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BRIEF REPORT

# Social Anxiety Is Negatively Associated With Theory of Mind and Empathic Accuracy

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Social anxiety interferes with accurate perceptions of others' thoughts and intentions, yet studies examining the association between social anxiety and social cognition have resulted in mixed findings. We examined the association between dimensional levels of social anxiety and assessments of lower- and higher-level social cognition. In Study 1 ($n = 1485$), we found that social anxiety was negatively related to accuracy in an assessment of higher-level social cognition (i.e., theory of mind) across all stimuli. However, no consistent association was found between social anxiety and accuracy in an assessment of lower-level social cognition (i.e., emotion recognition). In Study 2 ($n = 363$), we found that social anxiety was negatively associated with another higher-level form of social cognition, empathic accuracy, for positive but not negative stimuli. These findings demonstrate that social anxiety is negatively associated with higher-level social cognition but not lower-level social cognition, and this association appears to be more consistent for positive stimuli.

**_General Scientific Summary_**
Social anxiety is negatively associated with higher-level social cognition (i.e., theory of mind and empathic accuracy), but not lower-level social cognition (i.e., emotion recognition).

*Keywords:* social anxiety, social cognition, theory of mind, empathic accuracy

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Social anxiety disorder (SAD) interferes with the development and maintenance of interpersonal relationships (Alden & Taylor, 2004). Theoretical models posit that difficulties in interpersonal relationships in individuals with SAD may arise from a misunderstanding of others' thoughts and intentions for both negative and positive content (Morrison & Heimberg, 2013). The process of perceiving and understanding the emotions, thoughts, and intentions of others refers to the multifaceted construct of social cognition (Frith & Frith, 2007). Social cognition can be divided into lower- and higher-level processes (Green, Horan, & Lee, 2015). Lower-level aspects of social cognition include the processing and recognition of social cues such as facial expression and body posture, whereas higher-level social cognition involves using this information to make inferences about others' emotions, cognitions, and intentions (Green et al., 2015; Ochsner, 2008). Neuroimaging studies have shown engagement of regions such as the medial prefrontal cortex across levels, but more consistent involvement of the amygdala in lower-level social cognition and the temporoparietal junction in higher-level social cognition (Ochsner, 2008). Thus, these are considered related but distinguishable social–cognitive processes.

The extent to which social anxiety (SA) is associated with social cognition, however, is not fully understood (Morrison & Heim-

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berg, 2013). One meta-analysis (Plana, Lavoie, Battaglia, & Achim, 2014) found no effect of SA on lower-level social cognition in the form of emotion recognition, whereas another (O'Toole, Hougaard, & Mennin, 2013) found a small negative effect on the recognition of basic emotions, and a moderate negative effect of SA on the recognition of complex emotions or stimuli requiring participants to understand the context of an emotional situation (i.e., higher-level social cognition; see also Hezel & McNally, 2014). Thus, the link between SA and social–cognitive accuracy is inconsistent across studies, but there is some evidence suggesting that SA may have a greater negative impact on higher-level social cognition than lower-level social cognition.

Inconsistent findings relating SA to social–cognitive ability may also stem from comparing people with and without diagnosed SAD, as opposed to using a dimensional assessment of SA. Whereas *DSM*-defined disorders have high rates of comorbidities and heterogeneity of symptoms, dimensional models of psychopathology allow for the consideration of variance in symptoms across diagnoses, including subthreshold levels, as well as shared features across diagnoses (Cuthbert, 2005). Thus, the use of dimensional assessment may help clarify the association between SA and social cognition.

The lack of relevant covariates in previous research may be another reason for inconsistent findings. Given the correlational nature of extant findings, it is important to include relevant covariates that allow a partial test of whether observed effects for SA on social cognition might be better attributed to competing predictors. For example, reduced social–cognitive ability has been associated with older age (Ruffman, Henry, Livingstone, & Phillips, 2008), autism spectrum disorders (Baron-Cohen et al., 2015), depression (Loi, Vaidya, & Paradiso, 2013), social anhedonia (Germine, Garrido, Bruce, & Hooker, 2011), neuroticism (Hall, Andrzejewski, & Yopchick, 2009), and in males compared to females (Baron-Cohen et al., 2015). In contrast, greater social–cognitive ability has been associated with extraversion (Hall et al., 2009) and self-reported mentalizing ability (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001).

