



The
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Social anxiety, psychological distress and the autism spectrum

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Declaration Page

I, the author, declare that this thesis is my own work. It is submitted for the Doctorate in Clinical Psychology at the University of Sheffield and has not been submitted to any other University or for any other award.

Structure and Word Counts

Abstracts

Lay Summary: 490

Literature Review: 245

Empirical Study: 242

Literature Review

Main Body Excluding References and Tables: 7976

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Empirical Study

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Total

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Lay Summary

Sensory processing differences are common in autistic individuals as well as people who experience symptoms similar to psychosis. Social anxiety is also reported to be common in autistic people and people who experience psychotic-like symptoms. In addition to this, other research has suggested that psychological distress is common in autistic people and in individuals who experience psychotic-like symptoms, which some research has suggested could be related to sensory processing. As a result, this current research aimed to explore sensory processing, autistic traits, and psychotic-like symptoms in the general population, to investigate how much they explain experiences of social anxiety and psychological distress. Furthermore, although there is some research that has explored social anxiety in autism, it is not known how common it is for autistic individuals to experience social anxiety and what additional impact this has on other aspects of mental health and daily functioning.

The first part of this thesis aimed to review previous research on social anxiety in autistic adults to firstly assess how common it is, and to secondly explore the additional impact on mental health and functioning. A total of 19 studies were identified after a literature search and were included in the literature review. Five of these studies assessed how common social anxiety is in autism, finding an overall rate of 76%. Studies also found higher levels of depression and anxiety, and lower levels of well-being in autistic people who experience social anxiety. Some studies also suggested that alexithymia (difficulties in recognising emotions) and camouflaging (masking autistic traits) may increase the risk of social anxiety. There are several limitations in this part of the thesis which are described in detail below. Clinical implications and future research are also discussed in the main body of the thesis.

The second part of this thesis aimed to explore sensory processing, autistic traits, and psychotic-like symptoms in the general population, to investigate how much they explain experiences of social anxiety and psychological distress. An online survey was created and shared

among social media platforms and with some mental health and autistic charities. The survey included questions on demographics, autistic traits, psychotic-like experiences, sensory processing, social anxiety, and mental health. In total, 273 people completed the survey and were included in the analysis.

The results found that, in the general population, autistic traits, psychotic-like symptoms and sensory processing are all important in explaining the experience of both social anxiety and psychological distress. In addition, autistic traits, sensory processing, and psychotic-like symptoms were all significantly related to each other. Furthermore, 52 people who took part reported a formal diagnosis of autism; these people scored significantly higher on all measures used in the study (autistic traits, sensory processing, psychotic-like experiences, social anxiety, and psychological distress). However, the results of the study should be interpreted with caution due to the limitations of the research. The implications of the findings and suggestions for future research can be found in more detail below.

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Section 1: Literature Review

Social anxiety in autistic adults: A systematic literature review and meta-analysis

Abstract

Objectives: Social anxiety is an important construct in the experiences of autistic individuals. This review and meta-analysis aimed to quantify the prevalence of social anxiety in autistic adults and investigate the impact social anxiety and autism has on mental health, well-being, functioning and quality of life.

Methods: Studies were identified through searching four databases (Scopus, MEDLINE, PsycINFO and OpenGrey) using a combination of terms related to 'autism' and 'social anxiety'. A meta-analysis was conducted to assess the prevalence of social anxiety (SA) in autistic adults. A narrative synthesis of papers was carried out to investigate the additional impact on mental health and well-being. Studies were methodologically appraised using published tools.

Results: Overall, 19 studies were included in this systematic review. The majority of the included studies were assessed as weak to moderate in methodological quality. A meta-analysis ($k = 5$, $N = 670$) found a significant prevalence rate of 76% of SA in autistic adults (95% CI: 0.59-0.87%; $p < 0.005$). Narrative synthesis of studies confirmed this. Furthermore, findings also suggest evidence of positive relationships between SA and depression and anxiety in autistic adults. Lower levels of well-being and functioning were also reported. Risk factors to the development of SA in autism include alexithymia, camouflaging and social abilities; however, research is insufficient for clear themes to emerge.

Conclusions: Overall, these findings have important clinical and research implications. However, methodological limitations of the included studies should be accounted for, and conclusions drawn should be interpreted with caution.

Practitioner Points

- Social anxiety is highly prevalent among autistic adults. When working with autistic adults, clinicians should therefore consider and ask about the possibility of social anxiety.
- Autistic adults who experience social anxiety also report higher levels of depression, anxiety and impaired functioning, and lower levels of well-being. These factors should be considered during assessment, formulation, and intervention.
- Clinicians should consider interventions for social anxiety in autism spectrum disorder (ASD), such as adapted Cognitive Behaviour Therapy (CBT).
- Further clinical knowledge and research is required on the risk factors to developing social anxiety in autism, thus enabling an improved understanding and the development of more suitable interventions.

Key words: Autism, social anxiety, depression, anxiety, well-being

Introduction

Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental condition. Autistic individuals¹ commonly experience difficulties in social interaction, communication, restricted and repetitive behaviours, and hypo- and hyper- sensory processing (Diagnostic and Statistical Manual of Mental Disorders, 5th ed.; DSM-5; American Psychiatric Association, 2013). It is estimated that 1 in 44 children aged 8 years are autistic, and 2% of the American adult population are reported to be autistic (CDC, 2018).

Social Anxiety

Social anxiety (SA) involves physical symptoms of anxiety that occur in social situations, a fear of negative judgement or evaluation by others, and a behavioural response of avoidance or escape from situations that induce anxiety (APA, 2013). Research into causal and maintaining factors in neurotypical individuals has been carried out; Clark and Well's (1995) cognitive behavioural framework of SA suggests that SA develops due to psychosocial and environmental factors, underpinned by a biological predisposition. Experiences are then maintained by cognitive factors including overestimation of threat, negative beliefs about self, others and the world, and attentional and emotional biases. Behavioural factors also serve to maintain experiences through avoidance of feared situations and pre- and post- rehearsal of events. SA is therefore believed to be multifaceted.

ASD and Social Anxiety

It is well-known that anxiety is common in ASD, with some researchers debating whether anxiety is a characteristic of ASD (Kerns & Kendall, 2012); both clinical and epidemiological

¹ A large-scale study by Kenny et al. (2016), found that 'Autistic Adults' is the preferred term in the autistic community in the UK.

studies have consistently reported high rates of anxiety in ASD (Van Steensel & Heeman, 2017). SA is especially common in ASD, with prevalence estimates reported to be as high as 50% (Spain et al., 2016), significantly higher than estimates of 12% for the non-ASD population (NICE, 2013). The high prevalence has resulted in increased diagnoses of SA disorder and late diagnosis of ASD, with 17% of an adult psychiatric outpatient sample reporting to have been diagnosed with SA disorder prior to receiving their ASD diagnosis (Ryden & Bejerot, 2008). However, there are disparities among studies in terms of prevalence rates of SA in ASD, with studies utilising a range of different research methods, including differences in sampling (general population vs. clinical), types of measures, and method of assessment.

It is likely that the core characteristics of ASD are risk factors for and contribute to the development of SA in ASD. For example, socio-communication impairments are a key characteristic of ASD, thus impacting on social motivation and resulting in difficulties in social skills. Furthermore, restricted and repetitive behaviours, and sensory processing sensitivities, are likely to make social interactions more difficult. These things may negatively impact interactions and relationships for autistic individuals, potentially resulting in negative cognitive beliefs, thus triggering, and maintaining SA.

Social Anxiety and Mental Health

SA is believed to have an impact on overall mental health and functioning. Social identity, whereby a social group is internalised as an important part of one's self-concept, has been linked in previous research to mental health, resulting in fewer depressive symptoms (Cruwys et al., 2014). It has also been found that increasing identification with social groups in treatment for SA positively influences depression, anxiety, stress, and loneliness (Haslam et al., 2016). With those who experience SA being more isolated, it is therefore understandable that rates of depression and functional impairment are higher, and quality of life is lower in those with SA compared to those without (Adams et al., 2016; Lochner et al., 2003).

ASD, Social Anxiety and Mental Health

Mental health difficulties are more prevalent in those who experience SA, with increased levels of depression and poorer mental health outcomes (Stein et al., 2006). Research has also reported greater experiences of depression and anxiety in autistic adults in comparison to neurotypical individuals (Kanai et al., 2011). Such experiences have a substantial impact on the lives and well-being of autistic individuals, with higher levels of suicidality (Cassidy et al., 2019). Furthermore, autistic individuals face more barriers to maintaining social relationships and experiencing group belongingness, impacted on by SA, thus reducing the psychosocial benefits from being a part of social groups (Milton & Sims, 2016).

Overall, mental health difficulties in ASD are poorly understood, with little research exploring risk factors, contributing, and maintaining factors. There is also a lack of research into psychological interventions for autistic individuals (Hull et al., 2021).

ASD, Social Anxiety and Functioning

Previous research reports lower social and adaptive functioning (Moss et al., 2015), difficulties in education and employment (Keen et al., 2016) and poorer quality of life (Adams et al., 2019) in SA and ASD. Furthermore, previous research has explored the impact of ASD and SA characteristics, such as impairments in communication and social interaction, finding these traits to negatively impact adaptive functioning, education, and employment (Howlin et al., 2004; Levy & Perry, 2011; Magiati et al., 2014).

Previous Reviews

A previous systematic review was carried out on SA in ASD by Spain et al. (2018), which focused on the relationships between core ASD symptoms and SA in autistic individuals across the lifespan ($R = 6-57$ years). This review concluded that SA may be associated with core ASD symptoms including socio-communication impairments, social skills and reduced social motivation.

Spain et al. (2018) also found an association between self-reported SA and level of autistic traits in adults.

The Current Review

With the above in mind, the primary aim of the current review is to examine the prevalence of SA in adults with ASD. The secondary aim is to examine the impact of SA in adults with ASD on psychological well-being, quality of life, coping/functioning and additional mental health difficulties. Risk factors to the development of SA in adults with ASD will be considered (where papers consider this). Prevalence, mental health, and risk factors of SA in ASD were not considered in the previous 2018 review (Spain et al., 2018); studies only exploring prevalence of SA in ASD were excluded. Furthermore, there has been a wealth of research since the previous review which warrants evaluation. Finally, the Spain et al. (2018) review focused on autistic individuals across the lifespan; focusing solely on adults allows for more specific conclusions and clinical implications to be drawn.

It is increasingly understood that SA is common among autistic individuals, yet the degree to which SA occurs in this population has not been systematically reviewed or quantitatively synthesised. Understanding the prevalence of SA in autistic adults could have important clinical implications, especially considering the current increase in the development and delivery of psychosocial interventions aimed at increasing social functioning of autistic individuals (Pallathra et al., 2019). Furthermore, the additional impact on mental health, functioning and quality of life within autistic adults has not been considered, nor have potential risk factors for the development of SA in ASD. Considering the higher prevalence of anxiety and depression in the autistic population, and the possible influence of SA on such experiences, the synthesis of the current evidence in this area is essential, helping to guide further research and improve clinical understanding.

The aims of the current review were summarised into two research questions: 1. What is the prevalence of social anxiety in ASD? 2. What is the impact of social anxiety in ASD on measures of

psychological distress, well-being, coping/functioning, life attainment, additional mental health difficulties and quality of life? To answer the first research question, a meta-analysis will be conducted.

Hypotheses

It was hypothesised that SA in autistic individuals will be highly prevalent, with most participants scoring above the clinical cut-off on measures of SA; a large significant pooled mean event rate and effect size will be found in the meta-analysis.

It was further hypothesised that autistic individuals with SA will show difficulties in other areas, such as mental health, quality of life and well-being etc.; i.e., there would be significant positive correlations between SA and measures of depression and anxiety, and negative correlations with general well-being and functioning. Within subgroup analyses, the type of SA measure, the cut-off score used and how ASD was assessed and diagnosed would be moderators of the prevalence rate of SA.

Method

Search Strategy

This systematic review and meta-analysis was carried out following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009; CRD, 2009). Prior to the commencement of the review, the review protocol was registered on the PROSPERO database (See Appendix A). A systematic search was completed using SCOPUS, MEDLINE, PsychINFO and OpenGrey databases searching for relevant published and unpublished literature. Searches were carried out on 08.09.2021. Forward and backward citation searching was completed. Manual searching of Google Scholar and relevant articles and reviews was also carried out. See Table 1 below for a search term example where the terms were searched for in titles, abstracts, and keywords.

Table 1*Search Term Example*

Construct	Search Terms
Autism	Autism OR autistic OR ASD OR asperger* OR “autism spectrum” OR “autistic disorder”
Social Anxiety	“social anxiet*” OR “socialised anxiety*” OR “social phobia*” OR “social fear*” OR socialising OR “socialized anxiety” OR socializing

Note. Terms were combined using AND and OR. The Boolean operator * was used to identify variations in spelling and word-endings.

Eligibility Criteria

The inclusion and exclusion criteria for the review and meta-analysis can be found below in Table 2.

Table 2*Inclusion and Exclusion Criteria*

Inclusion Criteria	Exclusion Criteria
✓ Adult population (aged ≥ 18 years).	X Studies that include participants under the age of 18 years.
✓ Studies using an ASD population whereby ASD was formally diagnosed or self-diagnosed/suspected (with or without comorbid ID diagnosis).	X Studies that use a general population sample and an ASD screening tool.
✓ Studies that include a validated measure of social anxiety.	X Studies that do not include a validated measure of social anxiety.

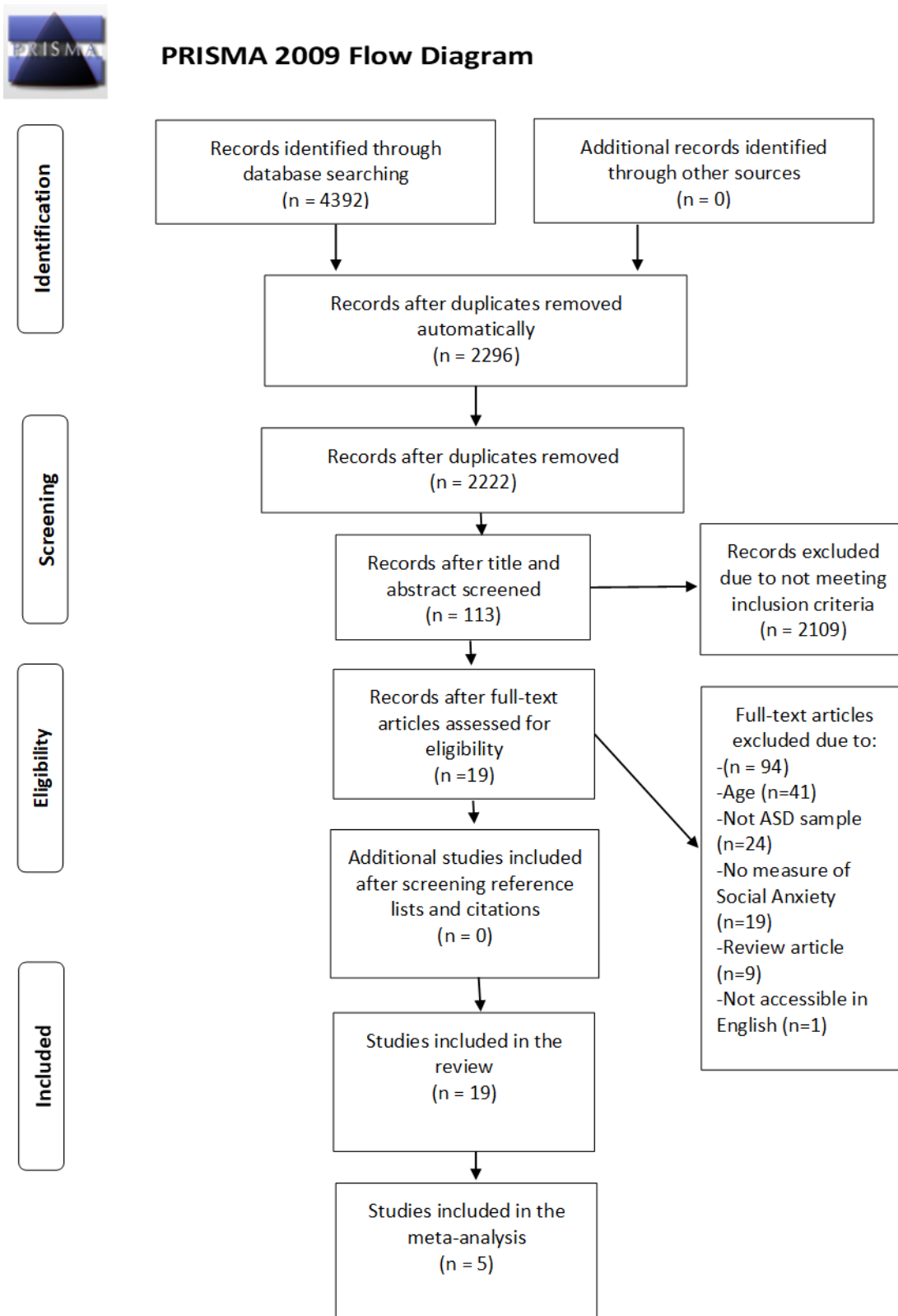
Inclusion Criteria	Exclusion Criteria
✓ English Language articles.	✗ Articles that are not accessible in the English Language.
✓ Quantitative studies, case-study, or case-series designs.	✗ Qualitative studies.
✓ Intervention studies that include baseline prevalence data for social anxiety.	✗ Intervention studies that do not include baseline prevalence data.
✓ For inclusion in the meta-analysis, papers were required to report the number/percentage of participants with ASD who met a pre-defined cut-off score on the measure of social anxiety.	✗ For the meta-analysis, relevant data for calculating the prevalence of social anxiety in ASD was unavailable or not provided by corresponding authors upon request. If participants are required to have SA to take part in the study.

Study Selection for Review

Papers from the searches were imported into Mendeley ($n = 4392$). Duplicates were automatically removed, resulting in a total of 2296 papers. An additional sift resulted in 2222 papers after the removal of additional duplicates ($n = 74$). Study titles and abstracts were screened and those deemed likely to meet selection criteria were reviewed in full ($n = 113$). No additional papers were identified through forward and backward citation searching. Full-text review excluded 94 articles, resulting in 19 studies included in the final review. Figure 1 depicts the study selection process.

Figure 1

Prisma Diagram



Study Selection for Meta-Analysis

A total of 18 of the 19 articles were deemed potentially appropriate to be included in the meta-analysis to assess the prevalence of SA in ASD. The study by Danforth et al. (2018) was not suitable to be included, as all participants had to score above clinical cut-off for SA for inclusion. For inclusion in the meta-analysis, studies were required to report the number/percentage of ASD participants who had scored above a pre-defined clinical cut-off on the study's measure of SA; only one study included this within the article (Spain et al. 2016). The main author contacted the authors of the remaining 17 studies to request the data required for the meta-analysis; four authors replied, providing the required data.

Following guidance from the Cochrane Handbook of conducting meta-analyses (Ryan, 2016), a small-scale meta-analysis was carried out on these five papers.

Data Extraction

As recommended by Boland et al. (2014), a data extraction tool was created a priori and piloted on four randomly selected studies. Relevant data was extracted verbatim to reduce transcription errors. The following data were extracted: study characteristics (i.e., authors, date, objectives, country, and population); sample demographics (i.e., sample size, age, gender, and ethnicity); and study results (i.e., autism diagnosis, SA measure, scores of SA in ASD compared to control group, additional measures of functioning, key findings, and statistical data).

Data extracted for the meta-analysis included prevalence rates of SA in ASD i.e., the number/percentage of ASD participants who scored above the clinical cut-off on the study's measure of SA. Where required statistical data were not provided for inclusion in the meta-analysis, studies were synthesised narratively. Findings relevant to the second research question on the impact of SA in ASD on other outcomes, were also synthesised narratively.

To ascertain the reliability of data extraction, 25% of the papers, selected at random, were checked by a second, independent blinded author. The second independent reviewer was a trainee clinical psychologist, thus ensuring appropriate qualification for this task.

Quality Assessment

Study quality was appraised using the Effective Public Health Practice Project (EPHPP) Tool for Quantitative Studies (Thomas et al., 2004). This tool was adapted for this review (Quintana et al., 2015). The EPHPP has well-established content and construct validity (53%-92% agreement in component ratings; Thomas et al., 2004) and fair inter-rater agreement (Cohen's kappa=0.60). Supplementary quality criteria were included from the quality evaluation grid devised by Glod et al. (2015) for studies including ASD samples. These criteria included: how ASD diagnosis was confirmed, assessment of cognitive functioning, and whether the study used measures that were validated for ASD populations.

Using the adapted EPHPP, studies were evaluated across seven methodological domains: selection bias, study design, potential confounders (for studies including a comparison group), data collection, management of attrition/missing data, ASD diagnosis, and cognitive functioning. Studies were rated using numerical values (1= strong, 2=moderate, 3=weak). Results led to an overall global rating of strong (no weak ratings), moderate (one weak rating) or weak (two or more weak ratings). It was decided a priori that studies would not be excluded if they were given a weak global quality rating, thus providing a holistic view of research in this area. Due to the broad nature of this review, an additional 'Not Applicable' option was added to the criteria. See Table B1 (Appendix B) for details on how studies were assessed.

The first author quality appraised all studies, and 25% of the papers were appraised at random by an independent reviewer (trainee clinical psychologist). Agreement between the reviewers on component and overall ratings was evaluated using weighted Cohen's Kappa (Schuck, 2004). Any discrepancies between ratings were resolved following discussion and changes in ratings were made

where needed. Inter-rater reliability before consensus ranged between ‘fair’ and ‘Excellent’. See Table C1 (Appendix C) for overall agreement statistics.

Meta-Analytic Strategy

The meta-analysis to assess the estimated prevalence of SA in ASD was conducted using Comprehensive Meta-Analysis (CMA-Version 3; Borenstein et al., 2018). A random effects model was selected due to the presence of heterogeneity between studies (Borenstein et al., 2010). The prevalence of SA in ASD was selected as the main measure of outcome, as measured by event rate and sample size, resulting in a pooled prevalence estimate for SA in ASD. Effect sizes were interpreted in-line with Cohen (1992) i.e., small (.10), medium (.30) and large (.50).

