ANXIETY, TREATMENT EFFICACY, AND THEORY OF MIND

by

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THESIS OVERVIEW

This thesis contains a single volume consisting of five chapters and is submitted to the University of Birmingham in fulfilment of the requirements for the degree of Doctor of Clinical Psychology. It encompasses a literature review and meta-analysis, an empirical research paper, and two accompanying press releases.

Literature Review and Meta-Analysis

The literature review and meta-analysis look at the effectiveness of psychological interventions at treating anxiety in autistic adults. Findings from the meta-analytic synthesis, along with subgroup analyses, are reported and these are discussed alongside limitations and clinical implications.

Empirical Research Paper

The empirical research paper describes a study investigating the impact of state and trait general and social anxiety on theory of mind. Theoretical and clinical implications of the findings are discussed.

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Finally, thank you to my partner, Max. I am incredibly privileged and grateful to have had the generous, patient, and steadfast support that you have so willingly offered. Thank you for going above and beyond to offer me your invaluable care and support. I appreciate you so much.

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CHAPTER ONE

Literature Review

Effectiveness of Psychological Interventions for Anxiety in Autistic Adults: A Systematic Review and Meta-Analysis

Abstract

Introduction There is a high prevalence of anxiety in autistic people. Psychological interventions are recommended as first-line treatment. Adaptations to existing treatments are recommended for autistic people. The current study aimed to answer two questions: 1) are psychological interventions for anxiety in autistic adults effective, and 2) what factors are associated with good treatment outcomes. **Method** Embase, PsycINFO, Medline, and PubMed were searched in May 2023 for studies that reported treatment outcomes for psychological interventions on anxiety in autistic adults. A meta-analysis of RCTs was carried out to assess for treatment efficacy. Subgroup analyses of change scores for all treatment effects, including pre-post studies, were performed to investigate any factors that may improve treatment efficacy. **Results** Nineteen studies met eligibility criteria. An omnibus test of nine RCTs found a small treatment effect size, d = -.27 (95% CI [-.45, -.09]), with low heterogeneity (I^2 = 13%). Subgroup analyses of treatment change scores found no significant differences between intervention type and sustained outcomes at three-month follow up. **Conclusion** Psychological interventions, particularly mindfulness and cognitive/behavioural interventions, have the potential to be effective for treating anxiety in autistic adults. Findings showed that interventions are less effective for autistic adults than for neurotypical adults but are similar to the findings for autistic children. More RCTs are needed, including with consideration to individual over group interventions. A wider range of appropriately adapted interventions should be offered and researched.

Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that varies in presentation and severity. Diagnosis is based on difficulties with social communication, social interaction, and restricted and repetitive behaviour patterns, including activities or interests, that limit and impair functioning (American Psychiatric Association, 2013). It is important to note that these difficulties are bi-directional, in that neurotypical people may also struggle in social interactions with autistic people[1] (Milton, 2012). While an estimated 1% of the global population are autistic (World Health Organisation, 2023.; Zeidan et al., 2022), this is likely to be an underestimation of true prevalence rates (McConkey, 2020; O'Nions et al., 2023). With growing rates of diagnosis across the lifespan and high prevalence of mental health conditions over the adult lifespan (Lever & Geurts, 2016), it is crucial to develop efficient and effective mental health services for autistic adults.

Anxiety and Autism

Autistic people are more commonly diagnosed with co-occurring physical, developmental, and mental health conditions across the lifespan than their neurotypical counterparts (Khachadourian et al., 2023), and there are particularly high rates of anxiety disorders (Baou et al., 2023; Malow et al., 2023; Thurm et al., 2019; Waizbard-Bartov et al., 2023). Hollocks et al.'s (2019) meta-analysis on the prevalence of anxiety and depression in autistic people found that 42% of autistic people experience an anxiety disorder at some point in their lifetime. In addition to autistic adults experiencing increased prevalence, they also tend to be more functionally impaired; 59% of respondents to a National Autistic Society Survey (NAS)

[1] Throughout this paper, identity-first language will be used as this has been endorsed by a large proportion of autistic adults (Kenny et al., 2016).

experienced anxiety to a degree that had a high impact on their ability to get on with their life (NAS, 2019). Thus, there is an increased need for the treatment of anxiety in this population (Joshi et al., 2013).

Menezes et al. (2022) described some of the potential mechanisms for the increased risk of anxiety in autistic adults. These include camouflaging and masking autistic traits to blend into social situations, alongside challenges in social communication that can lead to miscommunication, an increased sense of unpredictability, and misinterpretations of social situations. Additionally, difficulties in recognising and regulating emotions, sensory sensitivities, and difficulties with executive functioning can increase anxiety (Stark et al., 2021) and experiences of marginalisation can increase experiences of overall distress (Chellappa, 2024). Understanding these processes can help to build a foundation for exploring effective psychological interventions aimed at alleviating anxiety in autistic people.

Psychological Interventions for Anxiety in Autistic People

Psychological interventions are suggested as first-line treatment options for people with anxiety disorders, in preference to pharmacological treatment (National Institute for Health and Care Excellence, 2014). For adults, the National Institute for Health and Care Excellence (NICE) guidelines refer to the evidence base of a stepped-care approach using cognitive behavioural therapy (CBT). These guidelines note that methods of delivering treatment, including the duration of treatment, should be adapted for equality and diversity and advise to consult with a specialist for these adaptations but provide no specific recommendations for autistic people. NICE guidelines for autistic adults detail adaptations that should be made to cognitive behavioural interventions, including an increased emphasis on changing behaviour rather than cognition, providing explicit rules with reasons, avoiding metaphors and hypotheticals, using more written and visual information, involving a family member/partner/carer if agreed by the individual, and offering regular breaks and

incorporating any special interests (NICE, 2021). While these adaptations may be easily implemented, there are a lack of adaptations based on empirical evidence and there has been no systematic evaluation of their success in improving treatment efficacy (The British Psychological Society, 2021).

Baou et al. (2023) found that a smaller proportion of autistic adults using primary care psychological therapies saw reliable improvement compared with their neurotypical matched counterparts. This disparity highlights the need for specifically designed or effectively adapted interventions for autistic adults. While there is limited evidence for the efficacy of treating anxiety in autistic adults with psychological interventions, there is a significant and growing evidence base for psychological treatment for anxiety in autistic children and adolescents. Systematic reviews for autistic children and adolescents have mainly comprised CBT (Adams et al., 2019; Kester & Lucyshyn, 2018; Vasa et al., 2014). Meta-analyses have predominantly found CBT to be effective, with better outcomes for individual compared to group therapy but symptom reduction not maintained at follow up (Kreslins et al., 2015; Perihan et al., 2022; Sharma et al., 2021; Ung et al., 2015). However, there are differences in clinician, teacher, parent, and child reported outcomes post-treatment, with self-reported outcomes showing a lower effect size or insignificance.

Autistic individuals spend most of their lives as adults and psychosocial interventions show unclear yet potentially promising outcomes in this population. Bishop-Fitzpatrick et al. (2015) found effects of psychosocial treatment in autistic adults ranged from insignificant to extremely effective, although they noted that the quantity and quality of studies is limited. Menezes et al.'s (2022) systematic review on the treatment of anxiety in autistic adults found mixed evidence in support of CBT, with randomised controlled trials (RCTs) indicating that CBT did not achieve better results than waitlist control. The lack of clarity in the current

evidence for the effectiveness of the psychological treatment of anxiety in autistic adults demands further review.

Rationale and Aims of Current Study

To date, there has not been a meta-analysis of psychological interventions for treating anxiety in autistic adults. With the increasing number of intervention studies for autistic adults, a meta-analysis serves several purposes: investigating the consistency of effect across interventions, assessing conflict between existing research, improving precision where studies are small, and generating new hypotheses (Deeks et al., 2023). It is currently unclear if psychological therapies treating anxiety in autistic adults are at all effective. Therefore, **Aim-1 is to evaluate if psychological interventions are effective at treating anxiety in autistic adults.** RCTs represent the gold standard for inclusion in a meta-analysis, offering a robust foundation to assess the current evidence landscape, so Aim-1 will be addressed with these studies.

If psychological therapies are effective in treating anxiety in autistic adults, it is important to understand which ones work best or what moderators improve treatment efficacy. **Aim-2 is to evaluate factors are associated with good outcomes in psychological therapy for anxiety in autistic adults.** While enough RCTs now exist to provide a comprehensive overview, these are insufficient for a nuanced examination of the impact of moderating factors on the treatment efficacy of psychological interventions for anxiety in autistic adults. The inclusion of lower-tier studies may therefore offer valuable insights into certain aspects of this inquiry.

Method

To address both aims of this review and meta-analysis two samples were needed. A treatment efficacy sample addresses Aim-1 and includes RCTs to evaluate treatment efficacy.

A treatment implementation variability sample addresses Aim-2 and includes the wider literature, inclusive of non-randomised and pre-post studies. This sample uses subgroup analyses to look at the different factors across the studies and how they influence treatment efficacy, which generally requires a larger sample size of studies hence the wider inclusion of literature.

Articles were selected for inclusion in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols (PRISMAP; Moher et al., 2015). The protocol was registered with PROSPERO (CRD42023400640) before the initiation of article selection. The PRISMA checklist (Page et al., 2021) was used to ensure that all necessary items for reporting systematic reviews and meta-analyses were included. This can be found in appendix 7.

Search Strategy

Preliminary literature searches were carried out in Embase, PsycINFO, Medline, and PubMed[2] in May 2023. Search terms were defined using the Population, Intervention, Comparison, Outcome (PICO) method, as shown in table 1.1. Databases were searched from inception to May 2023. Search terms used were ((autism OR autistic OR asperger*) AND (anxiety or anxious)) AND (psych* intervention OR therap* OR psycho* therap* OR psychotherapy OR psycho* treatment OR cognit* therapy OR CBT). The terms were

[2] Originally Web of Science was also searched. However, on evaluation of the first 100 articles of the 3,566 returned, only one article was found to meet the eligibility criteria and this article was also found in the search results of PubMed. Web of Science was therefore deemed to have been less appropriate to the topic and so further results were not used. Use of four databases is consistent with many systematic reviews.

developed from previous systematic reviews and meta-analyses investigating the effectiveness of psychological interventions for anxiety in neurotypical people and anxiety in autistic adults (Menezes et al., 2022; Newby et al., 2015; Seekles et al., 2013).

Table 1.1

Search Terms Guided by Population Intervention Comparison Outcome (PICO) Method

PICO element	Description
Population	Autistic adults
Intervention	Psychological interventions targeting anxiety symptoms
Comparison	-
Outcome	Effectiveness/reduction in anxiety

Anxiety disorders such as panic disorder, agoraphobia, and specific phobias were not included in the search terms, despite the increased prevalence of these diagnoses within autistic adults (Hollocks et al., 2019). The review by Menezes et al. (2022) included search terms for phobia, panic, and agoraphobia in their review, however, only one study was identified that specifically looked at CBT for fears and phobias in autistic adults and this would not have met inclusion criteria for the current review as the sample size was too small. It was therefore concluded that there would not be enough interventions studies for panic or specific phobias in autistic adults to complement the current study aims, and so the current review aimed to focus on experiences of anxiety more generally.

For the search completed in the OVID databases (Embase, PsycINFO, and Medline), search results were refined to those that included the search terms in the abstract and title and duplicates were removed. Reference lists of included studies and relevant systematic reviews identified in the initial search were examined for additional studies that could be included. However, no additional studies were found.

Eligibility Criteria

Inclusion criteria were adapted from a recent systematic review on the treatment of anxiety in autistic adults by Menezes et al. (2022) and were defined as follows: a) population were adults (at least 18 years of age) and had a clinical diagnosis of autism, b) a psychological intervention was being evaluated, i.e., talking therapy not psychopharmacological intervention, and c) pre and post measures of anxiety are reported using a valid psychometric questionnaire. Psychological interventions were defined as those that were grounded in psychological theory, aimed to reduce anxiety symptoms (although this did not need to be the primary aim), and were delivered through a therapeutically structured relationship (Smith, 2012).

Exclusion criteria included a) case studies/reports and series, b) studies that reported aggregated data for adults (18 and over) and young people (under 18), c) studies that used a joint measure but did not report anxiety measures independently (e.g., used the Hospital Anxiety and Depression Scale without reporting depression and anxiety subscales independently of each other), and d) studies with small sample sizes ($N < 10$).

Inter-Rater Reliability

The reliability of the screening process was checked by an independent second rater, using a random sample of 25% (1,264) of the papers identified from the initial search. Five studies were identified by the second rater that had not reached full text screening. However, after full text screening by the initial rater none of these five studies met inclusion criteria. Initial inter-rater reliability was acceptable, $k = .51$ (Regier et al., 2013). Most discrepancies were records that had been screened in by the initial rater and a consensus on inclusion/exclusion was reached through discussion. The second rater then independently completed a full text screening of all papers that were screened as full texts by the initial rater (148). Following

discussion of full text discrepancies with the second rater, an additional two studies were included.

Data Extraction

Information relating to participant demographics, sample source and size, inclusion/exclusion of intellectual disability (ID) and cut-offs, diagnostic method, and anxiety measures used were extracted from each included study. Means, standard deviations, and sample size were also extracted from each paper by a first and second rater to ensure no extraction errors.

Data was extracted for each timepoint where there was post-intervention follow-up outcome data. Most studies that included follow-up data did so at three months and/or six months; none of the studies presented follow-up data exceeding six months. For studies that collected data at an uneven time point this was rounded to the nearest month (i.e., Langdon et al., 2016 reported follow-up data at 24 weeks so this was recorded as six-month follow up). Russell et al. (2020) report outcomes at baseline and one, seven, and fifteen week(s) following the end of the intervention. Therefore, data from one-week post-intervention was recorded as end of treatment, data from fifteen weeks was recorded as three-month follow up and the data for seven weeks post-intervention was not included in subgroup analysis for follow-up data.

Data extraction in each study focused on a single outcome measure. When multiple anxiety measures were employed, the selection process followed specific criteria: 1) preference was given to the stated primary outcome measure, 2) measures validated for autistic people were prioritised, 3) state outcomes took precedence over trait outcomes, unless the study explicitly aimed to address trait anxiety, 4) general anxiety scores were favoured over social anxiety scores, unless the intended aim of the study was to reduce social anxiety,

and 5) in cases where none of the above criteria applied, data from the most commonly used measure was chosen for consistency across eligible studies.

For Aim-1, the treatment efficacy sample included RCTs only. For these, the standardised mean difference (Becker, 1988) was calculated using Cohen's *d* (Cohen, 1988), which involved subtracting the mean score of the post-intervention treatment group by the mean post-intervention score of the control group and dividing this by the pooled standard deviation of both groups.

For Aim-2, the treatment implementation variability sample included all treatment effects (e.g., Pagni et al., 2020 & 2023, compare mindfulness-based stress reduction to social support, so change scores for both were calculated). For these, Cohen's *d* was calculated as the pre-post intervention change score for each of the treatment effects, even where studies used a control group. Where summary statistics were not reported, student *t* or *F* statistics were transformed into estimates of Cohen's *d* using the procedures described in Borenstein (2009).

Study Design Hierarchy and Risk of Bias Assessment

Studies were given an overall quality rating based on the efficiency of the basic design of the study and the risk of bias rating across eight domains. For study design, RCTs were given a score of 25, non-randomised controlled trials a score of 20, and pre-post studies a score of 5. For each risk of bias domain, studies rated as high risk were scored 0, unclear risk 1, and low risk 2. The overall quality rating was calculated as these combined scores divided by the maximum possible score and converted into a percentage. Some of the included studies were unable to be rated on performance bias due to the absence of a control or comparison group. For these studies the total maximum score excluded this bias rating.

