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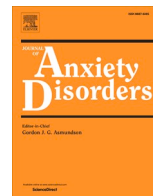
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Social Anxiety and Empathy: A Systematic Review and Meta-analysis

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ABSTRACT

Objective: This systematic review and meta-analysis aimed to clarify the association between social anxiety and affective (AE) and cognitive empathy (CE).

Methods: 1442 studies from PsycINFO, Medline, and EMBASE (inception-January 2020) were systematically reviewed. Included studies ($N = 48$) either predicted variance in empathy using social anxiety scores or compared empathy scores between socially anxious individuals and a control group.

Results: Social anxiety and AE were statistically significantly positively associated, $k = 14$, $r = .103$ (95%CI [.003, .203]), $z = 2.03$, $p = .043$. Sex ($Q_M(2) = 18.79$, $p < .0001$), and type of measures ($Q_M(1) = 7.34$, $p = .007$) moderated the association. Correlations were significant for male samples ($r_{\text{male}} = .316$, (95%CI [.200, .432])) and studies using self-report measures ($r_{\text{self-report}} = .162$ (95%CI [.070, .254])). Overall, social anxiety and CE were not significantly associated, $k = 52$, $r = -.021$ (95%CI [-.075, .034]), $z = -0.74$, $p = .459$. Sample type moderated the association ($Q_M(1) = 5.03$, $p < .0001$). For clinical samples the association was negative ($r_{\text{clinical}} = -.112$, (95%CI [-.201, -.017])).

Conclusion: There was evidence for a positive association between social anxiety and AE, but future studies are needed to verify the moderating roles of sex and type of measure. Besides, low CE might only hold for patients with SAD.

1. Introduction

Social Anxiety Disorder (SAD) is one of the most prevalent psychiatric diagnoses worldwide, with lifetime prevalence rates between 0.2% and 12.1% across countries (D. J. Stein et al., 2017). Individuals diagnosed with SAD are characterized by an intense fear during, and avoidance of, many social situations (American Psychiatric Association, 2013). As individuals rarely recover spontaneously, the symptoms are persistent and often chronic (Grant et al., 2005; Stein and Stein, 2008).

The hallmark symptom of SAD is impaired social functioning (Alden & Taylor, 2004; Morrison et al., 2016). Efforts have been made to identify the causes of impaired social functioning in individuals with SAD. One possible contributor may be altered empathy (Morrison et al., 2016). Empathy enables effective interpersonal behaviour (Zaki & Ochsner, 2012) and altered empathy might explain impaired social functioning in individuals with SAD (for a review, see Alden & Taylor, 2004). SAD is considered to exist at the upper end of a continuous

dimension of social anxiety, with shyness at the lower end (O'Toole, Hougaard, & Mennin, 2013). Altered empathic functioning may account, at least partially, for social impairments both in individuals who meet diagnostic criteria for SAD and in shy individuals who do not meet these criteria.

Social anxiety can be understood in interactional terms with the interpersonal signals of one person affecting the behaviour of another (Gilbert, 2001). A central theme for many socially anxious individuals is the fear of provoking a negative reaction from others (e.g., ridicule, criticism, or rejection). If empathy is impaired in socially anxious individuals, appropriate emotional reaction to and interpretation of social cues is hampered. This in turn, might negatively impact social interactions thus reinforcing the socially anxious individual's fear of acting inappropriately. An alternative line of reasoning might be that being unable to correctly infer the other persons' emotional state provokes uncertainty and anxiety in social interactions (Hazel & McNally, 2014), thus fostering fear in and avoidance of social interactions.

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Altered empathic functioning might thus play a role in both the development and maintenance of SAD.

A systematic review of clinical and subclinical studies on social anxiety and empathy could help establish whether social anxiety and empathy are indeed negatively associated. Moreover, insight into the empathic abilities of socially anxious individuals could advise revisions of SAD treatment and benefit clinicians involved in SAD treatment as well as SAD patients. If alterations in empathy are indeed linked to the development and maintenance of social anxiety, then therapeutic work could directly target altered empathy as a way to improve social functioning in socially anxious individuals. This was indeed recently suggested by some authors (e.g., most recently Auyeung & Alden, 2020).

1.1. Empathy

While various conceptualizations of empathy exist, most definitions of empathy differentiate between two distinct but connected mental processes: affective empathy (AE) and cognitive empathy (CE; for a review see Cuff, Brown, Taylor, & Howat, 2014). AE describes the experience of emotion elicited by another person's emotional experience (Cuff et al., 2014). This comprises co-experiencing the same emotion, for example, feeling personal distress because of another person's unpleasant situation, or feeling happiness because another person is in a pleasant situation (Lishner, Hong, Jiang, Vitacco, & Neumann, 2015). Co-experiencing another person's emotion might result in emotional concern, the tendency to approach and support others (Davis, 1983), or emotional contagion and shared pain, which might motivate withdrawal from social situations (Shamay-Tsoory, 2011). CE describes the ability to recognize and identify the emotional states of others (Cuff et al., 2014). CE incorporates concepts such as perspective taking (PT) and Theory of Mind (ToM; Pino, Pettinelli, Clementi, & Mazza, 2015). PT refers to the likelihood to adopt the viewpoint of others and is an important contributor to ToM, the ability to recognize that others' minds differ from one's own (Cuff et al., 2014).

This differentiation between AE and CE is reflected in the literature. Empirical studies commonly differ in their focus on either AE or CE, which is reflected in the utilized measures. Differentiating between AE and CE enables more nuanced inferences about alterations in empathic functioning underlying interpersonal difficulties in the context of social anxiety. A similar distinction has been made in a previous systematic review on the relationship between depression and empathy (e.g., Schreiter, Pijnenborg, & aan Het Rot, 2013).

1.2. Social Anxiety and Empathy

At present, there are two lines of research regarding the association of social anxiety and empathy. One side argues that social anxiety is associated with decreased empathy, and that this is due to the attentional biases and altered emotional experiences that are characteristic for social anxiety.

A self-focused attentional bias is suggested to contribute to the development and maintenance of social anxiety (Rapee & Heimberg, 1997). Preoccupation with the self might prevent attending to cues needed to correctly infer the emotional state of another person, thereby hindering correct identification of the other person's emotion (i.e., CE). In support of this explanation, social anxiety has been associated to difficulties in understanding the emotional state of others (O'Toole et al., 2013).

Elevated reporting of negative experiences might also account for decreased empathy in socially anxious individuals. Socially anxious individuals tend to report elevated negative and diminished positive experiences (Cohen et al., 2017). An over-attribution of negative states might interfere with their ability to correctly identify the emotions of others (i.e., CE) and lead to over-attribution of negative states. In line with this claim, socially anxious individuals have been found to perform more poorly at ToM tasks than non-socially anxious individuals (Hezel &

McNally, 2014). Further, elevated negative social experiences have been linked to deficiencies in facial mimicry (Likowski et al., 2011; Moody, McIntosh, Mann, & Weisser, 2007). As facial mimicry is a prerequisite of emotional contagion (Hatfield, Cacioppo, & Rapson, 1993), elevated negative experiences might disrupt AE. In line with this idea, individuals with social anxiety have been shown to have deficits in emotional mimicry compared to healthy controls (Dijk, Fischer, Morina, van Eeuwijk, & van Kleef, 2018; Dimberg, 1997).

While mechanisms such as self-focused attentional biases and altered emotional experiences might contribute to decreased AE and CE in socially anxious individuals, an opposing line of research argues that empathy may be increased in socially anxious individuals as compared to healthy individuals. This might be related to their heightened concern of being negatively evaluated by others and a more general oversensitivity for social situations. Perceptual and attentional biases to social situations may result in heightened sensitivity to social situations, including the expressions of other's emotions and cognitions (Alden & Taylor, 2004; Tibi-Elhanany & Shamay-Tsoory, 2011). Socially anxious individuals' central concern to be evaluated by others increases the likelihood to adopt the perspective of others (i.e., CE) and the tendency to experience feelings of empathic concern (i.e., AE; Tibi-Elhanany & Shamay-Tsoory, 2011).

Further, interpersonal difficulties could not only arise from deficits in empathy but also from oversensitivity to emotional cues and excessive empathic functioning. Impairments in empathic functioning have been conceptualized as stemming from both deficits (i.e., inability to conceptualize or represent the mental state of other; inability to apply knowledge of the mental states of others) or hypertrophy (i.e., over-attributing knowledge to the mental states of others). The latter is also referred to as hypermentalizing – excessively attributing mental states such as beliefs and intentions to others without objective evidence to support these attributions (Abu-Akel, 2003; Sharp & Vanwoerden, 2014). Some authors have argued that interpersonal difficulties in social anxiety arise from excessive alertness to social situations and a tendency to over-attribute mental states to others (i.e., Tibi-Elhanany & Shamay-Tsoory, 2011). In support for this explanation, their results suggested higher CE and self-rated AE for socially anxious individuals compared to healthy controls (Tibi-Elhanany & Shamay-Tsoory, 2011).

