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Social anxiety as a precursor for depression: Influence of interpersonal rejection and attention to emotional stimuli

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ABSTRACT

Social anxiety disorder (SAD) and major depressive disorder (MDD) are comorbid conditions, and SAD confers risk for MDD. Biased attention and interpersonal rejection are important for the development of SAD and MDD, but little research has examined how these processes may lead to MDD. We hypothesized that interpersonal rejection would result in SAD symptoms being associated with more "depression-like" attention biases. Participants (n = 164) completed a measure of SAD symptoms and an eye tracking task before and after a task in which they were randomized to be socially included or rejected. SAD symptoms, inclusion or rejection condition, and the interaction term were entered into separate hierarchical linear regressions predicting change in attention for five emotional faces. Rejection condition significantly moderated the effects of SAD on change in attention to sad, happy, and neutral faces. SAD predicted increased attention to sad faces and decreased attention to happy faces in the rejection condition, but not in the inclusion condition. SAD predicted increased attention to neutral faces in the inclusion condition, but not in the rejection condition. There were no significant effects for angry or disgust. Results suggest that SAD symptoms are associated with more depression-like attention biases in the context of interpersonal rejection.

1. Introduction

Major depressive disorder (MDD) and social anxiety disorder (SAD) are commonly comorbid disorders (e.g., Kessler et al., 2008; Ohayon and Schatzberg, 2010). Research suggests that SAD confers risk for later MDD (Wittchen et al., 2003). For example, research shows that social anxiety symptoms in adolescence are likely an antecedent of later depression, and that social anxiety is associated with higher depression severity (Stein et al., 2001). Little is known about why SAD confers risk for depression, but it may be because SAD results in, or is associated with, cognitive processes that are depressogenic. For example, a previous study found that the relationship between SAD and MDD was mediated by rumination (Grant et al., 2014). However, little other research has examined the relationship between SAD and potential depressogenic cognitive processes such as biased attention, cross-sectionally.

1.1. Biased attention in SAD and MDD

Biased attention is important for both SAD and MDD (Bantin et al., 2016; Armstrong and Olatunji, 2012) and research investigating biased information processing in SAD and MDD has been ongoing for decades (e.g., Cisler and Koster 2010; Judah et al., 2013; Mansell et al., 1999; Mattia et al., 1993; Mills et al., 2014; Ingram, 1984; Teasdale, 1988; Gotlib et al., 2004; Wells and Beevers, 2010). Attention bias in SAD is characterized by attention for potentially threatening stimuli (e.g., Rapee and Heimberg, 1997), whereas attention bias in MDD is characterized by increased attention to dysphoric information (Peckham et al., 2010).

Although further study is needed to understand underlying mechanisms of attention bias in SAD and MDD, empirical literature has well documented and characterized cognitive processing biases associated with both SAD and MDD, individually. Given that SAD confers risk for later MDD, we were interested in whether attention bias could help to explain this relationship and what conditions may elicit a more depressogenic bias (e.g., increased attention to dysphoric stimuli) within SAD. Interpersonal rejection is one such condition that may influence cognitive processes in SAD and MDD and that may increase risk for depression.

1.2. Social rejection in MDD and SAD

Social rejection is an important factor for both MDD and SAD. A recent meta-analysis examined emotional states caused by social

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rejection laboratory tasks and found that individuals who are rejected feel worse than controls, and individuals who are accepted feel better (Blackhart et al., 2009). Furthermore, research suggests that the experience of interpersonal rejection leads individuals to feel increased sadness, loneliness and hurt feelings, all of which are associated with MDD (Leary et al., 2001). Additionally, interpersonal rejection has been implicated as a risk factor for MDD (Slavich et al., 2010). Indeed, empirical research has demonstrated that increased symptoms of depression are associated with strong reactions to social rejection (Nezlek et al., 1997). This line of research suggests that social rejection may play a key role in the development and maintenance of depressive symptoms.

Similarly, research has implicated social rejection as a significant source of social anxiety, and that social rejection appears to be more distressing to individuals with social anxiety compared to those without social anxiety (Leary, 1990; Oaten et al., 2008). Furthermore, the effects of rejection (e.g., interpreting future ambiguous situations as threatening, viewing the rejecting individual in a negative manner), last longer among individuals with higher social anxiety compared to those with lower social anxiety (Zadro et al., 2005). Research has implicated social rejection as a maintaining factor of social anxiety because individuals with higher fears of negative evaluation engage in fewer prosocial behaviors after social rejection compared to those with lower fears of negative evaluation (Maner et al., 2007).

1.3. Bridging attention bias and interpersonal rejection

It is apparent that social rejection is important in both social anxiety and depression. Additionally, these experiences are potentially moderated by attention bias (Heeren et al., 2012). Specifically, negative attention bias has been associated with prolonged negative reactions to social rejection (Heeren et al., 2012). A more recent experimental study found that rejection sensitivity (a conferred risk factor for depression) was associated with increased attention to dysphoric stimuli within the context of interpersonal rejection (Kraines et al., 2018). This line of evidence indicates that attentional biases following social rejection may be an avenue for understanding the relationship between SAD and MDD. Specifically, empirical work suggests that social anxiety increases the likelihood an individual will experience social rejection (Maner et al., 2007); furthermore, evidence suggests that social rejection is associated with increased depressive symptoms (Leary et al., 2001) and is a risk factor for MDD (Slavich et al., 2010). To our knowledge, no study has examined attention bias in the context of social rejection among individuals with social anxiety symptoms as evidence for conferred risk for depression (i.e., a depressogenic attention bias).