Heterogeneity

Heterogeneity was assessed using the Cochran Q and I^2 statistics. A significant Q statistic signifies that statistical heterogeneity is present (i.e., the level of variance between study outcomes cannot be explained by sampling error alone). The I^2 statistic quantifies the proportion of variance across studies, whereby 25%, 50%, and 75% implies low, moderate and high heterogeneity respectively (Higgins et al., 2003).

Moderator Analysis

Subgroup analyses were to be completed to assess the association between prevalence rates and the type of SA measure (LSAS-SR vs other), cut-off score on the LSAS (35 vs 60), and how ASD was assessed and diagnosed. Moderator analysis was to be used to assess the relationship between prevalence rates and the quality of the study, year of publication, mean age, and proportion of females in the sample. However, due to few studies being included in the meta-analysis, it was not possible to complete moderator analyses, requiring at least three studies in each subgroup (Card, 2015).

Publication Bias

Studies with non-significant or smaller effect sizes are less likely to be published, resulting in the possibility of biased findings (Rothstein et al., 2005). Publication bias was mitigated through possible inclusion of unpublished studies. Funnel plots show a graphical depiction of each study's precision (i.e., standard error), which is plotted against the effect size; asymmetry is indicative of publication bias. Egger et al. (1997) regression test and fail-safe analysis were also conducted, informing how many missing studies were required to invalidate the results. If significant asymmetry is indicated, Duval and Tweedie's (2000) trim and fill method provides adjusted estimates to account for missing studies (Rothstein et al., 2005).

Results

Study and Participant Characteristics

As shown in table 3, 19 studies were included in this review. Identified papers were published between 2008 and 2021. One study utilised a randomised control trial (RCT), 12 studies utilised a case control design and the remaining six studies utilised a cross-sectional design. Studies were conducted across seven different countries, with the majority conducted in America ($n = 5$). A total of 13 studies included comparison groups, including neurotypical/non-ASD participants (Albantakis et al., 2020); Bejerot et al., 2014; Cath et al., 2008; Espeloer et al., 2021; Kanai et al., 2011; Kimura et al., 2020; Kleinhans et al., 2010; Perry et al., 2015; Schuck et al., 2019; Zukerman et al., 2019a; and Zukerman et al., 2019b), participants with SA (Bejerot et al., 2014; Cath et al., 2008; Espeloer et al., 2021; Richey et al., 2014; and Zukerman et al., 2019a), and one study included a group of participants with OCD (Cath et al., 2008). Zukerman et al. (2019a) included a group with high SA and a group with low SA. Danforth et al. (2018) was the only RCT which included a group who received methylenedioxymethamphetamine (MDMA) and a placebo group. Although not stated in the two papers, it is likely that Zukerman et al. (2019a) and Zukerman et al. (2019b) included the same ASD sample, due to reporting the same sample size and demographics.

These studies utilised a variety of different outcome measures, such as the GPA in Zukerman et al. (2019a) and the Y-BOCS-II and ABAS-II in Zukerman et al. (2019b). These outcomes will therefore be discussed separately, as appropriate. However, both papers used the BDI and STAI; as a result, these outcomes will only be reported from one of the papers.

The overall sample size for the systematic review was 2113 (ASD = 1205). The overall sample size of the meta-analysis was 670, all participants had a diagnosis of ASD. Of the studies that reported ethnicity ($n = 6$), the most predominant ethnic group was white/Caucasian. All studies reported gender distributions which ranged from 34% male in the ASD sample to 100% male in the ASD sample ($M = 78\%$).

Table 3*Study and Participant Characteristics for Social Anxiety in ASD*

Authors (Year)	Country	Objectives/Focus	Sample Size	Age (years): M, SD, R)	Gender (% male)	Predominant Ethnic Group (%)	IQ measure
Albantakis et al. (2020)	Germany	Explored whether alexithymic and/or autistic traits are risk factors for depression and social phobia in: adults with ASD; adults without ASD (NT); and adults with social interaction difficulties (non-ASD).	ASD: 122 Non-ASD: 62 NT: 261	ASD: M=33.46, SD=10.40 Non-ASD: M=35.15, SD=12.62 NT: M=26.41, SD=7.80	ASD: 68% Non-ASD: 60% NT: 46%	NR	NR
Bejerot et al. (2014)	Sweden	Explored the severity and prevalence of social anxiety in adults: with ASD; with SAD; and a non-ASD group.	ASD: 50 SAD: 100 Non-ASD: 53	ASD: M=30, SD=73, R=27.9-32.1 SAD: M=34.6, SD=9.1, R=32.8-36. Non-ASD: M=32.2, SD=10.8, R=28.4-32.5	ASD: 52% SAD: 37% Non-ASD: 53%	NR	NR
Bowri et al. (2020)	England	Explored demographic and psychological predictors of alcohol use and misuse in autistic adults.	237	M=41.91, SD=13.3, R=18-75	42%	European (71.3%)	NR
Cath et al. (2008)	Netherlands	OCD and SAD frequently co-occur in ASD; this study explored which features distinguish 'pure' anxiety disordered patients from those with comorbid ASD.	ASD: 12 OCD: 12 SAD: 12 Control: 12	ASD: M=34.5, SD=10.50 OCD: M=35.9, SD=11.9 SAD: M=38, SD=11 Controls: M=32.4, SD=11.3	83%	NR	NR

Authors (Year)	Country	Objectives/Focus	Sample Size	Age (years): M, SD, R)	Gender (% male)	Predominant Ethnic Group (%)	IQ measure
Danforth et al. (2018)	America	RCT to explore the viability of MDMA-assisted psychotherapy in autistic adults, in the reduction of social fear and avoidance.	MDMA: 8 Placebo: 4	M=31.3, SD=8.8	83%	White/Caucasian 50%	NR
Espeleor et al. (2021)	Germany	The study aimed to explore social anxiety and social competence in ASD compared to a non-clinical group and a social anxiety disorder group.	ASD: 23 NC: 25 SAD: 68	ASD: M=44, SD=10.55, R=23-58 NC: M=38.8, SD=10.42, R=23-57 SAD: M=37, SD=10, R=22-62	ASD: 74% NC: 40% SAD: 41%	NR	WAIS-III
Hull et al. (2021)	England	Explored the relationship between camouflaging and anxiety, and depression and social anxiety in autistic adults, exploring the moderating effect of gender.	305	M=41.90, R=18-75	34%	British 55%	NR
Kanai et al. (2011)	Japan	Examined the clinical characteristics of Asperger's Syndrome.	AS: 64 NT: 65	AS: M=32, R=19-50 NT: M=32, R=19-57	AS: 78% NT: 80%	NR	NART
Kimura et al. (2020)	Japan	Explored the effects of social reciprocity, letter fluency, and social anxiety, on communicative behaviours in autistic adults compared to typically developing adults.	ASD: 33 TD: 35	ASD: M=27.88, SD=6.23, R=18-43 TD: M=28.03, SD=5.88, R=19-40	ASD: 71% TD: 60%	NR	WAIS
Kleinhans et al. (2010)	America	Explored whether there is a relationship between self-reported social anxiety and	ASD: 31	ASD: M=23.57, SD=6.6	ASD: 95%	NR	WAIS

Authors (Year)	Country	Objectives/Focus	Sample Size	Age (years): M, SD, R)	Gender (% male)	Predominant Ethnic Group (%)	IQ measure
		fMRI activation in an autistic sample and a control sample.	Controls : 25	Controls: M=23.32, SD=5.15	Controls: 92%		
Pallathra et al. (2018)	America	Explored the behavioural components of social functioning (social motivation, social anxiety, social cognition and social skills) in ASD.	ASD: 28	ASD: M=26, SD=7.3, R=20-48	ASD: 86%	White 78.6%	WAIS-II
Perry et al. (2015)	Israel	Investigated interpersonal distance preferences in an ASD group using behavioural and ERP measures.	ASD: 13 NT: 13	ASD: M=25 NT: M=24	ASD: 92% NT: 100%	NR	NR
Richey et al. (2014)	America	Examine neural responses during social and non-social reward anticipation outcomes in: autistic adults; adults with social anxiety disorder; and a control group, via fMRI.	ASD: 16 SAD: 15 Control: 19	ASD: M=26, SD=9.1 SAD: M=26.9, SD=5.3 Control: M=25.3, SD=7	ASD: 88% SAD: 60% Control: 68%	NR	WASI
Schuck et al. (2019)	America	Investigated sex/gender differences in behavioural phenotypes and camouflaging in autistic adults.	ASD: 28 NT: 35	ASD: Males: M=23, SD=4.09) Females: M= 33, SD=9.72 NT: NR	ASD: 61% NT: 54%	ASD: White 75% NT: NR	SBIS-V
Spain et al. (2016)	England	Investigated self-reported behavioural, cognitive and affective symptoms of social anxiety in autistic adult males.	50	ASD: M=26.3, SD=5.8	100%	NR	WASI
Spain et al. (2017)	England	Evaluated a non-randomised group intervention for social anxiety and social skills in autistic adults.	18	ASD: M=31, SD=7.9, R=22-48	100%	White British 83%	NR

Authors (Year)	Country	Objectives/Focus	Sample Size	Age (years): M, SD, R)	Gender (% male)	Predominant Ethnic Group (%)	IQ measure
Zukerman et al. (2019a)	Israel	Examined the relationship between academic achievement and social anxiety among autistic University students.	ASD: 55 High SA: 31 Low SA: 25	ASD: M=23.56, SD=2.81 High SA: M=25.06, SD=2.62 Low SA: M=24.56, SD=2.18	ASD: 92% High SA: 83% Low SA: 84%	NR	GPA
Zukerman et al. (2019b)	Israel	Examined self-reported psychiatric symptoms in autistic students and explored their contribution to the variance in adaptive behaviours.	ASD: 55 Non-ASD: 40	ASD: M=23.5, SD=2.81, R=18–34 Non-ASD: M=25.08, SD=2.67, R=20–36	ASD: 92% Non-ASD: 83%	NR	NR
Zukerman et al. (2021)	Israel	Explore the gap between cognitive understanding of social behaviour and socially adaptive behaviour, and how this impacts social anxiety, OCD and depression in autistic adults.	53	ASD: M=23.53, SD=2.81, R=18–34	ASD: 92%	NR	WAIS Comprehension subtest

Note: M, Mean; SD, Standard Deviation; R, Range; NR, Not Reported; NT, Neurotypical; SAD, Social Anxiety Disorder; OCD, Obsessive Compulsive Disorder; NC, Neurotypical Controls; WAIS, Wechsler Intelligence Scale for Adults (Wechsler, 2008); NART, National Adult Reading Test (Nelson & Willison, 1991); TD, Typically Developing; WASI, Wechsler Abbreviated Scale of Intelligence (Wechsler, 2003); SBIS-V, Stanford Binet Intelligence Scales (Roid, 2003); GPA, Grade Point Average.

Quality Assessment

In total, ten studies received an overall rating of ‘weak’, six studies received an overall rating of ‘moderate’ and three received a ‘strong’ rating on methodological quality (Table D1, appendix D). Clear aims, objectives, and appropriate study designs were observed across all studies. Most studies ($n = 13$) were deemed ‘somewhat likely’ to be representative of the studied population. One study was deemed ‘very likely’ and received a ‘strong’ rating in that area, with 80-100% of participants approached consenting to take part. The remaining five studies received a ‘weak’ rating due to including clinical samples only or reporting limited information on how participants were selected. Most studies ($n = 12$) received a ‘moderate’ rating for study design as they were case control studies. One study employed an RCT design and attained a ‘strong’ rating for this component. The remaining studies were rated as ‘weak’ due to being cross-sectional.

Seven studies received a ‘moderate’ rating for their controlling of confounders, whilst three received ‘strong’ and three received ‘weak’. Confounders accounted for in studies included age and gender. The remaining studies were rated as ‘not applicable (N/A)’ as they were cross-sectional studies. Most studies ($n = 12$) received a ‘moderate’ rating for their data collection methods; measures used were deemed reliable, but studies did not report whether they were validated on ASD samples. All but two studies were rated as N/A for attrition; two studies that this was applicable for were assessed as ‘strong’.

Ten studies reported using gold-standard assessments of ASD (ADOS or ADI-R), resulting in ‘strong’ ratings for this component. The remaining studies utilised self- or other- report questionnaires, resulting in a ‘moderate’ rating. The most commonly used ASD screening measure was the AQ ($n = 9$) (Baron-Cohen et al., 2001). Six studies were given ‘strong’ ratings for their assessment of cognitive functioning, whereby standardised assessment instruments were utilised within the preceding 3 months. Five studies were given a ‘moderate’ rating within this component. The remaining studies were assessed as ‘weak’ in this domain as IQ information was not reported.

Narrative Synthesis of Main Findings

See Table 4 for an overview of study measures, outcomes, and overall quality appraisal score. Where prevalence data were reported, those marked with an asterisk were used in the meta-analyses.

Table 4

Measures and Outcomes for Studies Measuring Social Anxiety and Additional Mental Health Impacts in Autism

Authors (year)	Autism measure	Social Anxiety Measure	Social Anxiety ASD score (M, SD, and/or % above their cut-off)	Group comparison SA score (if included) (M, SD, and/or % above their cut-off)	Statistical difference between groups on social anxiety	Measures of impact (e.g. mental health, well-being) and scores	Key findings	Quality
Albantakis et al. (2020)	AQ	LSAS-SR	ASD: M=77.28, SD=26.81	Non-ASD: M=70.55, SD=29.17 NT: M=31.26, SD=18.36	F=203.37, p<0.001	BDI-II ASD: M=17.30, SD=11.59 Non-ASD: M=21.92, SD=10.54 NT: M=5.40, SD=5.33 F=148.41, p<0.001	Autistic adults scored highest on measures of social phobia ($p<0.001$). Alexithymic traits were predictive of depressive symptoms, and autistic traits predicted social phobic symptoms.	Weak
Bejerot et al. (2014)*	AQ HAGS	LSAS-SR	ASD: LSAS anxiety: M=30.7, SD=15.9 LSAS avoidance: M=25.9, SD=13.5 76%	SAD: LSAS anxiety: M=40.7, SD=12.0 LSAS avoidance: M=35.7, SD=11.5 Non-ASD: LSAS anxiety: M=10.7, SD=7.9 LSAS avoidance:	F=104.1, p<0.001	NA	Significantly higher scores of anxiety and avoidance in ASD compared to non-ASD group ($p<0.001$), but significantly lower scores compared to the SAD group. AQ scores were significantly correlated with LSAS-SR scores in ASD (anxiety: $r=0.67$, avoidance: $r=0.56$) and non-ASD group (anxiety: $r=0.55$, avoidance: $r=0.50$).	Moderate

				M=9.2, SD=7.8				
Bowri et al. (2020)*	BAPQ	LSAS-SR	M=84.31, SD=29.57 100%	NA	NA	PHQ-9: M=11.83, SD=6.90 GAD-7: M=9.78, SD=6.15 WEMWBS: M=38.13, SD=8.80 AUDIT: M=3.63, SD=4.99	Autistic traits were positively correlated with depression ($r=0.29$), generalised anxiety ($r=0.32$), social anxiety ($r=0.56$) and camouflaging ($r=0.26$), and negatively correlated with well-being ($r=-0.46$). Social anxiety was positively correlated with depression ($r=0.42$). Higher autistic traits were associated with both being a non-drinker and a hazardous drinker.	Weak
Cath et al. (2008)	AQ	LSAS-SR	ASD: M=107, SD=33.9 Controls: M=55.6, SD=9.8	OCD: M=92.7, SD=33.6 SAD: M=112.8, SD=21.2	No significant differences between groups.	Y-BOCS: ASD: M=13.6, SD=8.2 OCD: M=20.9, SD=6.2 SAD: M=2.4, SD=5.2 Control: M=2, SD=2.4 BAI: ASD: M=36.9, SD=9.2 OCD: M=39.7, SD=14.7 SAD: M=36.2, SD=9.7 Control: M=24.9, SD=3.9	No between group differences were found on social or general anxiety measures. The AQ significantly correlated with Y-BOCS ($r=0.35$), and the LSAS and AQ total significantly correlated ($r=0.64$). The LSAS significantly correlated with anxiety ($r=0.39$).	Weak

Danforth et al. (2018)	ADOS-2	LSAS-SR	MDMA baseline: M=91.8, SD=15.8 MDMA primary endpoint: M=46.4, SD=15.2	Placebo baseline: M=83.3, SD=11.9 Placebo primary endpoint: M=64, SD=13.3	T(9)=2.451, P=0.037	BDI-II: Data NR RSES: Data NR ERQ: Data NR	Reduction in social anxiety symptoms was significantly greater in MDMA group from baseline to primary endpoint, with a very large effect size ($d=1.4$). Changes were sustained and 6-month follow-up.	Weak
			100% above cut-off					
Espeloer et al. (2021)	ICD-10	SASKO	ASD total: M=76.57, SD=16.93 ASD interaction: M=21.52, SD=4.11	NC total: M=28.52, SD=13.35 SAD total: M=72.18, SD=18.33 NC interaction: M=6.52, SD=4.4 SAD interaction: M=16.4, SD=5.62	Total: NC:ASD SE=4.91, p=.000 ASD:SAD SE=4.13, p=.222 Interaction: NC:ASD SE=1.51, P=.000 ASD:SAD SE=1.19, P=.000	NA	No significant difference in social anxiety scores between SAD group and ASD group. Clinically significant higher scores of social anxiety in ASD and SAD groups compared to NC. Social competence deficits were greater in ASD compared to SAD and NC groups.	Moderate
Hull et al. (2021)*	BAPQ	LSAS-SR	Total sample: M=82.53 CI=79.20-85.87 77% Females: M=87.09, CI=82.84-92.24	NA	NA	Total sample: CAT-Q: M=111.11, CI=109.10-113.12 GAD: M=9.79, CI=9.10-10.49 PHQ: M=11.74, CI=10.97-12.51	Camouflaging was associated with greater symptoms of anxiety ($p<.001$), depression ($p<0.001$) and social anxiety ($p<0.001$), even whilst age and autistic traits were controlled. Camouflaging strongly predicted social anxiety. There was no	Weak

			Males: M=75.15, CI=69.04- 81.26				interaction between gender and camouflaging.	
Kanai et al. (2011)	AQ	LSAS-SR	AS: Median=69.5, R=4-133	NT: Median=17, R=1-77	$z=8.10,$ $p=<0.001$	HADS: AS: Median=22, R=1- 35 NT: Median=7, R=0- 21	The AQ, HADS, LSAS and NEO-FFI were all significantly higher among the AS group compared to NT group. The total AQ score correlated with the anxiety subscale score on the HADS ($p=0.01$).	Strong
Kimura et al. (2020)	DISCO	LSAS-SR	ASD: M=81.67, SD=31.56	ND: M= 36.14, SD=19.29	$t(52.5)=7.143,$ $p=<0.001$	Letter Fluency: ASD: M=29.06, SD=13.44 TD: M=35.37, SD=9.37 CC-SR: ASD: M=74.24, SD=39.09 TD: M=22.89, SD=17.74 SRS: ASD: M=112.18, SD=31.56 TD: M=47.51, SD=17.94	Communicative behaviours differed between the ASD and TD groups. Overall, in addition to difficulties in social reciprocity in ASD, social anxiety is a risk factor for worsening communicative behaviour difficulties in ASD ($r=0.68$).	Strong
Kleinhans et al. (2010)	ADI-R ADOS	SADS	ASD: M=15.83, SD=7.44	Control: M=2.52, SD= 4.17	$P= .00$	NA	In ASD, greater social anxiety was associated with increased activation in the amygdala and left temporal lobe when presented with emotional faces, and decreased activation in the fusiform face	Weak

Pallathra et al. (2018)*	ADOS-2 SCQ SRS-11 SRS-SR BAPQ	LSAS-SR	ASD: M=45, SD=26.8 67%	NA	NA	Social Motivation MAP-SR: M=28.8, SD=8.3 BAPQ: M=3.7, SD=1 SPQ-NCF: M=5, SD=2.1 Social Anxiety SPQ-SA: M=5.4, SD=2.5 Social Cognition ER40: M=77.9, SD=9.2 Social Skills CASS-INT: M=15.9, SD=4.5 CASS-BORED: M=19.8, SD=6.3 Social Functioning SNI: M=11.4, SD=7.4 SPWB: M=162.3, SD=15.9	<p>area. This indicates that level of social anxiety mediates the neural response to emotional face perception in ASD.</p> <p>Measures of social motivation were significantly correlated with measures of all other categories, as well as with social functioning and ASD phenotype ($p<.05$), but not with social cognition. Significant correlations were found between social anxiety and ASD phenotype, measures of social skills and social functioning, and measures of social skills and ASD phenotype.</p>	Moderate
Perry et al. (2015)	NR	LSAS-SR	ASD: M=51.38, SD=27.12	NT: M=42.92, SD=19.09	There was no significant difference in the LSAS between the two groups.	NA	<p>Findings show greater variance in interpersonal distance preferences in the ASD group. Furthermore, this variance can be explained by differences in level of social anxiety and can be predicted by the N1 amplitude (an early ERP component related to</p>	Weak

							attention and discrimination processes).	
Richey et al. (2015)	AQ	LSAS-SR	SA not measured in ASD or control group.	SAD: M=133, SD=13.24	NA	NA	The SAD and ASD group demonstrated decreased nucleus accumbens activation compared to the control group during anticipation of social reward. Greater amygdala activation was found in the SAD group compared to the ASD group during both anticipation and outcome of social rewards.	Weak
Schuck et al. (2019)	AQ ADOS	SPAI	ASD: Males: M=106.71, SD=115.91 Females: M=115.91, SD=41.35	NR	NR	BEQ: Males: M=33.64 Females: M= 40.59 Camouflaging (use of measure NR): Males: M=0.03, SD=0.20) Females: M=0.34, SD=0.24	Camouflaging was found to be more common in females with ASD than males ($p<0.008$), and it was not associated with social phobia. In autistic females, camouflaging was significantly negatively correlated with emotional expressivity ($r=-0.607$).	Weak

Spain et al. (2016)*	ADI-r ADOS-G	LSAS-SR (primary measure)	M=67.3, SD=28.5 52%	NA	NA	HADS overall sample: Anxiety: M=10.51, SD=5.1 Depression: M=6, SD=3.8 HADS in sample scoring above caseness on LSAS: Anxiety: M=12.5, SD=4.8 Depression: M=7.3, SD=3.2 BAI: M=12.5, SD=10.8 BDI: M=12.1, SD=10.8 Social Cognition: KDEF: NR RMET: NR FHA: NR	There were no significant differences between the two groups (above and below LSAS cut-off) on measures of emotion and social cognition. Significant differences between groups were found in HADS depression scores ($p=0.010$) and anxiety scores ($p=0.001$). Overall, there were no relationships between SA symptoms, ASD symptom severity or measures of socio-emotional processing.	Weak
Spain et al. (2017)	ADI-r ADOS-G	LSAS-SR	Pre-Intervention M=80, SD=30.7	Post-intervention M=61, SD=28	T=3.02, df=13, $p=0.01$	TAS-20: M=58.5, SD=10.9 RSE: M=21.3, SD=10.3 HADS: Anxiety: M=10, SD=4.8 Depression: M=8, SD=4.9 WSAS: M=20, SD=9.4	Significant improvements were found in scores of social anxiety ($p=0.01$). There were no significant improvements in low mood, anxiety or general functioning.	Weak
Zukerman et al. (2019a)	AQ	LSAS-SR	ASD: M=44.17, SD=23.22	High SA: M=49.59, SD=14.06	F=23.56, $p<0.01$	BDI – all groups below clinical cut-off STAI: ASD: M=44.49, SD=9.98	GPA's were significantly lower in the ASD group ($p<0.05$). Among the two groups without ASD, a significant negative	Strong

			Low SA: M=17.54, SD=9.65			High SA: M=40.80, SD=10.33 Low SA: M=33.68, SD=9.68 GPA: ASD: M=74.03, SD=23.22 High SA: M=77.02, SD=14.01 Low SA: M=83.17, SD=9.79	correlation was found between SA and grades ($r=-0.29$) however the reverse pattern was observed for ASD; higher SA was associated with higher grades ($r=0.30$).	
Zukerman et al. (2019b)	AQ	LSAS-SR	ASD: M=45.43, SD=24.60, R=3-108	Non-ASD: M=27.29, SD=17.65, R=2-75	F= 15.58*** 0.16 U = 621.00***	STAI: ASD: M=44.49, SD=8.99, R=26-62 Non-ASD: M=35.69, SD=10.61, R=21-62 Y-BOCS-II: ASD: M=13.12, SD=5.72, R=2-26 Non-ASD: M=4.45, SD=5.65, R=0-24 BDI: ASD: M=11.11, SD=11.54, R=0-28 Non-ASD: M=5.43, SD=4.78, R=0.17	Significantly higher scores were found in the ASD group on measures of social anxiety, trait anxiety ($p<0.001$), OCD ($p<0.001$) and depression ($p<0.01$). LSAS significantly correlated with OCD in ASD ($r=0.36$). ASD diagnosis and social anxiety severity significantly contributed to variance in adaptive skills, explaining 41.7% of the variance.	Moderate
Zukerman et al. (2021)	AQ	LSAS-SR	ASD: M=44.64, SD=23.07, R=3-108	NA	NA	BDI: M=9.59, SD=8.06, R=0-28 Y-BOCS-II: M=13.67, SD=5.87, R=2-26	There were no significant correlations between AQ scores and any of the psychopathology measures. A higher cognition – social adaptation discrepancy was associated with higher levels of social anxiety. This effect was moderated by autistic trait levels. LSAS	Moderate

significantly correlated with
measures of functioning on
ABAS.