A quality assessment tool for risk of bias was adapted from existing frameworks for assessing risk of bias in treatment efficacy studies. These were the Cochrane tool for

assessing risk of bias in randomised trials (Higgins et al., 2011), particularly this tool's generalisation to nonrandomised studies (Kim et al., 2013), and the risk of bias criteria used in Mingins et al.'s (2021) systematic review of anxiety and intellectual functioning in autistic children. The combination of these tools enabled a tailored assessment of the reliability and validity of autism diagnosis and the anxiety measurement used. It also allowed for the measurement of the methodological limitations of studies included in this meta-analysis in relation to its goals. This quality assessment framework can be found in table 1.2. A second rater independently completed a risk of bias assessment on all the studies using the pre-defined criteria, resulting in an acceptable inter-rater reliability, $k = .61$. Discrepancies were discussed and a final rating was agreed upon.

Statistical Analysis

Data analysis was carried out using the meta-analysis strategy from the Centre of Applied Psychology at the University of Birmingham. Version 4.3.2 of R (R Core Team, 2023) was used to conduct the meta-analysis and calculate intervention effect sizes. Cohen's *d* defines an effect size of 0.2 as small, 0.5 as medium, and 0.8 as large (Cohen, 1988). A random-effects model was used to account for variability between studies and reduce the likelihood of type-II errors. Cohen's *d* was used over Hedges *g* as each of the RCTs included in Aim-1 had combined sample sizes for the intervention and control group that equalled more than 20 (Turner & Bernard, 2006). This was less relevant for the sample from Aim-2 as treatment change scores were used for comparison of moderators rather than to ascertain an effect size, and so Cohen's *d* was used again for consistency.

The degree of problematic variance, i.e., the degree of variance beyond the expected variance from methodological differences, measurement error, or uncontrolled individual difference factors (Higgins et al., 2023), was assessed by calculating Higgins I^2. A Higgins I^2 value greater than 75% is associated with problematic heterogeneity (Higgins et al., 2023).

Publication bias was tested using funnel plots and Egger's regression test for funnel plot asymmetry (Egger et al., 1997).

Within-groups change scores from studies that did not use a control group are unreliable for suggesting the efficacy of treatment, as they do not account for confounding variables, natural processes, and patient and environmental characteristics (Cuijpers et al., 2016). However, the exclusion of studies that are not RCTs omits a substantial portion of the evidence base (Kösters, 2017). Aim-2 of the current study therefore did not seek to use treatment-only change scores to establish treatment effectiveness, but instead to further explore the factors that may be affecting treatment efficacy. Consequently, subgroup analyses were carried out on the treatment implementation variability sample to assess for potentially influential treatment factors, including the treatment type, time (i.e., whether effects are maintained at three- and six-month follow up), whether the anxiety measure used was validated, whether the intervention was modified or specifically developed for autistic people, and comparison of group and individual treatment. Interventions were broadly grouped for the intervention type subgroup analysis based on the underlying psychological theories of the interventions, e.g., given the principles of Cognitive Remediation Therapy are based on cognitive theories, this was grouped with other cognitive and behavioural therapies. For the subgroup analysis on anxiety measure used, the measure used by Spek et al. (2013) was rated as not validated, although this may be unclear as described below under risk of bias. For the subgroup analysis on specifically developed and modified interventions, the support groups from Pagni et al. (2020 & 2023) were not used as it was not clear whether they were made specifically for ASD or not. A subgroup analysis of risk of bias for each domain was also carried out for each individual study to assess the impact of study level risk of bias on heterogeneity.

Table 1.2

Quality Assessment Framework

Item	Low risk of bias	Unclear risk of bias	High risk of bias
Selection bias	Random sample.	Multiple non-random samples across regions.	Single non-random samples & single region samples.
Measurement of autism & reliability/validity of measurement of autism	Clinical diagnosis confirmed with validated assessment tool, e.g., ADOS.	Previous diagnosis of autism by a multidisciplinary team but not confirmed by, e.g., ADOS.	No confirmed diagnosis with validated tool.
Performance bias	Treatment and control groups were equally matched.	Significant differences between treatment and control group on a single demographic factor, but no differences on pre-intervention outcomes.	Significant differences between treatment and control groups on multiple variables.

Item	Low risk of bias	Unclear risk of bias	High risk of bias
Treatment fidelity	Treatment was sufficiently described such that it could be replicated. Treatment was applied as described and adhered to.	Treatment was described but not in sufficient detail to be replicated with high fidelity. Some minor deviations in treatment adherence.	Treatment was not described/treatment not adhered to.
Measurement of anxiety & reliability/validity of anxiety measure	Outcome measures were clearly defined, valid, and reliable for autistic people.	Reliability and validity of the outcome measure for autistic people was unclear.	Outcome measures not clearly defined/not validated for any autistic people.
Statistical bias	Appropriate statistical tests were used, and all necessary variables are clearly reported.	Appropriate statistical tests used but not all variables (e.g., standard deviations) reported.	Inappropriate statistical tests used, or multiple iterations of statistical tests used to seek a significant result.

Item	Low risk of bias	Unclear risk of bias	High risk of bias
Reporting bias	Study design, conduct, analysis, and results are all reported clearly.	Some missing detail in reporting of study details, e.g., participant demographics for each group.	Unclear reporting across design, conduct, analysis, and results. Non-significant results are not reported.
Generalisability	Sufficient sample for generalisation and representative of target population. A sample size justification, estimate, and power analysis was provided. The sample size is adequate to detect an effect.	Sufficient sample for generalisation but with some idiosyncratic features. A sample size justification, estimate, and power analysis were not provided.	Small sample with or without idiosyncratic feature. The sample size is not adequate to detect an effect.

Note. ADOS (Autism Diagnostic Schedule).

Results

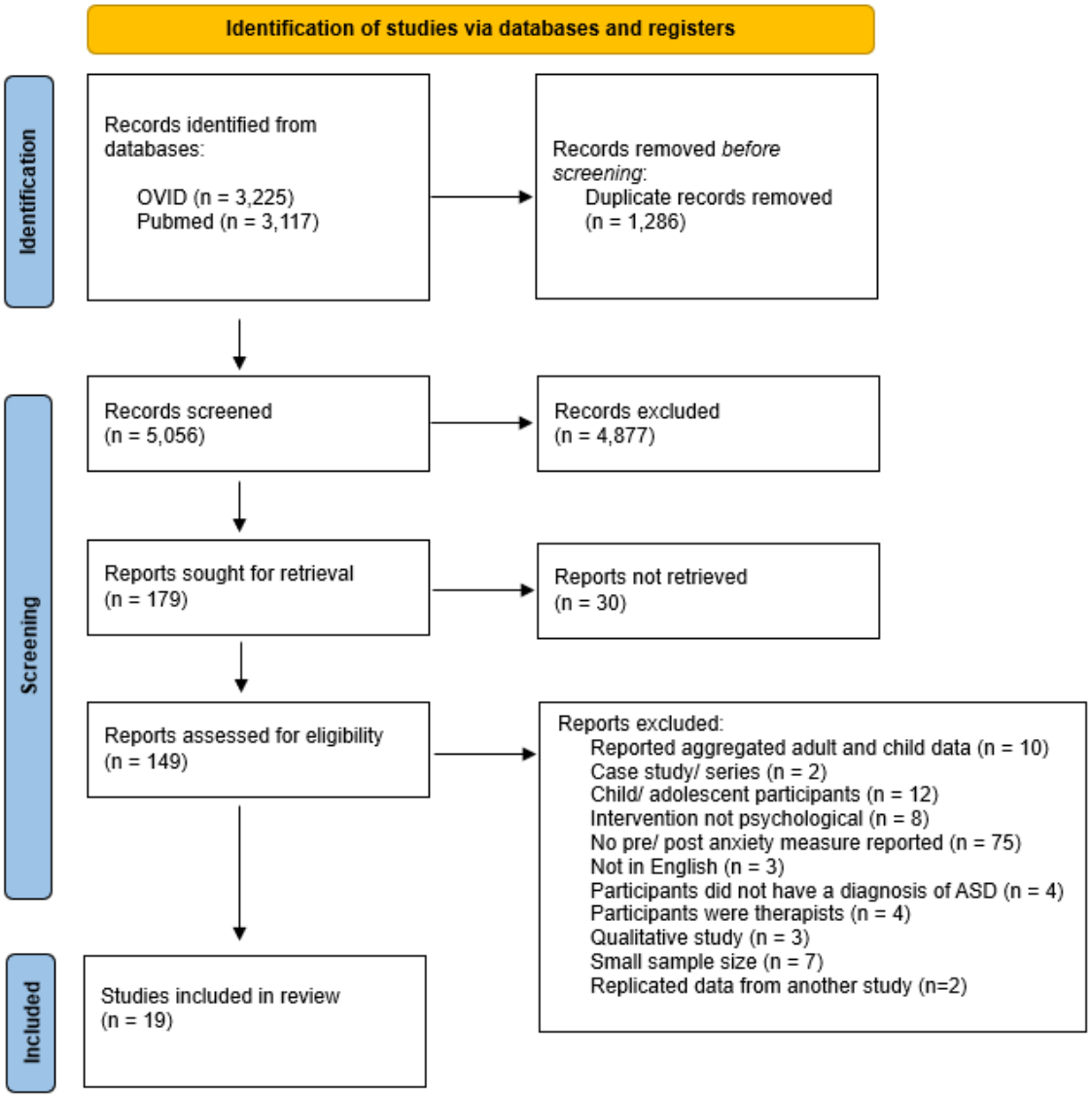
Study Selection

Searches from the three OVID databases provided 1,940 results and PubMed provided 3,117 following removals of duplicates. Some studies appeared to meet eligibility criteria but on detailed review were not included. Russell et al. (2020) replicated data used in Russell et al. (2019) and was therefore removed due to duplication despite meeting eligibility criteria. Pahnke et al. (2022) and Pahnke et al. (2019) similarly used the same data, but in addition one participant dropped out before post-treatment measures were collected resulting in N = 9 at post-intervention and subsequently neither were included as they failed to meet the eligibility criteria of $N \geq 10$. McVey et al. (2016) had one participant that was 17 at the time of pre-testing but turned 18 by the time of intervention, so this study was included. The full screening process is detailed in the PRISMA diagram in figure 1.1.

For Aim-1, nine RCTs were included in analysis. For Aim-2, all 19 studies were included in subgroup analyses, with a total of 22 treatment effects, as some studies compared two treatment groups (e.g., Sizoo & Kuiper, 2017).

Figure 1.1

Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) Flow Diagram of Screening Process



Study Characteristics

There were 19 studies reporting a total of 22 end of treatment effects in a unique sample of 881 participants across the various treatment and control/comparison groups. There were also 8 treatment effects for three-month follow up and one treatment effect at six-month follow up. Participants were selected primarily from community clinics and support groups and were

predominantly male, with percentages of male participants ranging from 52% to 100% across all included studies. Mean ages ranged from 20.22 to 42.25 and no studies included participants with a diagnosed ID. Some of the studies included participants with co-occurring conditions other than anxiety, including depression, substance use disorder, and obsessive-compulsive disorder (OCD). Two studies reported single cases of epilepsy, Tourette's Syndrome, Bipolar, and hearing loss within the treatment groups. One study reported a small number of cases of patient-reported attention deficit hyperactivity disorder (ADHD), OCD, post-traumatic stress disorder (PTSD), complex post-traumatic stress disorder (C-PTSD), dyspraxia, dyslexia, and eating disorders across treatment and control groups. Participant demographics, study design, type and length of intervention, anxiety measures used are presented in table 1.3.

Of the 19 included studies, nine were RCTs, one was a non-randomised controlled trial, one was a treatment comparison study, and the remaining eight were pre-post studies. Out of the controlled trials, for the control group, four used a waitlist control, three used treatment as usual (TAU), two used a support group/social education support, and one used an emotional prosody task. Of the 10 remaining studies, one compared mindfulness-based stress reduction to CBT and the remaining eight were pre-post single arm treatment studies. Only four of the 19 studies distinguished what type of anxiety they were aiming to treat/measure; two specified aiming to reduce social interaction anxiety and two specified social anxiety. The remaining 15 studies referred to anxiety in a general sense.

Six studies examined a CBT-based intervention (CBT group, CBT for social interaction, guided self-help), five studies examined interventions based on social support/functioning and/or relational skills development, four examined mindfulness-based stress reduction, one examined cognitive remediation therapy, one examined social cognition training, one study examined interoceptive training, and one study examined a biofeedback intervention. Only

two studies (Brezis et al., 2021; van Pelt et al., 2022) used individual treatment, the rest used a group treatment programme.

Twelve of the included studies used an intervention that was specifically developed for autistic people. Brezis et al. (2021) adapted relaxation techniques according to each individual's needs. Kiep et al. (2015) and Spek et al. (2013) avoided metaphors, removed cognitive elements, extended the programme duration and breathing exercise, and helped with practice planning. Okuda et al. (2017) tailored the contents of sessions for each participant according to their specific difficulties. Oswald et al. (2018) included a caregiver in the intervention, used interactive and multimodal teaching, facilitated concrete activities, and provided psychoeducation. The intervention in the study by Russell et al. (2008) was delivered by psychologists who were experienced in adapting therapy for ASD. Walhout et al. (2022) provided tailored psychoeducation, response prevention, and cognitive restructuring, and allocated each participant a buddy.

Table 1.3

Characteristics of Included Studies

Study	N	Mean age (range)	Gender n, % male	Study design	Participants	Inclusion/ exclusion of ID	Co-occurring conditions	Intervention & duration	Comparison group	Anxiety measure(s)
Chien (2021)	41	25.3 (18-23)	6F/35M 85%	RCT	Psychiatric outpatient sample	IQ > 70	None reported	Relational skills programme 16 weeks	TAU (n = 41) (mean age 27.6, 82.9% male)	SIAS
Langdon (2016)	26	33 (20-64)	11F/15M 57.69%	RCT	Community sample	IQ > 70	None reported	Group CBT 24 weeks	Waitlist control (n = 26)	HAM-A; SIAS; LSAS; SPIN
McVey (2016)	24	20.92 (18-28)	6F/18M 75%	RCT	Community sample	IQ ≥ 70	None reported	Social skills 16 weeks	Waitlist control (n = 23)	LSAS-SR; SPIN
Pagni (2020)	15	32 (16-64)	7F/8M 53.33&	RCT	Community sample	IQ ≥ 70	Single cases of epilepsy, Tourette's syndrome, and hearing loss	MBSR 8 weeks	Support group (n = 13)	STAI
Pagni (2023)	39	31.15 (18-67)	13F/26M 66.6%	RCT	Community sample	IQ ≥ 70	Excluded TBI, substance abuse, but single cases of epilepsy, Tourette's, Bipolar, & hearing loss	MBSR 8 weeks	Social education/ support (n = 39, mean age 33.89, range 18-72, 59% male)	STAI
Qadt (2021)	61	30 (18-64)	29F/32M 52.45%	RCT	Community sample	IQ > 80	ADHD (5), OCD (8), dyspraxia (1), eating disorder (1)	Interoceptive training 2-6 weeks	Emotional prosody intervention (n = 60)	STAI; GAD-7