In the present study, we examined the association between dimensionally assessed SA and three different forms of social cognition, after accounting for competing predictors. In Study 1, we combined an online sample and two undergraduate samples to test the hypothesis that higher levels of SA would be more strongly associated with decreased accuracy for higher-level (i.e., theory of mind), compared to lower-level (i.e., emotion recognition), social cognition. In Study 2, we examined whether findings from Study 1 were consistent using a subsample of participants who completed an additional measure of higher-level social cognition (i.e., an empathic accuracy video task). Due to the potential moderating role of stimuli valence (e.g., Hezel & McNally, 2014), we included positive, negative, and neutral stimuli. Based on previous research suggesting that individuals with SAD tend to suppress positive emotion (Farmer & Kashdan, 2012) and interpret ambiguous stimuli more negatively (Morrison & Heimberg, 2013), we predicted that higher levels of SA would be associated with less social–cognitive accuracy on tasks for positive and neutral, but not negative, stimuli. We also conducted post hoc exploratory analyses to examine the extent to which higher levels of SA would be associated with interpretation biases that could be contributing to associations with social–cognitive inaccuracy.

## Study 1

### Method

**Participants.** Based on previously reported effect sizes from studies examining anxiety, depression, and social cognition, ($R^2$ = .04–.084; Hezel & McNally, 2014; Loi et al., 2013), we determined that we would need 256 participants to find a similar effect at 80% power (G*Power; Faul, Erdfelder, Lang, & Buchner, 2007). We pooled together three large samples to account for the possibility of smaller effects of SA on social cognition. Participants were recruited from Amazon's Mechanical Turk (MTurk; $n$ = 506), Boston University (BU; $n$ = 426), and Southern Methodist University (SMU; $n$ = 553) and completed online surveys. For MTurk participants, eligibility criteria included having a rating of at least 90% completion on previous MTurk studies. Participants were removed if they completed all of the online assessments in too short a period of time (i.e., under 20 min; $n$ = 118) or failed our attention check validation ($n$ = 134; See online supplemental materials). This resulted in 1485 participants (69% female, age range = 18–77 years, $M$ age = 25.76, $SD$ = 11.63) who self-identified as White (71.7%), Black or African American (6.2%), Asian (16.1%), Native American or Alaska Native (0.6%) and Other (5.3%). MTurk participants were awarded monetary compensation, and BU and SMU students were awarded research credit for participation. The study was approved by the Institutional Review Board's at SMU (Protocol #2016–100-TABB) and BU (Protocol #4396E), and informed consent was obtained from all participants.

**Measures.**

***Social anxiety.*** Participants completed the Social Phobia Scale (SPS; Mattick & Clarke, 1998; α = .95), Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998; α = .95), and the self-report version of the Leibowitz Social Anxiety Scale (LSAS; Fresco et al., 2001; Liebowitz, 1987; α = .97). The scales were standardized and averaged to form a composite score (*composite reliability* = .98; Nunnally & Bernstein, 1994).

***Theory of mind.*** The Reading the Mind in the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) measures theory of mind, or the ability to understand the mental state of others. Participants were shown 36 black-and-white photographs of the eye-region of different male and female actors; after each photo they chose which of four words best described the actor's feeling. Items were scored based on accuracy (correct or not) and total scores were calculated (mean accuracy across items). In the present study, subscores were calculated for positive (8 items), negative (12 items), and neutral (16 items) stimuli (as in Harkness, Sabbagh, Jacobson, Chowdrey, & Chen, 2005). Following our primary analyses, we also conducted analyses to examine potential interpretation biases (i.e., the extent to which participants made incorrect answers that were more positive or more negative than the correct answer) in this task that are detailed in the online supplemental materials.

***Emotion recognition.*** The Emotion Perceptions of Biological Motion Task (Emo Bio; Heberlein, Adolphs, Tranel, & Damasio, 2004) assesses emotion recognition by asking participants to view 24 videos depicting human body movement related to specific emotions. Emotion is conveyed through point-light displays based on specific components of body movement (e.g., for sadness, the point light walker moves slowly with head hanging; Kern et al., 2013). This task removes potential confounding factors that may bias perceptions of socioemotional stimuli (e.g., race, perceived attractiveness). Following each video, participants chose the word that best described the movement: happy, sad, angry, afraid, and neutral. Total scores were calculated as mean levels of accuracy across stimuli based on weighted normed means. In the current study, subscores were calculated based on valence of positive (5 items), negative (14 items), and neutral (5 items) stimuli.

