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Review Article

Social anxiety and behavioral assessments of social cognition: A systematic review

Talha Alvi, Divya Kumar, Benjamin A. Tabak *

Department of Psychology, Southern Methodist University, 6116 N. Central Expressway, Suite 1300, Dallas, TX, USA

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ABSTRACT

Background: Social anxiety is highly prevalent and has increased in young adults during the COVID-19 pandemic. Since social anxiety negatively impacts interpersonal functioning, identifying aspects of social cognition that may be impaired can increase our understanding of the development and maintenance of social anxiety disorder. However, to date, studies examining associations between social anxiety and social cognition have resulted in mixed findings.

Methods: The aim of this systematic review was to summarize the literature on the association between social anxiety and social cognition, while also considering several potential moderators and covariates that may influence findings.

Results: A systematic search identified 52 studies. Results showed mixed evidence for the association between social anxiety and lower-level social cognitive processes (emotion recognition and affect sharing) and a trend for a negative association with higher-level social cognitive processes (theory of mind and empathic accuracy). Most studies examining valence-specific effects found a significant negative association for positive and neutral stimuli.

Limitations: Not all aspects of social cognition were included (e.g., attributional bias) and we focused on adults and not children, limiting the scope of the review.

Conclusions: Future studies would benefit from the inclusion of relevant moderators and covariates, multiple well-validated measures within the same domain of social cognition, and assessments of interpersonal functioning outside of the laboratory. Additional research examining the moderating role of attention or interpretation biases on social cognitive performance, and the potential benefit of social cognitive skills training for social anxiety, could inform and improve existing cognitive behavioral interventions.

1. Introduction

Social anxiety disorder (SAD) is one of the most common mental illnesses (Kessler et al., 2005), and levels of social anxiety (SA) have increased in young adults since the onset of the COVID-19 pandemic (Hawes et al., 2021). SAD is characterized by a fear of evaluation and avoidance of social situations, which can negatively affect social functioning (American Psychiatric Association, 2013; Clark and Wells, 1995). Indeed, individuals with SAD report having more interpersonal problems and difficulty maintaining relationships (Davidson and Beck, 2002; Kashdan et al., 2007; Tonge et al., 2020). These issues extend beyond close relationships and can have a substantial negative impact on occupational and educational functioning (Schneier et al., 1994; Wittchen et al., 2000) above and beyond the effects of comorbidities including depression (Aderka et al., 2012). One mechanism through which SA may negatively impact interpersonal functioning is via alterations in social cognitive processing (Morrison and Heimberg, 2013). Social cognitive ability (i.e., the ability to accurately understand others’ thoughts and emotions; Brothers, 1990; Frith and Frith, 2007) has been associated with beneficial outcomes in interpersonal relationships beginning in childhood and extending into adulthood (Banerjee, 1997; Gleason et al., 2009; Sened et al., 2017). Given the negative impact of SA on interpersonal functioning (Alden and Taylor, 2004), a key predictor of health and well-being (Holt-Lunstad, 2021), identifying specific aspects of social cognition that may be impaired can increase our understanding of the development and maintenance of SAD.

Although most studies using standardized measures of social cognition have included individuals with schizophrenia and autism spectrum

* Corresponding author at: Department of Psychology, Southern Methodist University, 6116 N. Central Expressway, Suite 1300, Dallas, TX 75206, USA.
E-mail address: btabak@smu.edu (B.A. Tabak).

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disorder, an increasing amount of research has focused on anxiety symptomatology, including SA. To date, three reviews and meta-analyses have examined the association between SA and social cognition in adults, but findings have been inconsistent. A potential reason for the lack of consistency stems from the complexity of social cognition and the extent to which different behavioral tasks index both related and distinct aspects of social cognitive processes. One method of categorizing the numerous domains of social cognition is to separate them into lower-level and higher-level processes (Green et al., 2013). Lower-level processes involve the recognition of basic social-emotional cues (e.g., emotion recognition; Green et al., 2008 and social cue perception; Penn et al., 2002; Pinkham et al., 2014), as well as affective empathic processes (i.e., shared feelings for others; Davis, 1983), such as affect sharing, which is thought to be automatic and reflexive (Hatfield et al., 1992; Singer and Lamm, 2009) and may precede cognitive processes (Fan and Han, 2008). Higher-level social cognitive processes involve the interpretation of complex social stimuli to make inferences about the thoughts and intentions of others (e.g., theory of mind; Baron-Cohen, 2001), and empathic accuracy (Ickes et al., 1990). In the first review and meta-analysis of the association between SA and social cognition, O’Toole et al. (2013) found a small negative effect between SA and basic emotion recognition and a moderate negative effect between SA and complex emotion recognition (higher-level social cognition). However, Plana et al. (2014) found no association between SA and emotion recognition, mentalizing ability, or social perception (no association with lower- or higher-level processes). More recently, Pittelkow et al. (2021) conducted a meta-analysis examining the association between SA and empathy (a multi-dimensional construct that is often used synonymously with the term social cognition). They distinguished cognitive empathy (i.e., the ability to recognize and identify others' emotions) from affective empathy (i.e., experiencing an emotion based on another's emotional experience), both of which can also be conceptualized as facets of social cognition. Pittelkow et al. (2021) found a positive association between SA and affective empathy and no association between SA and cognitive empathy. However, these results included studies measuring empathic processes based on self-report, which ask about one's perception of their own empathic tendencies or abilities, as well as behavioral assessments of social cognition, which examine the accuracy or congruence of one's responses in relation to targets or normed reference groups. The distinction between self-report and behavioral measures of social cognition is important given the weak correlation between the two, which suggests that self-report measures are not accurate proxies for ability (Murphy and Lilienfeld, 2019). Thus, it is important for reviews to distinguish between self-report and behavioral assessments when interpreting results to avoid conflating findings for separable constructs. Due in large part to a lack of studies available, previous reviews (O’Toole et al., 2013; Pittelkow et al., 2021; Plana et al., 2014) have also not examined the association between SA and empathy accuracy, a behavioral measure of higher-level social cognition. Beyond the type of social cognition assessed, previous reviews of SA and social cognition have not always examined valence-specific associations of SA on social cognitive processes or the method of measuring SA (i.e., dimensional measures, cutoff scores from dimensional measures, or diagnostic groups). Based on studies showing that greater levels of SA are associated with lower social cognitive ability for neutral and positive stimuli (Alvi et al., 2020; Washburn et al., 2016), parsing apart whether asocial (Alvi et al., 2020; Washburn et al., 2016), parsing apart whether asocial & SA & emotion recognition when SA is assessed dimensionally (Mullins and Duke, 2004), while others have found a significant, positive association when SA is categorized based on cut-off scores (Hunter et al., 2009). Thus, considering the type of SA assessment may help to elucidate whether associations are specific to individuals with the highest levels of SA (i.e., those meeting criteria for SAD based on diagnostic interview), or if associations are evident when assessing SA dimensionally. In addition to moderators that may help explain mixed findings, the inclusion of statistical covariates is also important to consider. Depression (Bora and Berk, 2016), gender (Barbouch et al., 1985; Doherty et al., 1995; Magen and Konasewich, 2011; Thayer & Johnsen, 2000), age (Ruffman et al., 2008), alexithymia (Di Tella et al., 2020), and IQ (Brüne, 2003) have all been associated with social cognitive functioning and/or SA, and therefore represent potentially competing predictors that may account for associations between SA and social cognition. For example, previous work has shown no association between SA and certain forms of social cognition (i.e., affect sharing) when including age, gender, depressive symptoms, alexithymia, and target expressivity as covariates; however, the association becomes statistically significant when covariates are removed (Alvi et al., in press). As a result, prior reviews that have not compared findings from studies that accounted for relevant covariates with those that did not, prevents an understanding of how much these related factors may explain the associations shown between SA and social cognitive ability. For example, the most recent meta-analysis by Pittelkow et al. (2021) did not examine the extent to which studies accounted for covariates such as depression and alexithymia.