Study	N	Mean age (range)	Gender n, % male	Study design	Participants	Inclusion/ exclusion of ID	Co-occurring conditions	Intervention & duration	Comparison group	Anxiety measure(s)
Oswald (2018)	25	24.9 (18-38)	9F/16M 64%	RCT	Community sample	IQ ≥ 70	None reported	Social & adaptive functioning group 21 weeks	Waitlist control (n =16)	ASEBA Adult Self-Report
Russell (2020)	35	35.3	11F/24M 68.57%	RCT	Community sample	Excluded if unable to understand study materials	Depression	Guided self-help 9 weeks	Treatment as usual (n = 35)	GAD-7
Spek (2013)	20	44 (18-65)	7F/13M 65%	RCT	Community sample	IQ > 85	None reported	Group mindfulness-based therapy 9 weeks	Waitlist control (n = 21)	SCL-90-R
Brezis (2021)	14	29.71 (19-48)	2F/12M 85.7%	Pre-post study	Community/assisted living sample	VIQ 12.64 (3.272), 8–19 PIQ 10.86 (3.592), 5–17	None reported	Biofeedback 16 weeks	None	GAS (adapted for ID)
Hillier (2018)	52	20.90 (18-28)	1F/51M 98%	Pre-post study	University students	No ID	None reported	Support group 7 weeks	None	CCAPS-34
Kiep (2015)	50	40 (20-65)	16F/34M 68%	Pre-post study	Community sample	IQ ≥ 85	None reported	Group mindfulness-based therapy 9 weeks	None	SCL-90-R
Oh (2021)	36	23.4 (18-35)	Unclear	Pre-post study	Community sample	IQ ≥ 70	None reported	Relational skills development 16 weeks	Delayed treatment group but only reported combined outcomes	STAI, BAI
Okuda (2017)	16	29.56 (18-49)	4F/12M 75%	Pre-post study	Psychiatric outpatient sample	IQ > 80	None reported	CRT 10 weeks	None	HADS; GAD-7
Russell (2008)	12	23.8	Not reported	Non-randomised	Equivalent numbers of both groups had been	Within average range	OCD	CBT	TAU (n = 12)	BAI

Study	N	Mean age (range)	Gender n, % male	Study design	Participants	Inclusion/ exclusion of ID	Co-occurring conditions	Intervention & duration	Comparison group	Anxiety measure(s)
				controlled trial	inpatients at some point during the study			Duration not reported		
Sizoo & Kuiper (2017)	27	35.1	8F/19M 70%	Non-randomised comparison study	Psychiatric outpatient sample	ID excluded	Anxiety & depression (score above 7 on HADS)	Group CBT 13 weeks	Group MBSR (n = 32, mean age 39.4, 59% male)	HADS
Spain (2017)	14	31 (22-48)	0F/14M 100%	Pre-post study	Psychiatric outpatient sample	No confirmed diagnosis of ID	None reported	CBT group 11 weeks	None	LSAS; HADS
van Pelt (2022)	26	27.62 (18-62)	5F/21M 81%	Pre-post study	Unclear	IQ ≥ 70	None reported	Social cognition training 12-16 weeks	None	SIAS; BFNE
Walhout (2022)	30	36.77 (19-64)	8F/49M 85.9%	Pre-post study	Community sample	IQ > 80	Substance use disorder	CBT-based intervention 12 weeks	None	DASS-21

Note. CBT (Cognitive Behavioural Therapy), MBSR (Mindfulness-Based Stress Reduction), CRT (Cognitive Remediation Therapy), TAU (Treatment as usual), GAS (Glasgow Anxiety Scale), ASEBA (Achenbach System of Empirically Based Assessment), STAI (State-Trait Anxiety Inventory), BAI (Beck Anxiety Inventory), LSAS (Liebowitz Social Anxiety Scale), SPIN (Social Phobia Inventory), HADS-A (Hospital Anxiety and Depression Scale-Anxiety), SIAS (Social Interaction Anxiety Scale), BFNE (Brief Fear of Negative Evaluation Scale), DASS-21 (Depression Anxiety and Stress Scales-21 Items), CCAPS-34 (Counseling Center Assessment of Psychological Symptoms-34 Scale), HAM-A (Hamilton Rating for Anxiety)

Risk of Bias Assessment

Overall quality ratings across the studies ranged from 38% to 97%, with RCTs receiving the higher scores. Selection and generalisability bias were areas of overall weakness. General strengths for the studies were statistical bias, reporting bias, and performance bias, as well as in the measurement of autism. A summary of each risk of bias item and overall quality rating can be found in table 1.4.

Selection Bias

Risk of selection bias was high across studies. Twelve studies were rated as high risk of bias and seven as unclear risk. Studies that received a rating of high risk of bias recruited from a single site or region and provided no details about ensuring the participants were selected at random, i.e., if they were selected by staff at the site. Where studies received an unclear risk of bias rating they recruited from multiple sites, however, again did not clarify the selection process.

Measurement of Autism Including Reliability and Validity

Most of the studies used the Autism Diagnostic Schedule (ADOS) (Gotham et al., 2006) to confirm participants met the criteria for an autism diagnosis. Other studies used the Autism Diagnostic Interview Revised (ADI-R) (Lord et al., 2000), one study used The Clinical Interview Schedule-Revised (CIS-R) (Subramaniam et al., 2006), and others used a Diagnostic and Statistical Manual (DSM) or equivalent diagnosis. Seventeen studies were given a low risk rating and two were given an unclear risk rating. Those given an unclear risk of bias for measurement of autism either relied on previous evidence of autism diagnosis without confirming, or noted in the inclusion criteria a DSM diagnosis was required but did not detail any confirmation of diagnosis or how this was known.

Performance Bias

Performance bias relates to any systematic differences between groups (Higgins et al., 2011), and was mostly low across studies. Seven studies were unable to be rated as they did not include a comparison or control group, two were rated as unclear risk either due to not reporting any differences between groups or due to the presence of some differences between groups. The remaining ten studies were rated as low risk as they reported measurements of differences between groups and no significant differences were found.

Treatment Fidelity

Fifteen studies were given a low risk of bias rating for treatment fidelity as they gave a detailed description of the intervention being evaluated. Two studies were rated as unclear risk, with one allowing participants to continue other therapies and the other providing minimal description of the intervention. The remaining two studies were given a high risk of bias rating as no details were provided on the intervention and how it was delivered.

Measurement of Anxiety and Reliability/Validity of Measure

Seven studies were rated as low risk for the measurement of anxiety. These studies used anxiety measures that have evidence for validity in autistic adults. The Liebowitz Social Anxiety Scale – Self-Report (LSAS-SR) (Fresco et al., 2001), The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983), The Social Interaction Anxiety Scale (SIAS) (Mattick & Clarke, 2012), and The Depression, Anxiety, and Stress Scales (DASS-21) (Lovibond & Lovibond, 1995) have been found to produce similar results between autistic people and their neurotypical counterparts (Boulton & Guastella, 2021; Park et al., 2020; Uljarević et al., 2018). Two studies were rated as unclear risk of bias as they used the Symptom Checklist-90 Revised (SCL-90-R) (Derogatis, 1994), which has been found to demonstrate somatic symptom burden in autistic adults compared to neurotypical adults with psychiatric conditions (Lever & Geurts, 2016) but not a neurotypical community sample. 10

studies were rated as high risk of bias as the anxiety measure used had not been validated for autistic people. Langdon et al. (2016) was rated as high risk as, although they used the SIAS, the primary outcome measure was the Hamiton Rating for Anxiety (Hamilton, 1959), for which there is no evidence of validity in autistic people.

Statistical Bias

17 studies were rated as low risk of statistical bias. Two studies were rated as high risk, one due to the use of multiple statistical tests with different covariates increasing the risk of type one error (Ranganathan et al., 2016), and one for not reporting standard deviations or effect sizes.

Reporting Bias

Oh et al. (2021) was rated as high risk of reporting bias. While the study used a delayed treatment group, the only outcome results reported a combination of the treatment group and the delayed treatment group after they had both undergone treatment. Oh et al. (2021) was therefore considered a pre-post intervention study and rated as such, as the data was not available to compare treatment with control. The gender of participants included in the analysis of this study was also unclear, as the authors reported one female participant being recruited but did not state if this participant was among those who dropped out. Two studies were rated as unclear risk of reporting bias for not clearly reporting non-significant results or for providing limited information. The remaining studies were rated as low risk of reporting bias.

Generalisability

No studies were rated as low risk of generalisability bias. Half of the studies were rated as high risk of bias in this area due to small sample sizes without a power analysis and/or recruiting effectively male only participants. The other half were rated as unclear risk for

either having a large sample size but no power analysis, or a power analysis had been completed but the sample size was small.

Table 1.4

Risk of Bias Rating for Eligible Studies

Study	Study design	Selection bias	Measurement of autism	Performance bias	Treatment fidelity	Measurement of anxiety	Statistical bias	Reporting bias	Generalisability bias	Overall quality rating (%)
Chien (2021)	RCT	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk	97
Langdon (2016)	RCT	Unclear risk	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	Unclear risk	93
McVey (2016)	RCT	Unclear risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk	95
Oswald (2018)	RCT	Unclear risk	Low risk	Low risk	Unclear risk	High risk	Low risk	Low risk	Unclear risk	88
Pagni (2020)	RCT	High risk	Low risk	Low risk	Low risk	High risk	Low risk	Low risk	Unclear risk	88
Pagni (2022)	RCT	High risk	Low risk	Low risk	High risk	High risk	Low risk	Low risk	Unclear risk	83
Qadt (2021)	RCT	Unclear risk	Low risk	Unclear risk	Low risk	High risk	Low risk	Low risk	Unclear risk	88
Russell (2020)	RCT	Unclear risk	Low risk	Low risk	Low risk	High risk	Low risk	Unclear risk	Unclear risk	88
Spek (2013)	RCT	High risk	Low risk	Low risk	Low risk	Unclear risk	Low risk	Low risk	High risk	88
Brezis (2021)	Pre-post study	High risk	Low risk	Not applicable	Low risk	High risk	Low risk	Low risk	High risk	33
Hillier (2018)	Pre-post study	High risk	Unclear risk	Not applicable	Low risk	High risk	High risk	Low risk	High risk	23
Kiep (2015)	Pre-post study	High risk	Low risk	Not applicable	Low risk	Unclear risk	Low risk	Low risk	Unclear risk	38

Study	Study design	Selection bias	Measurement of autism	Performance bias	Treatment fidelity	Measurement of anxiety	Statistical bias	Reporting bias	Generalisability bias	Overall quality rating (%)
Oh (2021)	Pre-post study	Unclear risk	Low risk	Not applicable	Low risk	High risk	High risk	High risk	Unclear risk	28
Okuda (2017)	Pre-post study	High risk	Low risk	Not applicable	Low risk	Low risk	Low risk	Low risk	High risk	38
Russell (2008)	Non-randomised controlled trial	High risk	Low risk	Unclear risk	High risk	High risk	Low risk	Unclear risk	High risk	63
Sizoo & Kuiper (2017)	Non-randomised comparison study	High risk	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk	Unclear risk	80
Spain (2017)	Pre-post study	High risk	Low risk	Not applicable	Unclear risk	Low risk	Low risk	Low risk	High risk	36
van Pelt (2022)	Pre-post study	Unclear risk	Unclear risk	Not applicable	Low risk	Low risk	Low risk	Low risk	High risk	38
Walhout (2022)	Pre-post study	High risk	Low risk	Not applicable	Low risk	Low risk	Low risk	Low risk	High risk	38

Aim-1: Are Psychological Interventions Effective for Treating Anxiety in Autistic Adults?

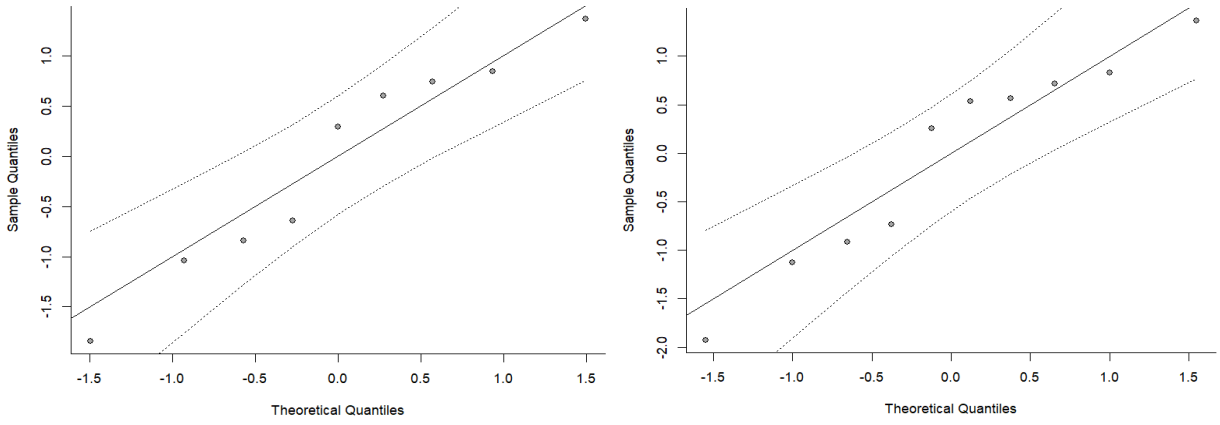
Addressing Aim-1 uses the treatment efficacy sample of nine RCTs, irrespective of intervention type.

Distribution of the Meta-Analytic Model

The use of the random effects model using the restricted maximum likelihood estimator of between studies variation was more suitable for the synthesis of this data, as the data is from a cohort of studies with different methodological strengths and weaknesses and with potentially uncontrolled individual difference factors. The random effects model also penalises small studies with results that are inconsistent with the rest of the literature. The fixed effects model was not appropriate as there was not uniform methodology across the included studies (Borenstein, 2009), despite evidence of linearity and normality in the distribution of intervention efficacy as shown in figure 1.2.

Figure 1.2

QQ Plot of the Fixed Effects Model and the Random Effects Model Using the Restricted Maximum Likelihood Estimator of Between Studies Variation



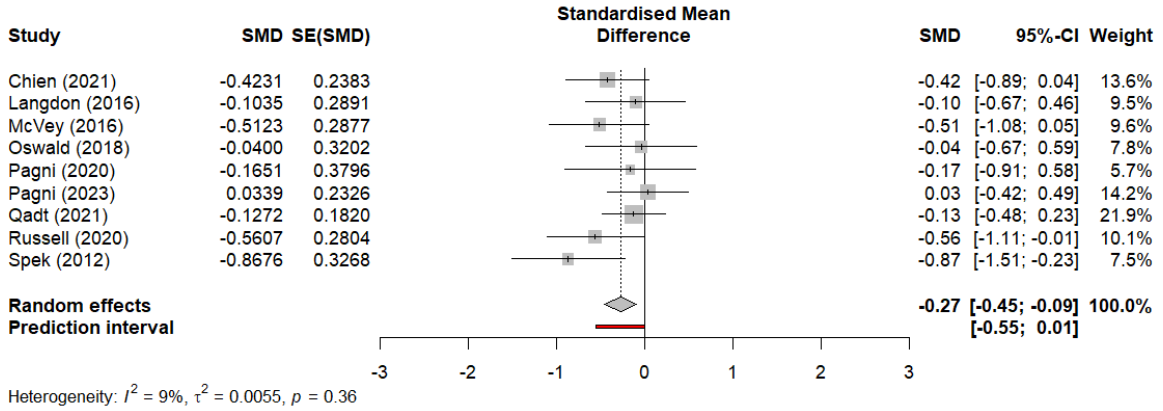
Random Effects Model *Fixed Effects Model*

The Omnibus Test

A random effects model was calculated using the generic inverse variance method (figure 1.3). Effects below zero indicate a reduction in anxiety favouring the treatment condition.