1.4. Current study

The aim of the current study was to test whether interpersonal rejection leads social anxiety symptoms to be associated with a more depressogenic attention bias. Given the importance of social rejection in both social anxiety (e.g., Oaten et al., 2008; Zadro et al., 2005) and depression (e.g., Coyne, 1976; Slavich et al., 2010), the current study used a laboratory manipulation of social rejection to examine attention to emotional stimuli. As such, we tested the following core hypothesis: social rejection will manifest the risk for MDD associated with SAD; specifically, we expected that a laboratory task inducing social rejection or inclusion would moderate the relationship between social anxiety symptoms and attention for sad facial expressions, such that individuals in the rejection condition would display a significant positive relationship between social anxiety symptoms and attention for sad faces, but there would be no such relationship for those in the inclusion condition. This prediction was based on literature suggesting that interpersonal rejection in SAD leads to increased negative thinking and other cognitive processes. Additionally, we hypothesized that symptoms of SAD would be associated with baseline attention to threatening faces (i.e., disgust and angry) and symptoms of depression would be associated with baseline attention for sad faces. We did not make *a priori* hypotheses about individuals in the social inclusion condition, nor did we make a priori hypotheses about baseline attention to happy or neutral faces.

2. Methods

2.1. Participants

One hundred eighty undergraduate students were recruited from the student subject pool at a large university. The final sample included 164 participants due to the exclusion of 16 participants due to poor quality eye tracking data (i.e., < 70% valid data). Participants had a mean age of 19.59, and a standard deviation of 2.04. Participants were primarily female (67.1%) and primarily Caucasian (78%). The remaining participants identified as Black or African American (6.7%), American Indian or Alaskan Native (6.7%), multiple races (<1%), and Asian and Native Hawaiian or Other Pacific Islander (<1%). Six point seven percent of the sample identified as Latino/a.

2.2. Measures

2.2.1. Demographics

Participants provided basic demographic information such as age, race, sex, and education level.

2.2.2. Social Interaction Anxiety Scale – 6 and Social Phobia Scale – 6 (SIAS-6/SPS-6)

We assessed social anxiety symptoms using the SIAS-6/SPS-6 (Peters et al., 2012). This measure is a twelve item self-report questionnaire, which assesses scrutiny fears (e.g., eating, drinking, writing, in the presence of others) and generalized social interaction fears (e.g., talking to friends/strangers, attending social gatherings). The six item scales were developed from the original 40 item combined questionnaires of the SIAS and SPS (Mattick and Clarke, 1998). Participants are asked to rate how characteristic each item is for them on a 0 to 4 scale (0 = *not at all characteristic or true of me*; 4 = *extremely characteristic or true of me*). The first six items compile the total score for the SIAS-6, and the second six items compile the total score for SPS-6. Higher scores indicate higher levels of anxiety. The SIAS-6/SPS-6 demonstrates strong psychometric properties with Cronbach's alpha > 0.90, and test-retest reliability correlations > 0.91, which are equivalent to the Cronbach alpha levels of the original SIAS and SPS questionnaires (Mattick and Clarke, 1998; Peters et al., 2012). Additionally, scores on the original SIAS and the SIAS-6 are correlated at rates greater than 0.88, and scores on the original SPS and the SPS-6 are correlated at rates greater than 0.92 (Peters et al., 2012). In the current study, we used a composite score of combined SIAS-6/SPS-6 responses to provide us with a general measure of social anxiety symptoms. Cronbach's alpha for the combined social anxiety variable was high ($\alpha = 0.88$).

2.2.3. Patient Health Questionnaire – 9 (PHQ-9)

Symptoms of depression were measured using the PHQ-9 (Kroenke et al., 2001). The PHQ-9 is a nine item self-report measure, in which items correspond with the 9 core symptoms of the diagnostic criteria for major depressive disorder according to the DSM-IV. Participants rate how often they experience each of the symptoms within the past two weeks on a 0 to 3 scale. Possible responses include “not at all,” “several days,” “more than half the days,” or “nearly every day.” Participants are also asked to rate how difficult these problems have made it for them to do their work at school, at home, or get along with other people with responses ranging from “not difficult at all,” “somewhat difficult,” “very difficult,” or “extremely difficult.” Possible scores range from 0 to 27 with scores of ≥ 5, ≥ 10, ≥ 15, indicating mild, moderate

and severe levels of depression severity, respectively. The PHQ-9 demonstrated good internal consistency in the current study (α = 0.84) and has been shown to have high test-retest reliability (Kroenke et al., 2001).