1.3. Moderating Factors

Overall, results in the published literature concerning the valence (i.e., positive, or negative) of the association between social anxiety and empathy appear mixed. Several factors might partially explain the heterogeneity of past results. Studies differ in sample characteristics and methodology. More precisely, samples vary in: (1) sample type (SAD vs. non-clinically socially anxious) and (2) sex distribution, while methods vary in (3) type of measure (performance-based vs. self-report), (4) valence of target emotions, and (5) presence vs absence of social threat cues. These differences might contribute to the observed heterogeneity of effects and should be considered when integrating the literature.

1.4. The Present Review

The present systematic review and meta-analysis aims to specify the association between social anxiety and empathic functioning. First, the overall association between social anxiety and (a) AE and (b) CE will be examined. Based on the literature, both a positive and a negative association with social anxiety seems possible. Thus, no *a priori* hypothesis is specified concerning the sign of the associations. Second, the degree of variability between reported effects will be considered. Third, effects of the potential moderators will be inspected using meta-regression and subgroup analysis.

2. Methods

2.1. Protocol and Registration

The study was designed and written according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. To ensure a reproducible and transparent research process, methods of the analysis and inclusion and exclusion criteria were specified and documented in a protocol *a priori*, which is registered with PROSPERO (registration number: CRD42018110700) accessible via http://www.crd.york.ac.uk/prospero/display_record.php?RecID=110700.

2.2. Eligibility Criteria

2.2.1. Type of Studies

This review considered primary, empirical studies published in English, using quantitative analysis with measures of social anxiety and (a) AE, (b) CE, or (c) both. We included studies predicting variance in empathy scores using social anxiety scores and studies comparing group mean differences in empathy scores between socially anxious individuals (both SAD and non-clinically socially anxious individuals) and a control group. This comprised both observational studies (including cohort, cross-sectional, and clinical studies) and experimental studies which manipulated (state) social anxiety to observe the impact on empathy or vice versa. If an overlapping sample had been published multiple times, the most recently written article was included. If multiple measurements were reported the baseline was extracted. Studies that were excluded comprised: (1) conference abstracts, (2) case studies, (3) dissertations that had a peer-reviewed published version,¹ and (4) studies with nonhuman subjects.

2.2.2. Types of Participants and Outcomes

The present review considered studies with clinical and sub-clinical socially anxious participants. This included: (a) individuals diagnosed with SAD or social phobia according to the Diagnostic and Statistical Manual of Mental Disorders (DSM; i.e., DSM-IV and DSM-5), or the International Classification of Diseases (ICD; i.e., ICD-9 and ICD-10), (b) studies of social anxiety symptoms including a valid and reliable measure of social anxiety. For example, the Brief Fear of Negative Evaluation Scale (Leary, 1983), Brief Social Phobia Scale (Davidson et al., 1991), Social Anxiety Scale for Adolescents (García-López, Olivares, Hidalgo, Beidel, & Turner, 2001), or Liebowitz Social Anxiety Scale (Heimberg et al., 1999). No restrictions regarding participants age or sex was imposed. No restrictions regarding comparison groups were employed. We considered various comparison groups, coded as: (1) other anxiety disorders, (2) other psychiatric conditions, or (3) healthy controls.

2.3. Information Sources and Literature Search

The literature search aimed at identifying studies considering the association between social anxiety and empathic abilities. To this end, electronic PsycInfo, Medline and EMBASE searches were conducted from inception to October 11th, 2018, and updated on January 25th, 2020. For PsycINFO and Medline, the search string (Social* anx* OR social* phob*) AND (Empath* OR perspective taking OR theory of mind OR emotional knowledge OR emotion recognition OR social cognition OR mentalization OR intersubjectivity OR emotion* contagion) was used. This search string was developed in collaboration with a librarian via pilot searches documented in Appendix A. For Embase the string was adapted to: ('Socially anxious' OR 'social phobia' OR 'social anxiety') AND (Empath* OR 'perspective taking' OR 'theory of mind' OR

'emotional knowledge' OR 'emotion recognition' OR 'social cognition' OR 'mentalization' OR 'intersubjectivity').

2.4. Study Selection

Screening was conducted using Covidence software available at <https://www.covidence.org/home>. After removing duplicate articles, titles and abstracts were screened by three independent raters (L.J.S., M.-M.P., N.F.). Studies were randomly divided so that each rater screened two thirds of the studies and each abstract was screened by two raters. The complete articles were assessed for inclusion eligibility by two independent raters. If full-text articles were not available online, authors were contacted. Disagreements on whether inclusion criteria were satisfied were resolved by discussion. If necessary, co-authors (A. M.R, M.a.h.R.) were consulted. If studies reported measures of social anxiety and empathy but did not relate them, authors were contacted and asked for either the effect of interest or the raw data to calculate this effect. Authors of conference abstracts that met initial selection criteria were contacted and asked for more extensive, peer-reviewed, published presentations of the results. If applicable, these were also screened and included in the analysis. In total, 14 authors were contacted and five authors (36%) provided further information.

2.5. Summary Measure

If possible, a Pearson correlation coefficient (r) between social anxiety and empathy was extracted. Positive correlations indicate that more socially anxious individuals obtain higher empathy scores. Alternatively, we extracted other effect sizes such as Cohen's d , t -values, and F -values. These were transformed into correlation coefficients following suggestions by Borenstein, Hedges, Higgins, and Rohstein (2009). An overview of the implemented formulas can be found in Appendix B. If available, we used group means and standard deviations to compute mean differences (Cohen's d), which were later transformed into correlation coefficients.

2.6. Data Collection Process

We developed a data extraction sheet in Excel and pilot tested it in a random sample of 10 included studies and refined it accordingly. The following data were extracted from included studies: year of publication, objective, study design, participant type, age group, participant's sex, inclusion criteria, exclusion criteria, sample size (in case of parallel trials sample size per group), type of social anxiety measure (self-report or performance-based), social anxiety measure, type of empathy (AE or CE), specifier empathy (e.g., ToM, PT, emotional contagion), type of empathy measure (self-report or performance-based), empathy measure, a description of the empathy measure, emotion included in assessment, emotional valence, social threat, outcome, Pearson correlation, other statistics (if correlation was not reported), and p -value. Extraction was performed by one reviewer (L.J.S. or M.-M.P.) and checked by a second reviewer (L.J.S., M.-M.P., or N.F.). No disagreements occurred. If applicable, additional information was extracted including experimental condition and comparison group.

Inclusion of statistically dependent effects, for example more than one outcome per study, presents a serious threat to the internal validity of meta-analytic results (Scammacca, Roberts, & Stuebing, 2014). If several outcomes were provided in a study, the following rules were applied to avoid dependency between effects: (1) in case of several different measures, one measure was chosen to represent the study: (a) if a study incorporated both a self-report and performance based measure, the performance based measure was included to ensure a subgroup large enough for moderator analysis; (b) if the measures were both either self-report or performance based, the most common measure was kept (i.e., Interpersonal Reactivity Index, Reading the Mind in the Eyes Task); (c) if a study reported on both accuracy and sensitivity or reaction time

¹ Dissertations that did not have a peer-reviewed published version were eligible for inclusion.

on a performance-based measure, the effect corresponding to accuracy was kept as the other two represent measures of interpretative biases, not empathy; (2) in case of multiple effects on the same outcome, effects were averaged using a composite score. For example, subscales of an outcome measure that represented the same concept (e.g., the Social Avoidance and Distress and Fear of Negative Evaluation subscales of the Social Evaluative Anxiety scale) were averaged; or if accuracy scores of facial emotion recognition were reported for various emotions separately, a composite score across all basic emotions (i.e., fear, anger, happiness, sadness, and disgust) was calculated; (3) in case effects were reported separately for female and male participants, both effects were included as these subgroups can be considered independent samples (Borenstein, Hedges, Higgins, & Rothstein, 2009).

Analysis for valence was performed separately for positive and negative emotions, and a total for negative and positive emotions was calculated leaving out “neutral” emotions. As exact dependency between outcomes within studies was unknown, a conservative approach assuming the correlation between outcomes to be 1 was adopted when estimating the variance of the composite score following Scammacca et al. (2014). To calculate the variance of the composite score, we first calculated the variance of each reported effect size. For effects that were transformed, the variance of the reported effect was calculated and then transformed into the variance of the transformed correlation. For an overview of the formulas used please refer to Appendix B.

2.7. Risk of Bias in Individual Studies

To ascertain the validity of eligible studies, two raters (L.J.S., M.-M.P.) assessed the methodological quality of included studies using the Joanna Briggs Institute (JBI) critical appraisal checklist (Munn, Moola, Riitano, & Lisys, 2014). Disagreement was resolved by consensus. This tool was chosen, as it is applicable to the variety of study types considered in this review.

2.8. Planned Methods of Analysis

Analyses were conducted in R.Studio 1.1.456 using the *metaphor* package (Viechtbauer, 2010). To answer our research questions, the pooled relationships between social anxiety and (a) AE and (b) CE were determined using random effect models. These allow for unconditioned inferences (Hedges & Vevea, 1998). The model was specified as restricted maximum-likelihood estimation to provide an approximately unbiased and efficient estimator of heterogeneity (Viechtbauer, 2005). Heterogeneity between the studies was assessed using both H^2 , an estimate of heterogeneity between studies, and I^2 , an estimate of the total variance explained by heterogeneity.