Note: M, Mean; SD, Standard Deviation; R, Range; NR, Not Reported; NT, Neurotypical; SAD, Social Anxiety Disorder; OCD, Obsessive Compulsive Disorder; NC, Neurotypical Controls; AQ, Autism Spectrum Quotient (Baron-Cohen et al., 2001); LSAS-SR, Liebowitz Social Anxiety Scale – Self Report (Heimberg et al., 1999); BDI-II, Beck Depression Inventory Second Edition (Beck et al., 1996); HAGS, high-functioning autism/Asperger syndrome global scale (Bejerot et al., 2001); BAPQ, Broader Autism Phenotype Questionnaire (Hurley et al., 2007); PHQ-9, Patient Health Questionnaire (Kroenke & Spitzer 2002); GAD-7, Generalised Anxiety Disorder (Spitzer et al., 2006); WEMWBS, The Warwick-Edinburgh Mental Wellbeing Scales (Tennant et al., 2007); AUDIT, Alcohol Use Disorders Identification Test (Saunders et al., 1993); Y-BCOS-II, Yale-Brown Obsessive Compulsive Scale – Second Edition (Storch et al., 2010); BAI, Beck Anxiety Inventory (Beck et al., 1988); RSES, Rosenberg Self-Esteem Scale (Rosenberg, 1965); ERQ, Emotion Regulation Questionnaire (Gross & John, 2003); CAT-Q, Camouflaging Autistic Traits Questionnaire (Hull et al., 2019); HADS, Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983); CC-SR, Communication Checklist – Self-Report (Bishop et al., 2009); SRS, Social Responsivity Scale (Chan et al., 2017); MAP-SR, Motivation and Pleasure Scale – Self-Report (Llerena et al., 2013); SPQ, Schizotypal Personality Questionnaire (Raine, 1991); SPQ-NCF, Schizotypal Personality Questionnaire – No Close Friends; SPQ-SA, Schizotypal Personality Questionnaire – Social Anxiety; ER-40, Penn Emotion Recognition Test – 40 (Kohler et al., 2003); CASS, Contextual Assessment of Social Skills (Ratto et al., 2011); SNI, Social Network Index (Bickart et al., 2011); SPWB, The Scales of Psychological Wellbeing (Ryff & Keyes, 1995); BEQ, Berkley Expressivity Questionnaire (Gross & John, 1995); TAS-20, Toronto Alexithymia Scale -20 (Bagby et al., 1994); WSAS, Work and Social Adjustment Scale (Mundt et al., 2002); STAI, State Trait Anxiety Inventory (Spielberger et al., 1983); GPA, Grade Point Average; KDEF, Karolinska Directed Emotional Faces (Calvo & Lundqvist, 2008); RMET, The Reading the Mind in the Eyes Task (Baron-Cohen et al., 2001); FHA, The Frith-Happe Animations Test (Castelli et al., 2001).

Prevalence of Social Anxiety

Four different self-report SA measures were used across the 19 studies; 16 studies used the LSAS-SR (Heimberg et al., 1999) as the primary measure. The remaining three studies used the Social Anxiety – Social Competence Deficit Scale (SAKSO; Kolbeck, 2008) (Espeloer et al., 2021); the Social Avoidance and Distress Scale (SADS; Watson & Friend, 2013) (Kleinhans et al., 2010); and the Social Phobia and Anxiety Inventory (SPAI; Banos et al., 2007) (Schuck et al., 2019).

Five of the included studies reported required data for a meta-analysis to be carried out on the prevalence of SA in ASD i.e., the percentage of autistic participants who scored above clinical cut-off on the measure of SA (Bejerot et al., 2014; Bowri et al., 2021; Hull et al., 2021; Pallathra et al., 2018; Spain et al., 2016). The remaining studies reported the mean and standard deviation in SA scores in autistic samples.

Mennin et al. (2002) describes the two clinical cut-off scores for SA on the LSAS-SR. Total scores of 30 and above are indicative of Social Anxiety Disorder (SAD) and scores of 60 and above are indicative of the Generalised Social Anxiety Disorder subtype (GSAD). GSAD is characterised by individuals fearing most social situations, rather than a limited range of social situations. All 18 studies that provided this data reported a mean above the SAD cut-off. All but four studies (Pallathra et al., 2018; Perry et al., 2015; Zukerman et al., 2019a; 2019b; Zukerman et al., 2021) reported a mean above the GSAD cut-off. The average LSAS-SR score across studies was 69.07 ($R = 44-107$). Percentage of autistic participants scoring above the cut-off ranged from 52% to 100% (Bejerot et al., 2014; Bowri et al., 2020; Hull et al., 2021; Pallathra et al., 2018; and Spain et al., 2016). However, it is possible that the clinical cut-off used in these studies varied; not all studies reported which cut-off they utilised. The SADS utilises a clinical cut-off of 12 and above; Kleinhans et al. (2010) reported a mean score of 15. The SAKSO utilises a total cut-off score of 49; Espeloer et al. (2021) reported a mean score of 76. A total score of 60 is indicative of social phobia on the SPAI; Schuck et al. (2019) reported a mean score of 110.

A total of 10 studies tested the difference between groups (ASD vs. other) on scores of SA (Albantakis et al., 2020; Bejerot et al., 2014; Cath et al., 2008; Espeloer et al., 2021; Kanai et al., 2011; Kimura et al., 2020; Kleinhans et al., 2010; Perry et al., 2015; Spain et al., 2017; Zukerman et al., 2019a and 2019b). Only two of these studies found no significant difference between groups (Cath et al., 2008; Perry et al., 2015), with all other studies reporting significantly higher levels of SA in the ASD group. Cath et al. (2008) and Perry et al. (2015) were assessed as methodologically weak studies. Comparison groups included neurotypical (Albantakis et al., 2020; Bejerot et al., 2014; Espeloer et al., 2021; Kanai et al., 2011; Kimura et al., 2020; Kleinhans et al., 2010; Perry et al., 2015; Zukerman et al., 2019b), a SAD group (Bejerot et al., 2014; Cath et al., 2008; Espeloer et al., 2021), high and low SA groups (Zukerman et al., 2019a), OCD (Cath et al., 2008), and pre- and post- intervention groups (Spain et al., 2017).

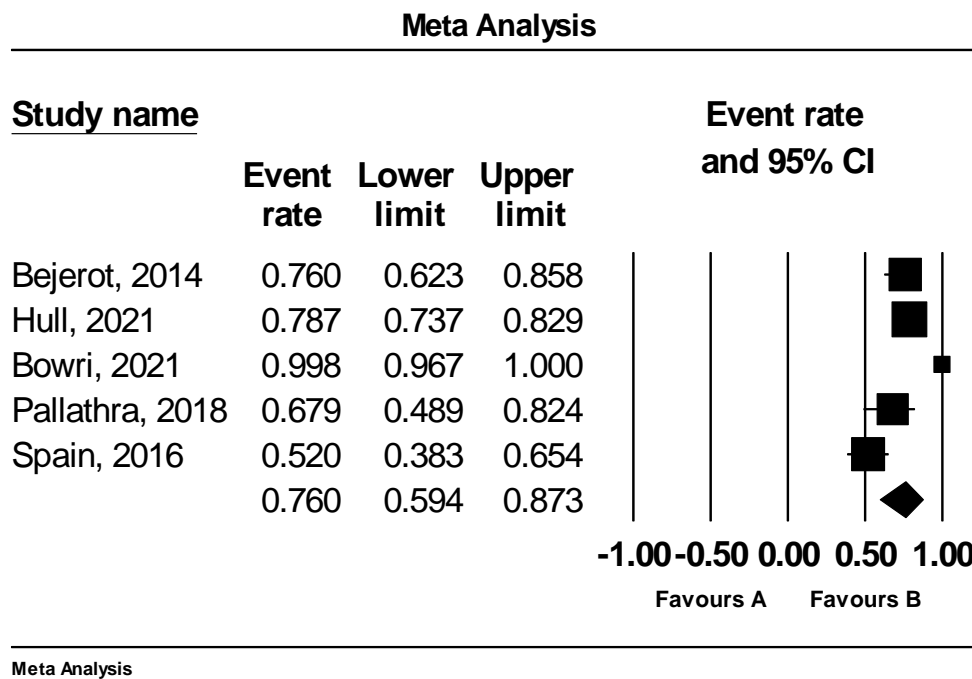
Bowri et al. (2020), Cath et al. (2008) and Pallathra et al. (2018), reported a significant correlation between SA and autistic traits. Zukerman et al. (2021) found non-significant correlations between ASD traits and symptoms of SA.

Meta-Analysis

Figure 2 shows individual studies' event rates with the pooled mean event rate. As anticipated, the event rates for the prevalence of SA in ASD were high, with a large overall pooled mean event rate. The combined prevalence for the total set of studies ($k = 5, N = 670$) was 0.76, i.e., 76% (95% CI: 0.59-0.87%; $p < 0.005$). Prevalence event rates ranged from 0.52 – 0.99. Using the prediction interval, this suggests the true effect size for any single study will fall in the range of 0.17 to 0.98.

Figure 2

Forest Plot for Meta-Analysis the Prevalence of Social Anxiety in ASD



Heterogeneity

Significant heterogeneity was present $Q(4) = 28.71, p = .00$. The I^2 statistic indicated substantial heterogeneity, with 86.07% variation between studies on outcomes. These findings indicate that the true effect size varies between studies and that these differences exist within the studies due to a source other than sampling error. Categorical moderator analyses were unable to be carried out to explore heterogeneity, due the small number of included studies (Card, 2015). However, despite all the studies using the same measure of SA (LSAS-SR), different cut-offs for this measure exist and it was not entirely clear in all papers which cut-off was utilised. Two out of the five studies utilised gold-standard assessment of ASD (Spain et al., 2016; Pallathra et al., 2018).

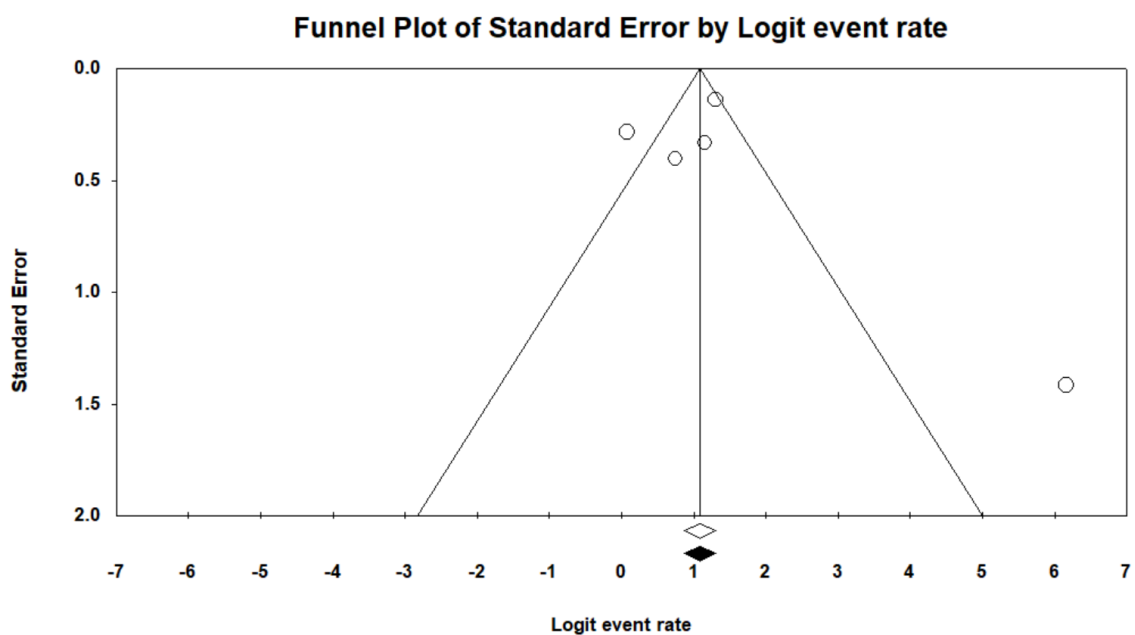
Publication Bias

Asymmetry of study effect sizes around the effect size mean can be seen in the funnel plot in figure 3, which depicts two studies outside of the 95% confidence limit. However, Duval and Tweedie’s (2000) trim and fill method identified 0 trimmed studies, with no studies imputed to the

left or to the right of the mean; this suggests no issues of publication bias. Fail-safe analysis indicated that 93 missing studies with a mean effect of zero would be required to nullify the overall effect. As this does not exceed the fail-safe threshold of $k = 110$, this may be suggestive of publication bias. Finally, Egger et al. (1997) regression test was completed, which examines the correlation between the effect sizes and their corresponding sampling variances; a strong correlation implies publication bias. Findings report an insignificant correlation ($p = .80$). Considering all of these analyses together, these findings suggest that publication bias is not a concern in this meta-analysis.

Figure 3

Funnel Plot of Standard Error against logit event rate for Meta-Analysis on the prevalence of social anxiety in ASD



Additional Outcomes and Impact

A total of 14 included studies reported data relevant to the second research question.

Depression and Anxiety. Eight studies (Albantakis et al., 2020; Bowri et al., 2020; Danforth et al., 2018; Hull et al., 2021; Spain et al., 2016; Spain et al., 2017; Zukerman et al., 2019a and

2019b; Zukerman et al., 2021) explored relationships between symptoms of depression in ASD samples. Five of these studies specifically explored the relationship between SA and depression/anxiety in ASD. Of relevance to the relationship between SA, ASD, and depression, Bowri et al. (2020) reported a significant correlation between SA and depression in ASD. However, Zukerman et al. (2019a) assessed levels of depression in three groups; ASD; non-ASD and high SA; and non-ASD and low SA; all groups were below the clinical cut-off for depression, with no significant differences between groups. Similarly, Zukerman et al. (2019b) reported a non-significant correlation between SA and depression in ASD. All but one of these studies (Zukerman et al., 2019a) are assessed as moderate to weak in quality.

Six studies (Cath et al., 2008; Bowri et al., 2020; Hull et al., 2021; Spain et al., 2016, Zukerman et al., 2019a and 2019b; Zukerman et al., 2021) explored relationships between symptoms of anxiety in ASD samples. Of relevance to the secondary aim of the review, Cath et al. (2008) found a significant correlation between SA and generalised anxiety in ASD. Further findings from Cath et al. (2008) found no difference between ASD, OCD, SA, and a control group, on measures of anxiety. However, Cath et al. (2008) is assessed as a methodologically weak study, due to selection bias and lack of assessment of cognitive functioning within participants.

Three studies (Kanai et al., 2011; Spain et al., 2016; Spain et al., 2017) utilised the HADS to assess symptoms of depression and anxiety in ASD samples. Spain et al. (2016) compared HADS scores in autistic adults separated into two groups based on their scores on SA. The study found higher scores on the HADS in the group who scored above clinical cut-off for SA, in comparison to those who scored below clinical cut-off. Conversely, Spain et al. (2017) utilised a cognitive-behavioural intervention to treat SA in ASD, which did not result in any significant improvements in measures of anxiety, depression, or functioning. All measures of depression and anxiety utilised in these studies relied on self-report, a potential factor in the mixed findings between studies.

Overall, a tentative conclusion can be drawn from these findings, suggesting evidence of a relationship between SA and depression/anxiety in ASD. Three of the five studies that explored the relationship between SA and depression/anxiety in ASD found evidence of significant correlations/significantly higher scores of depression and/or anxiety in higher SA groups, and the other two studies reported non-significant findings. To certify this evidence, further larger-scale studies are required.

Obsessive-Compulsive. Three studies (Cath et al., 2008; Zukerman et al., 2019b; Zukerman et al., 2021) explored obsessive compulsive traits/behaviours. Of relevance, Zukerman et al. (2019b) reported a significant correlation between SA and obsessive-compulsive traits in ASD.

Well-Being. Two studies (Bowri et al., 2020 and Pallathra et al., 2018) measured general well-being. Bowri et al. (2020), a methodologically weak study, found a significant negative correlation between SA and well-being in ASD.

Functioning. Four studies explored overall functioning among autistic adults. Spain et al. (2017), which included an autistic sample receiving an intervention for SA, reported an average score of 20 on the measure of work and social adjustment, thus suggesting a significant impairment in functioning within participants. Furthermore, this study measured friendship satisfaction, finding that half of the participants were 'quite dissatisfied' or 'very dissatisfied'. However, this is a non-validated measure, and its reliability and validity cannot be ascertained.

Zukerman et al. (2019a) utilised the Grade Point Average (GPA) measure to assess academic functioning. They found that GPAs were significantly lower in the ASD group. Interestingly, correlations in the ASD group were opposite to that in the non-ASD group, with higher levels of SA being associated with higher grades. ASD, SA and the interaction between the group and SA were significant predictors of GPA. Furthermore, this study found that ASD diagnosis and SA severity were significant predictors of adaptive skills. Zukerman et al. (2021) supports this finding, reporting significant correlations between SA and measures of adaptive

functioning in ASD. Zukerman et al. (2019a) is a good quality study, with the consideration of confounding variables and cognitive functioning accounted for.

Risk Factors

A total of 12 included studies (Albantakis et al., 2020; Bowri et al., 2020; Danforth et al., 2018; Hull et al., 2021; Kanai et al., 2011; Kimura et al., 2020; Pallathra et al., 2018; Schuck et al., 2019; Spain et al., 2016; Spain et al., 2017; Zukerman et al., 2019b; Zukerman et al., 2021) considered potential risk factors for developing SA in ASD. Consideration to the methodological quality of such studies should be considered, with only two studies achieving a strong rating (Kanai et al., 2011; Kimura et al., 2020).

Camouflaging. Three studies (Bowri et al., 2020; Hull et al., 2021; Schuck et al., 2019) explored camouflaging in ASD. Hull et al. (2021) found that camouflaging strongly predicted SA and was associated with greater symptoms of depression and anxiety. Similarly, Bowri et al. (2020) reported a significant correlation between SA and camouflaging in ASD. Conversely, Schuck et al. (2019) found camouflaging to be more common in females, but camouflaging was not significantly correlated with social phobia. The findings from Schuck et al. (2019) should be considered alongside its methodologically weak quality, with issues in selection bias and lack of validated measures.

Social Skills, Cognition, Functioning and Motivation. Four studies (Kimura et al., 2020; Pallathra et al., 2018; Spain et al., 2016; Zukerman et al., 2021) explored social skills, social cognition, social functioning, and social motivation in autistic individuals, studying the relationship between these variables and SA. Kimura et al. (2020) found significant positive correlations between SRS scores and the fear/anxiety scores and avoidance scores on the LSAS.

Zukerman et al. (2021) found that higher cognition-social adaptation discrepancy was associated with higher levels of SA, which is moderated by autistic traits; more avoidant symptoms were seen among students with high autistic traits. Conversely, Spain et al. (2016) found no

differences between low SA and high SA ASD groups on measures of emotion and social cognition, concluding that no relationship exists between SA, ASD, and measures of socio-emotional processing. These results should be considered alongside this study's weak methodological quality, due to its limitations in selection bias and study design.