***Covariates.*** Depressive symptoms were measured with the dysphoria subscale of the Inventory of Depression and Anxiety Symptoms-II (Watson et al., 2012; $\alpha = .92$). Participants also completed the neuroticism ($\alpha = .86$) and extraversion ($\alpha = .89$) subscales of the Big Five Inventory (John, Donahue, & Kentle, 1991), and the mentalizing factor (Palmer, Paton, Enticott, & Hohwy, 2015; $\alpha = .67$) of the Autism Spectrum Quotient (Baron-Cohen, Wheelwright, Skinner, et al., 2001) to measure traits related to autism spectrum disorders. Last, the 15-item version of the Revised Social Anhedonia Scale was used to assess social anhedonia (Winterstein et al., 2011; $\alpha = .86$). See the online supplemental materials for additional information on our use of these covariates.

**Procedure.** Participants completed questionnaires and behavioral measures (as well as other questionnaires that are unrelated to the present study) online via Qualtrics (Provo, UT).

**Statistical analysis.** All three samples were pooled together and two dummy variables were created using the BU sample as a reference group. Additional analyses changing the reference group were conducted to examine additional group-based interaction effects. Multiple linear regression analysis (using SPSS v. 24) was used to examine the association of SA on RMET and Emo Bio accuracy. Separate regressions were run for each task based on total, positive, negative, and neutral stimuli. SA, age, gender, neuroticism, extraversion, dysphoria, mentalizing, social anhedonia, the dummy coded group variables, and their interactions with SA, were included as predictors. To maintain the Type I error rate at .05, we corrected for multiple testing for the eight primary tests (i.e., positive, negative, neutral, and total for the RMET, and Emo Bio tasks) using the Benjamini & Hochberg, 1995 false discovery rate correction. Results remained unchanged after removing outliers, so all analyses were performed with all data.

## Results

**RMET accuracy.** SA emerged as a significant negative predictor of RMET total score accuracy ($b = -.024$, $SE = .005$, $p < .001$, $R^2 = .155$), negative stimuli ($b = -.027$, $SE = .007$, $p < .001$, $R^2 = .129$), positive stimuli ($b = -.017$, $SE = .007$, $p = .021$, $R^2 = .047$), and neutral stimuli ($b = -.025$, $SE = .006$, $p < .001$, $R^2 = .113$; see Supplemental Table 1). These associations remained significant following multiple test correction. Post hoc analyses showed no evidence of interpretation bias (see online supplemental materials).

**Emotion perceptions of biological motion accuracy.** SA did not significantly predict total accuracy ($b = -.001$, $SE = .005$, $p = .903$, $R^2 = .053$), accuracy for negative stimuli ($b = .004$, $SE = .006$, $p = .450$, $R^2 = .046$), positive stimuli ($b = -.004$, $SE = .007$, $p = .620$, $R^2 = .032$), or neutral stimuli ($b = -.009$, $SE = .006$, $p = .138$, $R^2 = .039$; see Supplemental Table 2). There was a significant interaction between Group (i.e., MTurk vs. BU) and SA, however, for positive stimuli accuracy ($b = -.027$, $SE = .014$, $p = .044$, $R^2 = .043$), but no significant differences were found between the MTurk and SMU samples, or the SMU and BU samples in the association between SA and positive stimuli accuracy. Simple slopes analysis showed no associations between SA and positive stimuli in the MTurk sample ($b = -.017$, $SE = .011$, $p = .133$), the SMU sample ($b = -.007$, $SE = .010$, $p = .500$), or the BU sample ($b = .010$, $SE = .011$, $p = .332$).

# Study 2

In Study 2, we examined the association between SA and another assessment of higher-level social–cognitive ability in the form of an empathic accuracy video task (Kern et al., 2013). SMU participants first completed Study 1 online. In Study 2, a subset of participants completed the empathic accuracy video task (Protocol #2016–100-TABB).

## Method

**Participants.** Participants initially included 390 undergraduate students from the SMU sample (77.2% female, age range = 18–37 years, *M* age = 19.64, *SD* = 2.02) who self-identified as White (79.9%), Asian (11.1%), Other (4.9%), Black or African American (3.9%), and Native American or Alaska Native (0.3%).