1.1. Review objectives

The present systematic review assessed whether there is an association between SA and behavioral measures of social cognition, while also considering several potential moderators and covariates that may influence findings. The primary objectives were to determine trends in the literature based on the: 1) type of SA assessment, 2) type of social cognition assessment, 3) domain of social cognition, 4) valence of stimuli, and 5) inclusion of covariates. By providing a more fine-grained examination of the different domains of social cognition, and parsing results based on potential moderators and covariates, our goal was to help clarify the mixed associations between SA and social cognition that have been found in prior reviews.

2. Method

The present study was designed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2015).

2.1. Literature search

Articles were identified through searches in PsycInfo, Psych and Behavioral Sciences Collection, and PsycArticles from the earliest available dates through September 26th, 2020. In all databases, the following search string was used: (social anxiety OR social phobia) AND (emotion recognition OR emotion knowledge OR emotion processing OR theory of mind OR mentalizing OR mentalising OR social perception OR empathic accuracy OR cognitive empathy OR social cognition OR social cognitive ability OR affective empathy OR affect sharing). Searches were limited to peer-reviewed articles written in English. Forward and backward searching were used in selected articles to capture any additional relevant articles.

2.2. Inclusion and exclusion criteria

Inclusion criteria included: a) an adult sample (≥18 years old), b) a measure of SA and/or a clinical, SA group, and c) at least one behavioral
measure of social cognition. Based on meta-analytic evidence that self-report assessments of empathy are only weakly related to behavioral assessments of social cognition (Murphy and Lilienfeld, 2019), in the present review, we focus specifically on behavioral assessments. Exclusion criteria included: a) use of a child/adolescent sample, b) no measure of SA or SA group, c) a sample that included comorbid diagnoses, d) no behavioral measure of social cognition, and e) imaging studies with no behavioral outcome. We chose to exclude studies containing individuals with comorbid disorders who did not have a primary diagnosis of SA since the focus of our review is on the unique effects of SA on social cognitive abilities. Importantly, recent evidence has shown that many interpersonal difficulties experienced by individuals with SAD exist above and beyond the effects of comorbid depression symptoms (Tonge et al., 2020).

2.3. Task classification

Social cognition tasks were classified into their respective domains using the framework proposed by Green et al. (2008). Emotion recognition tasks include those that prompt participants to identify a discrete emotion (e.g., happiness, sadness) in response to static or video stimuli (Heberlein et al., 2004; Joormann and Gotlib, 2006; Nowicki and Carton, 1993). Tasks measuring social perception include presentation of social scenes in which participants are asked to assess domains such as nonverbal cues, status, and intimacy (Conzelmann et al., 2013; Schroeder, 1995a, 1995b; Veljaca and Rapee, 1998). Measures of theory of mind include static and video stimuli that prompt participants to infer the mental states of others (Baron-Cohen, 1995; Baron-Cohen et al., 2001; Dziobek et al., 2006; Tibi-Elhanany et al., 2011). Studies in the present review assessed empathic accuracy for strangers using a video task in which participants continuously rate their perceptions of a target’s emotional state as the target tells an autobiographical story (Kern et al., 2013). The targets also rate themselves, and the ratings of the perceiver and target are then correlated to create an empathic accuracy score. Studies in the present review assessed affect sharing using the same empathic accuracy video task with altered instructions that ask participants to rate their own feelings, as they watch the target individual (Morrison et al., 2016). All tasks are considered measures of cognitive empathy, apart from the affect sharing task, which measures affective empathy.

2.4. Screening and coding procedure

Abstracts were independently screened by two raters using Abstrackr (http://abstrackr.cebm.brown.edu), an online software tool for screening and organizing literature searches. After the initial screen, full-texts were reviewed independently by both raters and assessed for inclusion criteria. Disagreements were discussed among raters and resolved through consensus.

Studies were coded for the following: total sample, mean age, percent female, assessment of SA, assessment of social cognition task, statistical covariates included, and effect size. Studies were coded for all covariates included, and then subsequently coded for specific covariates of interest (depressive symptoms, gender, age, alexithymia, and IQ). For studies that reported effect sizes, coding included both the metric reported in the original paper and the equivalent using a common metric (Cohen’s d) for ease of interpretation. Coding of all included full-text articles was completed by the first author. Further, 20% of the articles were randomly selected and coded by the second author to confirm agreement. Coders had 95% agreement prior to discussion and resolution of any disagreements.

3. Results

3.1. Search results and study selection

An overview of study selection and flow can be seen in Fig. 1. Database searches from PsychInfo, Psych and Behavioral Sciences Collection, and PsycArticles resulted in 1196 records. Following duplicate identification and removal (n = 148), 1048 unique records remained. An additional 16 records were identified through forward and backward searching, resulting in a total of 1064 records. After the first round of abstract screening, 935 records were excluded for the following reasons: no behavioral measure of social cognition (n = 436), no measure of SA or socially anxious group (n = 425), an imaging study with no behavioral outcomes (n = 34), child/adolescent samples (n = 33), case study (n = 7). The remaining 129 full-text articles were assessed for eligibility, and 81 articles were excluded for various reasons: no behavioral measure of social cognition (n = 67), no measure of SA or socially anxious groups (n = 7), samples with comorbid diagnoses (n = 4), child/adolescent samples (n = 2), an imaging study with no behavioral outcomes (n = 1). The final sample included 48 full-text articles.

3.2. Study characteristics

Across 48 full-text articles, 52 studies were identified. Since some of the articles included multiple studies, the number of social cognitive assessments and findings are sometimes greater than the total number of studies. Table 1 shows an overview of study characteristics. Most studies measured emotion recognition (n = 30), followed by theory of mind (n = 11), social perception (n = 5), empathic accuracy (n = 3), and affect sharing (n = 3). Sample size varied across studies (ranging from 20 to 1485 individuals), with an average total sample of 153.67 participants, and the direction and size of effects varied across studies as well (Table 2).

3.3. Lower-level social cognition

3.3.1. Emotion recognition

There were no apparent trends in findings from studies examining the association between SA and emotion recognition. Results based on SA assessment or emotion recognition assessment were also mixed apart from video emotion recognition and vocal/prosody tasks. Valence-specific findings were also mixed, however, there was some consistency with statistically significant associations of SA on neutral stimuli (i.e., all studies found greater SA to be associated with decreased accuracy for neutral stimuli).