Alexithymia. Albantakis et al. (2020) concluded that alexithymia increases the risk of depressive and social phobic symptoms.

Communication and Adaptive Skills. Two studies (Kimura et al., 2020 and Zukerman et al., 2019b) explored communication and adaptive skills within SA and ASD. Kimura et al. (2020) assessed letter fluency and communication using the Communication Checklist (CC-SR; higher scores indicate greater impairment) and compared results across an autistic and non-autistic sample. Results show significant positive correlations between CC-SR and SA, letter fluency and SA, and the CC-SR and SRS. Significant differences were observed between the ASD group and control group. The study concluded that SA is a risk factor for worsening communicative behaviour difficulties.

Zukerman et al. (2019b) found that the level of adaptive skills, as measured by the ABAS-II, correlated significantly and negatively with severity of SA symptoms in both the ASD group and control group, and obsessive-compulsive symptoms in the ASD group. Autism traits and SA significantly explained the variance in adaptive skills.

Summary. Overall, in terms of mental health, well-being, and functioning, results suggest a relationship between increased levels of depression/anxiety/OCD and SA in ASD. Results also suggest a relationship between SA and decreased functioning and adaptive skills in ASD. One study reported a negative correlation between SA and well-being in ASD. In terms of risk factors, conclusions are tentative due to the small number of studies; two studies found camouflaging to be related to SA in ASD, and a further study found alexithymia to increase SA in ASD. One study also concluded that SA worsens communicative behaviour difficulties.

Discussion

Autistic adults commonly experience SA. This review found a prevalence estimate of 76% of SA in ASD; it is suggested that the prevalence of SA in the general population is 12% (NICE, 2013). To further understand the prevalence of SA in ASD, and the additional impact this has on the mental health, well-being and functioning of autistic individuals, a systematic review was undertaken. A systematic search of empirical data assessing the prevalence of SA in autistic adults and associations between autism, SA and additional outcomes was carried out, whilst also considering potential risk factors to the development of SA in ASD. A total of 19 studies were included in the systematic review. All 19 studies were narratively synthesised, and five studies were statistically synthesised using a meta-analysis, assessing the overall prevalence of SA in ASD.

The primary aim of the review was to examine the prevalence of SA in autistic adults. It was hypothesised that a large significant pooled mean event rate and effect size would be found in the meta-analysis. Despite a small number of studies being eligible for inclusion, a meta-analysis was conducted due to conclusions being able to be drawn reliably from two or more studies (Valentine et al., 2010). A combined prevalence of 76% was found for SA in ASD, which is in line with the hypothesis. This finding is of substantial importance to the current literature and clinical field, providing a significantly high prevalence rate of SA in ASD in the first meta-analysis undertaken in this area. This not only encourages further research to be undertaken in this area, but also provides guidance for clinicians working in the field of autism and/or SA. Narrative synthesis of the data also indicated a relatively consistent trend, with all studies reporting a mean score of SA above the clinical cut-off on their measure, thus suggesting high levels of SA in ASD. Furthermore, a total of 11 studies tested the difference between groups (ASD vs. other) on scores of SA, with nine studies reporting significantly higher levels of SA in the ASD group. Cath et al. (2008) and Perry et al. (2015) reported no significant differences in scores on SA between groups. Perry et al. (2015) compared an autistic sample to a neurotypical sample, and Cath et al. (2008) included an ASD group, SAD group, OCD group and a neurotypical group; the utilisation of different groups could

impact on the findings, due to different presentations and experiences between groups that may not be accounted for. Furthermore, the sample size in both studies was small. Therefore, these issues, along with other methodological limitations, suggest that the findings of these studies should be interpreted with caution.

Within the first aim of this review, it is important to note the varied use of measures in assessing SA. The majority of studies utilised the LSAS-SR ($n = 16$), and three studies used other measures including the SAKSO, SADS and SPAI, none of which are validated for use in autistic samples. Whilst all five studies included in the meta-analysis used the LSAS-SR, this measure does not have a clear universal clinical cut-off, with studies utilising different cut-offs depending on which guidance they adhered to. For example, Mennin et al. (2002) describes the two clinical cut-off scores for SA on the LSAS-SR; total scores of 30 and above are indicative of SAD and scores of 60 and above are indicative of GSAD. However, Zukerman et al. (2019a) utilised a cut-off of 35 (Glischinski et al., 2018). Within the meta-analysis, Bowri et al. (2020), Pallathra et al. (2018), and Hull et al. (2021) used 30 as the cut-off, and Spain et al. (2016) utilised a score of 60. Bejerot et al. (2014) did not report the cut-off score utilised within their study. The lack of a universal cut-off score makes it difficult to draw reliable conclusions, as does the use of measures that are not validated for use within autistic populations. Nevertheless, with these limitations in mind, this review further emphasises the high prevalence of SA in ASD.

The second aim of the review was to examine SA in ASD, and how these relate to psychological well-being, quality of life, coping/functioning and additional mental health difficulties. This yielded mixed results and various themes emerged during narrative synthesis. The evidence from the included studies suggests that SA in autism comes with various comorbidities. Firstly, depression and anxiety were predominantly higher among autistic samples, with significant correlations reported between SA and depression (Bowri et al., 2020) and anxiety (Cath et al., 2008) in ASD samples. Obsessive-compulsive behaviours were also found to correlate with autistic traits and SA (Zukerman et al., 2019b). Furthermore, research suggests that autistic traits and SA are

negatively correlated with well-being (Bowri et al., 2020), which is also supported by other research in this area (Oakley et al., 2021). Spain et al. (2016) found higher scores on the HADS in the autistic group who scored above clinical cut-off on SA, in comparison to those who scored below clinical cut-off, thus suggesting the importance of SA in experiences of additional mental health difficulties in autism; these findings were replicated in a similar study by Zukerman et al. (2019b). It is interesting that in one study by Zukerman et al. (2019a), academic functioning in the ASD group was positively correlated with SA levels. This finding has not been studied elsewhere and should be considered within the limitations of this study. Replication of this in future research will be important, considering why SA may be important to academic functioning in autistic adults.

Some studies however do not support these results, with limited findings suggesting no link between depression, SA, and autism (Zukerman et al., 2019a; 2021), and camouflaging not being predictive of SA (Schuck et al., 2019). However, due to the nature of the included research being predominantly correlational, conclusions on causation cannot be drawn. Despite this, autistic individuals experience a high prevalence of SA, along with difficulties in depression, anxiety, well-being, and functioning; the extent to which requires further exploration in research.

Among the consideration of risk factors to developing SA in ASD, some tentative themes emerged. One study concluded that SA is a risk factor for worsening communicative behaviour difficulties (Kimura et al., 2020). A further study found that alexithymia and autistic traits increase the risk of depressive symptoms and SA (Albantakis et al., 2020). Zukerman et al. (2019b) found that autism traits and SA significantly explained the variance in adaptive skills. The main theme to emerge was around camouflaging, which was assessed in three studies. Two of these studies found that camouflaging is predictive of SA in ASD and is associated with higher levels of depression and anxiety (Hull et al., 2021; Bowri et al., 2020). Camouflaging in autism is of current interest within research, with many findings suggesting an impact on mental health and functioning (Cook et al., 2021). Overall, due to a variety of variables being assessed and mixed findings within this, clear conclusions are unable to be drawn.

Limitations of Included Studies

Several limitations within the included studies should be considered. Firstly, the sampling methods between studies varied, with some studies recruiting samples from the general population or Universities, and others seeking a clinical sample; the proportion of individuals involved with clinical services is unknown. Conclusions on differing demographic variables between samples can therefore not be drawn. Secondly, over half of the studies ($n = 10$) included a small sample size ($R = 12-56$), thus potentially reducing their capacity to generate clear and generalisable findings. Thirdly, the majority of the studies were conducted in Western cultures. Ethnicity data was infrequently reported; of those reported, there is an overrepresentation of Caucasian participants. It is possible that there are cultural variations in SA that are not considered within the psychometric properties of measures (Asnaani et al., 2015), it is therefore not clear whether the overall findings in this review are valid for non-Caucasian samples. Furthermore, the gender average across studies was 78% male, with some studies only including male participants. This makes it difficult to fully generalise to autistic females; SA in ASD is likely to be different among females with higher rates of camouflaging (Hull et al., 2021). Also, measures used to assess autism, SA and additional outcomes varied. Some measures utilised were also not yet validated in autistic samples, thus impacting the reliability and validity of findings. In addition, level of IQ was not consistently assessed in studies which could be a compounding factor. Seven studies were cross-sectional and causal interpretations can therefore not be made.

Strengths and Limitations of This Review

This review is strengthened by the comprehensive search strategy and rigorous eligibility criteria. This ensures confidence in the included studies being representative of the current evidence base. Furthermore, the inclusion of only diagnosed autistic samples and only adults allow for more specific conclusions to be drawn. Publication bias was assessed and there was no evidence of publication bias within the current meta-analysis. In addition, having a second independent author

assess the studies' methodological quality, which resulted in 'fair' to 'excellent' inter-rater agreement across all domains, provides confidence in the reliability of the quality assessment. Data extraction methods were also coded by a second author.

However, it is possible that bias may have been introduced during study selection as this was only conducted by the first author (Boland et al., 2014). Furthermore, due to the limited number of studies eligible for inclusion in the meta-analysis on the prevalence of SA in ASD, the influence of potential moderators was unable to be investigated. Therefore, the results of the meta-analysis should be interpreted with caution, alongside the limitations of the included studies themselves. In addition, non-English language published articles were omitted; results may therefore not reflect studies published in other languages and across cultures. It is also important to note the broad aims within the second part of this review, which resulted in a broad range of measures across different domains. This resulted in difficulties with the synthesis of data and the drawing of precise conclusions.

Clinical and Research Implications

It is important that clinicians consider the possibility of SA when working with autistic adults. Considering that autistic individuals may not seek support independently, due to the possible presence of SA but also because of core autistic traits that make seeking support difficult, it is crucial that assessment of SA presence and severity is incorporated into settings such as Universities, workplaces, and mental health services. Clinicians should also assess and consider additional impact on mental health and functioning within the assessment and intervention. Interventions to reduce SA should also be considered, whilst adapting this to the needs of autistic individuals e.g., adapted CBT for SA (NICE, 2013), which has been found to significantly decrease symptoms of SA (Spain et al., 2017). Clinicians should consider the role of autism in Clark and Well's (1995) cognitive behavioural model of SA, which states that SA is derived from a biological predisposition and triggered by psychosocial and environmental factors. SA is then maintained by

cognitive and behavioural factors, such as negative beliefs about the self and others, and avoidance. the findings of the current review prompts clinicians to consider the impact of difficulties in ASD on SA, and how these interact. For example, ASD is defined by socio-communication difficulties; this is likely to lead to difficulties in social interactions, increasing the risk for the development of SA. Similarly, SA in ASD may worsen socio-communication difficulties. These and similar issues are not considered in current models of SA and require attention in clinical settings.

Further research is needed on the prevalence of SA in ASD, with researchers using validated measures with a universal cut-off, allowing reliable and valid prevalence estimates to be made in a larger scale meta-analysis. Furthermore, some included studies within this review did not utilise measures that have been standardised in autistic populations. The lack of current valid and reliable measures of mental health in autism is recognised as a gap in the research, especially within adult populations (Brugha et al., 2015); recent research is addressing this (Rodgers et al., 2020). Such research should focus on informing a standardised decision for the use of assessment tools in autism, thus allowing data to be more easily compared. Future studies would benefit from including validated alexithymia measures (e.g., the Bermond-Vorst Alexithymia Questionnaire; Vorst & Bermond, 2001) to enable researchers to assess the reliability and validity of self-report measures. Research is particularly required in establishing similarities and differences in the SA profile in autistic individuals, considering risk factors and maintaining factors. The use of longitudinal research designs will help to further identify this as well as in being able to consider predictors of SA in autism, as well as factors that may mediate or moderate its association with additional mental health difficulties. Lastly, using gold-standard procedures for confirming autism diagnoses such as the ADOS (Gotham et al., 2006) and ADI-R (Rutter et al., 2008) would enable better generalisation of study findings to diagnosed autistic individuals.

Conclusion

This is the first systematic review using meta-analytic procedures to assess prevalence of SA in autistic adults, with results suggesting that autistic adults have a high prevalence of SA. This review also explored the additional mental health and functioning implications these experiences have in autistic adults, finding that depression, anxiety, reduced well-being, and impaired general functioning are also common experiences. The findings suggest that camouflaging, alexithymia, and autistic traits may increase the risk of depressive symptoms and SA; however, further research is needed in these areas to extend the evidence base. There are limitations within the included studies and within the review, with some studies of poor methodological quality; as a result, findings should be interpreted with caution. Nevertheless, this review demonstrates significant findings within this field, highlighting the high prevalence of SA in autistic adults and the additional impact this can have on aspects of mental health, well-being, and general functioning. This review has valuable research and clinical implications, particularly on the importance of clinicians considering SA when working with autistic individuals.

References

- Adams, G. C., Balbuena, L., Meng, X., & Asmundson, G. J. (2016). When social anxiety and depression go together: A population study of comorbidity and associated consequences. *Journal of Affective Disorders, 206*, 48-54.
<https://doi.org/10.1016/j.jad.2016.07.031>
- Adams, D., Clark, M., & Keen, D. (2019) Using self-report to explore the relationship between anxiety and quality of life in children on the autism spectrum. *Autism Research, 12*(10), 1505–15. <https://doi.org/10.1002/aur.2155>
- *Albantakis, L., Brandi, M. L., Zillekens, I. C., Henco, L., Weindel, L., Thaler, H., Schliephake, L., Timmermans, B., & Schilbach, L. (2020). Alexithymic and autistic traits: relevance for comorbid depression and social phobia in adults with and without autism spectrum disorder. *Autism, 24*(8), 2046-2056. <https://doi.org/10.1177/1362361320936024>
- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition: DSM 5* (Fifth). American Psychiatric Publishing.
<http://www.psyweb.com/content/main-pages/dsm-5-fifth-edition-of-the-diagnostic-and-statistical-manual-of-mental-disorders>
- Armijo-Olivo, S., Stiles, C. R., Hagen, N. A., Biondo, P. D., & Cummings, G. G. (2012). Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: methodological research. *Journal of Evaluation in Clinical Practice, 18*(1), 12–18. <https://doi.org/10.1111/j.1365-2753.2010.01516.x>
- Asnaani, A., Aderka, I. M., Marques, L., Simon, N., Robinaugh, D. J., & Hofmann, S. G. (2015). The structure of feared social situations among race-ethnic minorities and Whites with social

anxiety disorder in the United States. *Transcultural Psychiatry*, 52(6), 791-807.

<https://doi.org/10.1177/1363461515576823>

- Bagby, R. M., Parker, J. D., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—
I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic
Research*, 38(1), 23–32. [https://doi.org/10.1016/0022-3999\(94\)90005-1](https://doi.org/10.1016/0022-3999(94)90005-1)
- Baños, R. M., Botella, C., Quero, S., & Medina, P. (2007). The social phobia and anxiety inventory:
Psychometric properties in a Spanish sample. *Psychological Reports*, 100(2), 441-450.
<https://doi.org/10.2466/pr0.100.2.441-450>
- Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism
spectrum quotient (AQ): Evidence from asperger syndrome/high-functioning autism, males
and females, scientists and mathematicians. *Journal of Autism and Developmental
Disorders*, 31(1), 5–17. <https://doi.org/10.1023/A:1005653411471>
- Baron-Cohen, S., Wheelwright, S., Hill, H., Raste, Y., & Plumb, I. (2001). The reading the mind in
the eyes test revised version: A study with normal adults, and adults with asperger syndrome
or high functioning autism. *Journal of Child Psychology and Psychiatry*, 42(2), 241–251.
<https://doi.org/10.1017/S0021963001006643>
- Bauminger, N., Shulman, C., & Agam, G. (2004). The link between perceptions of self and of
social relationships in high-functioning children with autism. *Journal of Developmental and
Physical Disabilities*, 16(2), 193–214.
<https://doi.org/10.1023/B:JODD.0000026616.24896.c8>
- Beck, A.T., Steer, R.A., & Brown, G.K. (1996). *Manual for the beck depression inventory-II*.
Psychological Corporation.

- Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: psychometric properties. *Journal of Consulting and Clinical Psychology*, 56(6), 893. <https://doi.org/10.1037/0022-006X.56.6.893>
- Bejerot, S., Nylander, L., & Lindström, E. (2001). Autistic traits in obsessive-compulsive disorder. *Nordic Journal of Psychiatry*, 55(3), 169-176. <https://doi.org/10.1080/08039480152036047>
- *Bejerot, S., Eriksson, J. M., & Mörtberg, E. (2014). Social anxiety in adult autism spectrum disorder. *Psychiatry Research*, 220(1-2), 705-707. <https://doi.org/10.1016/j.psychres.2014.08.030>
- Bickart, K. C., Wright, C. I., Dautoff, R. J., Dickerson, B. C., & Barrett, L. F. (2011). Amygdala volume and social network size in humans. *Nature Neuroscience*, 14(2), 163–164.
- Bishop, D. V., Whitehouse, A. J. O., & Sharp, M. (2009). *The communication checklist-self report (CC-SR)*. Pearson.
- Boland, A., Cherry, M. G., & Dickson, R. (2014). *Doing a systematic review: A student's guide*. SAGE Publications Ltd.
- Borenstein, M., Hedges, L., Higgins, J., & Rothstein, H. (2018). *Comprehensive meta-analysis version 3.0*. Comprehensive meta-analysis. www.meta-analysis.com
- Borenstein, Michael., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2010). A basic introduction to fixed-effect and random-effects models for meta-analysis. *Research Synthesis Methods*, 1(2), 97–111. <https://doi.org/10.1002/jrsm.12>
- Borges Migliavaca, C., Stein, C., Colpani, V., Barker, T. H., Munn, Z., & Falavigna, M. (2020). How are systematic reviews of prevalence conducted? A methodological study. *BMC Medical Research Methodology*, 20(1), 1–9. <https://doi.org/10.1186/s12874-020-00975-3>

- *Bowri, M., Hull, L., Allison, C., Smith, P., Baron-Cohen, S., Lai, M. C., & Mandy, W. (2021). Demographic and psychological predictors of alcohol use and misuse in autistic adults. *Autism*, 25(5), 1469-1480. <https://doi.org/10.1177/1362361321992668>
- Byrt, T. (1996). How good is that agreement? *Epidemiology*, 7(5), 561.
- Calvo, M. G., & Lundqvist, D. (2008). Facial expressions of emotion (KDEF): Identification under different display-duration conditions. *Behavior Research Methods*, 40(1), 109-115.
- Card, N. (2015). *Applied meta-analysis for social science research* (S.A. Bushman, & J. Worley, Eds.). Guilford Press.
- Carter, E. C., Schönbrodt, F. D., Gervais, W. M., & Hilgard, J. (2019). Correcting for Bias in Psychology: A Comparison of Meta-Analytic Methods. *Advances in Methods and Practices in Psychological Science*, 2(2), 115–144. <https://doi.org/10.1177/2515245919847196>
- Cassidy, S.A, Gould, K., Townsend, E., Pelton, M., Robertson, A.E., & Rodgers, J. (2019). Is camouflaging autistic traits associated with suicidal thoughts and behaviours? Expanding the interpersonal psychological theory of suicide in an undergraduate student sample. *Journal of Autism and Developmental Disorders*, 50(10):3638–48. <https://doi.org/10.1007/s10803-019-04323-3>
- Castelli, F., Happé, F., Frith, U., & Frith, C. (2000). Movement and mind: A functional imaging study of perception and interpretation of complex intentional movement patterns. *NeuroImage*, 12(3), 314–325. <https://doi.org/10.1006/nimg.2000.0612>
- *Cath, D. C., Ran, N., Smit, J. H., Van Balkom, A. J., & Comijs, H. C. (2008). Symptom overlap between autism spectrum disorder, generalized social anxiety disorder and obsessive-compulsive disorder in adults: a preliminary case-controlled study. *Psychopathology*, 41(2), 101-110. <https://doi.org/10.1159/000111555>

- Centres for Disease Control and Prevention (CDC, 2018). *Autism spectrum disorder (ASD)*. CDC.
<https://www.cdc.gov/ncbddd/autism/data.html>
- Chan, W., Smith, L. E., Hong, J., Greenberg, J. S., & Mailick, M. R. (2017). Validating the social responsiveness scale for adults with autism. *Autism Research, 10*(10), 1663-1671.
<https://doi.org/10.1002/aur.1813>
- Clark, D. M., Wells, A. (1995). A cognitive model of social phobia. In R. Heimberg, M. Liebowitz, D. A. Hope, & F. R. Schneier (Eds.), *Social phobia: Diagnosis, assessment, and treatment*. New York: Guilford Press.
- Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159.
<https://doi.org/10.1037/0033-2909.112.1.155>
- Cook, J., Hull, L., Crane, L., & Mandy, W. (2021). Camouflaging in autism: A systematic review. *Clinical Psychology Review, 89*, 102080. <https://doi.org/10.1016/j.cpr.2021.102080>
- Croen, L.A, Zerbo, O., Qian, Y., Massolo, M.L., Rich, S., Sidney, S., & Kripke, C. (2015). The health status of adults on the autism spectrum. *Autism, 19*(7):814–23.
<https://doi.org/10.1177/1362361315577517>
- Cruwys, T., Haslam, S. A., Dingle, G. A., Haslam, C., & Jetten, J. (2014). Depression and social identity: An integrative review. *Personality and Social Psychology Review, 18*, 215–238. <https://doi.org/10.1177/1088868314523839>
- *Danforth, A. L., Grob, C. S., Struble, C., Feduccia, A. A., Walker, N., Jerome, L., Yazar-Klosinski, B., & Emerson, A. (2018). Reduction in social anxiety after MDMA-assisted psychotherapy with autistic adults: a randomized, double-blind, placebo-controlled pilot study. *Psychopharmacology, 235*(11), 3137-3148. <https://doi.org/10.1007/s00213-018-5010-9>

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56*(2), 455–463.

<https://doi.org/10.1111/j.0006-341X.2000.00455.x>

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal*, *315*(7109), 629–634.