**Measures.** We used an adapted version of the empathic accuracy video task (Kern et al., 2013) that includes 8 video clips (4 positive and 4 negative) lasting between 2 and 2.5 min each. Participants watched the videos in a fixed order and continuously rated how the person in the video (the "target") was feeling on a moment to moment basis using a 9-point scale (1 = *Extremely negative* to 9 = *Extremely positive*) through Presentation® software v. 18 (Neurobehavioral Systems, Inc., Berkeley, CA). Based on the association between greater target expressivity and increased empathic accuracy (Zaki, Bolger, & Ochsner, 2008), in each clip, general levels of emotional expressivity of the target were assessed with the Berkeley Expressivity Questionnaire (Gross & John, 1997). Correlations between target's and participant's ratings were captured in 2-s epochs throughout the clip. Accuracy scores were then calculated as the mean correlation per video (for additional details see Kern et al., 2013). Complete data was received from 361 participants (93%). The same covariates (except for age) from Study 1 were included in Study 2. Reliability estimates were: SA composite score (*composite reliability* = .97; Nunnally & Bernstein, 1994), neuroticism ($\alpha = .83$), extraversion ($\alpha = .89$), dysphoria ($\alpha = .91$), mentalizing ($\alpha = .65$), and social anhedonia ($\alpha = .81$). Skewness of variables ranged from −1.204–.477 (*SE* range = −.104–.106).

**Statistical analysis.** Multilevel modeling was used to examine predictors of empathic accuracy to account for repeated assessments within participants and differences in target expressivity across the videos. The Level 1 (within-person) model estimated within-person empathic accuracy scores and included the order of the video, video valence, and target expressivity as covariates. The Level 2 (between-person) model aggregated these within-person estimates to provide the average empathic accuracy score for the sample. SA was added as a predictor at level 2, along with all covariates which were grand-mean centered. Models were run using HLM v. 7 and missing data was estimated using restricted maximum likelihood. False discovery rate correction (Benjamini & Hochberg, 1995) was used once again for the eight primary tests to maintain $\alpha = .05$. As with the RMET, we performed additional post hoc exploratory analyses on the empathic accuracy video task to investigate the extent to which errors were made based on interpretation biases (see online supplemental materials).

## Results

**Empathic video task accuracy.** There was a significant interaction effect between SA and emotional valence of videos in predicting empathic accuracy ($b = -.023$, $SE = .007$, $p = .002$; see Supplemental Table 3). Simple slopes analyses indicated higher levels of SA were associated with lower empathic accuracy, and this relation was stronger for positive ($b = -.039$, $SE = .010$, $p < .001$) compared to negative ($b = -.016$, $SE = .007$, $p = .019$) stimuli. Post hoc analyses showed no evidence of interpretation bias (see online supplemental materials). Results remained unchanged following outlier removal (using the same method as Study 1).

# Discussion

The present study represents one of the largest to investigate the link between SA and social cognition. Consistent with previous findings (Hezel & McNally, 2014; Washburn, Wilson, Roes, Rnic, & Harkness, 2016), SA was significantly negatively associated with theory of mind (a higher-level form of social cognition) but not significantly associated with emotion recognition (a lower-level form of social cognition; Plana et al., 2014), supporting our primary hypothesis. In analyses with the RMET, higher levels of SA were associated with decreased accuracy for total, positive, negative, and neutral stimuli. These results supported our hypotheses regarding valence specific associations for positive and negative stimuli, but our hypothesis that we would not find a significant association with neutral stimuli was not supported. The present results are consistent with findings from Hezel and McNally (2014) who found decreased accuracy for total RMET and negative stimuli in individuals with SAD versus healthy controls, but also include negative associations between SA and positive (Washburn et al., 2016) and neutral stimuli accuracy (Lenton-Brym, Moscovitch, Vidovic, Nilsen, & Friedman, 2018; Washburn et al., 2016). Differences between our findings and those from previous studies may be related to our inclusion of several covariates that represent competing predictors of the association between SA and social cognition (e.g., mentalizing, social anhedonia) that were not included in previous studies.

In the empathic accuracy video task, there was a stronger negative association between SA and empathic accuracy for positive compared to negative stimuli. This finding is in contrast with two other studies of SA and empathic accuracy that found greater accuracy for negative stimuli following an experimental manipulation (Auyeung & Alden, 2016), and no differences in cognitive empathic accuracy in a group with SAD versus healthy controls (Morrison et al., 2016). Our results likely differed from previous studies because we did not include an experimental manipulation before the task (as in Auyeung & Alden, 2016), and we included several relevant covariates (e.g., target expressivity) as well as four positive and negative videos (compared to Morrison et al., 2016 who used one positive and three negative videos).