Of the 30 studies examining the association between SA and emotion recognition, 16 studies found a statistically significant association and 14 studies found no statistically significant association. Of the studies that noted statistical significance, eight found a positive association (i.e., higher levels of SA were related to greater emotion recognition accuracy) and 11 studies found a negative association (higher levels of SA were related to lower emotion recognition ability). In studies that reported an effect size, values ranged from d = 0–1.96, with an average effect size of d = 0.72.

When examining statistically significant valence-specific associations, for negative stimuli, six studies found a positive association, with higher levels of SA associated with greater accuracy in identifying stimuli as negative (Auyeung and Alden, 2020; Hunter et al., 2009; Mohlman et al., 2007; Quadflieg et al., 2007; Torro-Alves et al., 2016; Winton et al., 1995), and four studies found a negative association, where higher levels of SA were related to less accuracy (Garner et al., 2009; Gilboa-Schechtman et al., 2008; Oh et al., 2018; Tseng et al., 2017). For positive stimuli, one study found a positive association (Hunter et al., 2009) and three studies found a negative association (Bodner et al., 2012; Oh et al., 2018; Quadflieg et al., 2007). Studies that examined neutral stimuli had more consistency in findings; all three
found a negative association between SA and emotion recognition for neutral stimuli (Mohlman et al., 2007; Oh et al., 2018; Winton et al., 1995).

As mentioned previously, most studies used diagnostic groups of socially anxious individuals and healthy controls. In these studies, nine found a statistically significant association and nine found a non-significant association. Studies that created groups based on dimensional assessment also had mixed results, with five finding a statistically significant association (Bodner et al., 2012; Dickter et al., 2018; Hunter et al., 2009; Torro-Alves et al., 2016; Winton et al., 1995) and three finding a non-significant association (Button et al., 2013; Heuer et al., 2010; Schofield et al., 2007). Finally, in studies using dimensional assessment of SA, two found a statistically significant association (Auyeung and Alden, 2020; Lau et al., 2014) and two found a non-significant association (Alvi et al., 2020; Mullins and Duke, 2004).

Thus, there was no clear trend in findings based on category of SA assessment.

In considering the type of emotion recognition assessment, in studies that used a static, facial emotion recognition task, seven found a statistically significant association and eight studies found a non-significant association. Similarly, in studies that utilized a morphed faces task, half reported a statistically significant association (Garner et al., 2009; Gilboa-Schechtman et al., 2008; Montagne et al., 2006; Torro-Alves et al., 2016) and half reported a non-significant association (Heuer et al., 2010; Joormann and Gotlib, 2006; Philippot and Douilliez, 2005; Schofield et al., 2007). There was more consistency in results for studies that used a video emotion recognition task, as three studies found a statistically significant association (Auyeung and Alden, 2020; Lau et al., 2014) and one found a non-significant association (Winton et al., 1995). In addition, all three studies using a vocal/prosody task found a statistically significant association (Bodner et al., 2012; Quadrifeg et al., 2007; Tseng et al., 2017). There was only one study that used an emotional perception of biological motion task (Alvi et al., 2020) and one study that used an emotion intelligence task (M. Jacobs et al., 2008); neither found a statistically significant association of SA on emotion recognition.

3.3.2. Social perception

Overall, most studies found a statistically significant negative association between SA and social perception (i.e., greater SA was associated with decreased social perception). Although findings with social perception were generally consistent, there were few studies that examined this domain of social cognition.

In studies that found a statistically significant association, four studies found a negative association, with higher levels of SA relating to reduced social perception (Hampel et al., 2011; Schroeder, 1995b; Schroeder and Ketrov, 1997; Veljaca and R apee, 1998) and one study found a positive association between higher levels of SA and greater social perception (Veljaca and R apee, 1998). Only one study found a non-significant association between SA and social perception (Schroeder, 1995a). For studies that reported an effect size, values ranged from $d = 0.47–0.75$, with an average effect size of $d = 0.51$.

Only one study examined valence with a moderator, finding a significant negative association between SA and social perception for positive stimuli, such that those with higher levels of SA had lower accuracy in social perception (Veljaca and R apee, 1998). Of the studies that used a dimensional measure of SA, the majority found a statistically significant association (Hampel et al., 2011; Schroeder, 1995b; Schroeder and Ketrov, 1997) and one study did not (Schroeder, 1995a). Further, the study that created groups based on dimensional assessment of SA also found a statistically significant association (Veljaca and R apee, 1998). As most studies found a significant association, findings by measures of social perception were consistent. The studies that utilized a social intelligence task and social cue detection task found
Table 1
Overview of studies and study characteristics.