<https://doi.org/10.1136/bmj.315.7109.629>

*Espelöer, J., Hellmich, M., Vogeley, K., & Falter-Wagner, C. M. (2021). Brief report: Social anxiety in autism spectrum disorder is based on deficits in social competence. *Journal of Autism and Developmental Disorders*, *51*(1), 315–322.

<https://doi.org/10.1007/s10803-020-04529-w>

Gilbody, S. M., Song, F., Eastwood, A. J., & Sutton, A. (2000). The causes, consequences and detection of publication bias in psychiatry. *Acta Psychiatrica Scandinavica*, *102*(4), 241–249. <https://doi.org/10.1034/j.1600-0447.2000.102004241.x>

Glod, M., Riby, D. M., Honey, E., & Rodgers, J. (2015). Psychological Correlates of Sensory Processing Patterns in Individuals with Autism Spectrum Disorder: A Systematic Review. *Review Journal of Autism and Developmental Disorders*, *2*, 199–221.

<https://doi.org/10.1007/s40489-015-0047-8>

Glischinski, V. M., Willutzki, U., Stangier, U., Hiller, W., Hoyer, J., Leibing, E., Leichsenring, F., & Hirschfeld, G. (2018). Liebowitz Social Anxiety Scale (LSAS): Optimal cut points for remission and response in a German sample. *Clinical Psychology and Psychotherapy*, *25*(3), 465–473. <https://doi.org/10.1002/cpp.2179>

- Gotham, K., Pickles, A., & Lord, C. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 39(5), 693-705.
- Griffiths, S., Allison, C., Kenny, R., Holt, R., Smith, P., & Baron-Cohen, S. (2019). The Vulnerability Experiences Quotient (VEQ): a study of vulnerability, mental health and life satisfaction in autistic adults. *Autism Research*, 12(10), 1516–28. <https://doi.org/10.1002/aur.2162>
- Gross, J.J., & John, O.P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, 85, 348-362. <https://doi.org/10.1037/0022-3514.85.2.348>
- Gross, J. J., & John, O. P. (1995). Facets of emotional expressivity: Three self-report factors and their correlates. *Personality and Individual Differences*, 19(4), 555–568. [https://doi.org/10.1016/0191-8869\(95\)00055-B](https://doi.org/10.1016/0191-8869(95)00055-B)
- Haslam, C., Cruwys, T., Haslam, S. A., Dingle, G., & Chang, M. X.-L. (2016). Groups 4 Health: Evidence that a social-identity intervention that builds and strengthens social group membership improves mental health. *Journal of Affective Disorders*, 194, 188–195. <https://doi.org/10.1016/j.jad.2016.01.010>
- Heimberg, R. G., Horner, K. J., Juster, H. R., Safren, S. A., Brown, E. J., Schneier, F. R., & Liebowitz, M. R. (1999). Psychometric properties of the Liebowitz social anxiety scale. *Psychological Medicine*, 29(1), 199–212. <https://doi.org/10.1017/s0033291798007879>
- Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *In British Medical Journal* (Vol. 327, Issue 7414, pp.

557–560). BMJ Publishing Group. <https://doi.org/10.1136/bmj.327.7414.557>

Hofmann, S. G. (2014). Interpersonal emotion regulation model of mood and anxiety disorders. *Cognitive Therapy and Research*, 38(5), 483–492. <https://doi.org/10.1007/s10608-014-9620-1>

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, 45(2), 212–229. <https://doi.org/10.1111/j.1469-7610.2004.00215.x>

Hull, L., Mandy, W., Lai, M.C., Baron-Cohen, S., Allison, C., Smith, P., & Pwtrides, K.V. (2018). Development and validation of the camouflaging autistic traits questionnaire (CAT-Q). *Journal of Autism and Developmental Disorders*, 49(3), 819–33. <https://doi.org/10.1007/s10803-018-3792-6>

Hull, L., Petrides, K.V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M., & Mandy, M. (2017). “Putting on my best normal”: Social camoufaging in adults with Autism Spectrum Conditions. *Journal of Autism and Developmental Disorders*, 47(8), 2519–34. <https://doi.org/10.1007/s10803-017-3166-5>

*Hull, L., Levy, L., Lai, M. C., Petrides, K. V., Baron-Cohen, S., Allison, C., Smith, P., & Mandy, W. (2021). Is social camouflaging associated with anxiety and depression in autistic adults?. *Molecular Autism*, 12(1), 1–13. <https://doi.org/10.1186/s13229-021-00421-1>

Hurley, R.S.E., Losh, M., Parlier, M., Reznick, J.S., & Piven, J. (2007). The broad autism phenotype questionnaire. *Journal of Autism and Developmental Disorders*, 37, 1679–1690. <https://doi.org/10.1007/s10803-006-0299-3>

*Kanai, C., Iwanami, A., Hashimoto, R., Ota, H., Tani, M., Yamada, T., & Kato, N. (2011). Clinical characterization of adults with Asperger's syndrome assessed by self-report

questionnaires based on depression, anxiety, and personality. *Research in Autism Spectrum Disorders*, 5(4), 1451-1458. <https://doi.org/10.1016/j.rasd.2011.02.005>

Keen, D., Webster, A., & Ridley, G. (2016). How well are children with autism spectrum disorder doing academically at school? An overview of the literature. *Autism*, 20(3), 276–94. <https://doi.org/10.1177/1362361315580962>

Kenny, L., Hattersley, C., Molins, B., Buckley, C., Povey, C., & Pellicano, E. (2016). Which terms should be used to describe autism? Perspectives from the UK autism community. *Autism*, 20, 442–462. <https://doi.org/10.1177/1362361315588200>

Kerns, C. M., & Kendall, P. C. (2012). The presentation and classification of anxiety in autism spectrum disorder. *Clinical Psychology: Science and Practice*, 19(4), 323. <https://doi.org/10.1111/cpsp.12009>

*Kimura, Y., Fujioka, T., Jung, M., Fujisawa, T. X., Tomoda, A., & Kosaka, H. (2020). An investigation of the effect of social reciprocity, social anxiety, and letter fluency on communicative behaviors in adults with autism spectrum disorder. *Psychiatry Research*, 294, 113503. <https://doi.org/10.1016/j.psychres.2020.113503>

*Kleinhans, N. M., Richards, T., Weaver, K., Johnson, L. C., Greenson, J., Dawson, G., & Aylward, E. (2010). Association between amygdala response to emotional faces and social anxiety in autism spectrum disorders. *Neuropsychologia*, 48(12), 3665-3670. <https://doi.org/10.1016/j.neuropsychologia.2010.07.022>

Kohler, C. G., Turner, T. H., Bilker, W. B., Brensinger, C. M., Siegel, S. J., Kanes, S. J., Gur, R.E., & Gur, R. C. (2003). Facial emotion recognition in schizophrenia: intensity effects and error pattern. *American Journal of Psychiatry*, 160(10), 1768–1774. <https://doi.org/10.1176/appi.ajp.160.10.1768>

- Kroenke, K. & Spitzer, R.L. (2002). The *PHQ-9*: A new depression and diagnostic severity measure. *Psychiatric Annals*, 32(9), 509-52. <https://doi.org/10.3928/0048-5713-20020901-06>
- Levy, A., & Perry, A. (2011). Outcomes in adolescents and adults with autism: A review of the literature. *Research in Autism Spectrum Disorders*, 5(4), 1271-1282. <https://doi.org/10.1016/j.rasd.2011.01.023>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *Journal of Clinical Epidemiology*, 62(10), e1-e34. <https://doi.org/10.1136/BMJ.B2700>
- Llerena, K., Park, S. G., McCarthy, J. M., Couture, S. M., Bennett, M. E., & Blanchard, J. J. (2013). The Motivation and Pleasure Scale–Self-Report (MAP-SR): Reliability and validity of a self-report measure of negative symptoms. *Comprehensive Psychiatry*, 54(5), 568-574. <https://doi.org/10.1016/j.comppsy.2012.12.001>
- Lochner, C., Mogotsi, M., du Toit, P. L., Kaminer, D., Niehaus, D. J., & Stein, D. J. (2003). Quality of life in anxiety disorders: a comparison of obsessive-compulsive disorder, social anxiety disorder, and panic disorder. *Psychopathology*, 36(5), 255-262. <https://doi.org/10.1159/000073451>
- Magiati, I., Tay, X. W., & Howlin, P. (2014). Cognitive, language, social and behavioural outcomes in adults with autism spectrum disorders: A systematic review of longitudinal follow-up studies in adulthood. *Clinical Psychology Review*, 34(1), 73-86. <https://doi.org/10.1016/j.cpr.2013.11.002>

- Mennin, D. S., Fresco, D. M., Heimberg, R. G., Schneier, F. R., Davies, S. O., & Liebowitz, M. R. (2002). Screening for social anxiety disorder in the clinical setting: using the Liebowitz Social Anxiety Scale. *Journal of Anxiety Disorders, 16*(6), 661-673.
[https://doi.org/10.1016/S0887-6185\(02\)00134-2](https://doi.org/10.1016/S0887-6185(02)00134-2)
- Milton, D., & Sims, T. (2016). How is a sense of well-being and belonging constructed in the Accounts of autistic adults? *Disability & Society, 31*, 520–534.
<https://doi.org/10.1080/09687599.2016.1186529>
- Moss, P., Howlin, P., Savage, S., Bolton, P., & Rutter, M. (2015). Self and informant reports of mental health difficulties among adults with autism findings from a long-term follow-up study. *Autism, 19*(7), 1362361315585916. <https://doi.org/10.1177/1362361315585916>
- Mundt, J. C., Marks, I. M., Shear, M. K., & Greist, J. H. (2002). The Work and Social Adjustment Scale: A simple measure of impairment in functioning. *British Journal of Psychiatry, 180*(5), 461–464. <https://doi.org/10.1192/bjp.180.5.461>
- Nelson, H. E., & Willison, J. R. (1991). *The revised national adult reading test – Test manual*. NFER-Nelson.
- NHS Centre for Reviews and Dissemination. (2009). *Systematic reviews: CRD's guidance for undertaking reviews in health care*. NHS Centre for Reviews and Dissemination.
https://www.york.ac.uk/media/crd/Systematic_Reviews.pdf
- National Institute of Clinical Excellence (2013). *Social anxiety disorder: Recognition, assessment and treatment*. NICE. <https://www.nice.org.uk/guidance/cg159/chapter/Recommendations>
- Oakley, B. F., Tillmann, J., Ahmad, J., Crawley, D., San José Cáceres, A., Holt, R., Charman, T., Banaschewski, T., Buitelar, J., Simonoff, E., Murphy, D., & Loth, E. (2021). How do core autism traits and associated symptoms relate to quality of life? Findings from the

Longitudinal European Autism Project. *Autism*, 25(2), 389-404.

<https://doi.org/10.1177/1362361320959959>

Orsmond, G. I., Krauss, M. W., & Seltzer, M. M. (2004). Peer relationships and social and recreational activities among adolescents and adults with autism. *Journal of Autism and Developmental Disorders*, 34(3), 245–256.

<https://doi.org/10.1023/B:JADD.0000029547.96610.df>

*Pallathra, A. A., Calkins, M. E., Parish-Morris, J., Maddox, B. B., Perez, L. S., Miller, J., Gur, R., Mandell, D., Schultz, R., & Brodtkin, E. S. (2018). Defining behavioral components of social functioning in adults with autism spectrum disorder as targets for treatment. *Autism Research*, 11(3), 488-502. <https://doi.org/10.1002/aur.1910>

*Perry, A., Levy-Gigi, E., Richter-Levin, G., & Shamay-Tsoory, S. G. (2015). Interpersonal distance and social anxiety in autistic spectrum disorders: A behavioral and ERP study. *Social Neuroscience*, 10(4), 354-365.

<https://doi.org/10.1080/17470919.2015.1010740>

Quintana, D. S. (2015). From pre-registration to publication: a non-technical primer for conducting a meta-analysis to synthesize correlational data. *Frontiers in Psychology*, 1549.

<https://doi.org/10.3389/fpsyg.2015.01549>

Raine, A. (1991). The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophrenia Bulletin*, 17(4), 555-564.

Ratto, A. B., Turner-Brown, L., Rupp, B. M., Mesibov, G. B., & Penn, D. L. (2011). Development of the Contextual Assessment of Social Skills (CASS): a role play measure of social skill for individuals with high-functioning autism. *Journal of Autism and Developmental Disorders*, 41(9), 1277–1286. <https://doi.org/10.1007/s10803-010-1147-z>

- *Richey, J. A., Rittenberg, A., Hughes, L., Damiano, C. R., Sabatino, A., Miller, S., ... & Dichter, G. S. (2014). Common and distinct neural features of social and non-social reward processing in autism and social anxiety disorder. *Social Cognitive and Affective Neuroscience*, 9(3), 367-377. <https://doi.org/10.1093/scan/nss146>
- Roid, G. H., & Pomplun, M. (2012). The Stanford-Binet Intelligence Scales, Fifth Edition. In D. P. Flanagan & P. L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 249–268). The Guilford Press.
- Rosenberg, M. (1965). *Rosenberg Self-Esteem Scale (RSES)*. APA PsycTests. <https://doi.org/10.1037/t01038-000>
- Rothstein, H. R., Sutton, A. J., & Borenstein, M. (2005). *Publication bias in meta-analysis: Prevention, Assessment and Adjustments*. Wiley. <https://doi.org/10.1002/0470870168.ch1>
- Ryan, R. (2016). *Cochrane consumers and communication group: Meta-analysis*. Cochrane consumers and communication review group. <http://cccr.org>
- Rydén, E., & Bejerot, S. (2008). Autism spectrum disorder in an adult psychiatric population. A naturalistic cross sectional controlled study. *Clinical Neuropsychiatry*, 5(1), 13-21.
- Ryff, C. D., & Keyes, C. L. M. (1995). The Structure of Psychological Well-Being Revisited. *Journal of Personality and Social Psychology*, 69(4), 719–727. <https://doi.org/10.1037/0022-3514.69.4.719>
- Saunders, J.B., Aasland, O.G., Babor, T.F., de la Fuente, J.R., & Grant M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption II. *Addiction*, 88(6), 791-804. <https://doi.org/10.1111/j.1360-0443.1993.tb02093.x>
- Schuck, P. (2004). Assessing reproducibility for interval data in health-related quality of life questionnaires: Which coefficient should be used? *Quality of Life Research*, 13(3),

571–585. <https://doi.org/10.1023/B:QURE.0000021318.92272.2a>

- *Schuck, R. K., Flores, R. E., & Fung, L. K. (2019). Brief report: Sex/gender differences in symptomology and camouflaging in adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *49*(6), 2597-2604. <https://doi.org/10.1007/s10803-019-03998-y>
- Shattuck, P. T., Orsmond, G. I., Wagner, M., & Cooper, B. P. (2011). Participation in social activities among adolescents with an autism spectrum disorder. *PLoS ONE*, *6*(11), 76e27176. <https://doi.org/10.1371/journal.pone.0027176>
- *Spain, D., Happé, F., Johnston, P., Campbell, M., Sin, J., Daly, E., Ecker, C., Anson, M., Chaplin, E., Glaser, K., Mendez, A., Lovell, K., & Murphy, D. (2016). Social anxiety in adult males with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *32*, 13-23. <https://doi.org/10.1016/j.rasd.2016.08.002>
- *Spain, D., Blainey, S. H., & Vaillancourt, K. (2017). Group cognitive behaviour therapy (CBT) for social interaction anxiety in adults with autism spectrum disorders (ASD). *Research in Autism Spectrum Disorders*, *41*, 20-30. <https://doi.org/10.1016/j.rasd.2017.07.005>
- Spain, D., Sin, J., Linder, K. B., McMahon, J., & Happé, F. (2018). Social anxiety in autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, *52*, 51-68. <https://doi.org/10.1016/j.rasd.2018.04.007>
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Consulting Psychologists Press.
- Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*, *166*(10), 1092-1097.

- Stein, M. B. (2006). An epidemiologic perspective on social anxiety disorder. *Journal of Clinical Psychiatry*, 67, 3.
- Sterne, J. A. C., & Egger, M. (2005). Regression Methods to Detect Publication and Other Bias in Meta-Analysis. In Rothstein, H. R., Sutton, A. J., & Borenstein, M. *Publication bias in meta-analysis: Prevention, assessment and adjustments* (pp. 99–110). John Wiley & Sons, Ltd. <https://doi.org/10.1002/0470870168.ch6>
- Storch, E. A., Rasmussen, S. A., Price, L. H., Larson, M. J., Murphy, T. K., & Goodman, W. K. (2010). Development and psychometric evaluation of the Yale–Brown Obsessive-Compulsive Scale—Second Edition. *Psychological Assessment*, 22(2), 223–232. <https://doi.org/10.1037/a0018492>
- Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., Parkinson, J., Secker, J & Stewart-Brown, S. (2007). The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): development and validation. *Health and Quality of Life Outcomes*, 5(1), 1-13.
- Thomas, B. H., Ciliska, D., Dobbins, M., & Micucci, S. (2004). A Process for Systematically Reviewing the Literature: Providing the Research Evidence for Public Health Nursing Interventions. *Worldviews on Evidence-Based Nursing*, 1(3), 176–184. <https://doi.org/10.1111/j.1524-475X.2004.04006.x>
- Trevisan, D. A., Bowering, M., & Birmingham, E. (2016). Alexithymia, but not autism spectrum disorder, may be related to the production of emotional facial expressions. *Molecular Autism*, 7(1), 1-12. <https://doi.org/10.1186/s13229-016-0108-6>
- Valentine, J. C., Pigott, T. D., & Rothstein, H. R. (2010). How many studies do you need? A primer on statistical power for meta-analysis. *Journal of Educational and Behavioral Statistics*, 35(2), 215-247. <https://doi.org/10.3102/1076998609346961>

- van Steensel, F. J., & Heeman, E. J. (2017). Anxiety levels in children with autism spectrum disorder: A meta-analysis. *Journal of Child and Family Studies*, 26(7), 1753-1767.
<https://doi.org/10.1007/s10826-017-0687-7>
- Vorst, H. C., & Bermond, B. (2001). Validity and reliability of the Bermond–Vorst alexithymia questionnaire. *Personality and Individual Differences*, 30(3), 413-434.
[https://doi.org/10.1016/S0191-8869\(00\)00033-7](https://doi.org/10.1016/S0191-8869(00)00033-7)
- Wechsler, D. (2008). *Wechsler adult intelligence scale--Fourth edition (WAIS-IV)*. Psychological Corporation.
- Wechsler, D. (2003). *Wechsler abbreviated scale of intelligence (WASI)*. Psychological Corporation.
- Whitehouse, A. J. O., Durkin, K., Jaquet, E., & Ziatas, K. (2009). Friendship, loneliness and depression in adolescents with Asperger’s Syndrome. *Journal of Adolescence*, 32(2), 309–322. <https://doi.org/10.1016/j.adolescence.2008.03.004>
- Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta Psychiatrica Scandinavica*, 67(6), 361-370.
- *Zukerman, G., Yahav, G., & Ben-Itzhak, E. (2019a). Diametrically opposed associations between academic achievement and social anxiety among university students with and without autism spectrum disorder. *Autism Research*, 12(9), 1376-1385.
<https://doi.org/10.1002/aur.2129>
- *Zukerman, G., Yahav, G., & Ben-Itzhak, E. (2019b). Increased psychiatric symptoms in university students with autism spectrum disorder are associated with reduced adaptive behavior. *Psychiatry Research*, 273, 732-738.
<https://doi.org/10.1016/j.psychres.2019.01.098>
- *Zukerman, G., Yahav, G., & Ben-Itzhak, E. (2021). The Gap Between Cognition and Adaptive Behavior in Students with Autism Spectrum Disorder: Implications for Social Anxiety and

the Moderating Effect of Autism Traits. *Journal of Autism and Developmental Disorders*, 51(5), 1466-1478. <https://doi.org/10.1007/s10803-020-04632-y>

Appendices

Appendix A

Reference: CRD42021273400

PROSPERO
International prospective register of systematic reviews

NHS
National Institute for
Health Research

UNIVERSITY of York
Centre for Reviews and Dissemination

Systematic review

A list of fields that can be edited in an update can be found [here](#)

1. *Review title.

Give the title of the review in English

Social anxiety in autistic adults; a systematic review and meta-analysis

2. Original language title.

For reviews in languages other than English, give the title in the original language. This will be displayed with the English language title.

3. * Anticipated or actual start date.

Give the date the systematic review started or is expected to start.

01/09/2021

4. * Anticipated completion date.

Give the date by which the review is expected to be completed.

06/05/2022

5. * Stage of review at time of this submission.

This field uses answers to initial screening questions. It cannot be edited until after registration.

Tick the boxes to show which review tasks have been started and which have been completed.

Update this field each time any amendments are made to a published record.

The review has not yet started: Yes

Review stage	Started	Completed
Preliminary searches	No	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

Provide any other relevant information about the stage of the review here.

6. * Named contact.

The named contact is the guarantor for the accuracy of the information in the register record. This may be any member of the review team.

Lucy Stephens

Email salutation (e.g. "Dr Smith" or "Joanne") for correspondence:

Miss Stephens

7. * Named contact email.

Give the electronic email address of the named contact.

lstephens4@sheffield.ac.uk

8. Named contact address

Give the full institutional/organisational postal address for the named contact.

37 Lea Lane Selston Nottingham NG16 6BY

9. Named contact phone number.

Give the telephone number for the named contact, including international dialling code.

07969571717

10. * Organisational affiliation of the review.

Full title of the organisational affiliations for this review and website address if available. This field may be completed as 'None' if the review is not affiliated to any organisation.

University of Sheffield

Organisation web address:

<https://www.sheffield.ac.uk/>

11. * Review team members and their organisational affiliations.

Give the personal details and the organisational affiliations of each member of the review team. Affiliation refers to groups or organisations to which review team members belong. **NOTE: email and country now MUST be entered for each person, unless you are amending a published record.**

Miss Lucy Stephens. University of Sheffield
Professor Elizabeth Milne. University of Sheffield
Dr Georgina Rowse. University of Sheffield

12. * Funding sources/sponsors.

Details of the individuals, organizations, groups, companies or other legal entities who have funded or sponsored the review.

University of Sheffield

Grant number(s)

State the funder, grant or award number and the date of award

University of Sheffield

13. * Conflicts of interest.

List actual or perceived conflicts of interest (financial or academic).