Figure 1.3

Forest Plot of Treatment Efficacy Randomised Controlled Trials



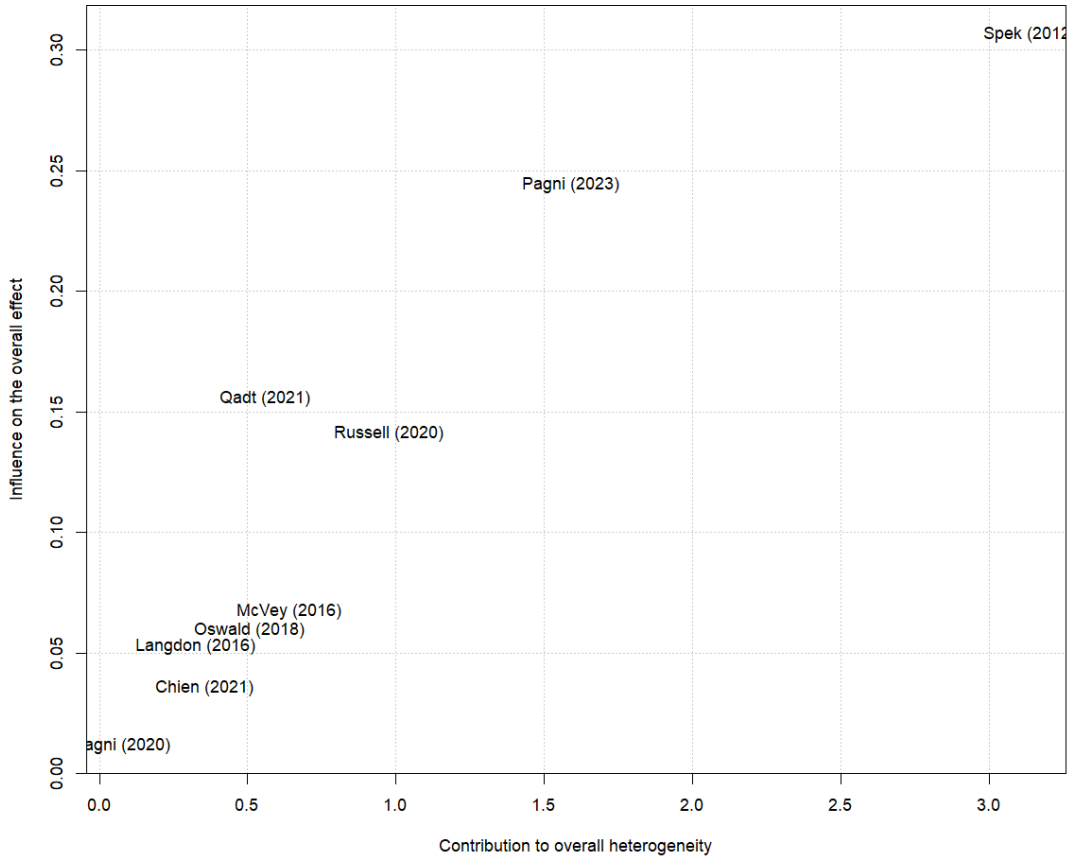
The weighted average treatment effect favoured the treatment condition (SMD = -.27) and was statistically significant (95%CI [-.45, -.09]). An acceptable level of unexplained between studies variation (i.e., heterogeneity) was observed (tau^2 < .01, p = .36, Higgin's I^2 = 9%), suggesting that study level effects were not markedly affected by inconsistencies in methodological and/or participant characteristics.

The Impact of Influential Studies

To identify influential studies, the random effects model was calculated by removing each primary study in turn and recording the change in weighted average effect size (i.e., influence) and the change in heterogeneity (i.e., discrepancy from the other studies). The results of the "leave-one-out" analysis are presented on a Baujat plot (Baujat, Pignon, & Hill, 2002) in figure 1.4.

Figure 1.4

Baujat Diagnostic Plot of Sources of Heterogeneity in Randomised Controlled Trials



Spek et al. (2013) is shown in figure 1.4 to be somewhat influential and discrepant, however, when Spek et al. (2013) is omitted the remaining RCTs report a statistically significant weighted average treatment effect of SMD = -.22 (95%CI [-.40, -.04]). In addition, when the study was reviewed for any methodological concerns, none were identified. Therefore, the inclusion of Spek et al. (2013) does not alter the substantive conclusions of this analysis.

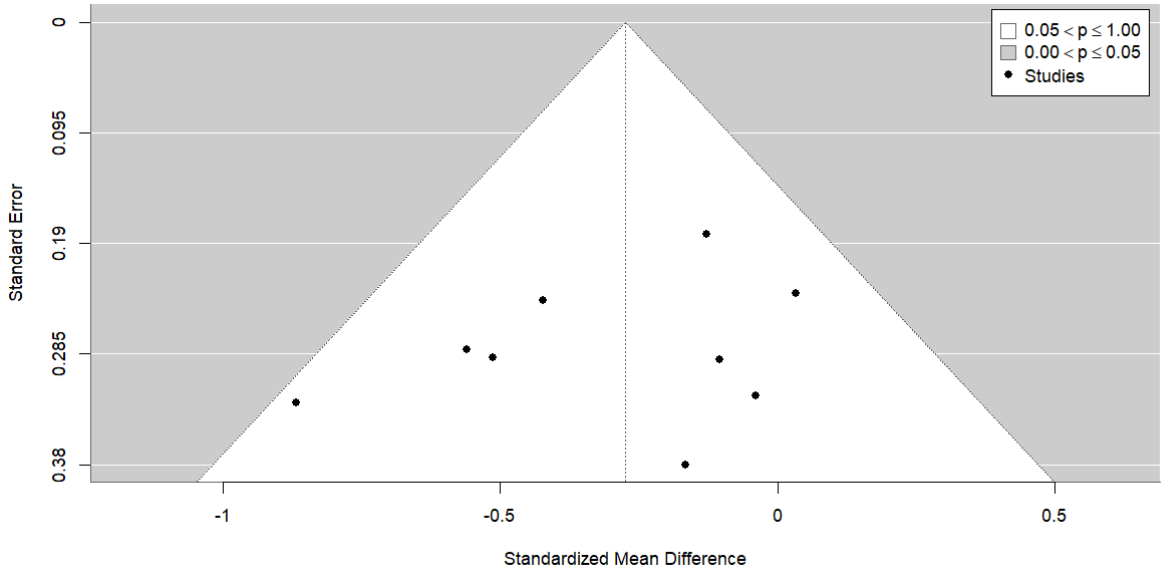
The Impact of Publication and Small Study Biases

The funnel plot (figure 1.5) shows no evidence of publication bias in the distribution of intervention effects, in that there are studies in the area of the funnel plot associated with null

effects and small samples. Further, a test of funnel plot symmetry did not identify funnel plot asymmetry (Egger et al., 1997) t = -.64, p = .54). Therefore, no simulation of and adjustment for publication bias and small study effects was undertaken.

Figure 1.5

Funnel Plot of Effect Sizes for Randomised Controlled Trials



Note. The 95% Confidence interval of the expected distribution of treatment effect is shown as an inverted "funnel".

Aim-2: What Factors Influence Treatment Efficacy of Psychological Interventions for Anxiety in Autistic Adults?

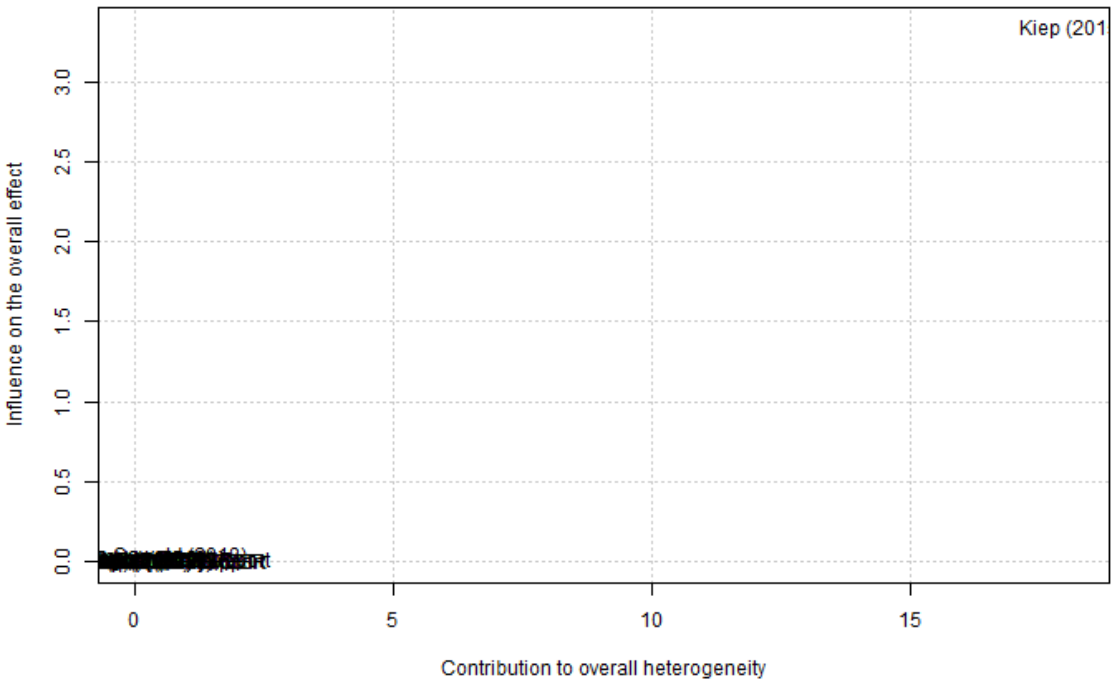
To address this aim, the implementation variability sample was used. This sample consists of pre-post intervention change scores for all the 22 treatment effects identified within the 19 included studies, as the treatment efficacy sample used above was insufficient to evaluate the influence of any moderating factors. The reliable comparison of moderating factors first requires the identification and removal of any influential studies.

The Impact of Influential Studies and Risk of Bias

The influence of individual effects on the overall estimate of the treatment effect was assessed using a "leave-one-out" analysis, with the results of this presented on a Baujat plot (Baujat, Pignon, & Hill, 2002) in figure 1.6. The study by Kiep et al. (2015) shows a high contribution to overall heterogeneity and is highly influential on the magnitude of effect. It was therefore reviewed for methodological or other biases that may account for its discrepancy from the rest of the literature. Reported standard deviations were extremely small and data for 20 out of the 50 participants was taken from Spek et al. (2013), however, it was ultimately excluded from further analyses solely because it accounted for a significant proportion of the overall effect.

Figure 1.6

Baujat Diagnostic Plot of Sources of Heterogeneity



Subgroup Analyses

Treatment Efficacy by Intervention. A subgroup analysis was carried out on the type of intervention used at end of treatment. A list of studies, their intervention, and how they were grouped for the analysis can be found in table 1.5. The weighted average treatment effects and their associated 95% confidence intervals are presented in table 1.6.

Table 1.5

Study Interventions and Groupings

Study name	Intervention type	Intervention group
Brezis (2021)	Biofeedback	Physiological
Chien (2021)	Relational skills	Social/relational skills development
Hillier (2018)	Support group	Social support
Langdon (2016)	Group CBT	Cognitive/behavioural
McVey (2016)	Social skills	Social/relational skills development
Oh (2021)	Relational skills development	Social/relational skills development
Okuda (2017)	CRT	Cognitive/behavioural
Oswald (2018)	Social & adaptive functioning group	Social/relational skills development
Pagni (2020)	MBSR	Mindfulness
Pagni (2020)	Support group	Social support
Pagni (2023)	MBSR	Mindfulness
Pagni (2023)	Social support/education	Social support
Qadt (2021)	Interoceptive training	Physiological
Russell (2008)	CBT	Cognitive/behavioural
Russell (2020)	Guided self-help	Cognitive/behavioural
Sizoo & Kiuper (2017)	MBSR	Mindfulness
Sizoo & Kiuper (2017)	CBT	Cognitive/behavioural

Spain (2017)	CBT for social interaction	Cognitive/behavioural
Spek (2012)	MBSR	Mindfulness
van Pelt (2022)	Social cognition training	Cognitive/behavioural
Walhout (2022)	CBT-based group	Cognitive/behavioural

Note. CBT (Cognitive Behavioural Therapy), MBSR (Mindfulness-Based Stress Reduction), CRT (Cognitive Remediation Therapy)

Table 1.6

Treatment Efficacy by Intervention Type

	k	SMD	95% CI		tau^2	tau
			LL	*UL*		
Physiological	2	-.34	-.80	.12	0	0
Social/relational skills development	4	-.12	-.48	.24	0	0
Cognitive/behavioural	8	-.66	-.96	-.35	0	0
Mindfulness	4	-.53	-.92	-.14	0	0
Social support	3	-.44	-.90	.03	0	0

Note. Some studies were included twice where the comparison group was another psychological intervention, e.g., Sizoo & Kuiper (2017) compared CBT to MBSR and therefore change scores for both are included in this analysis as treatment groups.

There were no significant differences between intervention type ($X^2 = 5.32$, $p = .26$), however the weighted average treatment effects for each of the individual treatment types shows that whilst all intervention types saw a reduction in anxiety, cognitive/behavioural and mindfulness interventions were only intervention types to evidence statistically significant effects. There is an absence of evidence that other intervention types are effective.

Time Point. To further explore the impact of study level covariates upon intervention efficacy, a subgroup analysis was conducted on the outcome timepoints (end of treatment, three-month follow up, and six-month follow up) and found no statistically significant difference between weighted average efficacy for interventions by time point (X2 = 3.09, p = .21). Statistically significant treatment effects at end of treatment and at three-month follow-up were evidenced, but there was no evidence for six-month follow-up efficacy, though only one study collected these data. See table 1.7.

Table 1.7

Weighted Mean Effects for End of Treatment, Three-month Follow Up, and Six-month Follow Up

	k	SMD	95%-CI		tau^2	tau
			LL	*UL*		
End of treatment	21	-.44	-.61	-.27	0	0
Three-month follow up	8	-.58	-.84	-.32	0	0
Six-month follow up	1	-1.19	-2.10	-.28	-	-

Further Subgroup Analyses. Further subgroup analyses did not find significant differences. These were carried out on end of treatment data comparing group to individual treatments (X^2 = .49, p = .49), whether the anxiety measure used had evidence of validity in autistic people (X^2 = .63, p = .43), and whether the treatment was modified or specifically developed for autistic people (X^2 = .13, p = .72).

The Effect of Risk of Bias

A series of subgroup analysis were conducted on the effect for the risk of bias ratings of "low risk" and "any risk" (i.e., unclear risk and high risk of bias combined) for each of the types of methodological bias for each study.

Table 1.8

Risk of Bias on Heterogeneity

	Low Risk				Any Risk					
	Effect	95% CI		k	Effect	95% CI		k	X^2	*p*
		LL	*UL*			*LL*	*UL*			
Selection bias					-.37	-.55	-.18	18	0	0
Measurement of autism	-.33	-.53	-.13	15	-.57	-1.03	-.12	3	.94	.33
Performance bias	-.34	-.58	-.10	10	-.27	-.73	.19	2	.67	.72
Treatment fidelity	-.41	-.61	-.21	14	-.18	-.60	.23	4	.91	.34
Measurement of anxiety	-.47	-.77	-.17	7	-.31	-.54	-.08	11	.68	.41
Statistical bias	-.38	-.57	-.18	16	-.29	-.91	.33	2	.07	.79
Reporting bias	-.38	-.57	-.17	15	-.33	-.85	.18	3	.02	.88
Generalisability bias					-.37	-.55	-.18	18	0	0

Note. Six studies are not included in performance bias assessment as this was not applicable to them, i.e., single group studies.

As can be seen from table 1.8, there were no statistically significant differences of risk of bias in the estimate of treatment efficacy. Therefore, differences in risk of bias rating do not seem to be reliably affecting the weighted average treatment effect.

Discussion

Summary of Evidence

This meta-analysis aimed to 1) assess the effectiveness of psychological interventions for reducing anxiety in autistic adults using RCT data, and 2) investigate any factors that may moderate treatment efficacy using the broader available literature. The outcome from the RCTs indicates that psychological interventions for treating anxiety in autistic adults have a small, statistically significant effect size in favour of a treatment condition compared to a control condition. That only two of the RCTs included demonstrated statistically significant effects (Russell et al., 2020 & Spek et al., 2013) is consistent with the small overall effect size and the benefits of a meta-analytic approach for drawing conclusions. The results from subgroup analyses of the broader literature, inclusive of pre-post studies, found no significant differences in intervention type, follow-up data, whether the anxiety measure used was validated for autistic people or not, or between group and individual interventions. These findings can be better understood within the context of existing literature on the effectiveness of psychological interventions for anxiety in neurotypical adults, anxiety in autistic children, and for other mental health conditions in autistic adults.