| Emotion recognition | Total N (SA/HC) | Mean age SA/HC | % women SA/HC | Sample type | Statistical covariates | Assessment of social anxiety | Social cognition task |
|---------------------|----------------|----------------|--------------|-------------|------------------------|-----------------------------|------------------------|
| Alvi et al. (2020) - Study 1 | 1485 | 25.8 | 69.0 | Student and Community | Age, gender, depressive symptoms, neuroticism, extraversion, mentalizing, social anhedonia | Composite (LSAS, SIAS, SPS) | Emotion Perceptions of Biological Motion Task (Heiberlein et al., 2004) |
| Arrnsi et al. (2010) | 231 (78/153) | 22.3/21.4 | 61.5/65.4 | Student | None | Diagnostic groups (based on SCID for DSM-IV) | Facial emotion recognition task using stimuli from Pictures of Facial Affect (Ekman and Friesen, 1976) |
| Auyeung and Alden (2020) - Study 1 | 134 | 20.5 | 79.8 | Student | Depression, age | SIAS-S | Video empathy task (with social exclusion manipulation) |
| Bell et al. (2011) | 57 (30/27) | 37.39 | 36.7/40.7 | Community | Gender, medication status | Diagnostic groups (based on SCID for DSM-IV) | Facial emotion recognition task using stimuli from the Karolinska Directed Emotional Faces set (Lundqvist et al., 1998) |
| Bodner et al. (2012) | 80 (39/41) | 28.6 | 40.0 | Community | Depression, age | Groups based on LSAS | Vocal improvisation recognition task (Bodner and Gilboa, 2006) and vocal prosody recognition task (Berger, 2002) |
| Button et al. (2013) | 102 (52/50) | 22/23 | 100/100 | Community | None | Groups based on BFNE | Facial emotion recognition task using stimuli from the Karolinska Directed Emotional Faces set (Lundqvist et al., 1998) |
| Campbell et al. (2009) | 40 (12/18) | 31.9/30.4 | 58.3/35.7 | Community | None | Diagnostic groups (based on MINI for DSM-IV) | Facial emotion recognition task using stimuli from the Japanese and Caucasian Facial Expressions of Emotion set (Marumoto and Ekman, 1988) |
| Dicker et al. (2018) - Study 2 | 208 (51/63) | 18.9 | 59.3 | Student | None | Groups based on SPAI | Facial emotion visual search task using stimuli from the NimStim Set of Facial Expressions (Tottenham et al., 2009) |
| Garner et al. (2009) | 33 (16/17) | 43.1/39.9 | 68.8/47.1 | Community | None | Diagnostic groups (based on MINI for DSM-IV) | Morphed faces task using stimuli from the NimStim Set of Facial Expressions (Tottenham et al., 2009) |
| Gilboa-Schechtman et al. (2008) - Study 2 | 202 (54/65) | 29.9/27.6 | 51.9/52.3 | Community | None | Diagnostic groups (based on SCID for DSM-IV) | Morphed faces task using stimuli from database of facial expressions (Haidarlakhdie and Niedenthal, 1997) |
| Hagemann et al. (2016) | 42 (21/21) | 26.9/27.0 | 76.2/76.2 | Community | None | Diagnostic groups (based on SCID for DSM-IV) | Facial emotion recognition task using stimuli from FACES Database (Diamond et al., 2010), Karolinska Directed Emotional Faces (Lundqvist et al., 1998), Radboud Faces Database (Langner et al., 2010) and the NimStim Set of Facial Expressions (Tottenham et al., 2009) |
| Heuer et al. (2010) | 57 (27/30) | 20.0/20.0 | 100/100 | Student | None | Groups based on LSAS | Morphed faces task using stimuli from the Karolinska Directed Emotional Faces set (Lundqvist et al., 1998) |
| Hunter et al. (2009) | 158 (24/121) | 18.71 | 52.7 | Student | Gender, depression, trait anxiety | Groups based on SPS | Diagnostic Analysis of Non-verbal Accuracy (Nowicki and Carton, 1992; Nowicki et al., 1998) |
| M. Jacobs et al. (2008) | 49 (28/21) | 32.4/36.0 | 46.4/47.6 | Community | General anxiety, overall impairment | Diagnostic groups (based on SCID for DSM-IV) | Mayer-Salovey-Caruso Emotional Intelligence Test: Experiential Emotional Intelligence (Mayer et al., 2002) |
| Joormann and Gotlib (2006) | 72 (26/46) | 30.2/31.6 | 61.5/68 | Community | Error rate | Diagnostic groups (based on SCID for DSM-IV) | Morphed faces task using stimuli from the Facial Expressions of Emotions-Stimuli and Test set (Young et al., 2002) |
| Lau et al. (2014) | 264 | 69.3 | Student | Gender, neuroticism | SAS-A | Diagnostic Analysis of Non-verbal Accuracy (Nowicki and Carton, 1992; Nowicki et al., 1998) |
| Mohlman et al. (2007) | 52 (26/26) | 21.5/21.1 | 62/65 | Student | Depression, trait anxiety, stimulus order | Diagnostic groups (based on SCID for DSM-IV) | Video Emotion Recognition Task (Kang and Lau, 2013) |
| Montagne et al. (2006) | 50 (24/26) | 36.7/37.6 | 58.3/53.8 | Community | None | Diagnostic groups (based on MINI for DSM-IV) | Facial emotion recognition task using stimuli from the Karolinska Directed Emotional Faces set (Lundqvist et al., 1998) |
| Mullins and Duke (2004) | 70 | 19.2 | 100 | Student | Pre-test anxiety | FNES | Diagnostic Analysis of Non-verbal Accuracy (Nowicki and Carton, 1992; Nowicki et al., 1998) |
| Oh et al. (2018) | 112 (56/56) | 27.3/25.8 | 46.4/44.6 | Community | None | Diagnostic groups (based on MINI for DSM-IV) | Facial emotion recognition task using stimuli from Pictures of Facial Affect (Ekman and Friesen, 1976) |
| Phan et al. (2006) | 26.7/26.6 | 50.0 | 50.0 | Unknown | None | Diagnostic groups (based on MINI for DSM-IV) | Facial emotion recognition task using Penn Emotion Recognition set (Gur et al., 2002) (continued on next page) |
| Study | Total N | Mean age | % women | Sample type | Statistical covariates | Assessment of social anxiety | Social cognition task |
|-------|---------|----------|---------|-------------|------------------------|-----------------------------|------------------------|
| Philippot and Douilliez (2005) | 80 (21/39) | 30.0/33.0 | 33.3/51.3 | Community | None | Diagnostic groups (based on SCID for DSM-IV) | Morphed faces task using stimuli from Hess and Blairy (1995) |
| Quadling et al. (2007) | 30 (15/15) | 23.3/23.9 | 53.3/53.3 | Student | Depressive symptoms | Diagnostic groups (based on SCID for DSM-IV) | Emotion prosody recognition task using stimuli from the “Magdeburger Prosodie-Korpus” (Wendt and Scheich, 2002) |
| Schofield et al. (2007) | 100 (49/51) | 18.5/18.9 | 75.5/52.9 | Student | None | Groups based on BFNE | Morphed faces task using stimuli from the Japanese and Caucasian Facial Expressions of Emotion set (Matsumoto and Ekman, 1988) and the Nonverbal Discrepancy Test (DePaulo, 1978) |
| Straube et al. (2004) | 20 (10/10) | 25.0/23.2 | 60.0/60.0 | Student and Community | None | Diagnostic groups (based on SCID for DSM-IV) | Facial emotion recognition task using stimuli from the NimStim Set of Facial Expressions (Tottenham et al., 2009) |
| Toro-Alves et al. (2016) | 43 (22/21) | 20.5/22.5 | 40.9/42.9 | Student | Age | Groups based on SPIN | Morphed faces task using stimuli from the NimStim Set of Facial Expressions (Tottenham et al., 2009) |
| Tseng et al. (2017) | 62 (31/31) | 29.6/30.9 | 45.2/45.2 | Community | Depression | Diagnostic groups (based on MINI for DSM-IV) | Diagnostic Analysis of Non-verbal Accuracy 2- Taiwan version (Chen, 2006) |
| Winton et al. (1995) | 24 (13/11) | 20.6/22.7 | 69.2/54.5 | Student | None | Groups based on FNES | Facial emotion recognition using stimuli from the Japanese and Caucasian Facial Expressions of Emotion set (Matsumoto and Ekman, 1988) and the Nonverbal Discrepancy Test (DePaulo, 1978) |
| Yoon et al. (2007) | 22 (11/11) | 27.0/26.9 | 54.5/54.5 | Unknown | None | Diagnostic groups (based on SCID for DSM-IV) | Facial emotion recognition task using Penn Emotion Recognition set (Gu et al., 2002) |
| Social perception | | | | | | | |
| Hampel et al. (2011) | 110 | 31.5 | 60.0 | Community | Trait anxiety | SBQ, SQQ, SAQ, and SAM | Magdeburg Test of Social Intelligence-Social Perception (Conzelmann et al., 2013) |
| Schroeder (1995a) | 84 | 22.0 | 59.5 | Student | None | SCS | Interpersonal Perception Task (Costanzo and Archer, 1989) |
| Schroeder (1995b) | 68 | 18.8 | 52.9 | Student | None | SCS | Interpersonal Perception Task (Costanzo and Archer, 1989) |
| Schroeder and Ketrov (1997) | 161 | 18-31 | 55.3 | Student | None | PRCA | Interpersonal Perception Task (Costanzo and Archer, 1989) |
| Veljaca and Rapee (1998) | 39 (19/20) | 22.4/24.2 | 89.5/70.0 | Student | None | Groups based on APPQ and NOQ | Social cue detection task |
| Affect sharing | | | | | | | |
| Alvi et al. (in press) - Study 1 | 202 | 19.8 | 68.2 | Student | Age, gender, depressive symptoms, alexithymia, target expressivity | Composite (LSAS, SIAS, SPS) | Affect sharing video task adapted from Kern et al. (2013) |
| Alvi et al. (in press) - Study 2 | 324 | 37.1 | 45.4 | Community | Age, gender, depressive symptoms, alexithymia, target expressivity | Composite (LSAS, SIAS, SPS) | Affect sharing video task adapted from Kern et al. (2013) |
| Morrison et al. (2016) | 64 (32/32) | 31.9/31.7 | 43.7/43.7 | Community | None | Diagnostic groups (based on ADIS for DSM-IV) | EC video task adapted from Zaki et al. (2008) |
| Theory of mind | | | | | | | |
| Alvi et al. (2020) - Study 1 | 1485 | 25.8 | 69.0 | Student and Community | Age, gender, depressive symptoms, neuroticism, extraversion, mentalizing, social anhedonia | Composite (LSAS, SIAS, SPS) | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) |
| Ballespi et al. (2018) | 113 (33/80) | 21.1 | 85.8 | Student | None | Groups based on SPAI-B and BFNE | Movie for the Assessment of Social Cognition task (Dziobek et al., 2006) and induced mentalization in self-referential paradigm |
| Buhlmann et al. (2015) | 140 (35/35) | 32.2/32.7 | 60.0/60.0 | Community | Non-social inferencing (control items) | Diagnostic groups (based on SCID for DSM-IV) | Movie for the Assessment of Social Cognition task (Dziobek et al., 2006) |
| Hezel and McNally (2014) | 80 (40/40) | 26.5/20.1 | 67.5/85 | Student and Community | Gender | Diagnostic groups (based on MINI for DSM-IV) | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) and Movie for the Assessment of Social Cognition task (Dziobek et al., 2006) |