Across both the RMET and empathic accuracy video task, there was a negative association between SA and accuracy for positive and negative stimuli. In agreement with previous research (Hezel & McNally, 2014), post hoc analyses found no clear pattern of interpretation bias in either task that could help to explain associations. Thus, there are several potential explanations that may underlie our findings. First, it is important to note that small correlations, or a lack of correlation, between social–cognitive assessments is not uncommon (e.g., Hezel & McNally, 2014). As shown in Supplemental Table 4, the correlation between total scores in the RMET and Emo Bio task in the pooled sample ($r = .308$) is approximately twice the size of the correlations between the RMET or Emo Bio tasks and the empathic accuracy task total scores ($r$s $= -.024$–.141). In addition, there were no significant correlations between positive stimuli in the empathic accuracy task and all other social–cognitive measures. Although small correlations between tasks are consistent with the conceptualization of social cognition as a multifaceted construct, they also demonstrate a lack of correspondence with their theorized grouping (Ochsner, 2008). This reflects the need to improve our measures of social cognition or demonstrates that social cognition involves a diffuse series of skills that may not group together. In addition, these small correlations also demonstrate that the inclusion of different tasks may have yielded different patterns of consistency or inconsistency related to valence specific findings. It may be appropriate to place greater emphasis on the valence specific results found in the empathic accuracy video task, as this task has shown good psychometric properties (Kern et al., 2013), and the dynamic nature of the stimuli is a more ecologically valid approximation of actual social interaction. However, in the present study, only one of the samples completed the empathic accuracy video task, so we do not know whether results may have changed had we been able to include this task in the pooled sample.

Although speculative, a second explanation for the negative association of SA with accuracy for positively valenced stimuli across two higher-level social cognition tasks may be related to patterns of positive emotion suppression (Farmer & Kashdan, 2012) in individuals with SAD that may extend to the interpretation of others' positive emotions. Morrison et al. (2016), however, did not find evidence that positive affect was associated with reduced emotional congruence (i.e., vicariously feeling the way someone feels, as opposed to understanding how they feel, as measured in the present study) in individuals with SAD versus healthy controls. Notably, Morrison et al. (2016) used a trait measure of positive affect, rather than a state measure, and did not include a direct assessment of positive emotion suppression, which may have contributed to their lack of findings. The majority of previous studies have examined empathy for positively valenced stimuli in the context of emotional congruence, but the present results suggest that the negative association between SA and accuracy for positively valenced stimuli in higher-level social cognition tasks, as well as the potential role of positive emotion suppression, deserves additional consideration.

One unexpected finding in the present study was the consistent, small negative association between extraversion and accuracy in all three social–cognitive tasks. Importantly, exploratory analyses also found that the inclusion of extraversion in the model relating SA to social cognition increased the size of the effect of SA, suggesting the possibility that extraversion is a suppressor or a collider in these analyses. However, the significant associations between SA and RMET and SA and empathic accuracy did not require the inclusion of extraversion to be significant, although the effects were small (See online supplemental materials). Thus, future research is needed to follow up on the possibility that SA and extraversion are both negatively associated with social cognition, and to determine the magnitude of these associations.

Strengths of the current studies include the power to detect small effects, models that included competing predictors, multiple assessments of social cognition, and participant diversity in age, racial background, and geographic location. Additionally, our dimensional assessment of SA allows for an interpretation of our results in individuals with higher levels of SA, rather than only those with diagnosed disorder. Limitations include our lack of ability to examine the extent to which attentional biases may have played a role in our findings (Morrison & Heimberg, 2013), no assessment of emotional congruence (i.e., participants' own feelings when viewing the target; Morrison et al., 2016), and our lack of neutral stimuli in the empathic accuracy video task.

In sum, we found a negative association between SA and two forms of higher-level social cognition (theory of mind and empathic accuracy), but no association with lower-level social cognition (emotion recognition). Future research should replicate and extend the present findings using both the same and other social cognition tasks, and also include positive, negative, and neutral stimuli as valence may moderate the link between SA and higher-level social cognition.

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