2.2.4. Laboratory-based social rejection/inclusion task

A computer-based behavioral task aimed to assess the effects of social rejection and ostracism was used to elicit social rejection or inclusion (Cyberball; Williams and Jarvis, 2006). In Cyberball, participants are told that they will play an online game of catch with two other individuals, and that the purpose of the task is to practice mental visualization. However, the two other players are actually preset, computer-generated players. Participants are instructed to mentally visualize the situation, themselves, and the other players, as if they were playing a game of catch in real life. The Cyberball interface displays three animated players (two representing other players, and one representing the participant), and an animated ball is thrown among the players. To throw the ball, the participant clicks on one of the other two animated players. Participants in the inclusion condition are thrown the ball an equal number of times as the other two players. In the rejection condition, the participant is only thrown the ball one time from each of the other two players, and then the participant is "rejected" (i.e., the ball is never thrown to the participant again). In each condition, (i.e., inclusion or rejection) Cyberball continues for a total of 30 throws which is approximately 5 min. Previous research has established the effectiveness of Cyberball as a social rejection manipulation (Williams et al., 2000; Williams and Jarvis, 2006). Furthermore, a recent meta-analysis found that Cyberball is quite effective at inducing ostracism and rejection as indicated by a large effect size (Hartgerink et al., 2015).

2.2.5. Manipulation check

Before being debriefed, participants answered three open-ended questions about Cyberball: 1) What did you think of the Cyberball game; 2) What did you think of the other players in the Cyberball game; and 3) In the Cyberball game, did you feel like the other players included you or excluded you?.

2.2.6. Eye tracking task

Participants completed two runs of an eye tracking task (Run A and Run B). Run order (AB, BA) was counterbalanced across participants. Each run was comprised of 10 trials, and each trial contained 5 images of the same male or female actor portraying emotions of angry, disgusted, happy, neutral, and sad faces (see Fig. 1 for example trial). Therefore, a total of 20 actors (10 female, 10 male; 100 images total) were selected from the Karolinska Directed Emotional Faces (KDEF) database (Lundqvist et al., 1998). See Appendix A for a list of the 100 images used in this study. The five different emotional faces were counter balanced in their placement in each trial (e.g., the sad face appears in the center only twice; once in a female trial, and once in a male trial per task). In between each trial, participants fixated on a white cross in the middle of a black screen. The slide was advanced manually by the experimenter after the participant fixated on the cross. Participants were asked to freely view the trials, as if they were viewing a photo album. Each trial lasted 30 s. Participants sat between 60 and 70 cm from the viewing screen, and each of the 5 faces per trial measured 9.19 cm (approximately 8.1° visual angle) × 7.11 cm (approximately 6.2° visual angle). The five faces were evenly distributed on the display screen.

We examined the internal consistency of each of the face types in the eye tracking task for this study. Happy faces had a good internal consistency (α = 0.84). Angry, sad, and disgust faces had acceptable internal consistency (α's = 0.78, 0.79, and 0.74, respectively). Neutral faces had questionable internal consistency (α = 0.68). These results are consistent with other recent eye tracking studies (e.g., Lazarov et al., 2016; Sears et al., 2018).

2.2.7. Eye tracking system

A Tobii T60 eye tracker and Tobii Studio software were used to assess line of visual gaze. The Tobii T60 screen measures 17″ diagonally and is 1280 × 1024 pixels. The TFT T60 monitor detects the position of the pupils and corneal reflection in both eyes simultaneously (binocular tracking) and has an accuracy of approximately 0.4° visual angle (Tobii Technology, 2011). Gaze location was sampled every 16.7 ms (60 Hz). Participants were calibrated to the eye tracker before beginning the eye tracking tasks. Each of the five faces per trial was identified as an area of interest (AOI) within Tobii Studio software. The AOI's consisted of a rectangle cropped around each emotional face, and included a small portion of a plain background.

2.2.8. Eye tracking outcome

Total visit duration was calculated for each AOI. A visit is defined as the total amount of time (in seconds) an individual spends looking at a particular AOI starting with the first fixation inside the AOI until an eye movement is recorded outside that AOI. Fixations were defined using the Tobii Fixation Filter algorithm, which uses a 0.42 pixels/ms threshold. This index measures the amount of sustained overt attention to a particular AOI across the entire task, and it is calculated by summing the amount of time an individual spends looking within an AOI across all task trials. Several previous studies have utilized total visit duration to examine attention bias, as this index is able to capture the allocation of overt attention over time (e.g. Eizenman et al., 2003; Sears et al., 2010).

2.3. Procedure

This study was approved by the university's Institutional Review Board (IRB). When participants arrived to the laboratory, they first provided informed consent using the IRB approved consent form. Next, participants completed questionnaires assessing demographics, social anxiety symptoms, and depression symptoms. Participants completed a baseline eye tracking task, then played Cyberball, and lastly completed the second run of the eye tracking task. After completing the study, but before being debriefed, participants completed a manipulation check. All participants were compensated with course credit for participation in this study.

2.4. Data preparation

Cyberball group was dummy coded as 0 = inclusion and 1 = rejection. Total SIAS-6/SPS-6 scores were mean centered (Aiken and West, 1991). To test moderation effects we calculated an interaction variable by multiplying the mean centered SA score by Cyberball condition. We calculated a change variable by subtracting the pre-Cyberball total visit duration for each emotional face from the post-Cyberball visit duration for each emotional face to indicate change in attention to angry, disgust, happy, neutral and sad facial stimuli before and after Cyberball.