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significant results. The studies that used the interpersonal perception task had mixed findings; two studies found a statistically significant association (Schroeder, 1995b; Schroeder and Kretow, 1997) and one did not (Schroeder, 1995a). Thus, overall, most studies examining SA and social perception found a significant, negative association.

3.3.3. Affect sharing

There were no apparent trends in findings in studies examining the association between SA and behaviorally assessed affect sharing based on statistically significant associations, type of SA assessment, or valence of stimuli.

In the three studies that examined the association between SA and affect sharing, two studies found a non-significant association (Alvi et al., in press) and one study found a statistically significant negative association (higher levels of SA were related to lower affect sharing) that was moderated by valence (Morrison et al., 2016). Specifically, SA was negatively associated with affect sharing for positive stimuli (Morrison et al., 2016). Effect sizes ranged from $d = 0.02$ to $0.55$, with an average effect size of $d = 0.20$.

3.4. Higher-level social cognition

3.4.1. Theory of mind

Most studies examining the association between SA and theory of mind found a statistically significant, negative association (i.e., higher levels of SA were associated with decreased theory of mind). Valence-specific findings were also consistent regarding positive and neutral stimuli (i.e., higher levels of SA were associated with reduced theory of mind for stimuli with positive and neutral valence). Results based on social cognitive assessment were also consistent in that nearly all studies that assessed theory of mind based on the eye region found a statistically significant association.

Overall, most studies found a statistically significant association (n = 8), with six studies finding a negative association indicating that higher levels of SA were related to reduced theory of mind ability (Alvi et al., 2020; Buhlmann et al., 2015; Herzel and McNally, 2014; Lyvers et al., 2019; Maleki et al., 2020; Washburn et al., 2016), and three studies finding a positive association, with higher levels of SA relating to better theory of mind ability (Sutterby et al., 2012; Maleki et al., 2020; Tibi-Elhanany et al., 2011). Further, four studies found a non-significant association between SA and theory of mind (Ballespi et al., 2018; M. Jacobs et al., 2008; Lenton-Brym et al., 2018; Maleki et al., 2020). For studies that reported an effect size, values ranged from $d = 0.06$ to $0.86$, with an average effect size of $d = 0.53$.

Findings by valence were mixed, although most studies found a statistically significant negative association (greater SA was related to reduced theory of mind ability). For negative stimuli, two studies found a statistically significant negative association (Alvi et al., 2020; Washburn et al., 2016) and one study found a statistically significant positive association between higher levels of SA and greater theory of mind ability (Maleki et al., 2020). Three studies, which examined both positive and neutral stimuli, found that higher levels of SA levels were

### Table 1 (continued)

| Study            | Total N | Mean age | % women | Sample type | Statistical covariates | Assessment of social anxiety |
|------------------|---------|----------|---------|-------------|------------------------|-----------------------------|
| M. Jacobs et al. (2008) | 49      | 32.4/    | 46.4/   | General anxiety, overall impairment | Diagnostic groups (based on SCID for DSM-IV) | Mayer-Salovey-Caruso Emotional Intelligence Test—Strategic Emotional Intelligence (Mayer et al., 2002) |
| Lenton-Brym et al. (2018) | 113     | 19.4/    | 71.8/   | Student | None | Diagnostic groups (based on SCID for DSM-IV) | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) and Movie for the Assessment of Social Cognition task (Dziobek et al., 2006) |
| Lyvers et al. (2019) | 242     | 23.2/    | 61.6/   | Student and Community | Age, gender, depressive symptoms, alexithymia | SIAS | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) |
| Maleki et al. (2020) | 107     | 27.5/    | 54.3/   | Community | None | Diagnostic groups (based on SCID for DSM-IV) | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) and faux pas task (Baron-Cohen et al., 1999) |
| Sutterby et al. (2012) | 56      | 19.1/    | 59.3/   | Student | None | Groups based on SPAI | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) and the Awareness of Social Inferences Test (McDonald et al., 2006) |
| Tibi-Elhanany and Shamay-Tsoory (2011) | 43      | 25.3/25  | 71.4/   | Community | Control condition | Groups based on LSAS | Cartoon ToM task (Baron-Cohen, 1995) |
| Washburn et al. (2016) | 119     | 19.8/    | 58.3/   | Student and Community | Age, gender, ethnicity, education, response latency | Diagnostic groups (based on SCID for DSM-IV) | Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001) and Movie for the Assessment of Social Cognition task (Dziobek et al., 2006) |
| Alvi et al. (2020) - Study 2 | 390     | 19.6/    | 77.2/   | Student | Gender, depressive symptoms, neuroticism, extraversion, target expressivity, video order | Composite (LSAS, SIAS, SPS) | EA video task (Kern et al., 2013) |
| Alvi and Alden (2016) | 121     | 20.1/    | 78.7/   | Student | Age | SIAS | EA video task (with anxiety induction) |
| Morrison et al. (2016) | 64      | 31.9/    | 43.7/   | Community | None | Diagnostic groups (based on ADIS for DSM-IV) | EA video task (Zaki et al., 2008) |