Discussion of Results from Aim-1

Studies focusing on the psychological treatment of anxiety in neurotypical adults have reported larger effect sizes than found in the current study of autistic adults; Newby et al. (2015) report a large effect size, and Seekles et al. (2013) report a moderate effect size. This difference is consistent with findings from Baou et al. (2023), in which there was clinically

meaningful reduction for anxiety in autistic adults, but these outcomes were poorer when compared to neurotypical adults. Considering autistic adults experience a heightened functional impairment from anxiety (NAS, 2019) and encounter a greater prevalence of coexisting mental health conditions throughout their lives when compared to neurotypical adults (Joshi et al., 2013), it is reasonable that psychological interventions are less effective for this population.

There are more meta-analyses investigating the effectiveness of interventions for anxiety in autistic children and adolescents than adults. These studies have reported varying effects for self-reported outcomes; Kreslins et al.'s (2015) findings were not significant, Sharma et al. (2021) found a small, significant effect, and Perihan et al. (2022) and Ung et al. (2015) found moderate, significant effects. Preventative approaches to mental health have been acknowledged as offering better outcomes and more effective treatment pathways prior to the onset or worsening of conditions (Colizzi et al., 2020; Jacka et al., 2013; Singh et al., 2022). This same principle may explain why there appears to be less efficacy for the treatment of autistic adults when compared with autistic children.

Paucity of meta-analyses investigating the effectiveness of psychological interventions for mental health conditions in autistic adults other than anxiety makes comparisons along these lines more difficult. Of the limited literature available, findings have been inconclusive (Linden et al., 2023). Therefore, the findings from this meta-analysis may provide a point of departure for future studies.

Discussion of Results from Aim-2

The analysis of the broader literature showed no significant differences between intervention types, though it clarified that the extant evidence was more substantive for mindfulness and cognitive/behavioural interventions. Menezes et al.'s (2022) systematic review concludes that mindfulness-based interventions may be effective for anxiety in

autistic adults, and that there have been inconsistent results regarding the effectiveness of CBT. This meta-analysis adds support to the potential promise of mindfulness-based interventions and provides some clarity on CBT, though it is worth noting that the current study groups various interventions into broader categories and as such the cognitive/behavioural interventions described here may not be comparable to 'purer' CBT. While meta-analyses of interventions for anxiety in neurotypical adults (Newby et al., 2015; Seekles et al., 2013) and in autistic children (Perihan et al., 2022; Sharma et al., 2021; Ung et al., 2015) conclude that CBT is effective, more evidence is needed before any definitive conclusions can be made on which interventions are the most effective for autistic adults.

Most of the meta-analyses on anxiety in autistic children and neurotypical adults have not presented findings from follow-up data. Of those that have, outcomes are not sustained for autistic children (Sharma et al., 2021) and there are conflicting findings for neurotypical adults, with Newby et al. (2015) reporting stable outcomes at follow up and Seekles et al. (2013) reporting significantly reduced outcomes at follow up. In comparison, the current study found that outcomes were maintained at short-term (three-month) follow up. Given that there was a smaller effect at end of treatment for autistic adults compared to autistic children and neurotypical adults, this raises a question about whether a period of time post-treatment adds value to the intervention for autistic adults. Alternatively, it is worth noting that this comparison was made across a relatively small number of studies and using the broader, non-randomised sample. It is also not possible to draw any conclusions about how this plays out over the longer term, as there was only one study that reported longer-term (six-month) follow-up data.

The effectiveness of individual compared to group interventions was less clear in the current study of autistic adults than in studies of autistic children (Kreslins et al., 2015; Sharma et al., 2021) and neurotypical adults (Newby et al., 2015), where group interventions

were found to be less effective than individual ones. The lack of clarity in the current meta-analysis is due to the small number of included studies (two) that used individual interventions. If individual therapy is indeed more effective for autistic adults, the group intervention majority included in the analysis may account for some of the overall small effect size.

Previous meta-analyses on the effectiveness of interventions for anxiety in autistic children and neurotypical adults, as well as for other mental health conditions in autistic adults, have not looked at the difference between using or not using an anxiety measure validated for autistic people. Nor have they looked at the differences between interventions that were specifically developed for autistic people and those that were developed for neurotypical people and later modified for autistic people. Given the lack of research into these potential moderators, it is difficult to draw further conclusions about the non-significant differences between them found in the current study.

Limitations

Limitations of the Review

The current review process had several limitations: it only included studies that were published in English; it did not include search terms on specific phobias (although, as discussed, there appears to be a lack of studies that would allow for this) and other anxiety disorders (e.g., generalised anxiety disorder and social anxiety disorder); and it limited the search to autistic adults only, whereas there may have been some studies that looked at broader populations but included separate data for autistic adults.

While the main aim of the review was to look at psychological interventions, studies were not excluded if participants were also receiving pharmacological therapy. Some of the included RCTs excluded participants if their medication changed during the treatment period, and some had equal numbers of participants on medication in both the treatment and control

groups. The influence of pharmacological therapy was therefore mostly controlled for, however, some of the evidence may be attributable to a combination of these interventions.

Limitations of the Included Literature

In addition to the limitations of the review process itself, some characteristics of the included literature further limit the applicability of the results from this meta-analysis. The quality assessment ratings highlighted issues across the studies particularly in terms of selection and generalisability bias. Few studies reported the selection process and most recruited from single sites or regions, and many of the studies either had small sample sizes and/or did not conduct a power analysis. There was also a dearth of intervention studies that met the search criteria and of those that did, a limited number were RCTs. Of the identified RCTs, four out of five did not report conducting an intention-to-treat analysis, which can bias the results and is less likely to produce real-world practice and outcomes (Andrade, 2022).

While the eligibility criteria used did not exclude interventions delivered to autistic adults with ID, all of the studies that met the criteria nonetheless excluded participants with ID. As Thurm et al. (2019) observe, studies estimate that between 30-70% of autistic people have co-occurring ID. Considering this prevalence, there is a significant gap in intervention studies for this population. Similarly in terms of the study samples, most studies recruited predominantly male participants. Although this imbalance may reflect existing understandings of the demographic profile of autistic people, as reported by Giarelli et al. (2010) and Zeidan et al. (2022), these estimates may underrepresent autistic women (Belcher et al., 2023; Hull & Mandy, 2017; Lockwood Estrin et al., 2021). Consideration should therefore be given to potential differences in efficacy and moderators of efficacy for autistic women.

Most of the included studies were group interventions, meaning that there were not enough individual studies to compare these outcomes to group intervention effects reliably.

As a result, while the existing evidence regarding the treatment of anxiety in autistic children and neurotypical adults suggests that individual interventions are more effective (Kreslins et al., 2015; Newby et al., 2015; Sharma et al., 2021), the current study has been unable to explore this in the context of autistic adults.

There is considerable evidence to suggest that autistic adults encounter obstacles in accessing psychological therapy (Brede et al., 2022; Camm-Crosbie et al., 2019). In Baou et al.'s (2023) estimation, autistic adults may be underrepresented in mental health services by up to five times compared to overall national prevalence estimates. This issue particularly impacts autistic older adults, autistic minority ethnic people, and autistic adults with ID. Therefore, per Baou et al.'s (2023) suggestion, the findings from the included studies may be limited to that subset of autistic adults that more commonly access, and are less frequently excluded from, services.

Future Research

The current study is the first meta-analysis to look at the efficacy of a broad range of psychological interventions for treating anxiety in autistic adults, adding to the evidence base around anxiety in autistic children and neurotypical adults. Still, there is a high prevalence of all comorbid mental health conditions in autistic adults (Khachadourian et al., 2023), and a lack of intervention studies for treating these. More research is therefore needed on psychological interventions for treating comorbid mental health conditions in autistic adults extending beyond anxiety. Further consideration should also be given to the development and evaluation of psychological interventions for treating anxiety and other comorbid mental health conditions in autistic adults with ID.

CBT is more researched than any other psychological intervention (David et al., 2018) and is effective for treating anxiety in autistic children (Perihan et al., 2022; Sharma et al., 2021; Ung et al., 2015) and neurotypical adults (Newby et al., 2015 & Seekles et al., 2013).

However, there may be a need to examine broader interventions for this population given the potential promise of mindfulness-based interventions. Additionally, Stark et al. (2021) suggest that there is an opportunity for further research exploring third-wave therapeutic approaches beyond MBSR.

Individual and group interventions have been evidenced as more effective for treating anxiety in autistic children and neurotypical adults (Kreslins et al., 2015; Newby et al., 2015; Sharma et al., 2021). However, the current study was unable to effectively distinguish the efficacy between individual and group interventions for autistic adults. More research should therefore prioritise individual interventions for autistic adults. Relatedly, as there was no difference between modified and specifically developed interventions, there may not be a need to develop innovative psychological treatments for autistic adults, as long as modifications are evidence-based and individually tailored. Further research could instead investigate the influence of different modifications, such as the inclusion of a caregiver or family member and whether intervention facilitators had received prior training to make appropriate adaptations.

Finally, the lack of identified RCTs highlights the need for future intervention studies to prioritise the implementation of control groups. Consideration should also be given to collecting longer term follow up data to facilitate further examination of the potential longer-term efficacy of interventions, as highlighted above. More research is needed to determine whether anxiety measures that have not been validated for autistic people reliably assess changes in anxiety symptoms.

Clinical Implications

This meta-analysis found psychological therapies to be an effective form of treatment for anxiety in autistic adults. As a result, services can offer a variety of interventions, including mindfulness and cognitive/behavioural based interventions, alongside appropriate

adaptations. Moreover, service providers could explore the adaptation of existing treatment frameworks not originally developed for autistic individuals using modifications suggested by NICE (2021) and the British Psychological Society (2021). This approach could enrich the therapeutic landscape, fostering inclusive and effective mental health support for autistic adults

As discussed, there is a lack of research on this topic. This may stem from autistic adults' poor access rates to mental health services, and is especially true for autistic older adults, autistic minority ethnic people, and autistic adults with ID (Baou et al., 2023). Consequently, prioritising improving access to mental health services for autistic adults is a primary objective. Co-design has been noted as a particularly important method for ensuring services are credible and acceptable, both in principle and in practice, for autistic young people (Hummerstone & Parsons, 2023), and is recommended by NHS England (2024) for autistic adults. Increased access is a necessary precursor to an increase in research on the effectiveness of different interventions.

Conclusions

This meta-analysis demonstrates that psychological interventions show some promise in terms of their efficacy in the reduction of anxiety in autistic adults, particularly mindfulness and cognitive/behavioural interventions. Outcomes were similar to those found for autistic children, and poorer than for neurotypical adults. Results indicate that outcomes are at least sustained for up to three-months after treatment ends. The analysis was limited by the narrow focus and small body of existing research on this topic, stemming from poor service access rates of autistic adults. Further research should take a broader view of comorbid mental health conditions in autistic adults and, in particular, individual interventions for treating these. This could inform future clinical practice around offering a wider range of

interventions that are appropriately adapted to patient needs. Doing so will, however, first require increasing access to services.

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CHAPTER TWO

Empirical Research Paper

Do State and Trait General and Social Anxiety Affect Theory of Mind?

Abstract

Introduction Theory of mind is an important skill to function in society and there is evidence that anxiety can impair the ability to use this skill effectively. However, current research is inconclusive, heterogeneously measures of theory of mind, and lacks distinction between anxiety types, such as general and social, despite these being known to present differently in clinical populations. False belief tasks are standard practice for assessing theory of mind in children and autistic participants and have also been found to adequately detect theory of mind differences in neurotypical adults. Yet these are not systematically used throughout the current literature. **Method** One hundred and sixty-eight participants completed the Generalised Anxiety Disorder-7 (GAD-7) and the Social Phobia Inventory (SPIN) prior to being randomly allocated to a general anxiety, social anxiety, or neutral mood condition. Following mood manipulation, participants completed a false belief task with either privileged knowledge or no knowledge. **Results** A 3x2 ANOVA found no significant main or interaction effects of general or social anxiety and false belief knowledge on performance, despite a reported increase of anxiety in the anxiety groups. There were also no significant correlations between trait general or social anxiety on theory of mind. **Discussion** The findings from this study do not support the previous evidence that anxiety increases egocentrism. Future studies should continue to distinguish systematically between state, trait, general, and social anxiety, and use reliable theory of mind measures.

Introduction

In a fundamentally social world, developing social relationships and understanding others is an important skill. Thinking about another person's mental state, referred to as theory of mind, is a process through which this skill is possible. Many factors can affect this ability, including emotions such as anxiety, which exists in a variety of categories (general, social), and can be experienced intermittently (state) and more persistently (trait). Some emotions may improve our theory of mind ability and others may reduce it. It is currently not clear whether state, trait, general, or social anxiety differ in their impact on theory of mind. Given the prevalence of anxiety disorders (Remes et al., 2016), and the need for an improved understanding and treatment of conditions that negatively impact social interactions, it is important to understand how theory of mind processes, such as belief reasoning, vary in relation to different sorts of experiences of anxiety.

Theory of Mind

Social interactions are a ubiquitous aspect of human life (Crosier et al., 2012; Li, 2020; Mühl, 2018). Our world is inherently social; to survive and thrive as individuals, as well as increase social capital, effectiveness at socialising with others is crucial (Todd et al., 2015). Understanding our own behaviours, intentions, and mental states as well as those of others is necessary for the effective management of social encounters. Various definitions have been used for these processes, most often "mentalizing" and "theory of mind" (Lin et al., 2010). Quesque et al. (2024) suggest that mentalizing refers to the ability to attribute mental states, while theory of mind encompasses mentalizing in addition to the theory that the process of attributing mental states is affected by other concepts (e.g., behaviour).

Traditional ways of thinking about theory of mind emerged from literature in children and non-human animals (Povinelli & Preuss, 1995) and have tended to focus on broad group

differences, neglecting that while different people vary in theory of mind ability, this can also vary within an individual from moment to moment. Individual differences in theory of mind ability have been well researched in terms of age (Henry et al., 2013), culture (Wu et al., 2013), language ability (Cutting & Dunn, 1999), autism, visual impairments, and auditory impairments (Peterson & Slaughter, 2006). Todd & Tamir (2024) include some of the more transitory factors in their review of factors that that can lead to an over-reliance on self-information when making inferences about another's mental state, including incidental emotions (emotions brought about by something unrelated to the main task). Converse et al. (2008) found that incidental emotions that are positive in valence increase egocentrism (an over-reliance on self-information when making inferences about another's mental state), yet Yip & Schweitzer (2019) found a negatively valanced emotion, anger, to also reduce theory of mind accuracy. Other studies have found that emotions high in uncertainty, such as anxiety, are also more likely to increase egocentrism (Lerner et al., 2015; Raghunathan & Pham, 1999; Todd et al., 2015).

Anxiety and Theory of Mind

Anxiety is a future-oriented (Eysenck et al., 2006), pervasive and valuable emotion that indicates potential threat and is designed to promote action to reduce susceptibility (Stein & Nesse, 2011), such as seeking and using advice (Gino et al., 2012). It has been described as negative in valence and high in physiological arousal (Shankman & Klein, 2003). State and trait anxiety differ; the former is a common and momentary emotion, and the latter reflects a chronic predisposition. Similarly, social and general anxiety differ; Khdour et al., (2016) note the differences between social anxiety disorder (SAD) and generalised anxiety disorder (GAD) symptomology, including in cognitive domains. While SAD has been found to produce impairments in attentive, executive, and visuo-spatial functions (Cohen et al., 1996,

as cited in Khdour et al., 2016), no correlation between cognitive deficits and GAD have been reported, although there has been limited investigation into cognitive function in GAD in particular (Khdour et al., 2016; Yang et al., 2015).

