

**Research Topic: Empathy and Social Anxiety**

**Course:** the Empathic Brain

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## Introduction & Research Context

This study examines the relationship between social anxiety disorder (SAD) and eye gaze patterns, which are examined to gain insights into the empathic abilities of affected individuals. Social anxiety disorder (SAD)<sup>1</sup> is a condition characterized by an intense fear response to social stimuli that leads to an aversion to social situations. SAD involves a phobia of being negatively judged or scrutinized by others. This manifests in various behavioral and physiological symptoms<sup>2</sup> (Pittelkow et al., 2021). Specifically, avoidance of eye contact is of interest to this paper. SAD is relatively prevalent, affecting between 0.2% and 12.1% of people across a sampling of high, middle, and low-income countries around the world (Stein et al., 2017). Ultimately the condition causes impaired social functioning and social isolation (Pittelkow et al., 2021). SAD remains a large problem in global society because of its contribution to the ‘loneliness epidemic’. Loneliness in turn predicts a higher rate of adverse physical outcomes such as higher mortality and morbidity risk, and a higher rate of mental health symptoms (Lim et al., 2016).

### *Social anxiety and empathy levels*

Despite the social hindrances that appear with SAD, studies remain unclear on whether affected individuals exhibit impaired or heightened levels of empathy. Current studies tentatively point to a lowered level of cognitive empathy in affected individuals. An extensive meta-analysis by Pittelkow et al. (2021) found a small but significant positive association between SAD and emotional empathy. However, the same study found a small but significant negative correlation between SAD and cognitive empathy. The same directions of effect were found by Alvi et al. (2020), who discovered that social anxiety negatively correlated with higher-level social cognition (cognitive empathy). This involves theory of mind, the ability to attribute mental states in others. By contrast, the study did not find significant associations between social anxiety and lower-level social cognition (emotion recognition). This is one such measurement of emotional empathy.

Tibi-Elhanany and Shamay-Tsoory (2011) initially observed that SAD-affected people exhibit elevated sensitivity to and concern for others’ affective states. This could lead to higher levels of empathic concern and mentalizing, they hypothesized. The study also found higher emotional empathy in people with SAD. However, “controlling for the general anxiety variable revealed that social anxiety was related to cognitive empathy measures” (2011) as opposed to emotional empathy measures. In comparison to people with low social anxiety, those with high social anxiety were less accurate in attributing cognitive mental states to others. That is, their theory of

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<sup>1</sup> Also known as *social phobia* (Tibi-Elhanany & Shamay-Tsoory, 2011).

<sup>2</sup> Specifically avoidance behaviors and autonomic arousal (fight-or-flight) responses (Pittelkow et al., 2021).

mind and mentalizing abilities were impaired. This finding is consistent with the previously mentioned studies by Pittelkow et al. (2021) and Alvi et al. (2020).

Empathy can be measured using an eye tracker task, in which participants are shown pictures of faces and an eye tracker maps their gaze patterns to areas of interest on the faces. Specifically, the eyes are shown to be emotional areas of interest. Eye tracking studies show a significant positive correlation between the amount of time spent fixating on the eye areas of a face, and one's levels of cognitive (Picó et al., 2020) and emotional (Cowan et al., 2014) empathy. However, this relationship is not observed in individuals with SAD. An eye tracking study by Moutinho et al. (2021) showed that individuals with SAD avoid looking at the eye areas of faces. This was due to specific aversion to looking at the eye areas and not due to attentional biases towards specific emotions. This association can be related to SAD-affected individuals' tendencies to avoid eye contact in real life. Moutinho et al. concluded that on these grounds, it is not possible to get a valid reading of empathy in SAD-affected people using an eye tracker.

An additional meta-analysis by Günther et al. (2021) confirmed that individuals with SAD avoid eye contact with faces displaying both positive and negative emotions. Early attentional biases were also found towards angry faces, while this bias disappeared in happy and neutral faces. This indicates that individuals with SAD are more threat-biased and attentive to the eye areas in the early stages of facial processing. Once it is confirmed that the face in question does not pose a threat, focus on the eye areas dips to below the mean level of non-affected individuals.