Note. LSAS = Liebowitz Social Anxiety Scale, SIAS = Social Interaction Anxiety Scale, SIAS-S = Social Interaction Anxiety Scale—Straight-forward Score, SPS = Social Phobia Scale, SCID = Structured Clinical Interview for DSM-IV, ADIS = Anxiety Disorders Interview Schedule for DSM-IV, BFNE = Brief Fear of Negative Evaluation scale, MINI = Mini International Neuropsychiatric Interview for DSM-IV, SPAI = Social Phobia and Anxiety Inventory, SAS-A = Social Anxiety Scale for Adolescents, FNES = Fear of Negative Evaluation Scale, SPIN = Social Phobia Inventory, SBQ = Social Behavior Questionnaire, SCQ = Social Cognitions Questionnaire, SAQ = Social Attitudes Questionnaire, SCS = Self-consciousness Scale, PRCA = Personal Report of Communication Apprehension, APPQ = Albany Panic and Phobia Questionnaire, NOQ = Negative Outcome Questionnaire, ToM = theory of mind, EA = empathic accuracy.
Table 2
Study findings and effect sizes.

| Emotion recognition | Effect size | Finding |
|---------------------|-------------|---------|
| Alvi et al. (2020) - Study 1 | For total, $d = 0.47$; for negative, $d = 0.44$; for positive, $d = 0.36$; for neutral $d = 0.40$ | No association between SA and emotion recognition |
| Arrais et al. (2010) | Not reported | Group X gender interaction-women in SA group required less emotional intensity to recognize faces displaying fear, happiness, and sadness compared to HC. |
| Auyeung and Alden (2020) - Study 1 | Not reported | Across both conditions, higher SA predicted greater accuracy of target’s negative affect |
| Auyeung and Alden (2020) - Study 2 | $d = 0.55$ | Across both conditions, SAD group had greater accuracy of target negative affect compared to HC. |
| Bell et al. (2011) | Not reported | No differences between groups on accuracy |
| Bodner et al. (2012) | $d = 0.94$ | SA group was less accurate at recognition of happy voices in female voices compared to HC. |
| Button et al. (2013) | Not reported | No difference between groups on accuracy |
| Campbell et al. (2009) | Not reported | No difference between groups on accuracy |
| Dickler et al. (2018) - Study 2 | $d = 0.37$ | For complex faces, high SA group was less accurate than low SA group |
| Garner et al. (2009) | $d = 0.64$ | SA group was less accurate at identifying fearful faces than HC |
| Gilboa-Schechtman et al. (2008) - Study 2 | $d = 0.55$ | SA group less sensitive to angry expressions than HC |
| Hagemann et al. (2016) | $d = 0.55$ | No difference between groups on accuracy |
| Heuer et al. (2010) | $d = 0$ | No difference between groups on accuracy |
| Hunter et al. (2009) | Not reported | SA group was more accurate for happy, sad, and fearful faces compared to HC. |
| M. Jacobs et al. (2008) | $d = 1.62$ | No difference between groups on accuracy; negative correlation between SA and experiential EI |
| Joormann and Gotlib (2006) | Not reported | No difference between groups on accuracy; SA group was able to identify angry faces more quickly than HC. |
| Lau et al. (2014) | $d = 0.84$ | Lower emotion recognition associated with lower social anxiety |
| Mohlman et al. (2007) | $d = 1.66$ (for positive association); $d = 1.96$ (for negative association) | SA group was more accurate at identifying angry faces, and less accurate at neutral faces, than HC, following threat manipulation |
| Montagne et al. (2006) | Not reported | SA group was less sensitive to negative emotions compared to HC. |
| Mullins and Duke (2004) | Not reported | No association between SA and accuracy, regardless of condition |
| Oh et al. (2018) | Not reported | SA group was less accuracy for total, fear, surprise, neutral, and happy stimuli than HC |
| Phan et al. (2006) | Not reported | No difference between groups on accuracy |

Table 2 (continued)

| Theory of mind | Effect size | Finding |
|----------------|-------------|---------|
| Alvi et al. (2020) - Study 1 | For total, $d = 0.86$; for negative, $d = 0.77$; for positive, $d = 0.44$; for neutral $d = 0.71$ | Negative association between SA and accuracy for total, negative, positive, and neutral stimuli |
| Ballespil et al. (2018) | Not reported | No difference between groups on accuracy in video task; hyper-mentalizing in SA group for self-referential paradigm |
| Buhlmann et al. (2015) | $d = 0.72$ | SA group was less accurate than HC in ToM |
| Hezel and McNally (2014) | $d = 0.63$ (for videos task) and $d = 0.70$ (for eyes task) | SA group was less accurate on both the video and eyes tasks compared to HC |
| M. Jacobs et al., (2008) | $d = 0.12$ | No difference between groups on accuracy |
| Lenton-Brym et al. (2018) | $d = 0.06$ | No difference between groups on accuracy |

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There were only a few studies examining empathic accuracy, and findings were mixed. There were no apparent trends in findings based on statistically significant associations, type of SA assessment, or valence of stimuli.

Of the three studies that assessed empathic accuracy, two studies found a statistically significant association between SA and empathic accuracy (Alvi et al., 2020; Auyeung and Alden, 2016) and one study found a non-significant association (Morrison et al., 2016). However, the study that found a non-significant association between SA and empathic accuracy had a smaller sample (n = 64) compared to the other two (n = 121–390); thus, these results should be interpreted with caution. Of the studies that found a statistically significant association, one study found that higher levels of SA were related to reduced empathic accuracy (Alvi et al., 2020) and the other found the opposite: higher levels of SA were related to increased empathic accuracy (Auyeung and Alden, 2016). Findings by valence were also mixed. One study found that higher levels of SA were related to reduced empathic accuracy for positive stimuli (Alvi et al., 2020). In contrast, another study found that higher levels of SA were associated with greater empathic accuracy for negative stimuli (Auyeung and Alden, 2016). Further, the study that utilized diagnostic groups found a non-significant association (Morrison et al., 2016) whereas the two studies that assessed SA dimensionally did find a statistically significant association (Alvi et al., 2020; Auyeung and Alden, 2016).

3.5. Covariates

Twenty-six (50.00%) studies included at least one statistical covariate in their model examining the association between SA and social cognition. Of the studies that did include covariates, 17 (65.38%) included two or less covariates. Across these studies, statistical covariates included age (11 studies; 42.31%), gender (11 studies; 42.31%), depression (13 studies; 50.00%), alexithymia (3 studies; 11.54%), and no studies statistically controlled for IQ. Most studies included age and gender as covariates, and several included depression; yet for all three variables, there was no clear trend in the patterns of results that included nonsignificant and significant associations in both the positive and negative directions (i.e., with higher levels of SA relating to both increased and decreased social cognitive ability) and effect sizes ranging from small to large. In the only study that controlled for alexithymia when examining SA and theory of mind, a negative association was found with a moderate effect size wherein individuals with higher levels of SA had reduced theory of mind ability (Lyvers et al., 2019). Interestingly, among the three studies examining SA and affect sharing, a significant association was only found for the one study that did not control for alexithymia or depression (Morrison et al., 2016), whereas the other two studies that did control for these variables found no association (Alvi et al., in press). These results suggest that covariates, particularly depression and alexithymia, may be most relevant when studying affect sharing; however, future studies are needed to replicate these findings.