When at least mild heterogeneity was present as indicated by $I^2 \geq 40\%$ (Deeks, Higgins, & Altman, 2008), pre-planned subgroups analyses and meta-regression were performed. Meta-regression was conducted to study the effect of (1) sample type (SAD vs. non-clinically socially anxious), (2) sex distribution (male vs. female vs. mixed), (3) and type of measure (objective vs. subjective). Significance of moderators was assessed based on the omnibus test Q_M (Viechtbauer, 2005). Subgroup analysis was performed to explore whether valence of target emotions would lead to different estimates. Initially, we planned to include presence of social threat cue as a moderator. However, as the literature search yielded only one study including a social threat cue, this moderator was excluded.

2.8.1. Risk of Bias Across Studies

Evidence of publication bias was assessed using visual inspection of funnel plots, Egger, Smith, Schneider, and Minder's (1997) regression test of funnel plot asymmetry, and trim and fill test.

2.8.1.1. Sensitivity Analysis. We planned sensitivity analysis of socially

anxious vs. healthy controls and socially anxious vs. other disorders if the number of studies was sufficient. Due to insufficient number of studies ($k = 1$) this analysis was dropped. Moreover, sensitivity analysis with and without converted studies was planned and performed (Borenstein, Hedges, Higgins, Rothstein et al., 2009). Lastly, we considered quality of studies in a sensitivity analysis.

3. Results

3.1. Study Selection

The first search of PsycInfo, MEDLINE, and EMBASE was performed in October 2018 and provided a total of 1636 articles. A second search in January 2020 resulted in an additional 290 studies. After removing duplicates, the title and abstract of 1442 studies were screened. 1327 studies were discarded as they clearly did not meet the pre-specified inclusion criteria. Thus, 115 studies were included in the full text screening. Of these, 39 studies were excluded as they did not include a measure of empathy or social anxiety. Additionally, eight studies were discarded as they did not report on the association between social anxiety and empathy and authors did not provide these upon our request (labelled as different outcome in the flowchart), only included post-treatment assessment of empathy but no baseline, or the design did not allow for clear identification of the association between social anxiety and empathy. Seven studies were not available, and an additional six conference abstracts were excluded. Moreover, we identified three additional duplicates which were not detected by the software and excluded these. For an overview of the study selection process please see Fig. 1.

The screening process resulted in a total of 48 articles including 50 studies. Of these, 36 studies reported multiple effects resulting in a total of 188 extracted effects. Selection and combining of effects using composite scores yielded a total of 101 effects (for an overview of this process please refer to Appendix C). Effects were classified as assessing either the association between social anxiety and (a) AE or (b) CE. For one study, the reported correlation incorporated both AE and CE as both subscales of the Basic Empathy Scale (BES) were combined to obtain the estimate. Thus, this study was included in both meta-analyses (Marlowe, 1986). Consequently, the meta-analysis regarding AE and social anxiety comprised 20 effects and the meta-analysis regarding CE and social anxiety comprised 81 effects.

For AE, 14 effects were considered in the main analysis, three in the subgroup analysis regarding positive and three in the subgroup analysis regarding negative valence emotions. For CE, 52 effects were considered in the main analysis, 13 in the subgroup analysis regarding positive and 15 in the subgroup analysis regarding negative valence emotion. Two effects were considered in both the main analysis and the subgroup regarding negative valence.

3.2. Study Characteristics

The included studies varied in design comprising cross-sectional ($k = 27$), case-control ($k = 16$), quasi-experimental ($k = 3$), longitudinal ($k = 1$), and randomized controlled studies ($k = 1$). Various aspects of CE including ToM ($k = 13$), PT ($k = 6$), facial or verbal emotion recognition ($n = 18$), affective and empathic forecasting ($k = 3$), mentalizing ($k = 1$), emotional intelligence ($n = 1$), and not further specified ($k = 10$) were inspected. Similarly, studies considering AE investigated various aspects such as emotional contagion ($k = 1$), facial mimicry ($k = 2$), and not further specified ($k = 11$). For an overview regarding the number of participants and further study characteristics please refer to Table 1.

3.3. Risk of Bias

Appendix E summarizes the risk of bias and provides an overview of all relevant judgements. As items varied per study design, ratings are

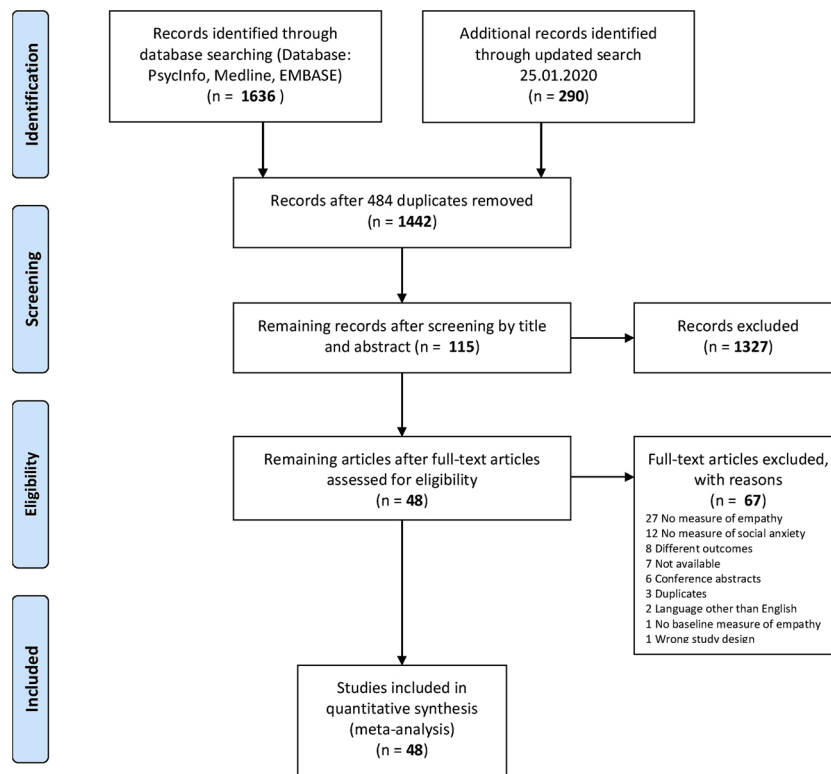


Fig. 1. Flow diagram of data extraction progress.

reported separately for case-control, cohort, cross-sectional, randomized controlled, and quasi-experimental studies. Post hoc sensitivity analysis excluded seven case-control studies, four cross-sectional studies, and one quasi-experimental study, which scored high on at least one item.

3.4. Data Synthesis

3.4.1. Social Anxiety and Affective Empathy

The meta-analysis regarding the association between social anxiety and AE ($k = 14$) yielded a statistically significant result, $r = .103$ (95% CI [.003, .203]), $z = 2.03$, $p = .043$. For a graphical overview refer to Fig. 2.

The index of heterogeneity between studies $H^2 = 14.74$ (95% CI [8.03, 41.90]) was significant ($Q(13) = 199.72$, $p < 0.001$), suggesting that the observed variability in the effects is larger than would be expected based on the sampling variance $I^2 = 93.22\%$ (95% CI [87.56, 97.61]). Thus, we must suspect that variability of effects might be due to differences between studies and, therefore, test for possible determinants of dispersion in a moderator analysis.

Table 2 presents an overview of the moderator and subgroup analyses. Sample type (clinical vs. non-clinical) did not significantly moderate the association between social anxiety and AE ($Q_M(1) = 0.01$, $p = .941$). Sex significantly moderated the association between social anxiety and AE ($Q_M(2) = 18.79$, $p < .0001$, $R^2 = 65.06$). Test of residual heterogeneity remained significant ($Q(11) = 62.22$, $p < .0001$). Heterogeneity decreased substantially $H^2 = 5.03$ (95% CI [3.23, 22.04]) and $I^2 = 80.12\%$ (95% CI [69.08, 95.46]). For male participants ($k = 4$), social anxiety and AE were significantly positively related ($r = .316$, (95% CI [.200, .432]), $z = 5.33$, $p < .0001$), whereas the association remained insignificant for female ($r = .037$, (95% CI [-.078, .151]), $z = 0.63$, $p = .529$), and mixed samples ($r = -.010$, (95% CI [-.113, .094]), $z = -0.18$, $p = .852$). A visualization can be found in Appendix F. Interpretation of these values is limited given the large confidence intervals and small number of studies.

Similarly, type of measure (self-report vs. performance based) moderated the association between social anxiety and AE ($Q_M(1) =$

7.34, $p = .007$). Test of residual heterogeneity remained significant ($Q(12) = 123.16$, $p < .0001$). Heterogeneity decreased $H^2 = 7.98$ (95% CI [4.61, 24.53]) and $I^2 = 87.48\%$ (95% CI [78.29, 95.92]). For studies employing self-report measures the pooled association between social anxiety and AE was small and positive, $r = .162$ (95% CI [.070, .254]), $z = 3.46$, $p = .0005$.