## **Research Gap**

The research described above points to a significant gap in knowledge about the empathic abilities of SAD-affected people. Firstly, the studies only show a tentative positive relationship between cognitive empathy and social anxiety as observed through eye gaze patterns.

Furthermore, this may be inaccurate due to how cognitive empathy is measured: with an eye tracker showing photos making 'direct eye contact' with viewers. It is interesting to note that all face photos used in these studies were looking directly at the camera, i.e. making 'eye contact' with the participants who viewed them. Therefore, it can be argued that the direct 'eye contact' of the photos constitutes a confounding factor in individuals with SAD, who have been shown to avoid direct eye contact. This would automatically translate to measurements of lower levels of cognitive empathy, which is what these studies concluded. To mitigate this effect, the present study examines fixation on the eye areas of various faces gazing either directly at the camera or peripherally in another direction. This study also only uses neutral and happy faces to avoid the confounding factor of threat bias. By implementing these parameters, the study thus hopes to obtain a more accurate measurement of cognitive empathy in individuals with SAD.

To examine markers of empathy in individuals with high social anxiety via fixation on the eye areas, this study poses the following hypotheses:

***Hypothesis 1:*** Compared to low social anxiety individuals, individuals with high social anxiety will fixate significantly more on faces gazing peripherally rather than directly into the camera.

***Hypothesis 2:*** If there exists a difference in fixation on happy versus neutral faces, individuals with high social anxiety will fixate more on the neutral faces (as neutral is one step closer to a negative valence emotion).

## **Methodology**

*Participant selection:* A sample of 20 AUC students was selected via convenience sampling. The sample comprised 12 females and 8 males, with a mean age of 20.05 (SD = 0.826).

*Survey:* Participants completed a survey based on the SAQ-A30<sup>3</sup> questionnaire. The original SAQ-A30 consists of 30 questions. However only 12 questions out of the questionnaire were selected for this study's survey to increase the probability of completion. The following categories of questions were identified and questions were selected from the SAQ-A30 based on them:

- Speaking up around other people
- Standing up for oneself
- Receiving criticism or negative feedback
- Interacting with the opposite sex
- Interacting with strangers
- Interacting with authority figures

At least one question was selected from each category.

The survey also included two self-reflective measures to cross-validate the questions from the SAQ-A30. These measures reported how socially anxious participants considered themselves to be, and if they suspected themselves to have SAD.

Using the SAQ-A30 scores and self-reflective measures, participants were split into high social anxiety (HA) and low social anxiety (LA) groups. They then completed an eye tracker task at Amsterdam University College.

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<sup>3</sup> The Social Anxiety Questionnaire for Adults (A30: composed of 30 questions) was developed by Caballo et al. and the CISO-A Research Team (2012).

### *Materials:*

Apparatus: The experiment was created and implemented on a Windows computer. An eye tracking camera and the eye tracking software Tobii Pro Studio 3.2.3 were used to run the experiment.

Visual stimuli: Sixteen photos were selected from the IAPS database, Google, and Pexels to fit the following categories:

- Four directly-looking happy face photos
- Four peripherally-looking happy face photos
- Four directly-looking neutral face photos
- Four peripherally-looking neutral face photos

All photos of directly-looking (happy and neutral) faces were sourced from the International Affective Picture System (IAPS) (Lang et al., 2008).

However, since none of the examined affective picture databases had photos with peripherally looking faces, such photos were sourced from Google and Pexels instead. The following criteria were observed when selecting the photos of peripherally looking faces:

- Heads can be turned up to 45° to the left or right with reference to the camera
- Plain (unicolored, untextured) backgrounds
- Similar size (approximately 1080 x 1920 px)

### *Design:*

The experiment consisted of 16 trials. Each trial consisted of a randomized photo that was shown to participants for an interval of 5 seconds. Each photo was preceded by a fixation cross of 5 seconds. Photos of directly-looking faces were sourced from the IAPS (Lang et al., 2008) while peripherally-looking photos were sourced from Google Images and Pexels. Running the experiment took a maximum of ten minutes per participant. When the data of all 20 participants was gathered, it was analyzed using a factorial ANOVA. To investigate the relationship between looking direction and anxiety and between looking direction and emotion within anxiety groups a two-tailed t-test was performed.