3.6. Trends in results

Most studies used diagnostic groups based on clinical interviews for the DSM-IV (45.9%) or cut-off scores through dimensional measures (27.9%) in their assessment of SA. Only 26.2% of studies used dimensional assessment of SA in their analyses. Overall, there was no general trend associated with the type of SA assessment and findings were mixed. Most studies examining social perception (80%), theory of mind (66.6%), and empathic accuracy (66.6%) found a statistically significant association. However, these domains, especially social perception and empathic accuracy, had far fewer studies than others, such as emotion recognition. Findings related to lower-level processes (emotion recognition, social perception, and affect sharing) were mixed. When these domains were collapsed, no general trend was found, which was largely driven by the heterogeneity in findings with emotion recognition. For

Table 2 (continued)

| Study          | Effect size | Finding                                                                 |
|----------------|-------------|-------------------------------------------------------------------------|
| Alvi et al. (2020) | 4.98        | Negative association between SA and ToM                                 |
| Auyeung and Alden (2016) | 0.67        | Group X gender interaction for tasks; women in SA group were more accurate compared to women in HC group |
| Tibi-Elhanany et al. (2011) | Not reported | SA group had greater cognitive accuracy, but less affective accuracy, than HC |
| Washburn et al. (2016) | d = 0.59   | SA group had lower ToM on eyes task for total, positive, and neutral stimuli compared to HC; no effect for video task |

Note. Effect sizes were converted to Cohen’s d to compare effect sizes using a standard unit; SA = social anxiety; SAD = social anxiety disorder; HC = healthy controls; ToM = theory of mind.
studies examining higher-level processes (theory of mind and empathic accuracy), the majority (66.6%) found a statistically significant association. Further, most of these studies (63.7%) found a negative association between SA and higher-level social cognition, with those with higher levels of SA exhibiting reduced abilities. Among studies that found a valence-specific effect, most found negative associations for positive (90%) and neutral (100%) stimuli, whereas findings for negative stimuli were mixed. In the two studies that examined gender moderation, both found a positive association between SA and social cognition (emotion recognition and theory of mind) for females only. Among the four studies that included experimental anxiety inductions (Table 1), results were mixed and no trend in findings could be identified based on the type of study design.

4. Discussion

This systematic literature review synthesized studies in adults that investigated the association between SA and behaviorally assessed social cognition. Further, it considered trends across studies based on the type of SA and social cognition assessment, the domain of social cognition, relevant covariates, and the valence of stimuli. The main finding of this review was that most studies examining the association between SA and higher-level social cognition found a statistically significant effect, with the majority finding a negative association (higher levels of SA relating to less social cognitive ability). These findings are consistent with O’Toole et al. (2013) who found a negative association between SA and complex emotions (higher-level social cognition) and suggest that greater SA is associated with impairment in higher-level social cognition. Findings related to lower-level social cognition were mixed, although the majority of studies examining the domain of social perception found a statistically significant negative effect of SA. Most studies did not examine valence-specific effects, but among those that did, findings suggest SA is negatively associated with the ability to accurately perceive positive and neutral stimuli.

The mixed findings associated with lower-level social cognitive processes may be explained by several factors. First, the assessments used to measure lower-level processes (e.g., emotion recognition) have been more varied than the assessments used to measure other domains of social cognition; this increased variability may explain the differences in findings. Indeed, the majority of studies assessing higher-level processes used the same measures of social cognition (81% of studies examining theory of mind utilized one or both of the same tasks, and all of the studies examining empathic accuracy utilized a version of the same task). In contrast, emotion recognition tasks varied greatly in terms of the stimuli presented (i.e., the assessment of facial, vocal, or body cues), as well as the sensory modality (i.e., videos, pictures, sounds). Further, the greater number of studies that examined emotion recognition relative to other forms of social cognition, in conjunction with the different forms of assessment, contributes to this variability. The discrepancy in the number of studies between domains of social cognition may be due in part to feasibility. Most studies examining emotion recognition used a static emotion recognition task, which are easily administered, scored, and analyzed. In comparison, behavioral measures of empathic accuracy and affect sharing often require specific computer software to run and analyze data, greater time for administration, and advanced statistical techniques (e.g., multilevel modeling). Finally, the mixed findings with lower-level social cognition may also be explained by the infrequent inclusion of covariates. The majority of studies examining these domains either included no covariates, or only a few (only 17.3% of all studies included more than two covariates), and these were generally limited to age, gender, and depressive symptoms. Future studies are needed to systematically examine the extent to which the factors we have identified contribute to increased replicability (e.g., do findings replicate using the same sample and covariates but with different measures of emotion recognition).

Evidence for a negative association between SA and positive or neutral (but not negative) stimuli may be explained by socially anxious individuals’ attentional biases away from positive information (Taylor et al., 2010), and the tendency to suppress positive emotions (Farmer and Kashdan, 2012), which can result in the misinterpretation of these social cues. Further, socially anxious individuals tend to interpret ambiguous stimuli more negatively (Morrison and Heimberg, 2013), which may explain the negative association between SA and accuracy for neutral cues. Future studies should include measures of cognitive biases to test whether associations between SA and social cognition are moderated by such attentional and/or interpretation biases. Evidence of such moderation would suggest that social cognition in socially anxious individuals may be improved by incorporating attention training toward positive stimuli (Heeren et al., 2012; Li et al., 2008), or positive affect treatment (Craske et al., 2019), within cognitive behavioral therapy.

Results from our review also found no apparent trend in findings of studies that included relevant covariates (age, gender, depressive symptoms, alexithymia, and IQ). Studies that included these covariates had mixed findings with effect sizes ranging from small to large. These results were comparable to studies that did not include covariates, suggesting that the variability in findings to date cannot be explained by the inclusion of covariates alone. Studies that included gender as a moderator found similar results (i.e., a positive association between SA and social cognition for females), which is supported by previous work demonstrating increased social cognitive ability in women (Babchuk et al., 1985; Thayer & Johnsen, 2000). However, only two studies examined this moderation, so future studies are needed to replicate this across domains of social cognition. Importantly, when examining specific domains of social cognition, alexithymia and depression seem to be relevant to consider when assessing affect sharing. Indeed, alexithymia is highly correlated with SA (Alvi et al., in press) and may mediate the association between SA and affect sharing (Morrison et al., 2016). Given the instructions in the affect sharing task that were used in the studies reviewed (i.e., assessing how you as a perceiver feel when watching a target recount an autobiographical story), it is likely that difficulty identifying emotions may impact performance on this task. Similarly, depression is highly comorbid with SA (Kessler et al., 2005) and shares an affective profile with SA of high negative and low positive affect (Kashdan, 2002), highlighting the importance of controlling for one when examining the other. As with studies that examined gender moderation, future work is needed to replicate the few findings of SA with affect sharing with a particular emphasis on these variables.