None

14. Collaborators.

Give the name and affiliation of any individuals or organisations who are working on the review but who are not listed as review team members. **NOTE: email and country must be completed for each person, unless you are amending a published record.**

15. * Review question.

State the review question(s) clearly and precisely. It may be appropriate to break very broad questions down into a series of related more specific questions. Questions may be framed or refined using PI(E)COS or similar where relevant.

2. What is the impact of SAISAD on measures of psychological distress, well-being, coping/functioning, life attainment, additional mental health difficulties and quality of life?

16. * Searches.

State the sources that will be searched (e.g. Medline). Give the search dates, and any restrictions (e.g. language or publication date). Do NOT enter the full search strategy (it may be provided as a link or attachment below.)

Searches will start in September 2021

Searches will be conducted on three databases: Scopus, PsycINFO and MEDLINE.

Unpublished literature will also be searched using the OpenGrey database.

English Language articles only

17. URL to search strategy.

Upload a file with your search strategy, or an example of a search strategy for a specific database, (including the keywords) in pdf or word format. In doing so you are consenting to the file being made publicly accessible. Or provide a URL or link to the strategy. Do NOT provide links to your search **results**.

https://www.crd.york.ac.uk/PROSPEROFILES/273400_STRATEGY_20210816.pdf

Alternatively, upload your search strategy to CRD in pdf format. Please note that by doing so you are consenting to the file being made publicly accessible.

Do not make this file publicly available until the review is complete

18. * Condition or domain being studied.

Give a short description of the disease, condition or healthcare domain being studied in your systematic review.

Social Anxiety

Autism Spectrum Disorder

19. ~~Change~~ Participants/population.

Specify the participants or populations being studied in the review. The preferred format includes details of both inclusion and exclusion criteria.

Exclusion Criteria: studies that do not include a measure of social anxiety; studies that include participants under the age of 18 years; articles that are not accessible in the English Language; qualitative articles; general population articles that use a non-ASD population; intervention studies that do not include baseline prevalence data. For meta-analyses, relevant data for calculating effect sizes unavailable or not provided by corresponding authors upon request.

Inclusion Criteria: studies using an ASD population whereby ASD can be formally diagnosed or self-diagnosed/suspected; studies that include a measure of social anxiety; adult population; English Language articles; quantitative articles; intervention studies that include baseline prevalence data. For inclusion in the meta-analysis, an appropriate effect size must be reported for SA in ASD (or calculable from available statistics).

20. * Intervention(s), exposure(s).

Give full and clear descriptions or definitions of the interventions or the exposures to be reviewed. The preferred format includes details of both inclusion and exclusion criteria.

Not applicable

21. * Comparator(s)/control.

Where relevant, give details of the alternatives against which the intervention/exposure will be compared (e.g. another intervention or a non-exposed control group). The preferred format includes details of both inclusion and exclusion criteria.

Some studies may compare ASD to non-ASD groups, though this is not essential.

22. * Types of study to be included.

Give details of the study designs (e.g. RCT) that are eligible for inclusion in the review. The preferred format includes both inclusion and exclusion criteria. If there are no restrictions on the types of study, this should be stated.

Quantitative studies – cross-sectional and longitudinal

23. Context.

Give summary details of the setting or other relevant characteristics, which help define the inclusion or exclusion criteria.

24. ~~Change~~ Outcome(s).

Give the pre-specified main (most important) outcomes of the review, including details of how the outcome is defined and measured and when these measurement are made, if these are part of the review inclusion criteria.

Prevalence of social anxiety in autistic adults measured by: effect sizes; the number of participants who score above clinical cut-off on measures of Social Anxiety; and by extracting data from the papers who discuss any significant differences between ASD and non-ASD participants on SA measures; a meta-analysis will be conducted providing there are enough included papers to do so. Lastly, understanding the impact of SA on autistic adults in terms of psychological distress, well-being, life attainment, additional mental health difficulties and quality of life; a qualitative synthesis will be conducted.

Predictors/risk factors of SA in ASD will be discussed providing there are enough papers.

Possible measures of SA:

- Liebowitz Social Anxiety Scale (LSAS)
- Social Anxiety Questionnaire for Adults (SAQ-A)
- Social Phobia and Anxiety Inventory-23 (SPAI-23)
- Brief Social Phobia Scale (BSPS)
- Social Phobia and Anxiety Inventory (SPAI)
- The Social Phobia Scale and the Social Interaction Anxiety Scale (SPS and SIAS)
- Social Phobia Inventory (SPIN) and Mini-SPIN

Impact:

- Symptom Checklist-90 Revised (SCL-90-R)
- Hospital Anxiety and Depression Scale (HADS)
- Depression Anxiety and Stress Scales (DASS-21).
- The Social and Emotional Loneliness Scale for Adults (SELSA)
- The Scales of Psychological Well-Being (SPWB)
- Patient Health Questionnaire-9 (PHQ-9)
- Buss and Perry Aggression Questionnaire (BPAQ)
- Academic attainment measures

Measures/assessments of ASD may include:

- Autism Spectrum Quotient (AQ)
- Autism Diagnostic Observation Schedule (ADOS)
- Ritvo Adult Autism Diagnostic Scales (RAADS)

Measures of effect

Please specify the effect measure(s) for you main outcome(s) e.g. relative risks, odds ratios, risk difference, and/or 'number needed to treat.

This will include looking at correlations of the relationship between SA and these variables, as well as regression, factor analysis, mediator/moderator analyses and machine learning analyses, where appropriate. Prevalence of SA in ASD will be assessed using a meta-analysis providing there are enough included papers to do so.

25. * Additional outcome(s).

List the pre-specified additional outcomes of the review, with a similar level of detail to that required for main outcomes. Where there are no additional outcomes please state 'None' or 'Not applicable' as appropriate to the review

Predictors/risk factors of SA in ASD will be discussed providing there are enough papers in this area.

Measures of effect

Please specify the effect measure(s) for you additional outcome(s) e.g. relative risks, odds ratios, risk difference, and/or 'number needed to treat.

This will include looking at correlations of the relationship between SA in ASD and risk factors/predictors, as well as regression, factor analysis, mediator/moderator analyses and machine learning analyses, where appropriate.

26. ~~Change~~ Data extraction (selection and coding).

Describe how studies will be selected for inclusion. State what data will be extracted or obtained. State how this will be done and recorded.

A systematic review of literature will be undertaken using three databases (Scopus, PsycINFO and MEDLINE). Papers will be retrieved, and duplicate papers discarded. The remaining papers will be screened for relevance based on title. If deemed appropriate based on title, papers will later be screened more thoroughly, including reading abstracts and full articles where necessary. References of the included studies will be used to search for additional papers which will then be screened for eligibility. Articles not meeting inclusion criteria will be excluded.

Screening will be conducted by one author. Data will also be extracted by one author. A second, blinded author, will check a small selection of the work (20%) in both the screening and extraction stages.

Discrepancies will be resolved appropriately.

In case of missing data, original authors will be contacted for additional details. Microsoft Excel software is to be used to organise extracted data in the following 113 categories. No particular tool will be used to extract the data.

The following data from each article will be extracted:

PROSPERO
International prospective register of systematic reviews

1. Authors.
2. Year of publication.
3. Country.
4. Design.
5. Theme addressed.
6. Included participants.
7. Age of participants.
8. Percentage of male participants.
9. Type of social anxiety measurement instrument; its reliability and validity
10. Type of autism measurement instrument; its reliability and validity
11. Measures of impact (if used)
11. Results: relevant statistics including associations between ASD and SA, prevalence of SA in ASD (e.g. mean, SA, effect size), impact of SA on psychological distress, well-being, additional mental health difficulties and quality of life and risk factors/predictors of SA in ASD.
12. Alternative statistics
13. Additional measures completed

27. * Risk of bias (quality) assessment.

State which characteristics of the studies will be assessed and/or any formal risk of bias/quality assessment tools that will be used.

The Quality Assessment Tool for Quantitative Studies developed by the Effective Public Health Project (EPHPP; Thomas et al., 2004) will be used to assess the quality of the included papers and to eliminate risk of bias. The EPHPP has been found to have good content and construct validity and good inter-rater reliability (Thomas et al. 2004; Armijo-Olivo et al. 2012). The EPHPP evaluates eight sections (selection bias, study design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity, analysis) using numerical values (1= strong, 2=moderate, 3=weak). Final results lead to an overall global rating of strong (no weak ratings), moderate (one weak rating) or weak (two or more weak ratings). A total of 20% of the quality assessment will be second coded.

28. Strategy for data synthesis.

Describe the methods you plan to use to synthesise data. This **must not be generic text** but should be **specific to your review** and describe how the proposed approach will be applied to your data. If meta-analysis is planned, describe the models to be used, methods to explore statistical heterogeneity, and software package to be used.

Data will be assessed by one author and described narratively.

The author will specifically describe:

- 1) The prevalence of SA seen in autistic adults as measured by the number of participants who score above clinical cut-off on validated measures of Social Anxiety.
- 2) Group means, standard deviations, sample sizes and effect sizes will be extracted for a random effects meta-analysis on the prevalence of SA in ASD. This information will be extracted by one researcher and another author will ensure this information has been recorded accurately. If more than one effect is reported per study, the effects will be statistically combined before entering the into the main meta-analysis. If the prevalence is assessed at more than one time-point, the baseline prevalence will be used. Following guidance from Quintana (2015), a meta-analysis will only be conducted if there are more than 8 eligible studies. Subgroup analysis will be conducted if there are more than 3 studies in each subgroup e.g. type of SA measure. A sensitivity analysis will be performed should any studies include different methodology from the rest of the studies.
- 3) The impact SA has on adults on the autism spectrum on other areas of mental health as well as quality of life and life attainment - this will be qualitatively synthesised and is not part of the meta-analysis due to heterogeneity.
- 4) Factors that make individuals more at risk of developing SA including factors that may explain the variance in SA seen in ASD will be discussed, providing there is enough research in this area.
- 5) Reasons for heterogeneity in results will be covered.
- 6) Areas for future research.

A descriptive summary of all studies selected will also be included (authors, year of publication, country, study design, sample size, methodological characteristics of each study, estimates of SA prevalence/relationships between SA and ASD features/impact, and any risk factors). A second author will ensure presented information has been accurately recorded. Relevant statistical data will be examined appropriately to inform and answer the research questions.

29. **Analysis of subgroups or subsets.**

State any planned investigation of 'subgroups'. Be clear and specific about which type of study or participant will be included in each group or covariate investigated. State the planned analytic approach.

Further meta-analytic subgroup analysis will be conducted. Type of SA measure by the presence of participant sex on the overall results, providing there are 10 included studies.

30. * **Type and method of review.**

Select the type of review, review method and health area from the lists below.

Type of review

Cost effectiveness
No

Diagnostic
No

Epidemiologic
No

Individual patient data (IPD) meta-analysis
No

Intervention
No

Living systematic review
No

Meta-analysis
No

Methodology
No

Narrative synthesis
No

Network meta-analysis
No

Pre-clinical
No

Prevention
No

Prognostic
No

Prospective meta-analysis (PMA)
No

Review of reviews
No

Service delivery
No

Synthesis of qualitative studies
No

Systematic review
No

Other
No

Health area of the review

Alcohol/substance misuse/abuse

No
Blood and immune system
No
Cancer
No
Cardiovascular
No
Care of the elderly
No
Child health
No
Complementary therapies
No
COVID-19
No
Crime and justice
No
Dental
No
Digestive system
No
Ear, nose and throat
No
Education
No
Endocrine and metabolic disorders
No
Eye disorders
No
General interest
No
Genetics
No
Health inequalities/health equity
No
Infections and infestations
No
International development
No
Mental health and behavioural conditions
No
Musculoskeletal
No

32. * Country.

Select the country in which the review is being carried out. For multi-national collaborations select all the countries involved.

England

33. Other registration details.

Name any other organisation where the systematic review title or protocol is registered (e.g. Campbell, or The Joanna Briggs Institute) together with any unique identification number assigned by them. If extracted data will be stored and made available through a repository such as the Systematic Review Data Repository (SRDR), details and a link should be included here. If none, leave blank.

34. Reference and/or URL for published protocol.

If the protocol for this review is published provide details (authors, title and journal details, preferably in Vancouver format)

Add web link to the published protocol.

Or, upload your published protocol here in pdf format. Note that the upload will be publicly accessible.

No I do not make this file publicly available until the review is complete

Please note that the information required in the PROSPERO registration form must be completed in full even if access to a protocol is given.

35. Dissemination plans.

Do you intend to publish the review on completion?

Yes

Give brief details of plans for communicating review findings.?

A paper will be submitted to a leading journal in this field.

36. Keywords.

Give words or phrases that best describe the review. Separate keywords with a semicolon or new line. Keywords help PROSPERO users find your review (keywords do not appear in the public record but are included in searches). Be as specific and precise as possible. Avoid acronyms and abbreviations unless these are in wide use.

Autism, autistic, ASD, ASC, social anxiety, social phobia, mental health, adults

37. Details of any existing review of the same topic by the same authors.

If you are registering an update of an existing review give details of the earlier versions and include a full bibliographic reference, if available.

Spain, D., Sin, J., Linder, K.B., McMahon, J. (2018). Social anxiety in autism spectrum disorder: A systematic Review. *Research in Autism Spectrum Disorders*, 52, 51-68.

38. * Current review status.

Update review status when the review is completed and when it is published. New registrations must be

ongoing so this field is not editable for initial submission.

Please provide anticipated publication date

Review_Ongoing

39. Any additional information.

Provide any other information relevant to the registration of this review.

40. Details of final report/publication(s) or preprints if available.

Leave empty until publication details are available OR you have a link to a preprint (NOTE: this field is not editable for initial submission). List authors, title and journal details preferably in Vancouver format.

Give the link to the published review or preprint.

Appendix B

Table B1

Calculating Overall Component Ratings Using Adapted EPHPP

Component	Rating			
	Weak	Moderate	Strong	N/A
Selection Bias	Assigned if: -Q1 is 3 (participants ‘not likely’ to be representative) -Q2 is 3 (less than 60% participation) -Q1 is 4 (can’t tell) -Q2 is 5 (participation not reported)	Assigned if: -Q1 is 1 or 2 (participants ‘somewhat likely’ to be representative) -Q2 is 2 (60-79% participation) -Q1 is 1 or 2 and Q2 is 5 (can’t tell)	Assigned if: -Q1 is 1 (participants ‘very likely’ to be representative) -Q2 is 1 (80% participation)	-
Study Design	Will be assigned to any other method (e.g., a one-time survey) or to studies that did not state the method used.	Will be assigned to cohort analytic study, case control study, cohort design, or an interrupted time series.	Will be assigned to RCTs and CCTs.	-
Confounders	Assigned if: -Q1 is 1 and Q2 is 3 (less than 60% confounders are controlled) -Q1 is 3 and Q2 is 4 (control of confounders not described)	Assigned if: -Q1 is 1 and Q2 is 2 (60-79% confounders controlled)	Assigned if: -Q1 is 2 or Q1 is 1 (80% confounders controlled)	Will be assigned for surveys with no control groups/one-time surveys.
Data Collection	Assigned if: -Q1 is 3 (data collection tools are valid) -Q1 is 4 and Q2 is 3 (reliability and validity described/referenced within the paper)	Assigned if: -Q1 is 2 or 2 (data collection tools shown to be valid in NT sample which is referenced in the paper) -AND Q2 is 2 (data collection tools	Assigned if: -Q1 is 1 AND Q2 is 1 (data collection tools are valid in ASD and NT sample which is referenced within the paper,	-

		have been shown to be reliable) OR Q2 is 3 (reliability not described)	AND data collection tools have been shown to be reliable)	
Attrition	Assigned if: -Q2 is 3 (complete rate less than 60%) -Q2 is 4 (withdrawals not described)	Assigned if: -Q2 is 2 (completion rate is 60-79%) -Q2 is 5 (N/A)	Assigned if: -Q2 is 1 (completion rate is 80%)	Will be assigned to one-time survey studies.
ASD Diagnosis	Will be assigned if ASD diagnoses was not confirmed for the study or diagnoses were self-reported only. Study does not attempt to confirm diagnoses.	Will be assigned when diagnosis has not been confirmed for the study by use of a gold-standard tool, but diagnosis has been confirmed via self-report or other report and a screening tool has been used (e.g., AQ, SRS).	Assigned when study has confirmed diagnoses by use of a 'gold-standard' diagnostic tool (i.e. ADOS or ADI-R).	-
Cognitive Functioning	Will be assigned when cognitive functioning is not reported.	Assigned if cognitive functioning is reported but is based on previous, non-recent assessment. OR cognitive functioning is based on non-standardised instrument (e.g. position in school system).	Assigned when cognitive functioning was assessed for the study or recently (within last 3 months) using a standardised instrument.	-

Appendix C

Table C1

Inter-Rater Agreement Statistics Prior to Consensus

Domain	% Agreed	Weighted Kappa	Rating
Global	80%	.68	Good
Selection Bias	80%	.61	Good
Study Design	100%	1.00	Excellent
Confounders	100%	1.00	Excellent
Data Collection	20%	.48	Fair
Attrition	100%	1.00	Excellent
ASD Diagnosis	100%	1.00	Excellent
Cognitive Functioning	100%	1.00	Excellent
Overall	87.5%	.77	Good

Notes: Weighted kappa values were interpreted using the Byrt (1996) criteria: none <0.01, poor = 0.01-0.20; slight = 0.21 - 0.40; fair =0.41 - 0.60; good = 0.61 - 0.80; very good = 0.81 – 0.92; and excellent = 0.93 – 1.00.

Appendix D

Table D1

Quality Appraisal Table

Study	Component Quality Rating							Global Quality Rating
	Selection Bias	Study Design	Control of Confounders	Data Collection	Attrition Management	ASD Diagnosis	Cognitive Functioning	
Albantakis et al. (2020)	Moderate	Moderate	Weak	Weak	N/A	Strong	Weak	Weak
Bejerot et al. (2014)	Moderate	Moderate	Moderate	Moderate	N/A	Strong	Weak	Moderate
Bowri et al. (2021)	Moderate	Weak	N/A	Moderate	N/A	Moderate	Weak	Weak
Cath et al. (2008)	Weak	Moderate	Strong	Moderate	N/A	Moderate	Weak	Weak
Danforth et al. (2018)	Moderate	Strong	Moderate	Weak	Strong	Strong	Weak	Weak
Espeloer et al. (2021)	Moderate	Moderate	Moderate	Weak	N/A	Moderate	Strong	Moderate
Hull et al. (2021)	Strong	Weak	N/A	Moderate	N/A	Moderate	Weak	Weak

Kanai et al. (2011)	Moderate	Moderate	Strong	Moderate	N/A	Moderate	Moderate	Strong
Kimura et al. (2020)	Moderate	Moderate	Moderate	Moderate	N/A	Strong	Strong	Strong
Kleinhans et al. (2010)	Weak	Moderate	Moderate	Weak	N/A	Strong	Strong	Weak
Pallathra et al. (2018)	Moderate	Weak	N/A	Moderate	N/A	Strong	Strong	Moderate
Perry et al. (2015)	Weak	Moderate	Weak	Moderate	N/A	Weak	Weak	Weak
Richey et al. (2014)	Moderate	Moderate	Weak	Weak	N/A	Strong	Strong	Weak
Schuck et al. (2019)	Weak	Moderate	Moderate	Weak	N/A	Strong	Moderate	Weak
Spain et al. (2016)	Weak	Weak	N/A	Moderate	N/A	Strong	Moderate	Weak
Spain et al. (2017)	Moderate	Weak	N/A	Moderate	Strong	Strong	Weak	Weak
Zukerman et al. (2019a)	Moderate	Moderate	Moderate	Moderate	N/A	Moderate	Moderate	Strong
Zukerman et al. (2019b)	Moderate	Moderate	Strong	Strong	N/A	Moderate	Weak	Moderate
Zukerman et al. (2021)	Moderate	Weak	N/A	Moderate	N/A	Moderate	Moderate	Moderate

Section 2: Empirical Study

The relationship between sensory processing, traits of autism spectrum conditions and psychotic-like experiences, and how these predict social anxiety and psychological distress

Abstract

Objectives: Sensory processing differences and social anxiety have been linked to both autism and psychotic-like experiences (PLE), and research suggests a link between sensory hypersensitivity and distress. This research study aims to address two research questions: to what extent do experiences of sensory processing difficulties, autistic traits and PLEs predict social anxiety and psychological distress in the general population.

Methods: A cross-sectional online survey was completed with 273 participants from the general population. Five questionnaires were used to measure: ASD traits (BAPQ), PLE (sO-LIFE); sensory processing (GSQ); social anxiety (LSAS-SR); and distress (DASS-21). Demographic information was collected, including age, gender and whether participants had a diagnosis of ASD. Hierarchical multiple regressions explored associations between these variables and assessed whether ASD, PLE and sensory processing were significant predictors of both social anxiety and psychological distress.

Results: Results found that ASD traits, PLE and sensory processing were all significant predictors of social anxiety. Sensory processing and PLE were significant predictors of psychological distress. PLE was the biggest predictor in both models. Social anxiety scores varied across different age and genders. ASD traits, PLE and sensory processing were all significantly correlated. Furthermore, participants who reported a formal diagnosis of ASD ($n = 52$) scored significantly higher on all study measures.

Conclusions: ASD traits, PLE and sensory processing are all important factors in experiences of social anxiety and psychological distress. Results of the study should be interpreted with caution, taking consideration of the methodological limitations.

Practitioner Points

- ASD traits, PLE and sensory processing difficulties are significant to the presentation of social anxiety. During assessment, formulation and intervention with individuals presenting with social anxiety, these factors require consideration.
- PLE appears to be central to experiences of social anxiety and psychological distress. Clinicians working with individuals who present with PLE should consider the additional impact this may be having on mental health and functioning.
- Social anxiety scores across age and gender were significantly different, with younger participants and transgender and nonconforming gender participants scoring higher.
- Ethnicity was important in PLE, with black participants scoring higher in comparison to a variety of other ethnicities.