Subgroup analysis of effects considering positive vs. negative emotional valence did not yield significant results. Yet, the number of studies is insufficient to interpret the results of this analysis (Borenstein, Hedges, Higgins, Rohstein et al., 2009b).

Risk of bias across studies was visually inspected using a funnel plot (Fig. 3). The plot does not suggest asymmetry and thus does not point towards the presence of publication bias. In accordance with the visual representation, the regression test for funnel plot asymmetry was non-significant ($z = -0.31$, $p = .757$). Based on the large observed between studies heterogeneity, a random-random effects trim and fill model was implemented to check for the presence of publication bias (Peters, Sutton, Jones, Abrams, & Rushton, 2007). According to the trim and fill, the estimate $r = .103$ (95% CI [-.003, .203], $z = 2.06$, $p = .043$) remained stable and no study was imputed.

3.4.2. Social Anxiety and Cognitive Empathy

The meta-analysis regarding the association between social anxiety and CE ($k = 52$) yielded a non-significant result, $r = -.021$ (95% CI [-.075, .034]), $z = -0.74$, $p = .459$. For a graphical overview refer to Fig. 4.

Corresponding to the variability in effects displayed in the forest plot, the index of heterogeneity $H^2 = 8.19$ (95% CI [5.65, 13.84]) was significant ($Q(51) = 631.10$, $p < 0.0001$), suggesting that the observed variability in the effects is larger than would be expected based on the sampling variance $I^2 = 87.79\%$ (95% CI [82.30, 92.78]). Thus, we must suspect that variability of effects might be due to differences between studies and, therefore, test for possible determinants of dispersion in a moderator analysis.

Moderator analysis suggested a statistically significant effect of

Table 1
Overview of Selected Studies Investigating the Association Between Social Anxiety and Empathy.

Study	Study design	Total N	Mean Age (SD)	Sex (% female)	Sample Groups	Continuous measure of social anxiety	Task: Instrument	Aspect of Empathy	Outcome	p-value
Affective Empathy										
Berryman, Ferguson, & Negy (2018)	cross-sectional	467	19.7 (3.9)	72	HV	LSAS	Questionnaire: IRI-empathic concern	EC	$r = -.124$	.007
Dijk et al. (2018)	cross-sectional	94	21.0 (6.0)	82	HV	SIAS	Facial Expression: FACS coding	FM	$r = -.021^a$	.840
Dimberg (1997)	cross-sectional	16	n.a.	100	HV	public report of confidence as a speaker questionnaire	facial EMG	FM	$r = -.187$	.448
Gambin, & Sharp (2018)	cross-sectional	260 143	15.8 (1.4)	65	HV	MAS-C	Questionnaire: BES	not specified	$r_f = .227^a$ $r_m = .222^a$	.0002 .007
Morrison et al. (2016)	case-control	32 32	31.9 (7.9) 31.7 (8.0)	56 56	SAD-G HC	LSAS	Questionnaire affect	EC	$r = -.147^a$	.246
Nunes, Ayala-Nunes, Pechorro, La Greca (2018)	cross-sectional	409 426	16.0 (1.7) 15.8 (1.7)	0 100	HV HV	SAS-A	Questionnaire: BES	not specified	$r_m = .330$ $r_f = .140$	$7.58E^{-10}$.0004
Nunes, Ayala-Nunes, Pechorro, La Greca (2018)	cross-sectional	244	16.7 (1.4)	0	HV	SAS-A	Questionnaire: BES	not specified	$r = .370$	$2.47E^{-9}$
Pechorro, Ray, Gonçalves, & Jesus (2017)	cross-sectional	426 409	15.8 (1.7) 15.9 (1.7)	100 0	HV HV	SAS-A	Questionnaire: BES	not specified	$r_f = -.030$ $r_m = .330$	.537 .0001
Pepper et al. (2019)	case-control	71 26	22.6 (6.0) 25.0 (6.6)	47 31	SAD HC	ADIS-IV/V	Questionnaire: CBSEQ	not specified	$r = .083$	.420
Cognitive Empathy										
Ale, Chorney, Brice, & Morris (2010)	cross-sectional	99	4.5 (n.a.)	50	HV	SPAS	Recognition of children facial expressions: DANVA2	FER	$r = .330$	.001
Alvi, Kouros, Lee, Fulford, & Tabak, (2020)	cross-sectional	1485	25.8 (11.6)	69	HV	SPS, SIAS, LSAS ^a	Inference of mental states: MIE	ToM	$r = -.073$	.005
Arditte Hall, Coleman, & Timpano (2019)	cross-sectional	93	36.2 (22.6)	52	HV	SIAS	Empathic forecasting task	EF	$r = .149^a$	.015
Arditte Hall, Joormann, Siemer, & Timpano (2018)	cross-sectional	100	19.1 (1.2)	67	HV	SIAS	Affective forecasting: Vignettes	AF	$r = -.057^a$	.058
Arditte Hall, Joormann, Siemer, & Timpano (2018)	cross-sectional	104	19.4 (1.6)	61	HV	SIAS	Empathic forecasting task	EF	$r = .217$	.003
Arrais et al. (2010)	case-control	78 153	22.3 (5.1)	62	SAD HC	BSPS	Recognition of facial expressions: pictures	FER	$d = 0.16$	.268
Auyeung & Alden (2016)	experimental	121	20.1 (2.3)	79	HV	SIAS	Recognition of facial expressions: empathic accuracy task	FER	$r = .215$	.018
Ballespí, Pérez-Domingo, Vives, Sharp, & Barrantes-Vidal (2018)	cross-sectional	48 148	14.7 (1.7)	53	NCSA HV	SAS-A	Questionnaire: MZQ	MZ	$r = .271^b$	.0001
Batanova & Loukas (2011)	cross-sectional	485	11.7 (0.8)	54	HV	SAS-A	Questionnaire: IRI-PT	PT	$r = -.010$	.826
Bodner, Aharoni, & Iancu (2012)	quasi-experimental	39 41	28.6 (4.6)	40	SAD HC	LSAS	Recognition of vocal prosody	VPR	$r = .162$	.151
Broeren, Muris, Diamantopoulou, & Baker (2013)	cross-sectional	224	6.1 (1.6)	54	HV	PAS-R	Interview: Theory on Mind test	ToM	$r = -.040$	.551
Buhlmann, Wacker, & Dziobek (2015)	case-control	35 35	32.2 (8.9) 32.7 (11.0)	60	SAD HC	LSAS	Inference of mental states: MASC	ToM ER Total	$r = .468$	.0001
Button, Lewis, Penton-Voak, & Munafó (2013)	case-control	52 50	23.0 (n.a.)	100	NCSA HC	BFNE	Recognition of facial expressions: morphed pictures	FER	$r = .000$	1
Campbell et al. (2009)	case-control	12 28	31.9 (10.7) 30.4 (11.0)	58 36	SAD-G HC	LSAS	Recognition of facial expressions: pictures	FER	$r = .049$.764

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Table 1 (continued)