Although findings based on the type of social cognitive assessment within each domain were mixed, there were some noticeable trends. For example, although only two studies included emotion recognition tasks involving vocal/prosody stimuli, both found a negative association with SA (Bodner et al., 2012; Quadflieg et al., 2007). Studies measuring theory of mind with the Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001) were also generally consistent in their association with SA (71.4% found a statistically significant negative association). This trend suggests that the construct measured by this task, which has been conceptualized as theory of mind (Baron-Cohen et al., 2001), but also emotion recognition (Oakley et al., 2016), is reliably associated with symptoms of SA. Although this task may be more closely associated with emotion recognition, it differs from most lower-level emotion recognition tasks that rely on basic emotions (e.g., happy, sad, angry) and instead assesses complex emotions (e.g., jealous, cautious, grateful) with a restricted amount of information from facial expression cues (i.e., only the eye region is presented). Since the RMET likely lies within a grey area between lower (i.e., emotion recognition) and higher-level social cognition (i.e., theory of mind), it may help to characterize this task as an intermediate-level social cognitive process moving forward. Alternatively, it could be characterized as theory of mind but distinguished by its assessment of decoding ability, rather than reasoning, due to the lack of context or additional information provided with the images (Sabbagh, 2004).

Importantly, when examining studies based on the use of a decoding
task (i.e., the RMET) vs. a reasoning task (i.e., MASC), results to date are still comparable. Most studies utilizing the MASC also found a significant negative association (i.e., 60% of studies), suggesting separation of findings based on decoding and reasoning tasks may not change the pattern of results. However, since far more studies of SA and social cognition have included the RMET compared to the MASC, this pattern of results should be viewed as preliminary. In sum, although most studies examining what we initially categorized as higher-level social cognitive processes found an association with SA, this finding is largely driven by studies that utilized the Reading the Mind in the Eyes Test. Thus, future within-person studies are needed to examine differential effects of SA on theory of mind that involves decoding vs. reasoning.

4.1. Limitations and future directions

Our systematic review has several limitations that are important to point out. First, all aspects of social cognition were not included. This review focused on processes and tasks that are based on accuracy (or the correlation between perceive and target responses as in the affect sharing task), however previous research has included domains such as attributional and attentional biases within social cognition (Green et al., 2012; Pinkham et al., 2016). Future reviews should examine findings in these additional areas to further understand the effect of SA on social cognition. Additionally, this review did not include unpublished studies, which may bias findings. Although unpublished studies may be of lesser quality due to the absence of the peer review process (Egger et al., 2003), publication bias may result from the exclusion of important findings in unpublished work. Indeed, unpublished studies often have smaller effects than published work (Hopewell et al., 2007); thus, the exclusion of grey literature may artificially inflate the overall significance and the effects of findings in the current review. Further, although this review focused on adult samples, SA may be related to social cognitive impairments in children and adolescents as well (Pittelkow et al., 2021). Future reviews should include studies in children and adolescents to determine if the trends in the present findings based on social cognitive domains, assessments, stimuli valence, and the inclusion of relevant covariates mirror those in studies with adult samples.

Our review also identified that research on SA and social cognition is far less common in some domains (e.g., affect sharing) compared to others (e.g., emotion recognition). Future studies should focus on more understudied areas to examine whether effects from previous studies are replicated. In addition, given the heterogeneity among measures within each social cognitive domain, future studies examining SA and social cognition should include large samples with well-powered designs involving multiple measures of the same social cognitive domain to confirm that associations are domain rather than task-specific. Since behavioral tasks assessing social cognition are known to have poor psychometric properties (Pinkham et al., 2014), future research would also benefit from the inclusion of more well-validated tasks, such as the Geneva Emotion Recognition Test (Schlegel et al., 2019). Although our review did not identify differences based on type of SA assessment, it is difficult to interpret these findings based on only a few studies that have measured SA dimensionally. Symptoms of psychological distress are thought to be more accurately operationalized using dimensional measures (Kessler, 2002), and creating groups based on cutoffs and relying on diagnostic groups may restrict the range of symptoms. Thus, future studies may further elucidate the association of SA and social cognition if SA is measured dimensionally.

Finally, future research examining the association between SA and social cognition would also benefit from the assessment of real-world social functioning. Although it is typically assumed that laboratory-based assessments of social cognitive performance correlate with real world functioning, there is limited work in this area as it pertains to SA. Studies employing daily diary, or ecological momentary assessment (Hur et al., 2019), would be particularly beneficial in this regard as this would allow researchers to extend their findings beyond the laboratory to examine whether differences in social cognition among socially anxious individuals translate into difficulties outside of the laboratory.

5. Conclusion and implications

In sum, this systematic review highlights several important findings. First, although there is mixed evidence for the association between SA and lower-level social cognitive processes, there is a trend in studies showing negative associations between SA and intermediate to higher-level social cognitive processes (theory of mind and empathic accuracy). Second, findings across studies suggest that stimuli valence is important to consider as a moderator in these associations. Of the studies that examined valence-specific associations, most found a significant negative association between SA and the ability to accurately perceive positive and neutral stimuli. Third, this review highlights the lack of inclusion of statistical covariates across studies, which may be most relevant when examining SA and affect sharing. To further clarify the relation between SA and social cognition, future studies would benefit from the inclusion of relevant moderators and covariates, multiple measures within the same domain of social cognition, and dimensional assessment of SA.

Findings related to impairment in higher-level social cognitive processes among those with SA symptoms may be explained cognitive models of SA, which propose that social cognitive misinterpretations result in and maintain symptoms (Beck, 2011; Clark and Wells, 1995). For example, individuals with SA may misinterpret social cues in everyday life resulting in automatic negative thoughts. These negative interpretations impact social behaviour (e.g., through avoidance of social situations) and interpersonal functioning. Thus, impairment in higher-level social cognitive processes, which includes mental state inference of complex social stimuli, is consistent with this theoretical understanding of SA. Likewise, this aligns with the cognitive model of SA which posits that emotions and behaviors are influenced by individuals’ thoughts (Beck, 2011). Thus, these findings highlight the utility of focusing on cognitive, as opposed to emotional, processes in psychotherapy for SAD. In addition, based on the present findings, it may be more beneficial for clinicians to focus on higher-level, rather than lower-level social cognitive processes. Indeed, our findings suggest that trials examining the efficacy of social skills training in combination with cognitive behavioral therapy (Beidel et al., 2014) may benefit from even more targeted social cognitive skills training (Kurtz et al., 2016). Future research using social cognitive interventions in individuals with SA is needed to examine these potential clinical implications.

CRediT authorship contribution statement

Talha Alvi: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project Administration, Writing-original draft, Writing-reviewing and editing. Divya Kumar: Formal analysis, Project administration, Writing-review & editing. Benjamin A. Tabak: Conceptualization, Supervision, Writing-review & editing.

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