### *Procedure:*

Participants firstly were asked to complete the survey. Two of the questions were self-reflective questions with ten-point Likert scales, where 1 = *not socially anxious at all* and 10 = *extremely socially anxious*. These questions measured (1) how socially anxious participants considered themselves to be, and (2) if they considered themselves to *have* social anxiety. The first self-reflective question was placed at the beginning of the survey and the second one at the end of the survey so as not to have a priming effect.

The remaining 12 questions were sourced from the SAQ-A30 survey of social anxiety and were scored on a Likert scale of one to five, where 1 = *no unease or stress* and 5 = *high unease or stress*. In addition to these measurements participants were asked for their contact details so that they could be scheduled for taking part in the eye tracker task of the study.

The experiment was carried out in a silent and non-distracting room in the building of AUC. The participants were instructed to sit on a chair in front of the computer. First, the experiment was briefly described and then the calibration for the eye tracker was carried out. The participants were asked to keep their posture as still as possible while performing the experiment. To make sure that there are no distractions the door of the room was kept closed and the experiments tried to stay as silent as possible.

The experiment first started with a slide that briefly explains what participants are required to do. The instruction was simply to look at the pictures. To start the experiment the participants had to press the spacebar. A fixation cross was shown before each image for 5 seconds. The images themselves were also shown for 5 seconds. All images were randomized. Each image had two Areas of Interest (AOIs), namely the eyes. The AOIs were drawn to be approximately the same size as the eyes of the picture of faces. The means for eye fixation duration on AOIs were recorded by the eye tracker software. The means were then added together and averaged for each category of pictures for each participant.

## **Results**

In order to test between subject differences, a factorial ANOVA was conducted. Figure 1 describes results for the three independent variables: anxiety level, emotion, and looking direction without outliers.

Figure 1. Factorial ANOVA results

Source	dF	Mean Square	F	Sig.
Corrected Model	7	762265.006	1.146	0.344
Anxiety * Emotion * Looking direction	1	12476.457	0.019	0.891
Anxiety	1	123832.637	0.186	0.667
Emotion	1	152377.886	0.229	0.634
<b>Looking direction</b>	<b>1</b>	<b>2942791.358</b>	<b>4.426</b>	<b>0.039</b>
<b>Anxiety * Emotion</b>	<b>1</b>	<b>289244.811</b>	<b>0.435</b>	<b>0.512</b>
<b>Emotion * Looking direction</b>	<b>1</b>	<b>746328.132</b>	<b>1.123</b>	<b>0.293</b>
<b>Anxiety * Looking direction</b>	<b>1</b>	<b>705764.608</b>	<b>1.062</b>	<b>0.306</b>

*The analysis shows significance for looking direction in general.*

With a standard precision level of  $\alpha = 0.05$ , looking direction provided a significant result below the threshold. Participants had a higher mean for peripheral ( $M = 1759$ ,  $SD = 870.5$ ) than direct images ( $M = 1652$ ,  $SD = 624.1$ ). Furthermore, there is a clear direction of effect for the relation between emotion and looking direction as well as anxiety and looking direction. Participants looked most at direct happy ( $M = 1897$ ,  $SD = 912.6$ ) and least at peripheral happy ( $M = 1493$ ,  $SD = 817.1$ ) eyes. While the difference between peripheral and direct images was minimal for the low anxiety group ( $M = 1735$ ,  $SD = 924.0$  and  $M = 1709$ ,  $SD = 658.0$  respectively), there was a clear difference for the high anxiety group ( $M = 1794$ ,  $SD = 835.6$  and  $M = 1575$ ,  $SD = 611.3$  respectively). It should be noted that the relation between anxiety and emotion does not show any direction of effect.

Next, a two-tailed t-test was performed to further investigate the relation between anxiety and looking direction, as well as emotion and looking direction.