3. Results

3.1. Descriptives

Table 1 provides information on the descriptives of the sample on measures of depression symptoms, social anxiety symptoms, and baseline and post-Cyberball eye tracking variables. Table 2 presents correlations of the baseline eye tracking data with social anxiety symptoms and depression symptoms in the overall sample. Table 3 presents correlations between post-Cyberball eye tracking data, social anxiety symptoms and depression symptoms in the overall sample. Table 4 presents correlational data between post-Cyberball eye tracking data, social anxiety symptoms and depression symptoms in the inclusion condition, and Table 5 presents correlational data between post-

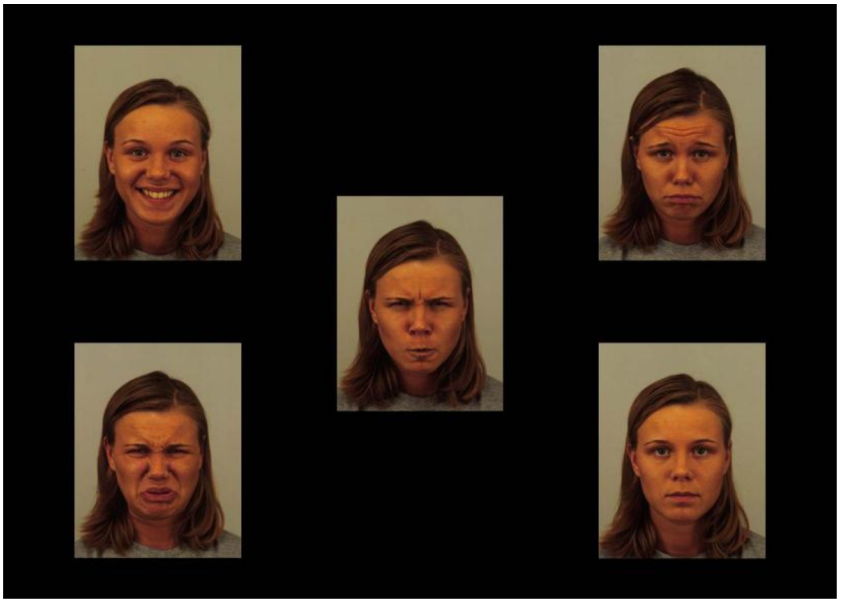

Fig. 1. An example trial used in the eye tracking tasks. Top Left = happy (face AF19HAS), Top Right = sad (face AF19SAS), Center = angry (face AF19ANS), Bottom Left = disgust (face AF19DIS), Bottom Right = neutral (face AF19NES). KDEF images reprinted here with written permission of the copyright holder.

Table 1
Means and standard deviations of the study variables.

Variable	Overall mean (SD)	Inclusion condition mean (SD)	Rejection condition mean (SD)
SA	4.2 (5.6)	4.45 (5.29)	3.98 (5.89)
PHQ-9	4.2 (4.46)	3.74 (3.77)	4.61 (5.00)
Pre_TVD_Ang	51.41 (11.68)	50.98 (10.98)	51.80 (12.33)
Pre_TVD_Dis	52.24 (12.87)	51.47 (12.36)	52.93 (13.35)
Pre_TVD_Hap	69.44 (29.87)	69.44 (26.79)	69.43 (32.58)
Pre_TVD_Neu	58.85 (18.45)	58.17 (21.60)	59.46 (15.15)
Pre_TVD_Sad	52.66 (11.42)	54.28 (11.25)	51.19 (11.44)
Post_ TVD_Ang	51.12 (13.02)	50.60 (12.09)	51.59 (13.87)
Post_ TVD_Dis	48.5 (13.42)	48.20 (14.18)	48.77 (12.77)
Post_TVD_Hap	72.14 (29.73)	71.80 (27.99)	72.45 (31.38)
Post_TVD_Neu	61.04 (23.43)	61.78 (23.75)	60.38 (23.25)
Post_TVD_Sad	50.63 (14.91)	49.81 (11.75)	51.38 (17.31)

Note: SA = Social Anxiety Symptoms; PHQ-9 = Patient Health Questionnaire-9; Pre_TVD_Ang = Pre-Cyberball total visit duration for angry faces; Pre_TVD_Dis = Pre-Cyberball total visit duration for disgust faces; Pre_TVD_Hap = Pre-Cyberball total visit duration for happy faces; Pre_TVD_Neu = Pre-Cyberball total visit duration for neutral faces; Pre_TVD_Sad = Pre-Cyberball total visit duration for sad faces; Post_TVD_Ang = Post-Cyberball total visit duration for angry faces; Post_TVD_Dis = Post -Cyberball total visit duration for disgust faces; Post_TVD_Hap = Post-Cyberball total visit duration for happy faces; Post_TVD_Neu = Post-Cyberball total visit duration for neutral faces; Post_TVD_Sad = Post-Cyberball total visit duration for sad faces; SD = standard deviation.

Cyberball eye tracking data, social anxiety symptoms and depression symptoms in the rejection condition. There were a total of 78 participants randomized to the inclusion condition of Cyberball and 86 participants randomized to the rejection condition. Participants did not differ by Cyberball condition on depressive symptoms or social anxiety symptoms (p's > 0.05). Furthermore, participants did not differ by Cyberball condition on baseline attention to different emotional faces (all p's > 0.05).

3.2. Manipulation check

The manipulation check questionnaire data were coded in two ways: 1) whether participants believed they were being rejected or included; and 2) whether participants believed that Cyberball was contrived with pre-set computer players. Of participants who were randomized to the inclusion condition, 70.4% believed that they were, in fact, included. Nineteen point seven percent of participants in the inclusion condition believed that they were rejected, and 9.9% believed that they were both included and rejected in Cyberball. Of participants who were randomized to the rejection condition, 16.7% believed that they were included, 80.6% believed they were rejected, and 2.8% believed they were both included and rejected. When we restricted the sample to those participants who believed they were being included in the inclusion condition and rejected in the rejection condition, the pattern and statistical significance of the results did not change. Therefore, results reported below include the full sample ($n = 164$) of

Table 2
Pearson's correlations of the variables at baseline in the overall sample.