Study	Study design	Total N	Mean Age (SD)	Sex (% female)	Sample Groups	Continuous measure of social anxiety	Task: Instrument	Aspect of Empathy	Outcome	p-value
Colonnesi, Nikolić, de Vente, & Bögels (2017)	cross-sectional	110	4.5 (0.1)	51	HV	PAS-R	Interview: Theory on Mind test -revised	ToM	$r = -.190$	.047
Gambin & Sharp (2018)	cross-sectional	260	15.8 (1.4)	65	HV	MAS-C	Questionnaire: BES	not specified	$r_f = -.048^a$ $r_m = -.150^a$	.441 .083
Gavilán & Haro (2017)	cross-sectional	96	20.8 (3.0)	73	HV	ESQUIZO-Q	Inference of mental states: MIE	ToM	$r = -.070^b$	.496
Hezel & McNally (2014)	quasi-experimental	40	23.3 (8.6)	76	SAD HC	LSAS	MASC	ToM	$r = .330$	.003
Janssen et al. (2014)	quasi-experimental	13	38.1 (11.2)	69	SAD HC	SIB	Deictic Framing Task	PT	$r = -.466$	.014
Lenton-Brym, Moscovitch, Vidovic, Nilsen, & Friedman (2018)	cross-sectional	78	19.4 (1.6)	72	NCSA HV	SPIN	Inference of mental states: MIE	ToM	$r = .073$	.449
Loudin, Loukas, & Robinson (2003)	cross-sectional	300	21.3 (1.3)	68	HV	SEA-SAD	Questionnaire: IRI	PT	$r_f = -.060$ $r_m = -.080$	.395 .436
Masten, Gillen-O'Neel, & Brown (2010)	cross-sectional	94	8.7 (1.8)	50	HV	SASC	Questionnaire: IRI	not specified	$r = .150$	.149
Montagne et al. (2006)	case-control	24	36.7 (10.4)	58	SAD-G HC	LSAS	Recognition of facial expressions: morphed pictures	FER	$r = .176$	.221
Morningstar, Nowland, Dirks, & Qualter (2019)	cross-sectional	122	15.4 (1.8)	57	HV	Social Anxiety Measures for Children and Adolescents	Vocal prosody recognition task	VER	$r = .049$	.093
Morrison et al. (2016)	case-control	32	31.9 (7.9)	56	SAD-G HC	LSAS	Recognition of facial expressions: movies	FER	$d = 0.10$	.695
Nunes et al. (2018)	cross-sectional	409	16.0 (1.7)	0	HV	SAS-A	Questionnaire: BES	not specified	$r_m = .002$ $r_f = .002$	.313 .537
Nunes et al. (2018)	cross-sectional	244	16.7 (1.4)	0	HV	SAS-A	Questionnaire: BES	not specified	$r = .004$	.061
Oh et al. (2018)	case-control	56	27.3 (9.6)	46	SAD HC	LSAS	Recognition of facial expressions: pictures	FER	$d = 0.49$	.011
Pechorro et al. (2017)	cross-sectional	426	15.8 (1.7)	100	HV	SAS-A	Questionnaire: BES	not specified	$r_f = .140$ $r_m = .050$	.003 .313
Pepper et al. (2018)	case-control	64	22.7 (6.0)	47	SAD HC	SIAS	Inference of mental states: MIE	ToM	$r = -.018$	.862
Pepper et al. (2019)	case-control	71	22.6 (6.0)	47	SAD HC	ADIS-IV/V	Questionnaire: CBSEQ	not specified	$r = -.439$	.0001
Pile, Haller, Hiu, & Lau (2017)	cross-sectional	59	15.3 (2.1)	54	HV	SAS-A	Inferring others mental states: Director task	PT	$d = 0.52$	.082
Quadflieg, Wendt, Mohr, Miltner, & Straube (2007)	case-control	15	23.3 (n.a.)	53	SAD-G HC	LSAS	Vocal prosody recognition task	VPR	$d = 0.73$	.065
Rawdon et al. (2018)	RCT	225	n.a.	59	HV	SPAI	Recognition of facial expressions: pictures	FER	$r = -.010^b$	.927
Ronchi, Banerjee, & Lecce (2019)	cohort	66	11.5 (0.3)	45	HV	SASC	Theory of mind task: Stranger Stories Task	ToM	$r = .120$	.337
Samson, Lackner, Weiss, & Papousek (2012)	cross-sectional	56	24.3 (6.3)	50	HV	SPIN	Theory of Mind cartoons: response latency	ToM	$r = -.200$	.139
Silvia, Allan, Beauchamp, Maschauer, & Workman (2006)	cross-sectional	30	n.a.	83	HV	SIAS	Recognition of facial expressions: pictures	FER	$r = .073^a$	.701
Silvia et al. (2006)	cross-sectional	27	n.a.	78	HV	SIAS	Recognition of facial expressions: pictures	FER	$r = .197^a$	.325
Summerfeldt, Kloosterman, Antony, & Parker (2006)	cross-sectional	2629	20.2 (3.6)	71	HV	SIAS	Questionnaire: EQI-S	EI	$r = -.400$.0001

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Table 1 (continued)

Study	Study design	Total N	Mean Age (SD)	Sex (% female)	Sample Groups	Continuous measure of social anxiety	Task: Instrument	Aspect of Empathy	Outcome	p-value
Sutterby, Bedwell, Passler, Deptula, & Mesa (2012)	case-control	27 29	19.1 (1.6)	59 62	SAD HC	SPAI	Inference of mental states: MIE	ToM	$r_f = .562$ $r_m = .100$	.001 .657
Taljaard, Doruyter, Stein, & Lochner (2017)	case-control	16 17	n.a.	n.a.	SAD HC	LSAS, SPIN	Recognition of facial expression	ER	$r = .391$	.004
Tibi-Elhanany & Shamay-Tsoory (2011)	cross-sectional	86	25.2 (7.4)	42	HV	LSAS	Questionnaire: IRI-cognitive	PT	$r = .250$	.020
Torro-Alves et al. (2016)	case-control	22 21	21.5 (3.0)	42	NCSA HC	SPIN	Recognition of facial expressions: pictures	FER	$d = 0.04$	.899
Tseng et al. (2017)	case control	31 31	30.2 (9.9)	55	SAD HC	LSAS	Recognition of facial expressions: pictures + Recognition of vocal prosody	FER + VPR	$d = 0.51$	.053
Vanhalst, Gibb, & Prinstein (2017)	cross-sectional	170	13.7 (0.6)	51	HV	SAS-A	Recognition of facial expressions: morphed pictures	FER	$r = .060$	.437
Washburn, Wilson, Roes, Rnic, & Harkness (2016)	case-control	12 40 24 43	19.4 (2.9)	68	SAD SAD + MDD MDD HC	SAASA	Inference of mental states: MIE	ToM	$r = -.065$	.482
Wieckowski et al. (2016)	cross-sectional	32 32	14.6 (1.7)	67	NCSA HC	LSAS	Recognition of facial expressions: pictures	FER	$r = .289$	.021
<i>Not further specified</i>										
Marlowe (1986)	cross-sectional	188	43.4 (n.a.)	84	HV	various	Questionnaire: IRI	not specified	$r = -.065$	.482

Note. ADIS-IV/V: Anxiety Diagnostic Interview Schedule; AF: Affective forecasting; BES: Basic Empathy Scale; BFNE: Brief Fear of Negative Evaluation Scale; BSPS: Brief Social Phobia Scale; CBSEQ: Cambridge Behaviour Empathy Quotient; DANVA2: The Adult and Child Facial Expressions; EC: Emotional contagion; EF: Empathic forecasting; EI: Emotional Intelligence; EMG: Electromyography; EQI-S: Bar on Emotional Quotient Inventory-short; ER: Emotion recognition; ESQUIZO-Q: Oviedo Schizotypy Assessment Questionnaire; FACS: Facial action coding system; FER: Facial Emotion Recognition; FM: Facial mimicry; HC: healthy controls; HV: healthy volunteers; IRI: Interpersonal Reactivity Index/Interpersonal Reactivity Scale; IRI-PT: Interpersonal Reactivity Index/Scale – Perspective taking subscale; LSAS: Liebowitz Social Anxiety Scale; MASC: Movie for Assessment of Social Cognition; MAS-C: Multidimensional Anxiety Scale for Children; MIE: Reading the Mind in the Eyes; MZ: mentalizing; MZQ: Mentalization Questionnaire; n.a.: not available; NCSA: non-clinical social anxiety; PAS-R: revised Preschool Anxiety Scale; PT: Perspective Taking; r_f = correlation for female sample; r_m = correlation for male sample; SAAS: Social Anxiety and Avoidance Scale for Adolescents; SAD: Social Anxiety Disorder; SAD-G: generalized Social Anxiety Disorder; SAS-A: Social Anxiety Scale for Adolescents; SASC: Social Anxiety Scale for Children; SEA: Social Evaluation Anxiety Scale; SIAS: Social Interaction Anxiety Scale; SIB: Scale for Personal Behaviour; SPAI: Social Phobia and Anxiety Inventory-Children; SPAS: Spence Preschool Anxiety Scale; SPIN: Social Phobia Inventory; ToM: Theory of Mind; VPR: Vocal Prosody Recognition.

^a Composite score.

^b Effect of interest calculated from raw data.

References for articles only included in the meta-analysis and not further discussed in the text can be found in Appendix D.

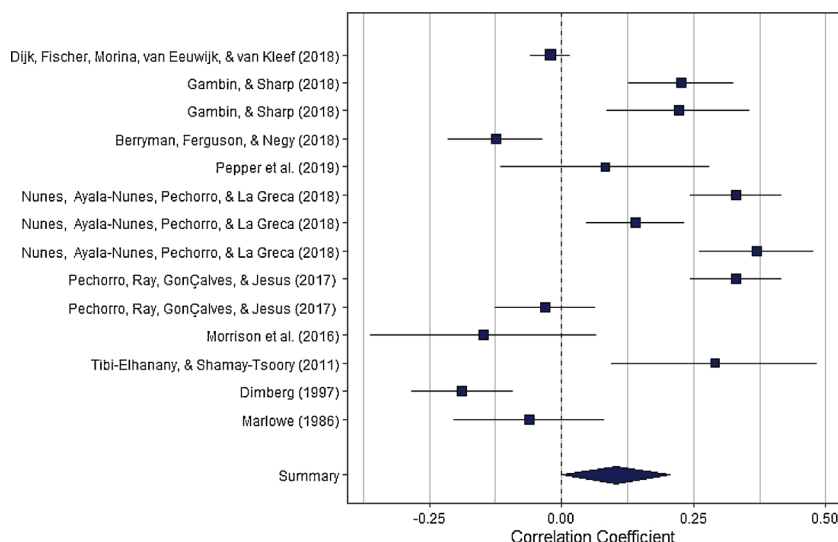


Fig. 2. Forest plot of the analysis of the association between social anxiety and AE. Studies are sorted by year of publication. Weighted effect size and 95% CI are presented on the right.