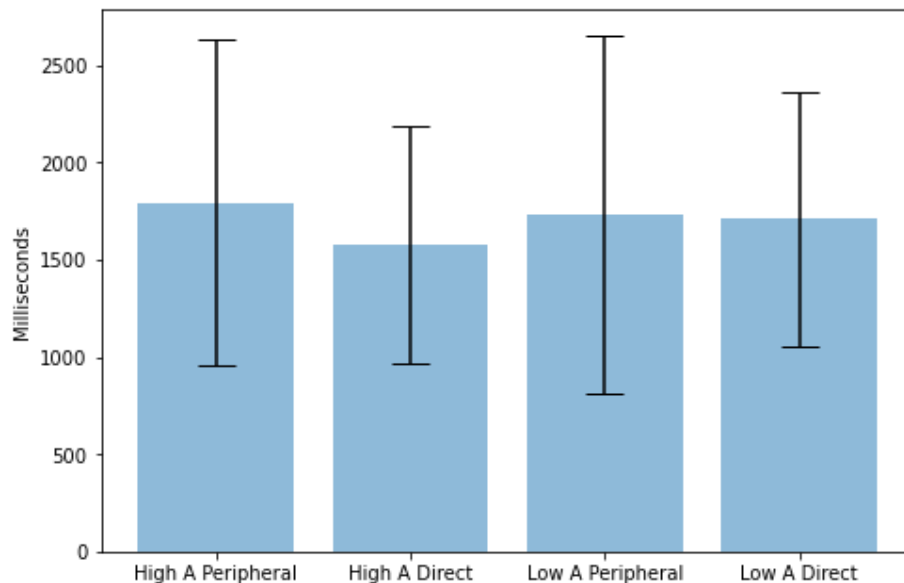
Figure 2. Relation between anxiety, emotion and looking direction.

2-Tailed T-Tests		
High anxiety	peripheral direct	0.2903
	happy neutral	0.2134
Low anxiety	peripheral direct	0.8497
	happy neutral	0.0296

*T-tests for the within-group relations provide additional insights.*

The p-values are reflective of the previously found direction of effect from the factorial ANOVA analysis. However, they are more indicative as they show the extent to which the direction of effect relates to the HA and LA group respectively. The results show a clear direction of effect for HA individuals and peripheral looking direction, but not for LA individuals and looking direction. The following table visually reflects this. It should be noted that the standard deviations are relatively high.

Figure 3. Mean scores for participants gaze duration with respect to peripheral and direct images.

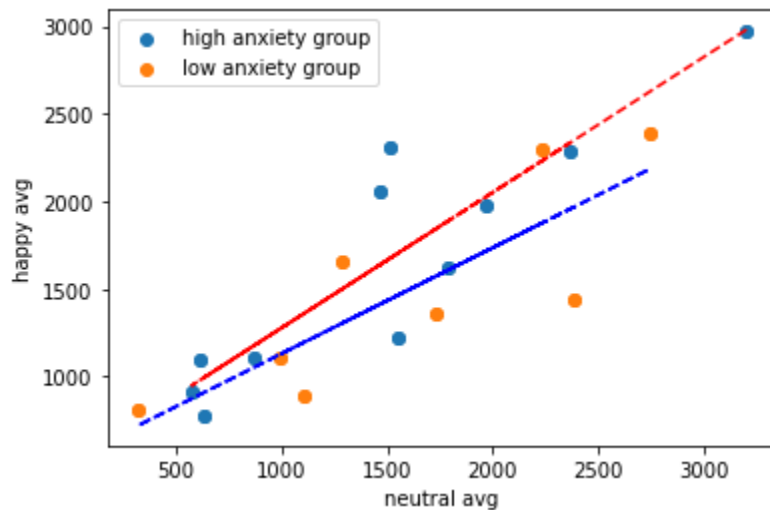


*While not significant, within-group differences are present for high anxiety individuals*

Figure Y also suggests that individuals with HA have a tendency to look more at neutral faces than happy faces ( $M = 1728$ ,  $SD = 780.8$  and  $M = 1575$ ,  $SD = 578.8$ ). For LA individuals this

effect is opposite and significant, ( $M = 1693$ ,  $SD = 888.1$  and  $M = 1783$ ,  $SD = 649.2$ ). Considering this, an interesting observation can be made when plotting all participants' average gaze durations when looking at the happy and neutral faces.

Figure 4. Average Neutral and Happy Gaze duration for all participants



*There is a slight trend towards neutral images for the high anxiety group.*

Even though there is a higher average fixation duration for happy over neutral, in general when a person from the HA group viewed a neutral image, the more they viewed a happy image, the longer they viewed the neutral image in comparison. This suggests that individuals in the LA group do have a tendency to look at the eye areas of more neutral faces.