Surtees et al., (2024) propose that anxiety increases egocentrism, as it creates a motivation to reduce uncertainty, which results in an over-reliance on our own thoughts and beliefs to predict those of others. However, there is limited and inconsistent literature regarding the impact of state anxiety, both general and social, on theory of mind. Some of these inconsistencies may have arisen from varied methodological approaches to measuring theory of mind, and some may be a result of researchers not distinguishing between general and social anxiety.

Using spatial and conceptual perspective-taking tasks to measure theory of mind, along with an autobiographical writing task to induce state anxiety that did not distinguish between general and social anxiety, Todd et al. (2015) found increased egocentrism in anxious participants compared to anger, disgust, and neutral mood conditions. Similarly, Todd and Simpson (2016) used a visual perspective-taking task and an autobiographical writing task and again did not distinguish between general and social anxiety. They found that anxiety, relative to anger and neutral feelings, impaired ability to use theory of mind with other people but notably not non-human objects, highlighting a link between social aspects of cognition and a reduced theory of mind ability. Dyer et al. (2021), on the other hand, distinguish between both state and trait, and general and social anxiety. In their study, state anxiety was induced through inhalations of 7.5% carbon dioxide enriched air, which they compare to the physiological and physical symptoms experienced in GAD and note that anxiety induction methods that incorporate a social element may produce different outcomes. The effects of this on emotion recognition task performance (emotion recognition is often closely related to

theory of mind; Mier et al., 2010) found high state anxiety to reduce emotion recognition accuracy. They also found that trait anxiety did not have an impact or moderate the impact of state anxiety on emotion recognition despite previous findings.

The findings from Dyer et al. (2021) highlight that there is also a lack of clarity at the trait level. A meta-analysis by Baez et al. (2023) found that individuals with SAD performed worse than healthy controls on theory of mind tests but were unable to draw any conclusions on GAD as only two studies met inclusion criteria. The outcomes of the included SAD studies varied in their findings. Some studies reported that social anxiety disorder can lead to excessive theory of mind use (Hezel & McNally, 2014; Washburn et al., 2016). Although this may be context dependent (Ballespí et al., 2019), other studies have suggested that SAD is negatively associated with theory of mind ability (Alvi et al., 2020). Furthermore, Lenton-Brym et al. (2018) found no significant differences on a social cognition task when they grouped participants based on their scores on the Social Phobia Inventory (SPIN) into sub-clinical high socially anxious and low socially anxious. For GAD, Zainal and Newman (2018) found that individuals with GAD performed better than controls at cognitive reasoning theory of mind tasks when induced with worry compared to when given a relaxation exercise, but also performed better when worried and presented with negative social stimuli compared to controls.

Baez et al. (2023) note that the substantial heterogeneity in outcomes across the included SAD studies may be due to the diversity of tests used to assess theory of mind; of the 18 SAD studies included in this meta-analysis, 13 different theory of mind tasks were used. They conclude that further studies with large homogeneous samples were needed to better understand the factors that influence social cognition outcomes in both SAD and GAD. Quesque and Rossetti (2020) identify two criteria that a task must meet to measure theory of

mind: 1) the task must involve attributing mental states to others (mentalizing), and 2) participants must maintain a distinction between their own and others' mental states, which they label the "non-merging" criterion. While they note that many tasks do not meet these criteria, they determine that false belief tasks are an adequate method of measuring theory of mind. False belief tasks require participants to infer another person's false belief about a particular scenario where they may or may not have privileged information about the scenario. Birch and Bloom (2007) suggest that a curse of knowledge bias in false belief reasoning can detect deficits in adult participants, i.e., if specific knowledge about an outcome increases egocentrism, and the study by Converse et al. (2008) has shown that mood manipulation can affect participants' responses on this task.

Current Study

The current study attempted to address the lack of clarity on distinguishing how state and trait, and general and social anxiety impact theory of mind. General and social state anxiety were manipulated, and general and social trait anxiety were measured. It also attempted to address the inconsistencies and oversights in measuring theory of mind by using a typical measure of theory of mind that has been well established in the literature. A widely used false belief task (Birch & Bloom, 2007) measured theory of mind in participants that were randomised to either a general anxiety, social anxiety, or neutral condition. It was predicted that the anxiety conditions would demonstrate a reduced theory of mind ability when compared to the neutral condition, and that the social anxiety condition would perform worse than the general anxiety condition.

Method

Methods were pre-registered on the Open Science Framework (https://osf.io/zc3pf/). Ethical approval for the study was obtained from the University of Birmingham Science Technology Engineering and Mathematics Ethics Committee and can be found in appendix 1.

The study followed a 3x2 between-subjects experimental design. Participants were pseudo-randomly assigned to one of three mood conditions (general anxiety, social anxiety, neutral) and one of two knowledge conditions (no knowledge, privileged knowledge).

Participants

A G*power analysis based on Converse et al., (2008), to give 80% power to detect a medium effect size ($\eta p^2 = .06$) at $\alpha < .05$, returned a suggested sample size of 155. One hundred and sixty-eight participants were recruited, exceeding the minimum sample size required to detect a medium effect size. Participants were split evenly (56 in each group) across the general anxiety, social anxiety, and neutral mood conditions. Half of each group received privileged knowledge and half received no knowledge for Vicki's violin task (see below). Most of the participants were female and white. Mean age of participants was 19.06 (SD 1.38), with a range of 18-32. Demographic information across conditions can be found in table 2.1. Participants received research credits for taking part. Participants were ineligible to take part if they were under 18, had a diagnosed psychiatric condition and/or neurodevelopmental disorder, their English language proficiency was below that required to perform the experiment, or if they were already participating in a trial using the same or similar protocol.

Table 2.1

Demographic Information by Condition

	Condition												Total	
	General anxiety				Social anxiety				Neutral					
	No knowledge		Privileged knowledge		No knowledge		Privileged knowledge		No knowledge		Privileged knowledge			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age	19	.90	19	.86	18.96	.84	18.89	.99	18.96	.69	19.54	2.80	19.06	1.38
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Gender														
Female	24	85.7	24	85.7	24	85.7	24	85.7	23	82.1	25	89.3	144	85.71
Male	2	7.1	4	14.3	4	14.3	4	14.3	5	17.9	3	10.7	22	13.10
Non-binary	2	7.1	-	-	-	-	-	-	-	-	-	-	2	1.19
Ethnicity														
White	14	50	14	50	13	46.4	15	53.6	19	67.9	12	42.9	87	51.79
Black	6	21.4	1	3.6	3	10.7	2	7.1	4	14.3	3	10.7	19	11.31
Asian	6	21.4	11	39.3	10	35.7	8	28.6	2	7.1	9	32.1	46	27.38
Mixed	1	3.6	2	7.1	-	-	2	7.1	3	10.7	4	14.3	12	7.14
Other	1	3.6	-	-	2	7.14	1	3.6	-	-	-	-	4	2.38
N total	28		28		28		28		28		28		168	

Note. Aggregated scores were used for ethnicity.

Procedure

On arrival at the lab, a QR code was scanned by participants to access and complete the information sheet (appendix 2) and consent form (appendix 3) via Qualtrix, along with the GAD-7 (appendix 4a) and the SPIN (appendix 4b) to measure trait general and social anxiety. Participants were then pseudo-randomly allocated to one of the general anxiety, social anxiety, and neutral conditions, and given the relevant written instructions (detailed below) for the respective mood manipulation task. This was followed by a mood manipulation check (appendix 5), Vicki's violin task (described below), and the debrief form (appendix 6).

Trait Anxiety Measures

The GAD-7 is a brief, validated tool for measuring generalised anxiety and its severity, and has shown excellent internal consistency ($\alpha = .92$), good test-retest reliability (intraclass correlation = .83) and good criterion, construct, factorial, and procedural validity (Spitzer et al., 2006). Participants are asked to consider the extent to which they have experienced seven items over the past 2 weeks. Responses range from 'Not at all' to 'Nearly every day'. A score between 5-9 indicates mild general anxiety, 10-14 moderate general anxiety, and 15-21 severe general anxiety.

The SPIN is a 17-item, validated self-rating scale assessing fear, avoidance, and physiological symptoms of social anxiety. It has shown good test-retest reliability ($r = .78$-$.89$), excellent internal consistency for the full scale ($\alpha = .94$), and good convergent validity (Connor et al., 2000). Participants are asked to rate the extent to which each statement applied to them over the past week. Responses range from 'Not at all' to 'Extremely'. A score of 21-30 indicates mild social anxiety, 31-40 moderate, 41-50 severe, and above 50 very severe social anxiety.

Mood Manipulation

Each of the mood manipulation tasks consisted of a relevant a writing task as well the prospect of a future follow-up task, as anxiety is a future-oriented emotion (Ballance et al., 2022; Endler & Kocovski, 2001; Eysenck et al., 2006; Grupe & Nitschke, 2013; Miloyan et al., 2017). This procedure has been shown to induce anxiety in healthy participants (Damasio et al., 2000). For consistency, the neutral condition also received a prospective future follow-up task.

Participants in the social anxiety condition were asked to complete an autobiographical writing task of a time at which they were worried before or during a social event: "Think about a time you felt anxious about having to speak in public. This might be a presentation or speech. When you have decided on a memory, write about it for 5 minutes. You are encouraged to think about thoughts that crossed your mind, how other people looking at you made you feel, and any physical sensations you experienced". Participants were also told that they will have to present what they have written: "At the end of these tasks, you will be asked to present on what you wrote for a further 5 minutes".

Participants in the general anxiety condition were asked to complete a writing task, in which they describe a time when they felt worried about an exam: "Think about a time you had to take an important or difficult test/exam. The memory you think of should be of a time you were feeling anxious about taking the test/exam. When you have thought of the memory, spend 5 minutes recounting this experience. You are encouraged to think about how you felt, worries you had, and any physical sensations you experienced". They were also informed that following the writing task, they will be given a test that will be marked: "At some point

throughout these tasks, you will be given a test that will be marked and your result fed back to you".

Participants in the neutral condition were asked to write about the last items they purchased from the grocery store, as used by (Todd et al., 2015): "Think about what you bought the last time you went shopping. You will have 5 minutes to write about the items you bought. You are encouraged to think about the items in detail; how much they cost, if you had bought them before, etc". Participants were informed that after completing the writing task, they will be asked to engage in a prospective neutral task: "Following this you will be asked to look at pictures of items from a shopping list".

Manipulation Check

Following the writing tasks, all participants were asked to complete a self-report questionnaire on their mood (appendix 5). This consisted of a 7-item Likert scale ranging from "Not at all" to "Very much so" on how strongly they felt anxious, nervous, tense, calm, indifferent, neutral, unemotional, alert, aroused, energetic, and excited (adapted from Todd et al., 2015).

False Belief Task

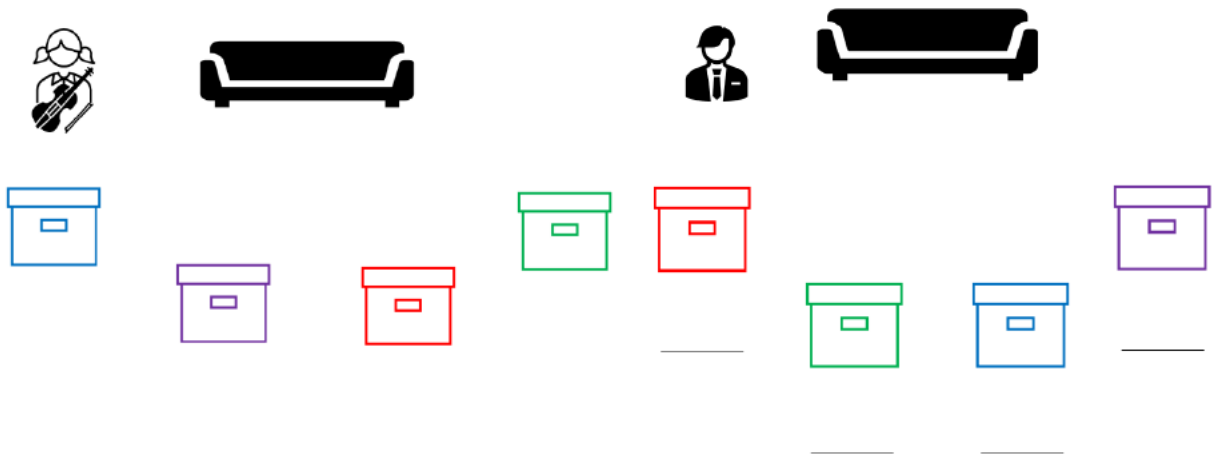
Following the writing task and manipulation check, participants from each condition then completed 'Vicki's violin' task as shown in figure 2.1 (adapted from Converse et al., 2008). Participants were randomly allocated either to a privileged knowledge condition or to receive the same knowledge that Vicki had. Both conditions receive the following text and visual: "This is Vicki. She finishes playing her violin and puts it in the blue container. Then she goes outside to play".

Figure 2.1

Vicki's Violin Task

Part A of Vicki's Violin Task

Part B of Vicki's Violin Task



The privileged knowledge group read: "While Vicki is outside playing, her sister, Denise, moves the violin to the red container". The no knowledge condition received the same knowledge as Vicki, which read: "While Vicki is outside playing, her sister, Denise, comes into the room". Both conditions receive the following text and image: "Then, Denise rearranges the containers in the room until the room looks like the picture below. When Vicki returns, she wants to play her violin. What are the chances Vicki will first look for her violin in each of the below containers? Write your answers in percentages in the space below each box". The key dependent variable is the estimated likelihood, as a percentage, that the participant attributes to the red box. In the privileged knowledge condition, if participants estimate a higher likelihood of Vicki looking in the red box compared to the no knowledge condition, this demonstrates egocentrism. The no knowledge condition acts as a control, in that the percentage estimates reflect how often participants identify the red box on the basis of it being moved alone. Responses on the false belief task that were more than 3 SDs from the overall mean were removed from the analysis, as described in Converse et al. (2008).

Once participants had completed the mood manipulation and false-belief tasks, they were presented with a debrief form that requested they do not share any details with their peers, as well as information regarding services that can be accessed for support with any prolonged anxiety that might be experienced.

Statistical Analyses

SPSS 29.0 was used to conduct statistical analyses. The dependent variable was recorded as a scaled percentage of what participants recorded as the likelihood of Vicki looking in the red box. For most participants, this reflected the percentage score they reported. Due to some participants providing a total percentage (for all boxes) that did not equal 100%, a scaled percentage value for the dependent variable was calculated by dividing 100 by the total percentage participants gave (for all boxes) and then multiplying this by the original red percentage value. Analyses of variance (ANOVA) and chi-square tests were carried out to assess for any differences between mood conditions and knowledge conditions in terms of age, gender, and ethnicity. ANOVA were also carried out to assess for any differences between group scores on the GAD-7 and SPIN, as well as on the manipulation check variables, with Scheffe post hoc tests. A 3x2 ANOVA was conducted to find any main or interaction effects between the two independent variables of mood condition (general anxiety, social anxiety, and neutral) and knowledge condition (no knowledge and privileged knowledge) and their impact on the dependent variable. Where relevant, effect sizes are reported as partial eta squared (η^2). Spearman's r correlations were performed for exploring the effects of trait anxiety on false belief task response.

Results

Although data were not normally distributed, an ANOVA was still conducted as these are typically considered robust to variations from non-normal distributions, particularly when group sizes are balanced (Blanca et al., 2017) and with sample sizes exceeding 30 (Ghasemi & Zahediasl, 2012). The current study meets both criteria. Histograms can be found in appendix 8.