Table 2
Results from Moderator and Subgroup Analysis Corresponding to the Meta-Analysis on the Association Between Social Anxiety and AE

		Sample size		Effect size			Heterogeneity	
		<i>k</i>	<i>n</i>	<i>r</i>	95%CI	<i>p</i>	<i>H</i> ²	<i>I</i> ²
Moderator analysis								
Sample type							14.79***	93.24
	clinical	4	564	.109	[-.084; .303]	.269		
	non-clinical	10	2765	.101	[-.015; .216]	.089		
Sex							5.03***	80.12
	female	4	1128	.037	[-.078; .151]	.529		
	male	4	1205	.316	[.200; .432]	<.001		
	mixed	6	996	-.010	[-.113; .094]	.852		
Type of Measure							7.89 ***	87.48
	performance-based	3	174	-.112	[-.288; .064]	.201		
	self-report	11	3155	.162*	[.070; .254]	.0005		
Subgroup analysis								
Valence							2.12*	52.79
	positive	3	174	-.128	[-.338; .083]	.235		
	negative	3	174	.015	[-.328; .357]	.932	6.33*	84.19

Note. *k* = number of studies [bold *k* indicates an insufficient sample size based on (Borenstein, Hedges, Higgins, Rohstein et al., 2009)]; *n* = number of participants; *H*²= sampling variability; *Esr* = overall mean effect size; *CI* = confidence interval; *Q* = heterogeneity statistic.
p* < .05. *p* < .01. ****p* < .001.

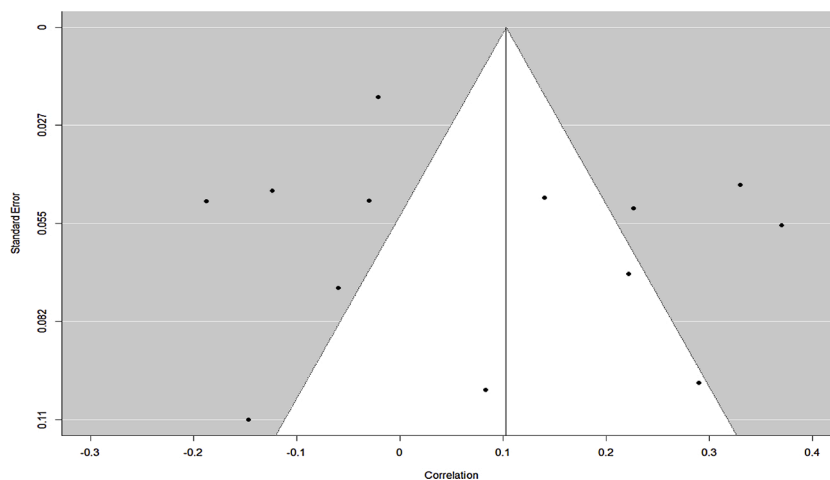


Fig. 3. Funnel corresponding to the meta-analysis on the association between Social anxiety and AE.

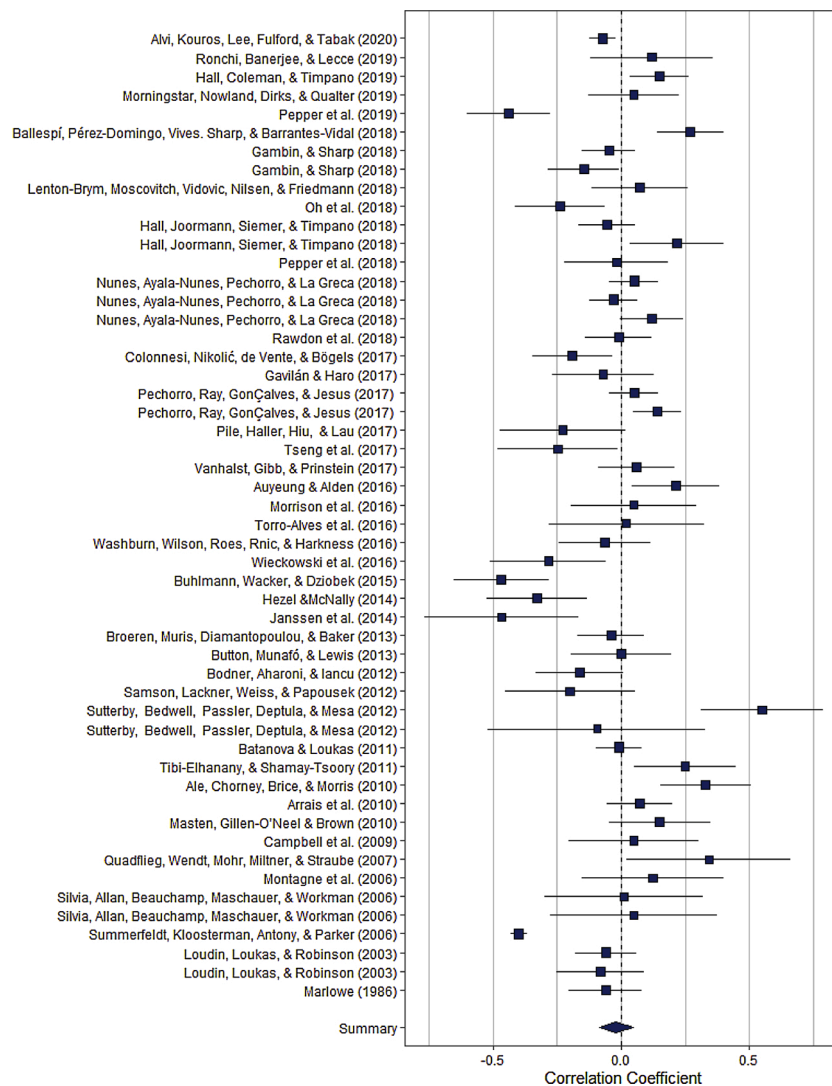


Fig. 4. Forest plot of the analysis of the association between social anxiety and CE. Weighted effect size and 95% CI are presented on the right. Studies are sorted by year.

Table 3

Results from Moderator and Subgroup Analysis Corresponding to the Meta-Analysis on the Association Between Social Anxiety and CE

		Sample size		Effect size			Heterogeneity	
		k	n	r	95%CI	p	H ²	I ²
Moderator analysis								
Sample type							7.25***	86.20
	clinical	16	1705	-.112*	[-.201, -.017]	.021		
	non-clinical	36	9310	.017	[-.044, .079]	.575		
Sex							7.59***	86.83
	female	6	1415	.073	[-.077, .223]	.337		
	male	6	1324	-.006	[-.160, .149]	.943		
	mixed	40	8240	-.039	[-.100, .023]	.218		
Type of Measure							7.65***	86.93
	performance-based	33	4233	-.010	[-.080, .060]	.782		
	self-report	19	6782	-.036	[-.121, .049]	.406		
Subgroup analysis								
Valence							3.45***	71.02**
	positive	13	2322	-.088	[-.188, .013]	.086		
	negative	15	2556	.021	[-.045, .087]	.532	2.35**	57.44

Note. k = number of studies [bold k indicates an insufficient sample size based on (Borenstein, Hedges, Higgins, Rohstein et al., 2009)]; n = number of participants; H²= sampling variability; Esr = overall mean effect size; CI = confidence interval; Q = heterogeneity statistic.

*p < .05. **p < .01. ***p < .001.

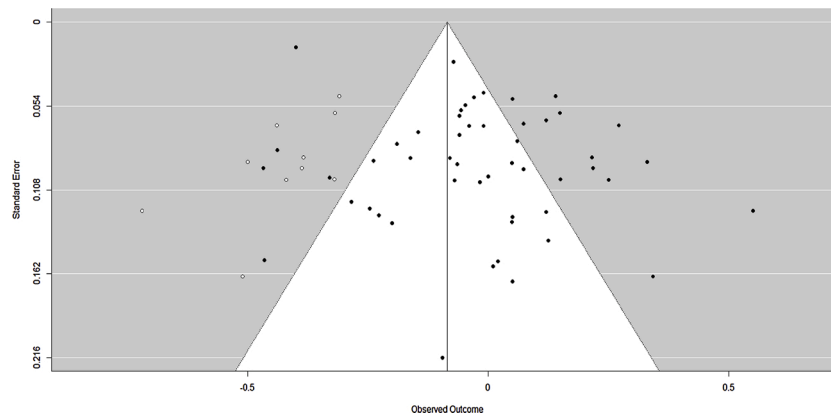


Fig. 5. Funnel corresponding to the meta-analysis on the association between social anxiety and CE.

sample type, $Q_M(1) = 5.03$, $p < .0001$, explaining R^2 3.96% of unexplained variability. Test of residual heterogeneity remained significant ($Q(49) = 546.18$, $p < .0001$). Heterogeneity decreased slightly $H^2 = 7.59$ (95% CI [5.43, 13.44]) and $I^2 = 86.83\%$ (95% CI [81.59, 92.56]) While the association was statistically non-significant for non-clinically socially anxious individuals ($r = .018$, (95% CI [-.044, .079]), $z = 0.56$, $p = .575$), social anxiety and CE were negatively related for individuals with clinical social anxiety ($r = -.112$, (95% CI [-.201, -.017]), $z = -2.31$, $p = .021$). A visualization can be found in Appendix F.