## Discussion

### *Implications*

The aim of this study was to investigate the relationship between social anxiety and cognitive empathy levels. The considered hypotheses were not confirmed. For Hypothesis 1, there was no significant effect between social anxiety levels and fixation on the eye areas of faces based on looking direction. For Hypothesis 2, there was no difference in attention paid to happy or neutral faces among people with different levels of social anxiety. Therefore, at the moment it is not possible to draw a relationship between social anxiety and cognitive empathy levels.

However, the direction of effect with regards to Hypothesis 1 reflects what was found in the previously-mentioned studies. That is, individuals with social anxiety are more likely to look at peripherally-gazing faces than at the directly-gazing faces, linked to their tendency to avoid eye contact. Even though this effect could not be replicated at a significant level ( $p < 0.05$ ), it mirrors these past studies which were significant. Further studies could shed more light on the mechanisms behind the tendency to avoid eye contact in both real social situations and simulated situations (photos of faces). This mechanism should also be explored in relation to cognitive and affective empathy levels. Most likely it indicates that individuals with SAD do not have any deviations from the norm in terms of cognitive empathy, but eye contact temporarily disrupts attending to the eye areas. This in turn makes emotion identification and mentalizing difficult, so cognitive empathy temporarily drops.

An interesting direction of effect was also found in Hypothesis 2, which was not significant but still indicated that socially-anxious people are more prone to looking at neutral than happy faces. This tentatively looks to be related to socially anxious individuals' tendency to fixate more on negative valence emotions over positive valence ones in the early stages of face processing. Further studies could make this link more explicit by focusing on a wider spectrum of positive, neutral, and negative emotions. As of now it is not possible to assume that the direction of effect holds among all segments along the emotion valence spectrum.

### *Limitations*

Finally, a number of important limitations need to be considered. Firstly, there was an uneven (and low) number of participants per group for social anxiety levels: 12 for LA and 8 for HA respectively. Secondly, the study was also limited by the selected photos. The forward-looking happy and neutral photos were sourced from the IAPS database. However, the peripherally looking photos were not selected from a verified database. This was due to the fact that there were no peripherally looking photos that fit the selected criteria in the IAPS database or any other database that was searched. Even though some of the photos had peripherally looking faces, they had distracting details and the faces were not the main focus of the photos. Furthermore, the direction of looking for peripherally looking photos were not controlled. Participants might have a bias towards the right or left sides of faces. Further studies should control for this bias. Lastly, the present study could also include a survey measuring cognitive empathy levels of the participants to cross-reference measures of cognitive empathy levels by people's gazing behavior. This would make the results even more robust.

## **Conclusion:**

The present study investigated the relationship between cognitive empathy levels and social anxiety through a survey and recorded gazing behaviors of participants. There were no significant results to confirm the stated hypotheses. However, this could be due to the several limitations of the study. Future studies can focus on this relationship while also controlling for the mentioned limitations of the current study. Specifically, such studies could use scientifically validated photos of peripherally-looking faces and more trials. Although there were no significant results, there were still some directions of effects that can be observed. These effects have been proven significant in the previous literature drawn upon when creating the experiment. Future studies can explore these directions of effects even further.

One interesting direction of effect was that people with social anxiety look longer at the eye areas of photos of faces looking peripherally rather than directly at the camera. Most likely this indicates that individuals with SAD do not have significantly different average levels of cognitive empathy as compared to non-affected people. For people with SAD, cognitive empathy could be temporarily inaccessible in the direct gazing scenario as they feel threatened. However, they may be able to access their full cognitive empathy capacity in the peripherally gazing scenario. Another direction of effect worth noting is that socially anxious people look more at neutral faces than happy faces, which may indicate an already-observed trend that they are more sensitive to negative valence emotions.

Overall, this study suggests several directions for further research. For example, studies can examine attention towards both positive and negative valence emotions. They can also examine attention towards faces gazing in different directions, and attention towards peripherally versus directly looking faces with more trials. Perhaps these dimensions will prove to be key details in the relationship between social anxiety and cognitive empathy levels.

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