Keywords: autism, psychotic-like experiences, sensory processing, social anxiety, distress, mental health

Introduction

Autism

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition. Individuals diagnosed with autism often display difficulties in social interaction, communication, and restricted and repetitive behaviours (Diagnostic and Statistical Manual of Mental Disorders, 5th ed.; DSM-5; American Psychiatric Association, 2013). Unusual sensory experiences and sensory processing difficulties are increasingly recognised as key features of ASD (Crane et al., 2009; Suarez, 2012). Sensory integration theories of ASD are now widely understood, which suggest deficits in the ability to register sensory input, modulate it appropriately and have the motivation to respond aptly (Kilroy et al., 2019); consequently, heightened senses and sensory stress are common (Smith & Sharp, 2013; Elwin et al., 2013). Sensory processing difficulties now form part of the diagnostic criteria for ASD (American Psychiatric Association, 2013).

Dunn (1997) developed a four-quadrant conceptual model of sensory processing; 1. sensation seeking (high threshold and active self-regulation strategy), 2. sensory avoiding (low thresholds and active self-regulation strategy), 3. sensory sensitivity (low threshold and passive self-regulation strategy), and 4. low registration (high threshold and passive self-regulation strategy). All elements of this model are prevalent in autistic² individuals. Individuals who experience the third quadrant of this model have low neurological thresholds for stimulation and experience discomfort with sensation. This part of the model appears relevant to the weak central coherence theory of autism (Shah & Frith, 1983), with individuals exhibiting attentional and perceptual abnormalities, with the ability to process fine detail and a difficulty in integrating parts of things to form a whole. Baron-Cohen et al. (2009) argues that this attention to detail is a result of sensory hypersensitivity.

² A large-scale study by Kenny et al. (2016), found that ‘Autistic Adults’ is the preferred term in the autistic community in the UK.

As it is now recognised that ASD symptoms follow a continuous distribution in the population (Baron-Cohen et al. 2001), research has begun to consider the relationship between sensory processing and ASD traits in the general population. Robertson and Simmons (2012) found a significant linear correlation between sensory processing difficulties and ASD traits. Furthermore, increased levels of psychological distress are reported in autistic individuals and those with high levels of autistic traits (Croen et al., 2015). Exploration of the relationship between sensory processing and psychological distress among individuals with high levels of autistic traits has, to our understanding, not yet been explored (Horder et al., 2014). Understanding how sensory processing difficulties and autistic traits are related to psychological distress is important to the field of mental health.

Psychosis

Experiences of psychosis are characterised by positive symptoms such as hallucinations, delusions, and disorganised behaviour, negative symptoms such as affective flattening, and cognitive symptoms with an early childhood onset (DSM-5; American Psychiatric Association, 2013). Psychotic experiences are not confined to clinical populations and are understood to exist on a continuum within the general population (Van Os et al., 2009).

Research suggests that sensory processing difficulties are prevalent in psychotic-like experiences (PLE; Parham et al., 2019); sensory modulation disorder has been hypothesised as a possible explanation, due to an inability to appropriately regulate and respond to sensory input (Olsen, 2011). Researchers have reported that sensory processing sensitivity is a correlate of parapsychological experiences seen in PLE (Irwin et al., 2014); individuals are over-responsive to subtle stimuli, and they process stimuli more deeply than others (Aron et al., 2012).

In line with Dunn's (1997) model of people with low neurological thresholds, others have put forward a hyper-theory of mind (HToM) theory in Psychosis, which is when individuals are more likely to infer incorrect mental states and predict behaviour based on inaccurate beliefs (Clemmensen

et al., 2014). Research into pre-adolescent children found that those with a HToM showed greater risk of PLE (Clemmensen et al., 2016). Likewise, there is some suggestion that people with high sensory processing sensitivity are more prone to parapsychological experiences (Houran et al., 2002). Recent research into the sensory characteristics of youth at clinical high risk for psychosis found that those with high risk demonstrated a variety of sensory difficulties, including active avoidance of stimuli, heightened sensitivity, reduced sensory seeking and reduced registration of sensations (Parham et al., 2019).

Overlap Between Autism and Psychosis

King and Lord (2011) describe how the relationship between ASD and psychosis has at times been viewed as incompatible, and at other times they have been seen as conditions whose broad phenotypes intersect. Studies have revealed that individuals with paranoid delusions do not differ from autistic people on Theory of Mind (Martinez et al., 2020). With both ASD and PLE appearing on continua in the general population (Constantino & Todd, 2003; Van Os et al., 2009), a call for more research into the overlap of these disorders has been made (King & Lord, 2011), particularly in using general population samples (Freeman et al., 2008).

Research involving college students reported associations between positive schizotypal traits (e.g., unusual perceptions and magical thinking) and specific autistic features (e.g., attention to detail and attention switching; Horder et al., 2014). Recent research explored this link in the general population and found a strong association between autistic traits and PLE (Martinez et al., 2020). Furthermore, a systematic review reported higher levels of autistic traits in people diagnosed with psychosis compared to the general population (Kincaid et al., 2017). Research investigating anomalous perception and out of body experiences in autistic individuals found a positive correlation, which was also linked to high levels of distress (Milne et al., 2017). Bevan et al. (2012) explored ASD traits at age seven years and PLE aged 12 years, finding that the greater number of early autistic traits meant a higher risk of developing PLE. It is therefore understood within research that ASD and PLE

are associated to some extent, however the understanding on the nature of this association is limited; sensory processing appears to be a common feature of both presentations.

Sensory Processing and Psychological Distress

In Dunn's (1997) conceptual model of sensory processing, individuals who are hypersensitive to stimuli cope by controlling the amount of input they receive. They report daily life as overwhelming, leaving them feeling exhausted and isolated (Kinnealey et al., 2011). Sensory sensitivity has also been linked to anxiety (Engel-Yeger & Dunn, 2011), stress (Benham, 2006), negative affect, agoraphobic avoidance (Hofmann & Bitran, 2007), increased restrictive and repetitive behaviours, and intolerance of uncertainty in ASD (Moore et al., 2021), and overall poor clinical outcomes (Liss et al., 2008). Metz et al. (2019) report that sensory processing difficulties can lead to distress and poor community integration, due to a tendency for individuals to withdraw.

Social Anxiety Across Conditions

Social anxiety involves autonomic symptoms of anxiety manifesting in social situations, a cognitive fear of negative evaluation or judgement by others, and a behavioural response of avoidance or escape from situations that induce anxiety (APA, 2013). Social anxiety disorder, ASD and psychosis are conditions that all exhibit difficulties in social interaction (Demetriou et al., 2018).

Social anxiety is especially common in ASD, with prevalence estimates reported to be as high as 50% (Spain et al., 2016), significantly higher than estimates of 12% for the non-ASD population (NICE, 2013). A recent meta-analysis on prevalence of social anxiety in autistic adults found a prevalence rate of 76% (Stephens et al., 2022). Due to similarities between ASD and social anxiety, symptoms are often misinterpreted (Tyson & Cruess, 2012). Furthermore, there is a wealth of research that has explored the relationship between autism and social anxiety, finding significant positive correlations between the two variables (Albantakis et al., 2020; Bejerot et al., 2014;

Espeloer et al., 2021; Kanai et al., 2011). Overall, autism and autistic traits are important to the experience of social anxiety, highlighted by the above findings.

Social anxiety also appears to be among the most prevalent anxiety disorder in psychosis, with prevalence rates ranging between 17% to 36%. In samples with first-episode psychosis, prevalence rates ranged between 25%-32% (Michail, 2013). The social stigma attached to PLE is believed to be a factor in the development of social anxiety (Birchwood et al., 2007).

Previous research has linked sensory processing difficulties to the development of social anxiety, with individuals with a generalised subtype of social anxiety (characterised by individuals fearing most social situations, rather than a limited range of social situations) reporting higher levels of sensory sensitivity, in comparison to individuals with a non-generalised subtype of social anxiety (Hofmann & Bitran, 2007).

Furthermore, previous research has highlighted that social anxiety is prevalent in both ASD and PLE, and sensory processing difficulties are also prevalent in ASD, PLE and psychological functioning; however, research to date has not explored these variables together in the general population. Doing so will enable a greater understanding of the individual differences in experiences of autistic traits, PLE and sensory processing in the general population, and whether these variables predict experiences of social anxiety and psychological distress. While these related constructs may represent a few possible pathways to social anxiety and distress, exploring this model will allow future studies to use this framework to investigate further areas of overlap and causal links among these constructs.

Demographics

Age is a key factor in the experience of PLE (Verdoux et al., 1998) and social anxiety disorder (Jefferies and Ungar, 2020), with younger individuals reporting greater experiences. Gender is critical in those with ASD traits, with males and females often displaying different

difficulties (Kreiser & White, 2013); autistic traits are also higher among gender-diverse individuals (Warrier et al., 2020).

Clinical Implications

Having a greater understanding of the relationship between sensory processing, autistic traits, and PLE, and whether these variables are predictive of social anxiety and psychological distress in the general population, will be useful for assessment and formulation in clinical presentations, allowing the development of a shared understanding of difficulties. A better understanding of the contributing factors to social anxiety and psychological distress will help to guide further theories, research, and psychological interventions, and will support with an individual, clinician and service level understanding of social anxiety and distress. A greater understanding of the relationship between ASD traits and PLE in the general population will help to develop appropriate support in the areas of autism and psychosis, considering the important possibility of comorbidity (Haddock & Lewis, 2005). Sensory processing within PLE is a particular area where research is lacking; exploring this relationship will aid our understanding of PLE. Finally, and crucially, there is a continuum of severity in ASD, PLE, sensory processing, social anxiety, and distress; exploring non-clinical experiences of these conditions is important, also helping to inform the understanding of clinical experiences (Freeman et al., 2008).

Current Study Aims

The primary aim of this research was to explore the extent to which sensory processing, autism traits and PLE, separately and together, explain the variance in both social anxiety and psychological distress.

Using a general population sample, two research questions were addressed by the study: 1) To what extent do experiences of sensory processing difficulties, autistic traits and PLEs predict social anxiety? 2) To what extent do experiences of sensory processing difficulties, autistic traits and PLEs predict psychological distress?

Current Study Hypotheses

1. Sensory processing, autism trait scores and psychotic-like experiences scores will each individually be significant predictors of levels of social anxiety and together will explain a larger and significant amount of the variance in levels of social anxiety.
2. Sensory processing, autism trait scores and psychotic-like experiences scores will each individually be significant predictors of levels of psychological distress and together will explain a larger and significant amount of the variance in levels of psychological distress.
3. Autism trait scores will be the biggest predictor of levels of social anxiety.

Method

Design

This cross-sectional study included an online survey, measuring social anxiety and psychological distress as the continuous dependent variables. There were three independent variables: ASD traits, sensory processing, and PLE. Demographic variables found to be important to ASD, PLE, social anxiety and well-being in prior research were also measured to control for potential confounding i.e., age and gender (Beggiato et al., 2016; Stagg & Vincent, 2019; Verdoux et al., 1998; Jefferies & Ungar, 2020).

Participants & Recruitment

Exclusion criteria included participants under the age of 18 and individuals unable to read English. Opportunity sampling was used; the study was advertised on the university volunteers list, social media, and a research participant recruitment website ‘Call for Participants’ (see Appendix A and B). To increase the range of ASD traits and PLE, charities were approached for advertising, such as Mind, Autism Speaks, the National Autistic Society and the local Hearing Voices groups (Autism Speaks agreed to advertise this research). All data were collected between April 2021 and November 2021.

Completers versus Non-Completers Analyses

Chi-Square analyses were conducted on completers and non-completers, assessing the difference in demographic variables.

Sample Size Calculations

A priori power analysis using G*Power Version 3 for Multiple Regression was carried out to determine the required sample size for preventing type two errors. Assuming a medium effect size of $f^2 = 0.15$, a significance level of $\alpha = 0.05$ and nine predictor variables, a total sample size of 114 was required to achieve 80% power. In addition, Cohen's (1992) power table suggests 112 participants based on nine independent variables. A minimum sample size of 114 is also comparable to the recommendation of 10-15 participants per variable when conducting multiple regression analysis (Field, 2017). A medium effect size was selected based on previous studies in this area; one study on ASD traits and PLE reported a medium effect size (Martinez et al., 2020), and a medium effect size was also found in a study on ASD and social anxiety (Bejerot et al., 2014).

Measures

To ensure reliability and validity, measures of autistic traits, PLE, sensory processing and social anxiety were studied prior to selection. Validated measures that had the least overlap on items were selected (i.e., questions across the measures were not repeated).

Autism Traits. The Broader Autism Phenotype Questionnaire (BAPQ; Hurley et al., 2007) is a 36-item self-report questionnaire that is used to assess traits of autism in the general population (Appendix C). The broader autism phenotype is a milder expression of the social and communication difficulties seen in autism. Questions are rated on a 6-point Likert scale; 1 = very rarely; 2 = rarely; 3 = occasionally; 4 = somewhat often; 5 = often; 6 = very often. Some items are reverse scored. Questions include "I have been told that I talk too much about certain topics" and "I

prefer to be alone than with others”. There are 12-items in each of the three subscales which include aloof, rigid, and pragmatic language. Cronbach’s alpha for each subscale are .94, .91 and .95 respectively. Cut-off scores (to determine above average scores) documented in Hurley et al. (2007) are as follows: for males a score of 3.25 for aloof, 2.95 for pragmatic language, 3.65 for rigid and a total score of 3.65. For females a score of 3.00 for aloof, 2.70 for pragmatic language, 3.25 for rigid and a total score of 3.25.

Psychotic-Like Experiences. The Short Scales Oxford-Liverpool Inventory of Feelings and Experiences (sO-LIFE; Mason et al., 2005) is a 42-item self-report questionnaire that assesses schizotypy (see Appendix D). The sO-LIFE has four subscales: unusual experiences, cognitive disorganisation, introvertive anhedonia and impulsive non-conformity. Cronbach’s alpha for each subscale are .80, .77, .62 and .63 respectively. Questions are rated on a 2-point scale, where an answer of ‘Yes’ scores 1 and ‘No’ scores 0; some items are reversed scored. Questions include “does a passing thought ever seem so real it frightens you?” and “do you stop to think things over before doing anything?”. Average scores are 3.17 for males and 3.39 for females (unusual experiences), 4.28 for males and 4.44 for females (cognitive disorganisation), 2.80 for males and 2.40 for females (introvertive anhedonia) and 2.70 for males and 2.59 for females (impulsive non-conformity).

Sensory Processing Differences. The Glasgow Sensory Questionnaire (GSQ; Robertson & Simmons, 2013) is a 42-item self-report questionnaire that assesses hyper- and hypo- sensitivity in seven modalities: visual, auditory, gustatory, olfactory, tactile, vestibular, and proprioceptive (see Appendix E). Cronbach’s alpha of .94 is reported (Robertson & Simmons, 2013). Questions ask how frequently certain sensory experiences occur, such as “do you find yourself fascinated by small particles?” and “do you react very strongly when you hear an unexpected noise?”. Responses are on the following scale: 0 = never, 1 = rarely; 2 = sometimes; 3 = often; 4 = always. Scores range from 0 to 168, with higher scores suggesting higher levels of sensory difficulties.

Psychological Distress. The Depression and Anxiety Scale-21 (DASS-21; Antony et al., 1998) is a 21-item self-report questionnaire that assess levels of depression, anxiety, and stress, which form three subscales (see Appendix F). This measure is used to assess psychological distress across various experiences (Demetriou et al., 2018; Masillo et al., 2012). The measure has good reliability ($\alpha = .88$ for the Depression scale, $\alpha = .82$ for the Anxiety scale, $\alpha = .90$ for the Stress scale, and $\alpha = .93$ for the total scale; Henry & Crawford, 2005). Items are scored on a 4-point Likert scale: 0 = did not apply to me at all; 1 = applied to me to some degree or some of the time; 2 = applied to me a considerable degree or a good part of the time; 3 = applied to me very much or most of the time. Questions include “I found it hard to wind down” and “I felt I was close to panic”. Scores above nine for depression, seven for anxiety and 14 for stress are considered to be above the ‘normal’ range.

Social Anxiety. The Liebowitz Social Anxiety Scale (LSAS-SR; Heimberg et al., 1999) is a 24-item self-report questionnaire that assesses level of fear and avoidance in social situations (see Appendix G). Questions ask individuals to imagine how much fear they’d have if they were faced with a situation such as “eating in public places”, with possible answers being: 0 = none; 1 = mild; 2 = moderate; and 3 = severe. Individuals are then asked how often they would avoid this same situation, including: never 0%; occasionally 1-33%; often 34-66%; and usually 67-100%. The LSAS-SR has shown excellent reliability (Cronbach's α of 0.90, 0.90, and 0.95 for the fear, avoidance and total scores, respectively; Fresco et al., 2001; Oakman et al., 2003). The LSAS-SR has also shown excellent internal consistency in autistic adults (Cronbach's α of 0.94, 0.92 and 0.96 for the fear, avoidance and total scores respectively; Kanai et al., 2011; Spain et al., 2016). Scores above 30 indicate social anxiety and scores above 60 indicate generalised social anxiety subtype (Mennin et al., 2002).

Demographics. Relevant demographic information was collected to allow for appropriate analyses and to contextualise the samples. Information such as age, gender, ethnicity, education

level, sight/hearing conditions, and diagnosis/no diagnosis of ASD and mental health conditions was collected (see Appendix H).

Public and Patient Involvement

Prior to the main recruitment, six individuals (three recruited from the general population and three via ASD/mental health groups) provided feedback via email on the online survey. This resulted in some changes, including making explicit the advance warnings regarding being asked about mental health. The layout of the LSAS-SR was also altered to include a table format, as feedback suggested that it was repetitive in nature. No changes were made to the wording of any of the questions in the questionnaires.

Procedure

The online survey was presented on Qualtrics. Participants who were interested in taking part were provided with a study link or QR code. Participants who clicked on the link were given the study information sheet (Appendix I) and consent form (Appendix J). When participants had consented, they were asked to provide demographic information. Participants were then provided with the set of questionnaires described above, which were randomised in order. Participants were able to withdraw from the survey at any time prior to completion, by exiting the webpage. Upon completion, participants were provided with a debrief form (Appendix K) and they were given the opportunity to enter a separate survey for the chance to win an Amazon voucher. The two winners of the prize draw were determined at random once data collection had ceased.

Ethical Considerations

Ethical approval was gained from the University of Sheffield Department of Psychology Research Ethics Committee (Appendix L). Study data were stored in a password protected file and email addresses provided for the prize draw were stored securely and deleted following completion of data collection. Participant's data was removed from Qualtrics when the study was completed.

Participants were asked to think about their own experiences of distress and anxiety, which could have induced distress. Participants were made aware of this prior to commencing the study to ensure informed consent to participate. Participants were provided with information to contact the researcher or mental health services if needed. Participants were made aware that they could exit the survey at any time prior to completion. As part of the debrief procedure, participants were signposted to relevant support networks and websites.

In line with the British Psychological Society (2014, 2021) ethical guidelines, participants were given the chance to opt into a prize draw at the end of the study for the opportunity to win one of two £25 Amazon vouchers. A total of 279 participants entered the prize draw. The winners were randomly selected on 22nd February 2022.

Data Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS; Version 25). Descriptive statistics were calculated for demographic (categorical) variables (i.e., frequencies and percentages), and study (continuous) variables (i.e., means, ranges and standard deviations). To assess the importance of categorical variables, Kruskal-Wallis Tests were carried out on the demographic variables and predictor and outcome variables. Significant demographic variables (i.e., significant differences were found across the two or more groups of the demographic variable, for example age, on the continuous outcome variables) were then collapsed to dichotomous variables for them to be added into the regression models. Gender was dummy coded to allow for all genders to be analysed. To assess for significant differences between scores on continuous data and dichotomous variables, Mann Whitney U tests were performed. Cronbach's alpha was assessed and reported to determine the internal consistency of the responses on the continuous scale questionnaires.

Due to the large sample size, the distribution of continuous variables were assessed using the skewness and kurtosis statistics, examining the histograms, Q-Q plots, and using the Sharipo-

Wilk test of normality (Field, 2009). The hypotheses were tested using two hierarchical multiple regression analyses with social anxiety and psychological distress as the outcome variables, assessing the associations between the variables and the value of the predictor variables.

Relationships between the variables were explored using Spearman's correlational analyses. Effect sizes for Spearman's Rho (r), Kruskal-Wallis (H), Chi-Square (Φ ; ϕ), and Mann Whitney U results were interpreted as: .10-.29=weak, .30-.49=moderate and $\geq .50$ =strong (Cohen, 1992).

Supplementary Analyses

Additional analyses were completed, which was dependent on the results of the regression analyses.

Results

Data Screening

All data was checked for missing values, errors, and duplicates. When full measures were missing, this was accounted for by excluding cases listwise (Little, 1992; Field, 2009). No errors were found; therefore, outliers were believed to be reflective of participants' true scores and were not removed from the dataset (Field, 2009). There were no missing items on questionnaires and a total of 137 participants were excluded due to missing complete measures.

Tests of normality on the continuous variables, as measured by the Kolmogorov-Smirnov and the Shapiro-Wilk statistic, found that the sO-LIFE, LSAS-SR, GSQ and DASS-21 were significantly different from a normal distribution (Appendix M). Visual inspection of the histograms, Q-Q plots and Skewness and Kurtosis values supported these results. Consequently, assumptions of normality on the continuous variables were therefore violated, thus resulting in the use of non-parametric tests for subsequent analyses. Spearman's rho correlations were used to analyse the relationship between the continuous variables. The predictor variables were not significantly highly correlated ($> .80$); the assumption of multicollinearity was therefore met. In

addition, the VIF and tolerance values were below 10 and above 0.2 respectively (Field, 2009). The histograms and P-P plots showed that the residuals of continuous variables in the regression analyses were normally distributed, and the scatterplots and trend lines indicated that the assumption of homoscedasticity was met (Appendix N and O). Therefore, log transformation of the outcome variables was not required.

Participant Characteristics

A total of 410 participants took part in the survey and the final sample (following the removal of missing data), comprised 273 participants (43% aged 18-25 years, 65% female). Participants with missing measures ($n = 137$) were excluded. A total of 132 participants were excluded for not completing more than one study measure. A further four participants were excluded for not completing the LSAS-SR and one was excluded for not completing the GSQ. The sample was predominantly White British (62%), and highly educated (33% with a postgraduate qualification and a further 33% with an undergraduate degree). A total of 52 participants reported a diagnosis of an autism spectrum disorder and 108 participants reported having a diagnosed mental health condition. Due to preserving participants anonymity through the generation of random participant numbers, it is not possible to determine how many participants came from which method of recruitment. Sample characteristics are shown below in Table 1.