Descriptive Statistics

There was no significant main effect of mood condition, $F(2, 166) = .83$, $p = .54$., or knowledge condition $F(1, 166) = .59$, $p = .44$, and no significant interaction between the two, $F(2, 166) = .90$, $p = .41$, in terms of age. There was no significant difference between the gender of participants across the three mood conditions ($\chi^2(4) = 4.26$, p = .37). Within each of the mood conditions, there was also no difference between the gender of participants across knowledge conditions (General, $\chi^2(2) = 2.67$, $p = .26$; Social, $\chi^2(2) = 0$, $p = 1$; Neutral, $\chi^2(2) = .58$, $p = .45$). There was no significant difference between the ethnicity of participants across the three mood conditions ($\chi^2(34) = 29.93$, p = .67). Within each of the mood conditions, there was also no difference between the gender of participants across knowledge conditions (General, $\chi^2(12) = 12.15$, $p = .43$; Social, $\chi^2(13) = 11.49$, $p = .57$; Neutral, $\chi^2(12) = 14.38$, $p = .28$). There were also no significant differences between the combined conditions and scores on the GAD-7 or SPIN, $F(5, 166) = 1.53$, $p = .22$. Means and SDs for each group are shown in table 2.2, demonstrating that the groups were equally matched for trait anxiety.

Table 2.2

Means and Standard Deviations of Scores on the GAD-7 and SPIN by Study Condition

	Condition													
	General anxiety				Social anxiety				Neutral				Total	
	No knowledge		Privileged knowledge		No knowledge		Privileged knowledge		No knowledge		Privileged knowledge			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
GAD	5.29	3.57	6.00	3.80	5.11	2.97	6.86	4.21	6.50	4.26	5.86	4.32	5.93	3.87
SPIN	19.04	10.59	24.54	12.46	21.14	9.93	24.07	12.63	19.86	11.79	19.32	10.96	21.33	11.48

On the GAD-7, 66 participants scores fell within the minimal range, 75 within the mild range, 21 within the moderate range, and 6 within the severe range. On the SPIN, 86 participants scored within the minimal range, 42 within the mild rage, 32 within the moderate range, 6 within the severe range, and 2 within the very severe range.

Manipulation Check

An ANOVA looking at differences between each of the manipulation check items and the three mood conditions found there were significant differences between condition (general anxiety, social anxiety, neutral) and the extent to which participants reported feeling anxious $F(2, 165) = 15.41$, $p < .001$, $\eta^2 = .16$, General = Social > Neutral, nervous $F(2, 165) = 9.77$, $p < .001$, $\eta^2 = .11$, General = Social > Neutral, tense $F(2, 165) = 13.35$ $p < .001$, $\eta^2 = .14$, General = Social > Neutral, calm $F(2, 165) = 6.71$, $p = .08$, $\eta^2 = .06$, General = Social < Neutral, and neutral $F(2, 165) = 7.27$, $p < .001$, $\eta^2 = .08$, General = Social < Neutral. This suggests that the manipulation induction was successful, in that the anxious groups reported increased anxiety with similar intensity for both social and non-social situations. No other mood manipulation items were significantly different between mood conditions. Results for each mood manipulation check item can be found in table 2.3.

Table 2.3

Means, Standard Deviations, and Analysis of Variance (ANOVA) results of Manipulation Check Items

	Condition								Scheffe post-hoc		
	General anxiety		Social anxiety		Neutral		ANOVA		General v social	General v neutral	Social v neutral
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	*p*	*p*	*p*
Anxious	2.96	1.35	2.95	1.21	1.82	1.18	15.41	< .001	1	< .001	< .001
Nervous	2.73	1.57	2.79	1.35	1.77	1.18	9.77	< .001	1	.001	< .001
Tense	2.79	1.53	3.04	1.43	1.79	1.06	13.35	< .001	.62	< .001	< .001
Calm	3.30	1.55	3.55	1.72	4.37	1.59	17.60	.002	.72	.003	.03
Indifferent	2.95	1.59	3.02	1.69	3.66	1.81	3.00	.05	.98	.09	.14
Neutral	3.23	1.75	3.61	1.89	4.48	1.71	7.27	< .001	.54	.001	.04
Emotional	2.95	1.78	3.21	1.78	3.64	1.85	2.12	.12	.74	.13	.46
Alert	3.43	1.59	3.87	1.64	3.79	1.53	1.24	.29	.33	.50	.96
Aroused	2.07	1.26	2.45	1.55	2.12	1.18	1.29	.28	.34	.98	.45
Energetic	2.48	1.19	2.29	1.41	2.61	1.17	.92	.40	.71	.87	.71
Excited	2.39	1.37	2.16	1.46	2.41	1.30	.57	.57	.67	1	.63

The Impact of State Anxiety on False Belief Reasoning

Thirty-six participants' percentages on the false belief task did not add up to 100%, varying from 90% to 330%, and therefore data was scaled for all participants' responses as described in the method. One outlier was greater than 3 SDs from the mean and was therefore removed from analysis.

A 3 (general anxiety, social anxiety, neutral) x 2 (privileged knowledge, no knowledge) between-subjects ANOVA yielded no main effect of mood condition, $F(2, 161) = .88$, $p = .42$, $\eta^2 = .01$, or knowledge condition, $F(1, 161) = 2.08$, $p = .15$, $\eta^2 = .01$ on participants' prediction of how likely Vicki was to look in the red box. The interaction effect was also non-significant, $F(5, 161) = .08$, $p = .92$), $\eta^2 < .01$, see figure 2.2.

Figure 2.2

Violin Plot of Participants' Predictions that Vicki Will Look in the Red Box by Mood and Knowledge Condition

Correlation Between Trait Anxiety and False Belief Reasoning

Spearman's correlations revealed a significant correlation between trait general and social anxiety in the no knowledge condition, $r = .45$, $p < .001$, but no significant correlations between trait general anxiety and scaled red box response $r = -.03$, $p = .82$, or trait social

anxiety and scaled red box response, $r = .21$, $p = .06$. Similarly, for the privileged knowledge condition, there was a significant correlation between trait general and social anxiety, $r = .39$, $p < .001$, but no significant correlations between trait general anxiety and scaled red box response $r = -.18$, $p = .11$, or trait social anxiety and scaled red box response, $r = .05$, $p = .64$.

Discussion

In this study, participants' state general and social anxiety was effectively manipulated after completing an autobiographical writing task, with a prospective future follow-up task. There was, however, no evidence that state general and social anxiety had an impact on theory of mind measured through a false belief task, when compared to a neutral mood group. There were also no significant correlations between trait general and social anxiety and theory of mind ability in the false belief task. There was a correlation between trait general and trait social anxiety, suggesting that people who experience trait general anxiety are more likely to also experience trait social anxiety and vice versa.

The Impact of State Anxiety on Theory of Mind

The current study's findings are inconsistent with previous studies on anxiety and theory of mind by Todd et al. (2015) and Todd and Simpson (2016). The findings from Todd et al. (2015) suggest that egocentrism is increased by emotions that are characterised by uncertainty. In the current study participants in each condition reported being significantly more anxious in the anxiety conditions, yet the outcomes do not demonstrate a motivation to reduce uncertainty, or this motivation may have been overridden. Todd and Simpson (2016) suggest that the impact of anxiety on theory of mind may be particularly noticeable for social aspects of cognition, however, the current study found no differences between social and non-social anxiety on a theory of mind task. Dyer et al. (2022), on the other hand, found no

effects of state anxiety on emotion recognition, and although they did not distinguish between general and social anxiety, these findings are more consistent with the current study.

The discrepancy between the findings from this study and previous studies poses queries about whether anxious participants experienced increased egocentrism, and if they did, how this may not lead to a reduced theory of mind ability. This resonates with Todd and Tamir's (2024) argument that the capability to override an egocentric pull depends on the strength with which egocentric information is activated, as well as individual characteristics that influence someone's motivation or ability to override this pull. In the current study, the strength of the activation of self-information may rely on the intensity of experienced anxiety or the failure of the false belief task to create a curse of knowledge adequately, which is suggested from the absence of a significant main effect of knowledge state. Overall, the outcomes of this study indicate that even when people are anxious, they can still utilise their knowledge about others' knowledge to make accurate, unbiased inferences in a false belief task.

The Impact of Trait Anxiety on Theory of Mind

Baez et al.'s (2023) meta-analysis looking at the impact of trait anxiety on theory of mind concludes that SAD produces a reduced theory of mind ability compared to healthy controls, despite some of the variability between studies. In the current study, trait social anxiety did not lead to a reduced theory of mind, which is more consistent with the findings from the study by Lenton-Brym et al. (2018) that found no differences between high and low socially anxious participants based on their scores from the SPIN. Considering that increased trait social anxiety was positively correlated with trait general anxiety in the current study, it may be worth considering if there are differences in the impact on theory of mind when these are present in isolation and in combination (i.e., trait social anxiety with no trait general anxiety,

trait general anxiety with no trait social anxiety, and both trait social and general anxiety together).

While the non-significant findings of trait general and social anxiety in the current study echo the findings from Dyer et al. (2022), the latter study used an emotion recognition task. Emotion recognition is often associated with theory of mind (Mier et al., 2010) but Quesque and Rossetti (2020) argue that emotion recognition tasks do not measure theory of mind. Despite this disjuncture, given the close association between these two concepts, these similarities in findings may suggest that the cognitive processes linking theory of mind and emotion recognition remain unaffected by trait general and social anxiety.

Strengths and Limitations

Previous studies that have looked at the influence of anxiety on theory of mind and its related concepts have failed to measure state and trait and general and social anxiety as distinct concepts. This study was the first to differentiate between both state and trait, and general and social anxiety, while using a well-established measure of theory of mind.

While the mood manipulation procedure was shown to adequately induce a mood state of sufficient intensity, i.e., participants in the anxiety conditions reported being significantly more anxious than the neutral group, it is not clear if the duration of this manipulated mood state was sufficient to affect the cognitive processes underlying theory of mind. There may also be a question around whether the curse of knowledge in the false belief task was sufficient to detect theory of mind deficits in this cohort of participants, as there was no effect of knowledge condition. However, Converse et al. (2008) used similar mood manipulation procedures with moderate effect sizes and discovered significant differences in mood groups on Vicki's Violin theory of mind task in a similar cohort of university students.

The findings from this study are limited by the potentially mismatched impact of mood manipulation tasks within a laboratory environment when compared to real-world

experiences in terms of a) intensity and b) differences between generalised and social anxiety. Bhanot et al. (2020) comment on the ecological validity of autobiographical mood induction tasks relative to other laboratory methods, noting that these can often encounter a demand effect due to the wording used and may be limited in external validity. Still, laboratory results have been evidenced to reliably replicate field results when there are large effect sizes (Anderson et al., 1999; Mitchell, 2012). Given that Converse et al. (2008) found a significant impact of mood on theory of mind with moderate effect sizes for manipulation check items, and the current study's manipulation check demonstrated medium to large effect sizes, the non-significant effect in this study may indeed offer a reliable outcome of anxiety on theory of mind.

Differences in general and social anxiety on the manipulation check items could help to ensure distinctions between the two conditions. That is, it could be argued that a participant's anticipation of a larger audience for the social anxiety condition prospective follow-up task (having been told they would have to present their writing) could increase these distinctions. However, studies investigating the impact of audience size on level of social anxiety have found no significant effects (Mostajeran et al., 2020; Wankel, 1977).

The current study showed good internal validity, given that there were no differences found between conditions in terms of participants' age, gender, and ethnicity, suggesting that the non-significant findings are not a result of these factors. However, an overall majority of study participants identified as female. This imbalance potentially limits the generalisability of the findings to male samples, particularly as female participants have been shown to demonstrate a greater self-other distinction whilst under stress whereas male participants respond with increased egocentrism (Tomova et al., 2014). If women demonstrate an enhanced theory of mind ability under negatively valanced emotions, the majority female

sample in the current study may have contributed to the absence of a significant main effect of anxiety on theory of mind.

Future Directions

The current study suggests several additional avenues for future research. First, future research should continue to determine which concepts are being measured (theory of mind, mentalizing, etc) and when measuring theory of mind should use specific and well-established theory of mind tasks, such as the one used in this study. They should also continue to distinguish systematically between state and trait, and general and social anxiety as distinct phenomena. Replicating the current study's protocol could verify the findings. Second, further analyses could explore the relationship between trait anxiety and susceptibility to state mood manipulation. Third, while the current study did not incorporate integral emotions, similar distinctions between different emotional phenomena and reliable measures should be used when investigating how these may affect theory of mind. Finally, future studies should aim to recruit more balanced samples of gender and ethnicity so that outcomes can be generalised to broader populations and subgroup differences can be explored.

Clinical Implications

The significant, bi-directional correlation between trait general and trait social anxiety supports the conclusions from Goldenberg et al. (1996) that GAD and SAD are more commonly experienced as comorbidities than not. Despite this known association, quality standards for the treatment provided by the National Institute for Health and Care Excellence (NICE) for GAD and SAD differ; a stepped care approach is recommended for GAD and specifically developed Cognitive Behavioural Therapy (CBT) interventions are recommended for SAD (NICE, 2014). Given the treatment distinctions, individuals presenting at mental

health services with GAD or SAD should be screened for the presence of the other condition, and interventions should be offered for both conditions when necessary.

Conclusions

The current study showed that state general and social anxiety did not impact the curse of knowledge people experience when reasoning about false beliefs. Equivalent null results were found for trait general and social anxiety. These findings prompt further questions about what factors may exist that provide someone with the ability to override an egocentric motivation to reduce uncertainty. The study builds upon previous research and begins to provide a systematic approach to discriminating between the varying impacts of these different phenomena on reliably measured theory of mind.

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CHAPTER THREE

Press Release for the Literature Review

University of Birmingham Press Release

Interventions for Anxiety in Autistic Adults Are Insufficient

A recent comprehensive review of scientific studies has shown that interventions for treating anxiety in autistic adults are only slightly effective. Led by Charlotte Foulds, the study sheds light on the efficacy of psychological interventions in addressing some of the mental health challenges faced by this demographic, marking a significant advancement in understanding and addressing how we treat mental health challenges in this population.

The guidelines from the National Institute of Health and Care Excellence recommend psychological interventions as a first-line treatment for anxiety. Additionally, these guidelines underscore the importance of making adaptations to cater for the needs of autistic people. They offer some example adaptations, however, the British Psychological Society note that many of these have not been tested through research.

Anxiety is highly prevalent among autistic adults, emphasising the critical need for appropriate and effective psychological interventions. While existing research has focused on psychological interventions for anxiety in autistic children and neurotypical adults, there has been a notable gap in understanding the efficacy of these interventions for autistic adults.

This study aims to bridge this gap by synthesizing data from numerous studies to provide a clearer understanding of the efficacy of psychological interventions. The study found that while the effectiveness of interventions for anxiety in autistic adults may be similar to some of what has been found for autistic children, this is worse than what we see in interventions for neurotypical adults. The lead author commented that, “despite the known disparity in health service access and treatment for autistic people compared to

neurotypical people, there is simply not enough research being done on how to make interventions more effective for this population."

The findings suggest that the effects of psychological interventions did not decline over the short-term, but more data is needed about the longer-term. The findings also suggest that interventions based on mindfulness and cognitive and/or behavioural principles could show some promise. It is important for future research not to focus primarily on Cognitive Behavioural Therapy (CBT), which is often the most researched therapy. Notably, the study found no difference between interventions that had been specifically developed for autistic adults and those that had just been modified. This suggests that existing treatments could be suitable options for this population, as long as suitable and individually tailored adaptations are made.

"We conducted this study to address the critical need for effective interventions to alleviate anxiety in autistic adults," said Foulds. "Our findings underscore the importance of increasing access to services for this population, so that more research can done on how appropriately adapted psychological interventions can help tackle the disproportionate mental health conditions that this population experience."

The publication of this study marks a significant step forward in addressing the mental health needs of autistic adults. As awareness grows and research progresses, there is hope for the development of more targeted and effective support to meet the unique needs of this population.

-ENDS-

CHAPTER FOUR

Press Release for the Empirical Research Paper

University of Birmingham Press Release

Anxiety Shows No Impact on Our Ability to Think About Each Other's Thoughts

A study conducted at the University of Birmingham with 168 undergraduate students found that anxiety did not impact their ability to think about another person's thoughts, a process referred to as theory of mind, despite previous research finding that this is the case. "We embarked on this study to try to further unravel the intricate connections between anxiety types and theory of mind," explained Charlotte Foulds, the lead author. "Our findings challenge prevailing assumptions and underscore the need for nuanced investigations in this domain."