Neither sex ($Q_M(2) = 1.88$, $p = .391$), nor type of measure ($Q_M(1) = 0.21$ $p = .643$) significantly moderated the association between social anxiety and CE.

Subgroup analysis of effects considering positive vs negative emotional valence did not yield significant results. There was no statistically significant association between social anxiety and CE for negative or positive emotions. Please refer to Table 3 for an overview of the moderator and subgroup analysis.

The funnel plot (Fig. 5) is slightly asymmetrical, which might indicate presence of publication bias. Nonetheless, the Egger's (1997) regression test for funnel plot asymmetry was non-significant ($z = 0.22$, $p = .828$). Based on the large observed between studies heterogeneity, a random-random effects trim and fill model was implemented to check for the presence of publication bias (Peters et al., 2007). The estimate was statistically significant after imputation of ten potentially missing studies on the left $r = -.086$ (95% CI [-.145, -.026], $z = 2.81$, $p = .005$). Regardless, no clear statement about a possible influence of publication bias is possible. In the light of substantial heterogeneity, the trim and fill method is known to perform poorly (Peters et al., 2007; Terrin, Schmid, Lau, & Olkin, 2003).

3.5. Additional Analysis

3.5.1. Sensitivity Analysis

Whether effects were a composite score or not, did not significantly moderate the association between social anxiety and AE ($Q(1) = 1.54$, $p = .215$) nor CE ($Q(1) = 0.31$, $p = .581$). The number of studies did not suffice to perform sensitivity analysis regarding the comparison group.

Exclusion of studies identified as being at risk regarding their quality did not result in a meaningful change regarding the pooled estimate of the association between social anxiety and AE ($r = .117$, 95% CI [.006, .229], $z = 2.07$, $p = .039$) and estimated degree of heterogeneity ($H^2 = 17.72$, $I^2 = 94.36$, $Q(10) = 74.94$, $p < .0001$). For the meta-analysis regarding social anxiety and CE, the pooled estimate did not change meaningfully ($r = -.020$, 95% CI [-.077, .036], $z = -0.70$, $p = .484$). The estimated degree of heterogeneity ($H^2 = 7.53$, $I^2 = 86.71$, $Q(37) = 529.85$, $p < .0001$) remained very high.

3.5.2. Post Hoc Analysis

Given the diversity in aspects of both AE and CE considered in the present sample of studies, post-hoc analysis (not specified a priori in protocol) was performed to investigate whether differences between different aspects of either AE or CE exist. For AE, moderator analysis indicated a statistically significant difference in effect estimates between studies considering facial mimicry, emotional contagion, or not further specified aspects of AE ($Q(2) = 7.41$, $p = .025$). Our analysis indicated a statistically significant positive association for studies considering not further specified aspects of AE ($r = .162$, 95% CI [.070, .253], $z = 3.47$, $p = .0005$). For CE, moderator analysis indicated differences across different aspects of CE ($Q(6) = 13.99$, $p = .030$). The estimated association between emotional intelligence and social anxiety was significant ($r = -.400$, 95% CI [-.687, -.113], $z = -2.74$, $p = .006$), whereas emotion recognition (composed of both verbal and facial emotion recognition), mentalizing, PT, empathic forecasting (also including affective forecasting) and ToM did not yield significant estimates. Nonetheless, the present sample contained only one study considering emotional intelligence thus preventing interpretation of these results. Results did not change significantly when the study that considered emotional intelligence was deleted.

4. Discussion

This systematic review and meta-analysis aimed to clarify the association between social anxiety and empathy. Prior lines of research had argued for both lower (e.g., Dijk et al., 2018; Dimberg, 1997; O'Toole et al., 2013) and higher empathy (e.g., Alden & Taylor, 2004; Morrison et al., 2016; Tibi-Elhanany & Shamay-Tsoory, 2011) in socially anxious individuals. The present results indicate a positive association between social anxiety and AE, meaning that social anxiety is associated with increased AE. Overall, CE and social anxiety did not appear to be associated based on the main analysis.

Between-study heterogeneity was substantial in both main analyses, with effect sizes varying from medium negative to medium positive for AE and from large negative to large positive for CE. This variability is reflective of the divergent theories in the field. To examine the possibility that third variables partially accounted for the inconsistency of effects, subsequent moderator analyses were performed, which are discussed in detail below.

4.1. Social Anxiety and Affective Empathy

As the overall association between social anxiety and AE was weak, moderator analysis was performed to clarify whether the association might be stronger for specific subgroups. Indeed, a priori specified analyses suggested sex to be a moderator. Meta-regression suggested a moderate positive correlation between social anxiety and AE for all-male

samples while the association remained non-significant for all-female and mixed samples. Studies considering male participants only consisted of samples of children and/ or adolescents. Increased difficulty to disengage from social threat cues in socially anxious male compared to female children and adolescents (Zhang, Ni, Xie, Xu, & Liu, 2017; Zhao, Zhang, Chen, & Zhou, 2014) might explain the observed effect. Attentional bias to social threat had previously been positively related to social anxiety in men, with no association for women (Zhao et al., 2014). For socially anxious individuals, the presence of another person can present a social threat (e.g. anticipation of judgement or embarrassing oneself). Being captured by the social threat (i.e., the other person), might help with picking up subtle emotional cues as to the emotional state of the other person. In other words, the attentional bias to social threat cues might make males more sensitive to the emotions of others.

A priori specified analyses also suggested type of measure to moderate the association between social anxiety and AE. Results suggest a small positive association between social anxiety and AE for studies employing self-report measures, while the pooled association was non-significant for studies employing performance-based measures (i.e., facial EMG, FACS coding). The discrepancy might indicate that socially anxious individuals have poor insight into their empathic abilities or reflect a tendency to answer socially desirable out of fear to be evaluated negatively. Self-report measures of empathy are subjective and susceptible to distortions by response biases such as the social desirability bias (Neumann, Chan, Boyle, Wang, & Westbury, 2015), while behavioural measures are deemed to be more objective and ecologically valid compared to self-report and reduce the impact of the social desirability bias (Anastassiou-Hadjicharalambous & Warden, 2007). Overall, methodological differences, such as different types of measures might account for some of the observed variability in the published literature.

Sample type and valence did not yield a statistically significant moderation effect. Additionally, in a post hoc analysis we considered whether specific aspects of AE would account for a proportion of the observed heterogeneity. Pooled estimates varied between studies considering facial mimicry, emotional contagion, or not further specified aspects of AE, with the statistically significant positive association between social anxiety and not further specified aspects of AE. We would like to stress that interpretation of this post hoc analysis is very limited. First, studies considered not further specified aspects of AE commonly employed self-report measures, thus being prone to the biases mentioned above. More importantly, only three studies considered specified aspects of AE compared to 11 studies considering non-specific aspects of empathy. These unequal groups severely limit interpretation of statistical significance.

While the present meta-analysis suggests a small positive association between social anxiety and AE, we do not give much weight to this finding. Interpretation of the present meta-analysis regarding the association between social anxiety and AE is limited by several aspects. First, the small number of included studies limits interpretation. Moderators had not been assessed consistently across studies, resulting in moderator analysis including subgroups ranging from three to a maximum of 11 studies. Consequently, pooled estimates and associated significance tests might be unreliable and estimates prone to overestimation (Aguinis, Gottfredson, & Wright, 2011; Borenstein, Hedges, Higgins, Rohstein et al., 2009b) evident by large confidence intervals observed (Snijders, 2001). Thus, definite conclusions should be postponed until more evidence is gathered.

Moreover, we note that the two statistically significant moderator effects (of sex and type of measure) are driven by the same two studies (i.e., Gambin & Sharp, 2018; Pechorro, Ray, Gonçalves, & Jesus, 2017), which differed from the remaining eight studies. First, they differentiated effects for male and female participants while other studies did not. The possibility of publication bias – other studies also differentiating between sex but not reporting statistically non-significant sex effects – cannot be dismissed. Second, both employed self-report measures, which may be subject to the biases innate to these types of measures.

Third, these studies examined the association between social anxiety and AE in children. It is conceivable that a sex difference is only present in children and adolescents. As there are no sex differences in the onset of social anxiety (Asher & Aderka, 2018), this could point towards a sex-specific mechanism underlying the emergence of social anxiety in children and adolescents. Sex-consistent stereotypes are thought to reinforce empathic concern for girls but not boys (Van der Graaff et al., 2014). For boys, the inability to overtly express emotional concern might result in social withdrawal and foster social anxiety.

Additionally, visual inspection of the funnel plot reveals a lack of studies concerning null effects and effects tending to group into the extremes of the plot suggesting selective publication based on the p-value (Higgins & Altman, 2008). Overall, there is need to replicate present studies and further examine the association between social anxiety and AE in samples of both adults and children, including sex as a common moderator. Thus, definite conclusions should be postponed until further studies allow for more compelling conclusions.

