biases associated with emotion recognition in individuals exhibiting higher social anxiety scores. Specifically, our study aimed to explore the general emotion recognition ability of these individuals, their prioritization of facial regions during emotion decoding, the development of attentional biases towards gaze, and the potential relationship between these biases and the three cognitive aspects of social anxiety.

5.1. Demographics

In analyzing demographic data, our results diverge from previous studies that emphasized gender differences. Specifically, within the group of individuals with higher social anxiety scores, women did not exhibit significantly higher anxiety scores compared to men. This finding partially supports the notion of a transformative socio-cultural and technological process, potentially influencing changes in the

social distribution of anxiety across genders.

5.2. Emotion recognition

The accuracy of emotion recognition was comparable between the group with higher social anxiety scores and the control group. Both groups correctly recognized emotions, consistent with a previous study (Silvia et al., 2006). Based on the results, the social anxiety questionnaire score did not have a significant effect on accurate emotion recognition.

5.3. Hypervigilance

Contrary to the hypervigilance hypothesis (Kleberg et al., 2021), our study found that individuals with higher social anxiety scores did not fixate their gaze faster on the eyes of threatening faces than the control group, indicating no initial hypervigilance towards threatening stimuli. This contradicts the meta-analysis conducted by Bar-Haim et al. (2007). Furthermore, our results also showed that both groups focused their attention on the eyes rather than the mouth, regardless of emotion. This confirms that eyes are attention-grabbing and visually salient for individuals, regardless of the degree of social anxiety, likely because they convey important information about others' intentions and thoughts.

5.4. Avoidance and delayed disengagement

Regarding the avoidance/delayed disengagement hypotheses (Kleberg et al., 2021), we found that individuals with higher social anxiety scores showed avoidance towards threatening stimuli. While the results are not significant, they lend some support to the avoidance hypothesis and contradict the delayed disengagement hypothesis. These results align with studies on social anxiety, as well as studies employing eye-tracking technology and computerized faces, which found that individuals with social anxiety fixate less on the eye region and more quickly avert their gaze (Chen et al., 2020; Moukheiber et al., 2010). Future research should explore these attentional biases using different experimental paradigms.

5.5. Social cognition

Lastly, our study aimed to explore the potential relationship between attentional biases and maladaptive schemas characteristic of social anxiety. The questionnaire results indicated that prominent schemas were associated with both social anxiety scores and gender, particularly pertaining to performance situations and visible signs of anxiety. These findings raise inquiries into the underlying factors driving these associations, warranting further investigation. Intriguingly, our data revealed that both men and individuals of Asian descent scored higher in terms of the frequency of maladaptive schemas and their belief in them. This observation aligns with the proposition that cultural and socialization effects may exert significant influence over the threshold and manifestation of symptoms in social anxiety. Consequently, investigating the interplay between social anxiety, socialization, and cultural factors in relation to maladaptive schemas may provide deeper insights into the phenomenon.

5.6. Limitations

This study is not without limitations that are important to mention, and that future research may address. The sample size examined was relatively small, which may result in non-representative results. Another notable limitation is that we did not employ general psychopathological measures for either the group with higher social anxiety scores or the control group, thus other mental health problems and their effects cannot be ruled out. Previous eye-tracking studies, for example, have found that concurrent depressive diagnoses and depressive symptoms

(Capriola-Hall et al., 2021) can influence face perception, particularly attention to the eyes. Therefore, we cannot know if co-occurring depression potentially influenced our results. Another significant limitation is the use of self-report measures to assess social anxiety, which could have influenced the results as self-report assessments reflect individuals' subjective perceptions. Furthermore, future research could examine whether these findings are observable in ethnically and culturally diverse samples.

Finally, our study relied on the free-viewing eye-tracking paradigm, which compared to real-world social interactions, limits its ecological validity. As such, future research could benefit from using more innovative, ecologically valid eye-tracking approaches, exploring the possible associations outlined in this paper above in a more naturalistic environment or anxiety-inducing situations (e.g., Dechant et al., 2017; Price et al., 2016).

Abbreviations

SA	Social Anxiety
SAD	Social Anxiety Disorder
LSAS	Liebowitz Social Anxiety Scale
SCQ	Social Cognitions Questionnaire
AOI	Area of interest

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CRediT authorship contribution statement

Csongor István Szepesi: Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Petra Böszörményi-Zelizi:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **Anita Szemán-Nagy:** Writing – review & editing, Supervision, Methodology, Data curation, Conceptualization. **Mihály Soós:** Visualization, Software, Methodology, Data curation. **Nóra Horváth:** Investigation, Formal analysis. **Viktor Rekenyi:** Investigation, Formal analysis. **Salome Zurashvili:** Investigation. **László Róbert Kolozsvári:** Writing – review & editing, Resources, Project administration, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors have no conflicts of interest to report.

Data availability

Data will be made available on request.

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