Social anxiety tends to centre worries around other people, for example meeting new people, speaking in groups, or being in crowds. General anxiety can include aspects of this, as well as worrying about day-to-day life, such as health, relationships, or finances. These are experiences that everyone can have from moment to moment, referred to as state anxiety, and some people experience one or both of these more persistently, which is referred to as trait anxiety. Given the importance of being able to communicate and interact socially with others for both individual wellbeing and societal success, it is important to gain a more detailed understanding of how these different worries can affect our ability to do this successfully.

Previous studies that have found anxiety to impact theory of mind have failed to make distinctions between social and general anxiety, as well as between state and trait anxiety. This study is the first to systematically differentiate between these various forms of anxiety in the context of measuring its impact on theory of mind.

Previous studies have also employed a multitude of methods for measuring someone's theory of mind ability. However, these methods have sometimes been inappropriate, and

some used measures of concepts closely linked to theory of mind instead of theory of mind itself. In contrast, the present study used a well-established and robust theory of mind measure, setting the standard for future research in this domain.

Although the study found no impact of state, trait, general, or social anxiety on theory of mind, it did identify a correlation between trait general and trait social anxiety. This suggests that people who experience one of these are also likely to experience the other. This finding has important implications for clinical practice, indicating that mental health services should ensure that when people present with either general or social anxiety they should be assessed for the other and offered the relevant treatment for both.

It will be important for future research to continue to make distinctions between state, trait, general, and social anxiety, and to use well-established methods for measuring theory of mind.

-ENDS-

CHAPTER FIVE

Appendices

Appendix 1: Email from Ethics Committee Granting Full Ethical Approval

From: Samantha Waldron (Research Strategy and Services Central)

[redacted]

Sent: Wednesday, January 4, 2023 1:30 PM

To: Andrew Surtees (Psychology) [redacted] Charlotte Foulds (ClinPsyD Clinical Psychol FT) [redacted]

Subject: Application for Ethical Review ERN_21-0653AP4

Dear Dr. Andrew Surtees,

Re: "Investigating the effect of anxiety on perspective taking"

Application for Ethical Review ERN_21-0653AP4

Thank you for the above application to use Programme of Work ERN_21-0653P. This has now been considered by the Science, Technology, Engineering and Mathematics Ethical Review Committee.

On behalf of the Committee, I can confirm a favourable ethical opinion for this application.

I would like to remind you that any substantive changes to the nature of the study as described in the Application for Ethical Review, and/or any adverse events occurring during the study should be promptly brought to the Committee's attention by the Principal Investigator and may necessitate further ethical review.

Please be aware that whilst Health and Safety (H&S) issues may be considered during the ethical review process, you are still required to follow the University's guidance on H&S and to ensure that H&S risk assessments have been carried out as appropriate. For further information about this, please contact your School H&S representative or the University's H&S Unit at healthandsafety@contacts.bham.ac.uk.

If you require a hard copy of this correspondence, please let me know.

Kind regards

Ms Sam Waldron (she/her)

Research Ethics Officer

Research Strategy & Services Division

University of Birmingham

Appendix 2: Participant Information Sheet

Title of Project: Anxiety, memory recall and reasoning

Researchers: Charlotte Foulds and Dr Andrew Surtees

Invitation

We would like to invite you to take part in our research studies. Before you decide, we would like you to understand why the research is being done and what it would involve for you. Please read this information carefully and contact us if you have any questions. Our contact information is included at the end of this sheet. Reading this information sheet will take up to 5 minutes.

What is the purpose of this research?

These research studies are projects being run by Charlotte Foulds, a Trainee Clinical Psychologist, as part of her clinical psychology doctorate degree at the University of Birmingham.

What would taking part involve?

If you agree to take part, you will be invited to complete two questionnaires around your experiences of anxiety in day-to-day life. You will then be asked to book a time to come in to take part in two studies.

Study 1

For the first study you will be randomly allocated to one of three conditions:

Condition 1: You will be asked to recount a memory of a time you had to take a test or an exam and then write about it for 5 minutes. Following this you will be asked to take part in a test that will be marked and your result fed back to you.

Condition 2: You will be asked to think about a time you felt anxious about having to speak in public and write about it for 5 minutes. Following this you will be asked to talk about what you wrote to another participant for a further 5 minutes.

Condition 3: You will be asked to recount the items you purchased on your last shopping trip and write about it for 5 minutes. Following this you will be asked to look at pictures of items from a shopping list.

After participating in one of the above three conditions, you will be given a rating scale for various emotions to complete.

Study 2

For the second study you will be asked to read a vignette and answer some questions based on what you know from the information provided.

The following exclusion criteria applies, please do not continue if you meet any of the criteria below:

- You are under the age of 18
- You have been diagnosed with a psychiatric condition.
- You have been diagnosed with a neurodevelopmental disorder (e.g., autism spectrum disorder).
- You are unable to give your consent because of English language proficiency,

neurological conditions, or because of impaired movement through disease or old age.

– You are participating in a trial using the same or similar protocol.

How long will it take?

The studies will take approximately 30 minutes.

What are the possible disadvantages and risks of taking part?

You may experience some emotion in relation to the memory you recall, which could be unpleasant – but this is not expected to be any more than you would experience day to day. If you did notice your discomfort increasing, the experimenter will be able to offer relaxation techniques to reduce this. It is not expected that the discomfort levels will be overwhelming or last longer than the studies, however, a trainee clinical psychologist/ clinical psychologist will be available for participants in the event the discomfort persists after the studies.

What are the possible benefits of taking part?

The primary benefit of taking part will be the research credits gained, which will be issued after completing the studies. However, participating is also an exciting opportunity to be a part of an emerging area of research. It is anticipated your participation will help researchers clarify what, and how certain emotions affect perspective taking.

What will happen if I do not want to carry on with the studies?

Participation is completely voluntary. If you start the studies, but change your mind, please tell the researcher you no longer want to participate - you do not have to continue if you do not want to. You do not have to give a reason why you do not wish to participate. You will have 14 days after taking part to withdraw your responses if you wish.

Please note, if you withdraw from the studies, you will only be allocated research credits equal to the amount of time you remained in the studies for, rather than the credits equal to full participation.

What will happen to the information I give?

All data will be managed in line with the Data Protection Act (2018). The data collected from the studies will be stored electronically in a database with the data from other participants, so it can be analysed. Your information will be identified by an anonymous code, in a file protected with a password, and will be kept separately from your name and any other personal identifiable data about you. Paper files will be stored in a locked filing cabinet in a secure building. Only members of the research team will have access to your information.

What will happen to the results of the research studies?

The findings will be written up as part of Charlotte's clinical psychology doctorate thesis. In addition, we will publish any interesting findings in scientific journals. If you would like a copy of the results, please don't hesitate to make a request with Charlotte.

Who has approved these studies?

These studies have been reviewed and approved by the University of Birmingham's Science, Technology, Engineering and Mathematics Ethical Review Committee.

What happens if I have any further concerns?

If you have any concerns about taking part, we encourage you to talk to other people you are close to about it or contact the research team. Remember, you do not have to take part if you do not want to.

If you would like to discuss any aspect of this research, please contact:

Charlotte Foulds: [redacted]

Dr Andrew Surtees: [redacted]

If you have concerns about the conduct of this research, you can contact Professor Edward Wilding (Head of the School of Psychology [redacted] or Dr Birgit Whitman (Head of Research Governance and Integrity - [redacted]

What should I do if I want further support?

Although the studies themselves are unlikely to lead to any lasting anxiety for you, you may feel the need to seek further support. To access support with your mental health, you may want to contact your General Practitioner. If you live in Birmingham, you can also seek support from Forward Thinking Birmingham (https://www.forwardthinkingbirmingham.org.uk/, if you are 25 or younger) or Birmingham Healthy Minds (https://www.bsmhft.nhs.uk/our-services/birmingham-healthy-minds/, if you are 26 or older). The Samaritans (https://www.samaritans.org/, 116123) operate a support service 24 hours a day, 365 days a year.

Appendix 3: Consent Form

Participant Identification Number: .....

***Title of Project**:* Anxiety, memory recall & reasoning

Researcher: Charlotte Foulds and Dr Andrew Surtees

Please initial each box if you agree:

1. I confirm that I have understood the information sheet dated September 2022 (version 1) for the above studies. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I can stop at any time, without giving any reason, without my own or my loved one's medical/social care or legal rights being affected. ☐

3. I understand I may experience mild anxiety (but this is not expected to have any lasting effect). ☐

4. I understand that once I have submitted my responses, there will be a time period of 14 days in which I can withdraw from the studies, however following this it will not be possible to withdraw from the studies. ☐

5. I understand that the data collected during these studies will be looked at by the researcher and relevant others at the University of Birmingham to ensure that the analysis is a fair and reasonable representation of the data.

6. I agree to take part in the above studies.

.....	.....	.....
Name of participant	Date	Signature
.....	.....	.....
Name of person taking consent	Date	Signature

Appendix 4: Measures Used for Empirical Research Paper

4a. Generalized Anxiety Disorder -7

GAD-7

Over the last 2 weeks, how often have you been bothered by the following problems? *(Use "✔" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	0	1	2	3

(For office coding: Total Score T____ = ____ + ____ + ____)

4b. Social Phobia Inventory

SOCIAL PHOBIA INVENTORY (SPIN) ©

Please indicate how much the following problems have bothered you during the past week. Mark only one box for each problem, and be sure to answer all items.

		Not at all	A little bit	Somewhat	Very much	Extremely
1.	I am afraid of people in authority	☐	☐	☐	☐	☐
2.	I am bothered by blushing in front of people	☐	☐	☐	☐	☐
3.	Parties and social events scare me	☐	☐	☐	☐	☐
4.	I avoid talking to people I don't know	☐	☐	☐	☐	☐
5.	Being criticized scares me a lot	☐	☐	☐	☐	☐
6.	Fear of embarrassment causes me to avoid doing things or speaking to people	☐	☐	☐	☐	☐
7.	Sweating in front of people causes me distress	☐	☐	☐	☐	☐
8.	I avoid going to parties	☐	☐	☐	☐	☐
9.	I avoid activities in which I am the center of attention	☐	☐	☐	☐	☐
10.	Talking to strangers scares me	☐	☐	☐	☐	☐
11.	I avoid having to give speeches	☐	☐	☐	☐	☐
12.	I would do anything to avoid being criticized	☐	☐	☐	☐	☐
13.	Heart palpitations bother me when I am around people	☐	☐	☐	☐	☐
14.	I am afraid of doing things when people might be watching	☐	☐	☐	☐	☐
15.	Being embarrassed or looking stupid is among my worst fears	☐	☐	☐	☐	☐
16.	I avoid speaking to anyone in authority	☐	☐	☐	☐	☐
17.	Trembling or shaking in front of others is distressing to me	☐	☐	☐	☐	☐

Appendix 5: Manipulation Check

Please rate how strongly you currently feel the following emotions

	Not at all						Very much so
	1	2	3	4	5	6	7
Anxious							
Nervous							
Tense							
Calm							
Indifferent							
Neutral							
Unemotional							
Alert							
Aroused							
Energetic							
Excited							

Appendix 6: Debrief Form

Investigating the impact of anxiety on perspective taking

Many thanks for your participation in our study!

In the study, you took part in 4 tasks:

- Screening questionnaires measuring for trait anxiety
- An anxiety inducing task (either writing information to present to someone else, or writing about a time when you took an exam) OR a neutral task
- A manipulation check
- A false-belief task

Each of these tasks allows us to compare how someone's ability to take another persons' perspective whilst socially anxious, generally anxious, or in a neutral state. In the false-belief task there were two groups with differing information about the location of the violin. This allows for a comparison of whether someone is more or less likely to use their ability to take another's perspective when experiencing general anxiety, social anxiety, or in a neutral state. We are interested in how perspective taking is affected by social anxiety compared to general anxiety. One hypothesis is that we become more egocentric (selfish) when we're generally anxious and less egocentric when socially anxious, as our focus of attention is centred around what others might be thinking. Ours is the first study to try and find out if there are differences between these two types of anxiety.

If you have any further questions or would like to know the outcome of the study, please ask the researcher or contact the Principal Investigator for the study, Dr. Andrew Surtees on [redacted] If you have concerns about the conduct of this research, you can contact Professor Edward Wilding (Head of the School of Psychology [redacted]

[redacted] or Dr Birgit Whitman (Head of Research Governance and Integrity - [redacted]

What should I do if I decide to withdraw from the study?

You do not have to give a reason why you do not wish to withdraw. You will have 14 days after taking part to withdraw your responses if you wish. Please contact the researcher on [redacted]

What should I do if I want further support?

If your concerns relate to your mental health, and you live in Birmingham, you can also seek support from Forward Thinking Birmingham (https://www.forwardthinkingbirmingham.org.uk/, if you are 25 or younger) or Birmingham Healthy Minds (https://www.bsmhft.nhs.uk/our-services/birmingham-healthy-minds/, if you are 26 or older). The Samaritans (https://www.samaritans.org/, 116123) operate a support service 24 hours a day, 365 days a year.

Please do not talk to others about the hypotheses of the study

Appendix 7: PRISMA Checklist

Section and topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist (table 2).	
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	

Section and topic	Item #	Checklist item	Location where item is reported
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from	

Section and topic	Item #	Checklist item	Location where item is reported
		each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made	

Section and topic	Item #	Checklist item	Location where item is reported
		about any missing or unclear information.	
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	

Section and topic	Item #	Checklist item	Location where item is reported
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	
	13d	Describe any methods used to synthesise results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	

Section and topic	Item #	Checklist item	Location where item is reported
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesised results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram (see fig 1).	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	

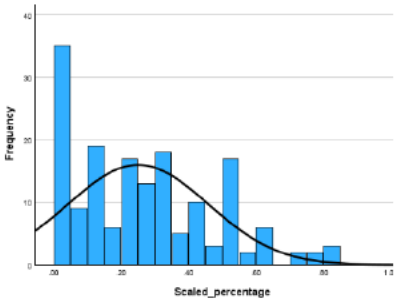
Section and topic	Item #	Checklist item	Location where item is reported
Study characteristics	17	Cite each included study and present its characteristics.	
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical	

Section and topic	Item #	Checklist item	Location where item is reported
		heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesised results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	

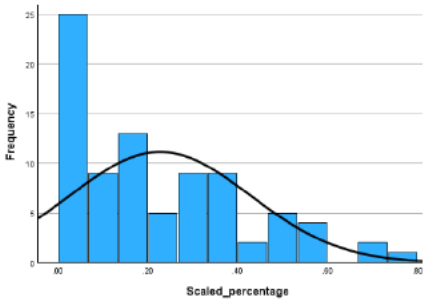
Section and topic	Item #	Checklist item	Location where item is reported
	23b	Discuss any limitations of the evidence included in the review.	
	23c	Discuss any limitations of the review processes used.	
	23d	Discuss implications of the results for practice, policy, and future research.	
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	

Section and topic	Item #	Checklist item	Location where item is reported
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code, and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

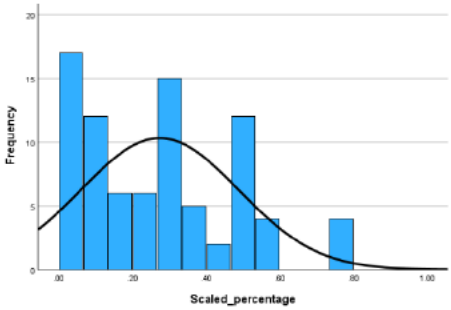
Appendix 8: Histograms for the Empirical Research Paper



Scaled red box score



No knowledge condition



Privileged knowledge condition