4.2. Social Anxiety and Cognitive Empathy

The present meta-analysis did not suggest an overall association between social anxiety and CE. Nonetheless, moderator analysis indicated a small negative association between social anxiety and CE for clinical socially anxious individuals (i.e., SAD patients). We would like to note that the association became statistically significant only after the updated analysis including 9 additional sources published between 2018 and 2020, while the effect estimate remained roughly the same. Additionally, considering the forest plot provided in Appendix F, we still observe a high degree of variability between the studies considering clinical samples, suggesting caution when interpreting the result.

Nonetheless, our analysis does suggest a small association between social anxiety and cognitive empathy for SAD patients or individuals scoring above the clinical cut-off. The meaning of this association, however, is far from clear. Lower CE might either be a cause or consequence of SAD or simply a correlate. Following the cognitive behavioural model of social anxiety (Rapee & Heimberg, 1997), preoccupation with the self in anxiety provoking social situations might prevent allocation of attention to cues needed to correctly infer the emotional state of another person, thus making lower CE a consequence of SAD. Moreover, avoidance of social situations and impaired social functioning (Alden & Taylor, 2004; Morrison et al., 2016), symptoms more likely to be present in clinical but not subclinical socially anxious individuals, might further limit CE. It is also conceivable that sufficiently low CE might contribute to the development of SAD as individuals develop anxiety in uncertain situations (i.e., when they cannot understand the emotional reactions of others). Lastly, we cannot exclude the possibility that the observed association between CE and SAD might be due to a third variable, such as the presence of comorbid depressive disorders. SAD and depression, for which a negative association with CE has been previously found (Schreiter et al., 2013), are highly comorbid (Ohayon & Schatzberg, 2010). Taken together, it is difficult to establish whether low CE contributes to or is a consequence of SAD. Future research might be able to establish meaning of the association.

4.3. Limitations of the Present Meta-analysis

4.3.1. Limitations at the Study Level

Results of the present systematic review and meta-analysis need to be considered in light of limitations. Social threat cue could not be investigated as a potential moderator. Only one study examining the effect of social threat cues on the association between social anxiety and CE (i.e., Auyeung & Alden, 2016) was identified. As hypothesized, socially anxious individuals were more accurate at inferring other's negative emotions compared to low socially anxious individuals when exposed to social threat, but not in its absence. This suggests that social anxiety might affect empathy especially in situations of social threat.

Nonetheless, a definite conclusion should not be based on a single study alone. To clarify whether empathy is altered in socially anxious individuals, future studies should compare empathic abilities between socially anxious and non-socially anxious individuals in socially threatening situations involving more than one person.

A central limitation of this meta-analysis is that sample characteristics, outcome variables, and exposure variables varied between studies, introducing sources of bias not accounted for in the analysis. The observed high percentage of unexplained heterogeneity was expected due to the inclusion of non-randomized studies, which introduce bias of unpredictable direction (Reeves, Deeks, & Higgins, 2008). Some of the variation in outcomes could be reduced by selecting the most commonly employed measure if studies reported multiple outcomes. Nonetheless, heterogeneity was substantial and could only partially be explained.

One potential source of heterogeneity could be differences in sample characteristics with regards to levels of psychological symptoms such as depression. SAD and major depressive disorder (MDD) in particular are highly comorbid disorders (c.f., Koyuncu, İnce, Ertekin, & Tükel, 2019). Impaired empathy has been observed in both individuals diagnosed with MDD and sub-clinically depressed individuals (Schreiter, Pijnenborg, & aan het Rot, 2013). The present meta-analysis did not consider comorbidity with MDD or other disorders as a potential confounder. This might have contributed to the observed variability in effects. Nonetheless, we do not consider this would have led to an overestimation of the association between social anxiety and empathy, because the observed association was weak and not negative as for MDD and empathy, although it could have led to an underestimation.

Additionally, statistically dependent effects were included by calculating pooled effect sizes for studies reporting more than one effect size. Commonly, inclusion of dependent effects artificially reduces the estimate of variance and inflates Type I errors (Borenstein, Hedges, Higgins, & Rothstein, 2009). Here, a conservative approach was adopted inflating the Type II error (Scammacca et al., 2014). Sensitivity analysis and the remaining large variability do not suggest a negative influence of the approach we took.

Lastly, risk of bias varied between studies. For included case-control studies, appropriate matching was oftentimes unclear, or this information was not provided. Repeatedly, participants were not matched but mean group characteristics compared (i.e., Buhlmann, Wacker, & Dziobek, 2015; Button, Lewis, Penton-Voak, & Munafò, 2013). The absence of appropriate matching might have introduced biases and thereby may have obscured the effects. Moreover, inclusion and exclusion criteria were oftentimes unclear or not reported thus potential third variables could have introduced spurious findings. For cross-sectional studies, some of the measures had not been validated extensively. Nonetheless, sensitivity analysis excluding studies with a high risk of bias did not significantly alter results.

4.3.2. Limitation at the Outcome Level

For the present review, the pool of available studies was limited to studies published in English. Efforts are sometimes made to locate and include non-English-language articles in systematic reviews to minimize this potential source of bias. However, there is some evidence that solely including English-language studies does not bias meta-analyses, at least in the field of conventional medicine (e.g., Morrison et al., 2012). Representativeness was also limited as not all authors provided us their unpublished data upon request. Consequently, failure to identify all relevant studies might distort the results and prevent dismissal of publication bias. The screening instrument employed here, the funnel plot trim and fill method, performs poorly in light of considerable heterogeneity (Peters et al., 2007; Terrin et al., 2003). Moreover, funnel plot asymmetry plots effect sizes based on the results that are published but cannot clearly determine to what extent such results have been affected by outcome reporting bias (Turner, Knoepfelmacher, & Shapley, 2012). Regarding the meta-analysis on social anxiety and AE, statistical power

of the funnel plot is further limited by the small sample (Sterne et al., 2011). Taken together, the presence of publication bias, especially for AE, cannot be ruled out. Lastly, we did not contact authors to provide insight into the role of sex. Thus, we can only speculate whether non-significant subgroup analysis exists that were not published.

4.4. Implications for Research and Treatment

Future studies are needed to clarify the association between social anxiety and empathy before making inferences. First, the extent to which the association between social anxiety and AE varies between sexes needs further investigation as the present integration was limited by a low number of studies. Moreover, most included studies relied on self-report measures of AE and hence might be biased by the tendency to respond socially desirable or as a result of poor insight. Future studies should employ implicit measures such as coding of facial expressions, and skin conductance levels, instead of, or in combination with self-report measures. This would allow for a direct comparison of AE on explicit and implicit measures. In sum, we argue for more studies exploring the association between social anxiety and AE taking sex and age into account and employing implicit measures of AE. Based on pooled outcomes of these studies, experimental studies could be designed to clarify causality and mechanisms underlying impaired AE in social anxiety. Similarly, future efforts are needed to conclusively establish whether CE and SAD are negatively associated. Moreover, investigations regarding the directionality and causality of such a negative association between CE and SAD are needed.

Given the presently weak evidence for an association between social anxiety and empathy, we are cautious to support the recent suggestion to advise empathy-targeting treatment for socially anxious individuals (Auyeung & Alden, 2020). Nonetheless, following our results for CE specifically, if low CE contributes to the development and maintenance of SAD, then treatment approaches increasing CE might benefit patients with SAD. This association however needs to first be sufficiently demonstrated and replicated.

Lastly, we would like to note that most of the present studies did not take context into account. Only one study considered the association between social anxiety and empathy in the presence of a social threat cue, while the other studies examined the association in a non-social context (i.e., in the laboratory or via questionnaires). Though performance-based measures, such as facial emotion recognition, do provide a more ecological valid measure of empathy, they do not require social involvement from the individual being tested. In the context of social anxiety an interactive social component might be especially important. Socially anxious individuals might react very differently based on the context and whether self-centered attentional biases or other-oriented biases are activated. We suggest that future studies take this into account by measuring empathy in interpersonal situations and relating this to measures of social anxiety. We believe that this would provide a more valid picture regarding the association between social anxiety and empathy.

4.5. Conclusion

In sum, the present results highlight great variability between studies considering the association between social anxiety and empathy. Results of the present integration of the literature support neither line of research arguing for a positive or negative association but suggest a more nuanced picture. The present integration suggests a positive association between social anxiety and AE, which appears to be especially pronounced for male participants. No overall association between social anxiety and CE became apparent. Subgroup analysis suggested that for clinical samples social anxiety and CE are negatively associated. Methodological variations and small subgroups complicate interpretation of the present findings. Thus, we call for additional research before making sound conclusions.

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Contributors

Authors A.M.R., M.a.h.R, and M.-M.P. designed the study and wrote the protocol. Authors L.J.S., M.-M.P., and N.F. conducted the initial screening and data extraction. Authors L.J.S. and M.-M.P. conducted the quality assessment, updated screening, and data extraction. Author M.-M.P. conducted the analysis and wrote the first draft of the manuscript. Author A.M.R. was consulted for questions regarding the analysis and author M.a.h.R. was consulted regarding study inclusion and interpretation of the results. All authors contributed to and have approved the final manuscript.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendices A–E. Supplementary data

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