Measure	1.	2.	3.	4.	5.	6.	7.	
1.	SA	–						
2.	PHQ-9	0.458***	–					
3.	TVD_Ang	**0.008**	0.054	–				
4.	TVD_Dis	**−0.023**	−0.031	0.640***	–			
5.	TVD_Hap	0.012	0.003	−0.657***	−0.620***	–		
6.	TVD_Neu	0.003	0.037	−0.211**	−0.274***	−0.257**	–	
7.	TVD_Sad	0.066	**−0.069**	0.579***	0.426***	−0.553***	−0.288***	–

Note: *** = $p < 0.001$; ** = $p < 0.01$; SA = Social Anxiety Symptoms; PHQ-9 = Patient Health Questionnaire-9; TVD_Ang = Total visit duration for angry faces; TVD_Dis = Total visit duration for disgust faces; TVD_Hap = Total visit duration for happy faces; TVD_Neu = Total visit duration for neutral faces; TVD_Sad = Total visit duration for sad faces; Bolded values represent hypothesized correlations.

Table 3
Pearson's correlations of the variables post-Cyberball in the overall sample.

Measure	1.	2.	3.	4.	5.	6.	7.	
1.	SA	–						
2.	PHQ-9	0.458***	–					
3.	TVD_Ang	−0.003	0.012	–				
4.	TVD_Dis	−0.046	−0.021	0.563***	–			
5.	TVD_Hap	−0.074	−0.054	−0.599***	−0.540***	–		
6.	TVD_Neu	0.033	0.052	−0.378**	−0.386***	−0.187*	–	
7.	TVD_Sad	0.169*	0.053	0.474***	0.427***	−0.549***	−0.346***	–

Note: *** = $p < 0.001$; ** = $p < 0.01$; SA = Social Anxiety Symptoms; PHQ-9 = Patient Health Questionnaire-9; TVD_Ang = Total visit duration for angry faces; TVD_Dis = Total visit duration for disgust faces; TVD_Hap = Total visit duration for happy faces; TVD_Neu = Total visit duration for neutral faces; TVD_Sad = Total visit duration for sad faces.

Table 4
Pearson's correlations of the variables post-Cyberball in the inclusion condition.

Measure	1.	2.	3.	4.	5.	6.	7.	
1.	SA	–						
2.	PHQ-9	0.519***	–					
3.	TVD_Ang	−0.103	−0.184	–				
4.	TVD_Dis	−0.072	−0.089	0.528***	–			
5.	TVD_Hap	0.032	0.164	−0.537***	−0.549***	–		
6.	TVD_Neu	0.088	0.086	−0.494***	−0.389***	−0.172	–	
7.	TVD_Sad	−0.085	−0.212	0.682***	0.668***	−0.538***	−0.445***	–

Note: *** = $p < 0.001$; ** = $p < 0.01$; SA = Social Anxiety Symptoms; PHQ-9 = Patient Health Questionnaire-9; TVD_Ang = Total visit duration for angry faces; TVD_Dis = Total visit duration for disgust faces; TVD_Hap = Total visit duration for happy faces; TVD_Neu = Total visit duration for neutral faces; TVD_Sad = Total visit duration for sad faces.

participants.

When examining whether participants believed Cyberball was contrived, we found that 9.9% of individuals in the inclusion condition believed they were playing against preset computer players. In the rejection condition, 26.4% of individuals believed they were playing against preset computer players. When we removed participants from the dataset who believed they were playing against pre-set computer players, the pattern of statistical significance remained similar, with slightly stronger effects. Therefore, we decided to keep the whole sample for the results reported below ($n = 164$). Furthermore, previous studies have demonstrated that Cyberball is still effective in making participants feel rejected or included even if participants believe that the game is contrived (Zadro et al., 2004).

3.3. Hypothesized results

To examine our core hypothesis, that a laboratory social rejection or inclusion task would moderate the relationship between social anxiety symptoms and attention for sad faces, SA score, Cyberball condition (inclusion or rejection), and the interaction term between SA and Cyberball condition were entered into a hierarchical linear regression predicting change in attention for sad faces.[1] The model including only SA did not significantly predict change in attention to sad faces, adjusted $R^2 = 0.011$, $\beta = 0.130$, $F(1, 162) = 2.8$, $p = 0.096$.

When Cyberball condition is included in the model, the model predicts a significant amount of variance in change in attention for sad faces, adjusted $R^2 = 0.037$, $F(1, 161) = 4.158$, $p = 0.017$. Adding Cyberball condition significantly increases the amount of variance predicted by the model, $DR^2 = 0.032$, $p = 0.021$. In this model, SA score was not a significant predictor of change in attention to sad faces ($\beta = 0.138$, $t(161) = 1.79$, $p = 0.075$); however, Cyberball condition was a significant predictor of change in attention to sad faces ($\beta = 0.179$, $t(161) = 2.33$, $p = 0.021$).

The model including SA score, Cyberball, and the interaction variable between SA score and Cyberball, predicted a significant portion of the variance in change in attention for sad faces, adjusted $R^2 = 0.111$, $F(1, 160) = 7.77$, $p < 0.001$, and adding the interaction term significantly improves the model $\Delta R^2 = 0.078$, $p < 0.001$. In this model, SA score is not a significant predictor of change in attention to sad faces, $\beta = -0.189$, $t(160) = -1.662$, $p = 0.098$. Cyberball condition is a significant predictor, $\beta = 0.175$, $t(160) = 2.37$, $p = 0.019$. Importantly, and in line with our hypothesis, the interaction variable between Cyberball condition and SA score is a significant predictor of change in attention to sad faces, $\beta = 0.430$, $t(160) = 3.78$, $p < 0.001$. This moderated effect is the result of a significant positive correlation between SA score and change in attention in the rejection condition, $r = 0.333$, $p = 0.002$, and a significant negative correlation between SA score and change in attention to sad faces in the inclusion condition, $r = -0.255$, $p = 0.025$ (See Fig. 2).

Because of the established association between social anxiety and depression, we also ran the model including PHQ-9 score to ensure that the change in attention to sad faces was not due to depressive symptoms. When PHQ-9 score was included as a predictor in Step 1 (through Step 4), it did not improve the model, nor was it a significant predictor of change in attention to sad faces. Furthermore, within this model, the interaction variable between Cyberball condition and SA was still a significant predictor of attention to sad faces, $\beta = 0.430$, $t(162) = 3.77$, $p < 0.001$.

3.4. Exploratory analyses of other facial emotions

Additional analyses including other emotional stimuli as dependent variables revealed several significant findings. Similar to the analyses

[1] Results excluding individuals who "failed" the manipulation check and believed that Cyberball was contrived, showed that when predicting change in attention to sad faces, model 1 (including SA only) was a significant predictor ($p = .025$), model 2 (including SA and Cyberball condition) was also a significant predictor ($p = .006$), and model 3 (including SA, Cyberball condition, and the interaction variable between the two) was still significant ($p = .001$). As such, these results show a similar pattern to the full sample, and therefore, we included the full sample in all analyses.

Table 5
Pearson's correlations of the variables post-Cyberball in the rejection condition.

Measure	1.	2.	3.	4.	5.	6.	7.	
1.	SA	–						
2.	PHQ-9	0.434***	–					
3.	TVD_Ang	0.071	0.124	–				
4.	TVD_Dis	−0.021	0.027	0.601***	–			
5.	TVD_Hap	−0.150	−0.190	−0.645***	−0.539***	–		
6.	TVD_Neu	−0.015	0.033	−0.285**	−0.384***	−0.199	–	
7.	TVD_Sad	0.315**	0.171	0.366**	0.283**	−0.564***	−0.294**	–

Note: *** = $p < 0.001$; ** = $p < 0.01$; SA = Social Anxiety Symptoms; PHQ-9 = Patient Health Questionnaire-9; TVD_Ang = Total visit duration for angry faces; TVD_Dis = Total visit duration for disgust faces; TVD_Hap = Total visit duration for happy faces; TVD_Neu = Total visit duration for neutral faces; TVD_Sad = Total visit duration for sad faces.

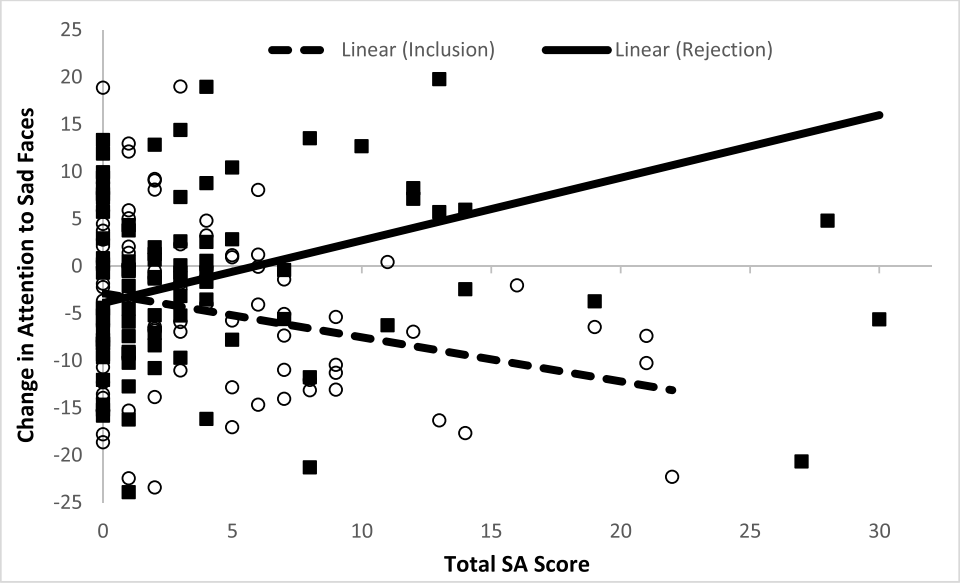

Fig. 2. Regression line plots indicating significant moderation.

used in our hypothesized results, we entered SA, Cyberball, and the interaction variable between the two into a hierarchical linear regression predicting change in attention to happy faces. Interestingly, the overall model including only SA score (adjusted $R^2 = 0.010$, $p = 0.107$), the overall model including SA score and Cyberball (adjusted $R^2 = 0.004$, $p = 0.270$), and the overall model including SA score, Cyberball, and the interaction variable between SA and Cyberball (adjusted $R^2 = 0.022$, $p = 0.089$) were not significant predictors of change in attention to happy faces. However, adding the interaction variable significantly increases the amount of variance predicted by the model, D$R^2 = 0.024$, $p = 0.048$. Furthermore, the interaction variable between Cyberball condition and SA score is a significant predictor of change in attention to happy faces, $\beta = -0.237$, $t(160) = -1.99$, $p = 0.048$. This moderated effect is the result of a significant negative correlation between SA score and change in attention to happy faces in the rejection condition, $r = -0.242$, $p = 0.025$, but not in the inclusion condition, $r = 0.060$, $p = 0.600$.

We also examined a hierarchical linear regression predicting change in attention to neutral faces. The overall model including only SA score (adjusted $R^2 = -0.004$, $p = 0.581$), the overall model including SA score and Cyberball (adjusted $R^2 = -0.004$, $p = 0.503$), and the overall model including SA score, Cyberball, and the interaction variable between SA and Cyberball (adjusted $R^2 = 0.015$, $p = 0.140$) were not significant predictors of change in attention to neutral faces. In the first two models, neither SA score nor Cyberball condition were significant predictors of change in attention to neutral faces. However, adding the interaction variable significantly increases the amount of variance predicted by the model, D$R^2 = 0.025$, $p = 0.043$. Further, the interaction variable between Cyberball condition and SA score is a significant predictor of change in attention to neutral faces, $\beta = -0.244$, $t(160) = -2.04$, $p = 0.043$. This moderated effect is the result of a significant positive correlation between SA score and change in attention to neutral faces in the inclusion condition, $r = 0.261$, $p = 0.021$, but not in the rejection condition, $r = -0.088$, $p = 0.420$.

Additional hierarchical linear models including change scores for angry and disgust face change scores as dependent variables, and SA score, Cyberball, and the interaction variable between the two, revealed no main effects and no moderation effects of social rejection or inclusion on the relationship between SA score and attention for disgust or angry faces (all p's > 0.05). With regard to Pearson's correlations, social anxiety was not significantly associated with baseline attention to threatening facial expressions (i.e., disgust or angry; p's = 0.77, 0.92 respectively), and depressive symptoms were not significantly related to attention to sad faces ($p = 0.38$).

4. Discussion

Consistent with our hypothesis, we found that a social rejection or inclusion laboratory task moderated the relationship between social anxiety symptoms and attention for dysphoric faces. Within these results, we found that individuals in the rejection condition exhibited a significant increase in attention to sad faces after being rejected, whereas those in the inclusion condition showed a significant decrease in attention to sad faces after being included. Thus, it appears that

social rejection or social inclusion influences the relationship between social anxiety symptoms and attention for dysphoric information. Moreover, these individuals displayed a decrease in attention to happy faces. Both of these attentional patterns have been demonstrated to be associated with depression (e.g., Peckham et al., 2010; Armstrong and Olatunji, 2012). Furthermore, the finding that individuals in the rejection condition displayed decreased attention to happy faces is consistent with early attention bias literature which showed strong effects for decreased attention to sad faces in depressed individuals (McCabe and Gotlib, 1995; Soltani et al., 2015). These findings combined, suggest that social rejection may be a mechanism by which social anxiety conveys risk for depression, as evidenced by these depression-like attention biases. The current study adds to an existing literature examining ways in which social anxiety symptoms may lead to depression symptoms (e.g., Grant et al., 2014; Stein et al., 2001; Wittchen et al., 2003).

Specifically, previous research has demonstrated that depressive cognitive styles mediate the relationship between symptoms of social anxiety and symptoms of depression (Grant et al., 2014). Empirical research also indicates that social rejection is experienced more intensely among depressed individuals (Nezlek et al., 1997), leads to increase depressive symptoms (e.g., Leary et al., 2001), and is a risk factor for developing MDD (Slavich et al., 2010). The current findings merge the literature regarding the role that social anxiety and social rejection play in the development of depression by positing a mechanistic pathway. Specifically, previous research suggests individuals who experience rejection display emotional and cognitive factors associated with depression (Leary et al., 2001). Results of this study extend this literature by empirically demonstrating acute social rejection results in depressogenic attentional styles. The importance of this finding is underscored by prior research indicating that socially anxious individuals are at higher risk to experience social rejection (Maner et al., 2007), and have more severe (e.g., Oaten et al., 2008) as well as longer lasting reactions to rejection (Zadro et al., 2005).

It is also important to note the results of our manipulation check. As noted above, the results of the study were stronger, when we restricted the sample to only individuals who believed they were in the "correct" Cyberball condition (i.e., those who were rejected, believed they were rejected, and those who were included, believed they were included) and believed they were playing with other "real" players. However, the results of our study using the full, larger sample ($n = 164$) are still statistically significant and using the full sample demonstrates that the effect persists even when including the participants who "failed" the manipulation check. Furthermore, as noted above, literature has shown that even when participants believe Cyberball is contrived, the task is still effective at inducing feelings of rejection (Zadro et al., 2004).

In regards to neutral faces, SA and social inclusion interacted to predict increased attention, whereas this was not the case in the social rejection condition. This result is consistent with previous literature suggesting that social anxiety may be associated with avoidance of emotional facial expressions in empirical paradigms with extended stimulus presentations times (i.e., > 200 ms; e.g., Mogg et al., 2004; Rossignol et al., 2012; for review see: Bantin et al., 2016) and literature showing that threat bias was not present under manipulated social threat (Helfinstein et al., 2008). In the current study, social inclusion may analogue interaction with a potential for negative evaluation, a core threatening situation associated with SAD (American Psychiatric Association, 2013). Theorists have postulated that acute inductions of anxiety may have a deleterious effect on threat detection systems associated with SA (Williams et al., 1996). Researchers have suggested eye tracking methods, such as those employed in the current study, are optimal for examining attention in experiments with longer duration presentation of stimuli (Bantin et al., 2016). Furthermore, the current study addresses a gap noted in the literature examining specific contexts and factors that influence attention bias in social anxiety (Bantin et al., 2016). Alternatively, the current results are also consistent with the possibility that induced threat potentially influences threat detection mechanisms in social anxiety such that even neutral stimuli are perceived as threatening (Bantin et al., 2016). Furthermore, empirical research has demonstrated that socially anxious individuals interpret ambiguous social information as threatening (Yoon and Zinbarg, 2007). Future research is needed to clarify the nature of engagement with neutral faces among individuals high in social anxiety.

Inconsistent with our hypotheses and previous literature, social anxiety symptoms were not associated with baseline attention to angry or disgust facial expressions, nor were depression symptoms associated with baseline attention to sad faces. It is possible that we did not detect these relationships because we did not use a sample with clinically elevated social anxiety or depressive symptoms. Other studies investigating attention bias paradigms in anxiety and depression have also failed to show an association between baseline attentional bias indices and anxiety or depression symptoms (Kappenman et al., 2014; McCabe and Gotlib, 1995). Therefore, it is possible that these attention biases effects are not as robust or consistent as purported.

The current study should be considered in light of its limitations. Our study used a sample of college students. As such, our sample had relatively low levels of social anxiety and depressive symptoms. Examining these relationships in a clinical sample of individuals with diagnosed social anxiety and depression would provide stronger support for our initial results. Had our sample included clinically depressed individuals, we would be able to draw stronger and unambiguous conclusions about social anxiety conferring risk for depression. The current study also had several notable strengths. Whereas much literature in attention bias uses dot-probe paradigms (e.g., Heeren et al., 2012), our study employed eye tracking which provides a more naturalistic measure of attention bias and has been suggested as the optimal method for examining attention bias in the paradigm employed in the current study (Bantin et al., 2016). Furthermore, using eye tracking methodology we were able to present five different emotional stimuli at once, which likely strengthens our significant findings, rather than using only one or two stimuli per trial. Simultaneously presenting five emotional faces provides more competition for attentional resources to different emotional faces. Furthermore, presenting five stimuli at once increased the efficiency of the study and reduced participant burden. It should be noted though, that presenting five faces of the same person at once, may limit the generalizability of the task, given that seeing five faces of the same person is unnatural.

Overall, our study adds to the literature addressing the comorbidity of SAD and MDD by demonstrating a specific context in which social anxiety may confer risk for depression. Given that social rejection appears to be particularly important for this relationship, targeting interpersonal relationships and interpersonal skills in individuals with SAD in treatment may help to prevent the later development of MDD. Future studies should examine these relationships longitudinally, within a clinical sample.

Declarations of interest

None

Conflict of interest

The authors declare that there are no conflicts of interest.

Appendix A. List of KDEF (Lundqvist et al., 1998) images used in the study

AF01ANS, AF01DIS, AF01HAS, AF01NES, AF01SAS, AF19ANS, AF19DIS, AF19HAS, AF19NES, AF19SAS, AF13ANS, AF13DIS, AF13HAS, AF13NES, AF13SAS, AF25ANS, AF24DIS, AF25HAS, AF25NES, AF25SAS, AF16ANS, AF16DIS, AF16HAS, AF16NES, AF16SAS, AM09ANS, AM09DIS, AM09HAS, AM09NES, AM09SAS,

AM11ANS, AM11DIS, AM11HAS, AM11NES, AM11SAS, AM17ANS, AM17DIS, AM17HAS, AM17NES, AM16SAS, AM23ANS, AM23DIS, AM23HAS, AM23NES, AM23SAS, AM04ANS, AM04DIS, AM04HAS, AM04NES, AM04SAS, AF33ANS, AF33DIS, AF33HAS, AF33NES, AF33SAS, AF26ANS, AF26DIS, AF26HAS, AF26NES, AF26SAS, AF14ANS, AF14DIS, AF14HAS, AF14NES, AF14SAS, AF05ANS, AF05DIS, AF05HAS, AF05NES, AF05SAS, AF03ANS, AF03DIS, AF03HAS, AF03NES, AF03SAS, AM05ANS, AM05DIS, AM05HAS, AM05NES, AM05SAS, AM13ANS, AM13DIS, AM13HAS, AM13NES, AM13SAS, AM25ANS, AM25DIS, AM25HAS, AM25NES, AM25SAS, AM31ANS, AM31DIS, AM31HAS, AM31NES, AM31SAS, AM34ANS, AM34DIS, AM34HAS, AM34NES, AM34SAS.

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