Table 1

Sample Demographics

Demographics	<i>n</i>	%
Gender		
Male	69	25.3
Female	178	65.2
Transgender Female	2	0.7
Transgender Male	5	1.8
Non-Binary	14	5.1

Demographics	<i>n</i>	%
In another way	3	1.1
Prefer not to say	2	0.7
Age (years)		
18-25	116	42.5
26-35	95	34.8
36-45	29	10.6
46-55	21	7.7
55-65	9	3.3
66-75	2	0.7
75+	1	0.4
Ethnicity		
White British	170	62.3
White Irish	7	2.6
White European	40	14.7
Black British	1	0.4
Black African	4	1.5
Black Caribbean	3	1.1
Asian	25	9.2
Mixed Race	10	3.7
Asian British	5	1.8
Other	8	2.9
ASD Diagnosis		
Yes	52	19
No	221	81
Mental health diagnosis		
Yes	108	39.6
No	165	60.4
Education Level		
No formal Qualifications	1	0.4
GCSE (or equivalent)	10	3.7
A-Level (or equivalent)	76	27.8
Undergraduate Degree	90	33

Demographics	<i>n</i>	%
Post-Graduate Qualification	89	32.6
Other	7	2.6
Sight and Hearing Conditions		
Hearing Loss	10	3.7
Anosmia	9	3.3
Non-correctable Vision	7	2.6
None of the above	247	90.5

Completers versus Non-Completers

A series of chi-square analyses showed that there were no significant differences between completers and non-completers on gender ($\chi^2(6) = 10.01, p = .124$), ethnicity ($\chi^2(10) = 7.27, p = .700$) and mental health diagnosis ($\chi^2(1) = 2.71, p = .100$). Chi-square analyses showed that there was a significant difference between completers and non-completers on age ($\chi^2(6) = 29.15, p = .000$), with younger participants, specifically ages 26 – 35 years, having the highest level of dropout. Education level was also significantly different between the two groups ($\chi^2(5) = 11.87, p = .037$), with A Level and Undergraduate students showing the highest dropout levels. Having an ASD diagnosis resulted in significantly higher dropouts ($\chi^2(1) = 25.21, p = .000$), as did the presence of vision/hearing difficulties ($\chi^2(4) = 83.08, p = .000$).

Descriptive Statistics

Table 2 shows the mean and standard deviations of participant scores for the dependent and independent variables. The study sample displayed similar scores on measures in comparison to other samples in published studies (Bowri et al., 2020; Foncesca-Pedrero et al., 2015; Park et al., 2020; Robertson & Simmons, 2012; Albantakis et al., 2020), with raised scores on the sO-LIFE and LSAS-SR.

Table 2*Descriptive Statistics*

Scale (measure)	Mean	SD
	(Comparison Score)	(Comparison Score)
Aloof (BAPQ)	3.53	.99
Pragmatic Language (BAPQ)	3.30	.91
Rigid (BAPQ)	3.55	.93
BAPQ Total	3.46 (4.37)	.82 (0.67)
Unusual Experiences (sO-LIFE)	5.01 (2.32)	2.84 (2.21)
Cognitive Disorganisation (sO-LIFE)	3.79 (1.50)	2.21 (1.36)
Introvertive Anhedonia (sO-LIFE)	6.79 (4.12)	3.32 (2.67)
Impulsive Nonconformity (sO-LIFE)	4.18 (2.55)	2.48 (1.81)
sO-LIFE Total	19.77	8.30
Depression (DASS-21)	15.82	11.86
Anxiety (DASS-21)	11.49	9.43
Stress (DASS-21)	19.33	11.58
DASS-21 Total	46.64 (57.54)	29.86 (29.26)
Sensory Processing (GSQ)	60.90 (56.65)	30.73 (23.60)
Fear (LSAS-SR)	33.67	15.30
Avoidance (LSAS-SR)	54.40	16.57
LSAS-SR Total	88.07 (77.28)	30.93 (26.81)

Scale Reliability

Table 3 displays Cronbach's alpha scores for continuous scales and subscales used within the study.

Table 3*Cronbach's Alpha Statistics of Survey Measures*

Scale (measure)	Participants (n)	Cronbach's Alpha (α)	Internal Consistency
Aloof (BAPQ)	273	.90	Excellent
Pragmatic Language (BAPQ)	273	.85	Good
Rigid (BAPQ)	273	.88	Good
BAPQ Total	273	.94	Excellent
Unusual Experiences (sO- LIFE)	273	.74	Acceptable
Cognitive Disorganisation (sO-LIFE)	273	.62	Questionable
Introvertive Anhedonia (sO-LIFE)	273	.85	Good
Impulsive Nonconformity (sO-LIFE)	273	.68	Questionable
sO-LIFE Total	273	.88	Good
Depression (DASS-21)	273	.92	Excellent
Anxiety (DASS-21)	273	.90	Excellent
Stress (DASS-21)	273	.88	Good
DASS-21 Total	273	.95	Excellent
Sensory Processing (GSQ)	273	.96	Excellent
Fear (LSAS-SR)	273	.94	Excellent
Avoidance (LSAS-SR)	273	.94	Excellent
LSAS-SR Total	273	.97	Excellent

Bivariate Analyses

Social Anxiety

Table 3 shows Spearman's rho correlations between all continuous variables. Analysis of the data indicated a strong positive correlation between social anxiety and PLE; PLE and sensory processing; social anxiety and ASD traits; social anxiety and sensory processing; ASD traits and PLE; and ASD traits and sensory processing.

Table 3

Spearman's Correlations among all dependent and independent variables

Variable	Social Anxiety	ASD Traits	Psychotic-like Experiences	Sensory Processing	Psychological Distress
Social Anxiety (LSAS-SR)	-	.698***	.725***	.638***	.688***
ASD Traits (BAPQ)		-	.675***	.666***	.580***
Psychotic-like Experiences (sO-LIFE)			-	.740***	.701***
Sensory Processing (GSQ)				-	.676***
Psychological Distress (DASS-21)					-

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Kruskal-Wallis one-way analysis of variance test was carried out between categorical variables (age, gender, ethnicity level, educational level, and sight/hearing conditions) and social anxiety. This was to explore the significance of the relationships between the categorical variables and outcome variable (social anxiety), to inform which variables should be added into the regression model as control variables. Results provided evidence of a significant difference between the mean ranks of social anxiety and age ($H(6) = 18.74, p = .005$). Pairwise comparisons were carried out for each pair of groups, finding significant differences between ages 66-75 and 18-25, 66-75 and 18-25, 46-55 and 18-25, and 26-35 and 18-25. A significant difference between the mean ranks of social anxiety and gender was found ($H(4) = 21.81, p = .000$). Pairwise comparisons found significant differences between male and other, male and non-binary, and female and non-binary. No significant differences were found for social anxiety and ethnicity, education level and sight/hearing conditions.

The Mann-Whitney U test was carried out between dichotomous variables, ASD diagnosis ($n = 52$) and mental health diagnoses ($n = 108$), and social anxiety. A significant difference in social anxiety was found between those with a diagnosis of ASD and those without ($U(52,221) = 4199, p = .003$), with a higher mean rank in those with a diagnosis. A significant difference in social anxiety was also found between those with a mental health diagnosis and those without ($U(108, 165) = 6330, p = .000$), with a higher mean rank in those who answered 'yes'.

Psychological Distress

Table 3 shows Spearman's rho correlations between all continuous variables. Analysis of the data indicated that distress had a strong positive relationship with all variables, including social anxiety, PLE, sensory processing and ASD traits.

The Kruskal-Wallis one-way analysis of variance test was carried out between categorical variables (age, gender, ethnicity level, educational level, and sight/hearing conditions) and psychological distress. Results provided evidence of a significant difference between the mean

ranks of psychological distress and age ($H(6) = 21.45, p = .002$). Pairwise comparisons were carried out for each pair of groups, finding significant differences between ages 66-75 and 18-25, 56-65 and 36-45, 56-65 and 26-35, 56-65 and 18-25, 46-55 and 18-25, 36-45 and 18-25, and 26-35 and 18-25. No significant differences were found for psychological distress and ethnicity, gender, education level and sight/hearing conditions.

The Mann-Whitney U test was carried out between dichotomous variables and psychological distress. A significant difference in psychological distress was found between those with a diagnosis of ASD and those without ($U(52,221) = 3604, p = .000$), with a higher mean rank in those who answered 'yes'. A significant difference in social anxiety was also found between those with a mental health diagnosis and those without ($U(108, 165) = 6290, p = .000$), with a higher mean rank in those who answered 'yes'.

Multiple Hierarchical Regression Analyses

To investigate whether the main independent variables (ASD traits, PLE and sensory processing) were significant predictors and explained any variance in social anxiety (LSAS-SR) and psychological distress (DASS-21) above any variance explained by relevant demographic variables, several hierarchical multiple regressions were conducted.

Forced-entry regression analyses were initially run for both regression models, to determine which predictors should be added into the main regressions and in what order, thus reducing the number of non-significant variables entered, enhancing the accuracy of the final model (Field, 2013).

Social Anxiety

Age, gender, ASD diagnosis and mental health diagnosis were entered into the model as categorical variables. Gender was dummy coded, to allow for analysis between all genders (Beggiato et al., 2016; Stagg & Vincent, 2019). Age was entered as a dichotomous variable, with

77% aged 35 and under. Age was dichotomised as social anxiety disproportionately affects the younger population (Jefferies and Ungar, 2020). Non-significant demographic variances were not entered into the final model (Appendix P). The final hierarchical regression model was conducted with LSAS-SR social anxiety scores as the dependent variable. ASD diagnosis was entered as a predictor variable in the first block. The first block was significant (R^2 adjusted = .032, $p < .05$). The sO-LIFE PLE scores were added into the second block, which significantly improved the model, $F_{change}(2,270) = 290.91$, $p = .000$), resulting in an increase in the variance in social anxiety accounted for (R^2 adjusted = .532, R^2 change = .500). The variable entered into the third block was GSQ sensory processing scores. The third block significantly improved the model, $F_{change}(3,269) = 19.20$, $p < .001$, resulting in an increase in the variance in social anxiety accounted for (R^2 adjusted = .562, R^2 change = .031). The BAPQ ASD trait scores were entered into the fourth block, which significantly improved the model $F_{change}(4,268) = 55.18$, $p < .001$, R^2 change = .074, generating a final, highly significant model, $F(4,268) = 119.44$, R^2 adjusted = .635, $p < .001$, accounting for 63% of the variance. In the final model, ASD diagnosis ($\beta = .110$, $p = .007$), PLE ($\beta = .391$, $p = .000$), sensory processing ($\beta = .154$, $p = .007$) and ASD traits ($\beta = .386$, $p = .000$) were all associated with and significant predictors of social anxiety. See table 4 below for the regression coefficients.

Table 4

Hierarchical Multiple Regression Predicting Social Anxiety

Variable	B	β	R^2 (Adj.)	F Change	Sig F Change
Block 1					
ASD Diagnosis	-14.809	-.188**	.032	9.97	.002
Block 2					
Psychotic-Like Experiences (sO-LIFE)	2.784	.747***	.532	290.91	.000

Variable	B	β	R ² (Adj.)	F Change	Sig F Change
Block 3					
Sensory Processing (GSQ)	.265	.264***	.565	19.20	.000
Block 4					
ASD Traits (BAPQ)	14.599	.386***	.635	55.18	.000

Note. Adjusted R² = .635 (N=273, p = .000). *p<.05, **p<.01, ***p<.001

Psychological Distress

Age, ASD diagnosis and mental health diagnosis were entered into the model as categorical variables. Gender was dummy coded, to allow for analysis between all genders. Age was entered as a dichotomous variable, with 77% aged 35 and under. All demographic variables were insignificant and were therefore not entered into the final model (Appendix Q). The final hierarchical regression model was conducted with psychological distress as the dependent variable. SO-LIFE PLE scores were entered as a predictor variable in the first block. The first block was significant (R² adjusted = .512, p < .001). The BAPQ ASD traits scores were added into the second block, which significantly improved the model, Fchange(1,271) = 8.10, p = .005), resulting in an increase in the variance in psychological distress accounted for (R² adjusted = .524, R² change = .014). The GSQ sensory processing scores were entered into the third block, which significantly improved the model Fchange(2,270) = 35.72, p < .001, R² change = .055, generating a final, highly significant model, F(3,269) = 125.39, R² adjusted = .578, p < .001, accounting for 57% of the variance. In the final model, PLE (β = .412, p = .002) and sensory processing (β = .354, p = .000) were significantly associated with and predictors of psychological distress; BAPQ ASD trait scores became non-significant in block three when GSQ sensory processing scores were added into the model (β = .071, p = .202). See table 5 below for the regression coefficients.

Table 5*Hierarchical Multiple Regression Predicting Psychological Distress*

Variable	B	β	R² (Adj.)	F Change	Sig F Change
Block 1					
Psychotic-Like Experiences (sO-LIFE)	2.577	.717***	.512	286.05	.000
Block 2					
ASD Traits (BAPQ)	5.932	.162**	.524	8.10	.005
Block 3					
Sensory Processing (GSQ)	.344	.354***	.578	35.72	.000

Note. Adjusted R² = .578 (N=273, p = .000). p<.05, **p<.01, ***p<.001

Supplementary Analyses*Psychotic Experiences*

Table 3 indicates a strong positive correlation between PLE and all measures. Further exploration of PLE across the demographic variables was carried out using the Kruskal-Wallis test. Results provided evidence of a significant difference between mean ranks of PLEs and gender, ethnicity, age, and educational level (see Appendix R).

ASD and Social Anxiety

Additional analyses were completed to assess whether the BAPQ and LSAS-SR were measuring different constructs. Analyses were re-run using modified BAPQ scores that had been re-calculated after excluding items on the BAPQ that were similar to items on the LSAS-SR; analyses revealed no changes in the study's findings (see Appendix R).

ASD Diagnosis

Mann-Whitney U tests were carried out to explore the differences in scores on the measures in those who answered ‘yes’ to having a formal ASD diagnosis, and those who answered ‘no’. Scores on all measures were significantly higher in the group who disclosed a formal diagnosis of ASD (Appendix R).

Exploratory Post-hoc Mediation Analyses

Autistic Traits, Sensory Processing and Psychological Distress

In the psychological distress regression model, autism traits were significantly associated with, and a predictor of, psychological distress prior to the addition of sensory processing scores in the model. With the addition of sensory processing in block three, autism trait scores were no longer predictive of psychological distress. This suggests some common variance between autism traits, sensory processing, and psychological distress, indicating a possible interaction. A post-hoc moderation analysis was undertaken using the PROCESS Model for SPSS (Hayes, 2012), which was non-significant (Appendix S). A post-hoc mediation analysis was undertaken, finding evidence of a partial mediation via sensory processing. The direct path (c path) from autism traits to psychological distress was significant $B = 20.99$, $SE = 1.81$, $t(272) = 11.56$, $p = .000$. In the mediation model, the direct path (c' path) from autism traits to psychological distress was significant $B = 8.19$, $SE = 1.99$, $t(272) = 4.11$, $p = .0001$. The path between autism traits and sensory processing (a path) was significant $B = 23.69$, $SE = 1.77$, $t(272) = 13.36$, $p = .000$. The path between sensory processing and distress was significant (b path), $B = .54$, $SE = .05$, $t(272) = 10.20$, $p = .000$. The indirect path of autism traits, sensory processing and psychological distress was significant $B = 12.79$, $SE = 1.52$.

Autistic Traits, Sensory Processing and Psychotic-like Experiences

The BAPQ, GSQ and SO-LIFE were all significantly correlated. The possibility of sensory processing as a mediator of the relationship between autistic traits and PLE was carried out using a post-hoc mediation analysis using PROCESS Model for SPSS (Hayes, 2012). This analysis found evidence of a partial mediation via sensory processing. The direct path (c path) from autism traits to PLE was significant $B = 6.91$, $SE = .45$, $t(272) = 15.28$, $p = .000$. In the mediation model, the direct path (c' path) from autism traits and PLE was significant $B = 3.78$, $SE = .33$, $t(272) = 7.57$, $p = .000$. The path between autism traits and sensory processing (a path) was significant $B = 23.70$, $SE = 1.77$, $t(272) = 13.37$, $p = .000$. The path between sensory processing and PLE (b path) was significant $B = .13$, $SE = .01$, $t(272) = 9.97$, $p = .000$. The indirect path of autism traits, sensory processing and PLE was significant $B = 3.13$, $SE = .33$.

Discussion

This study aimed to address two research questions; firstly, whether sensory processing difficulties, autistic traits and PLE were predictors of and explained unique variance in social anxiety (LSAS-SR), and secondly, whether sensory processing difficulties, autistic traits and PLE were predictors of and explained unique variance in psychological distress (DASS-21).

Findings support the first hypothesis that sensory processing, autistic traits and PLE would all be significant predictors of social anxiety, together explaining a significant amount of variance in social anxiety. This is in line with previous research, which confirms the relationship between social anxiety and ASD (Spain et al., 2016), social anxiety and PLE (Aunjitsakul et al., 2021), and sensory processing sensitivity and social anxiety (Hoffman & Bitran, 2007). However, this is the first study to date that has explored individual differences in ASD traits, PLE, sensory processing and social anxiety in a general population sample. It is also the first study to explore ASD traits, PLE, sensory processing and social anxiety together in one model. The final regression model within the current study is highly significant, explaining 63.5% of the variance in social anxiety.

Consequently, current prominent models of social anxiety, such as the Clark and Wells (1995) cognitive behavioural model, which emphasises the importance of faulty cognitions and avoidant behavioural responses to feared social situations, could have better scope if they considered wider issues within this, such as autistic traits, PLE, and sensory processing difficulties.

Findings partially support the second hypothesis, that sensory processing, autistic traits, and PLE would all be significant predictors of psychological distress, together explaining a significant amount of variance in psychological distress. The final regression model within the current study is highly significant, explaining 57.8% of the variance in psychological distress. Regression analyses found that in step two of the model, PLE and autistic traits were significant predictors of psychological distress, which is in line with previous research (Croen et al., 2015); however, in step three when sensory processing was added, autistic traits were no longer predictive of psychological distress. This is an interesting finding; research supports the concept of increased levels of psychological distress in autistic individuals and those with high levels of autistic traits (Croen et al., 2015). Post-hoc mediation analyses found evidence of a partial mediation, with sensory processing significantly mediating the relationship between ASD traits and psychological distress. This could therefore explain the reason for autistic traits becoming non-significant when sensory processing was added into the model; sensory processing plays a key role in the relationship between autistic traits and psychological distress.

The third hypothesis, that autistic traits would be the largest predictor of social anxiety, was not supported by the findings of this study. Although autistic traits were a significant predictor and did explain a significant amount of unique variance in social anxiety, PLE scores were the biggest predictor. This finding is interesting, as although the prevalence of social anxiety is reported to be high in both ASD (Spain et al., 2016) and PLE (Michail, 2013), there's a larger evidence base for the relationship between social anxiety in ASD. However, research has identified that shame cognitions arising from the stigma of psychosis is found to be a strong predictor of social anxiety (Carden et al., 2020; Michail & Birchwood, 2013). Furthermore, social anxiety and aspects of

psychosis are believed to share many of the same predictive factors (such as anxiety, depression, and interpersonal sensitivity; Freeman et al., 2008). Analyses also revealed that the sO-LIFE was an important predictor of levels of psychological distress, and it was strongly positively correlated with all other continuous variables in the study. Supplementary analyses found that PLE scores significantly varied across genders, with non-binary and transgender male participants reporting significantly higher average ranks. Recent research has found that females report higher levels of PLEs (Stainton et al., 2021), however this research does not explore non-binary genders. In addition, PLE scores significantly differed across ethnicities, with significantly higher mean scores among black British, black Caribbean, Asian British and white Irish. Previous research supports the notion that PLEs are more common among the black community (Morgan et al., 2009), with research linking discrimination to PLE (Oh et al., 2014). PLEs were also found to significantly vary across age; this is supported by previous research, with PLE's reported to be more common in the younger population (Scott et al., 2008).

Previous research has considered the relationship between autism and psychosis, with very limited research exploring these domains within the general population (Martinez et al., 2020). Based on previous findings, it was expected that these two variables would be significantly correlated. Considering the associated liabilities model (Chisholm et al., 2015), which suggests that autism and psychosis are related by shared risk factors but are still distinct, and the multiple overlapping etiologies model (Chisholm et al., 2015), which suggests high clinical heterogeneity between the two experiences is a result of multiple etiological pathways, this study is the first to discover the role of sensory processing as a shared risk factor or shared etiological pathway; a significant partial mediation was found between ASD traits, sensory processing and PLE.

Strengths and Limitations

This study was enhanced through involving a small number of autistic individuals and individuals engaging with mental health services in the planning stages. Online participation

facilitated efficient recruitment and enhanced the accessibility of the survey. However, online opportunity sampling methods can be prone to selection bias (Jager et al., 2017). Raised scores on social anxiety and PLE were observed in the current study, which may impact the generalisability of the findings of this study. Furthermore, 43% of the sample was aged between 18-25 years, thus limiting the generalisability of these findings to the older population.

Strengths of the study includes the study's high power and comparisons between non-completers and completers. Despite efforts to increase the diversity of the sample through recruiting from a variety of sources, the sample remained predominantly female, white British, and educated, which does not represent the general population. It is possible that the sample was highly educated due to the use of the University volunteers list, however this cannot be ascertained due to participants anonymity. The cross-sectional and correlational design means that conclusions cannot be drawn on the causal direction of the associations between the variables examined in this study.

The effect of covariates, including demographic variables, ASD diagnosis and any mental health diagnoses were investigated, finding that for social anxiety, ASD diagnosis was the only variable to have significant effect, and none of the variables were significant in the psychological distress model.

A further limitation is that data collection occurred following UK-wide social restrictions due to Covid-19 (Office for National Statistics, 2020). It is possible that higher levels of social anxiety were present because of a reduction in previous social engagement (Arad et al., 2021). A major limitation is that this study did not assess or control for any impacts of Covid-19.

A key limitation was the sensory processing measure; a measure that enabled analyses on subscales would have been helpful, allowing for exploration between hypo- and hyper-sensory processing. In addition to this, due to the proven overlap between the constructs being measured (sensory processing, ASD, PLE and social anxiety), selecting measures that were distinct proved a challenge. A key strength of the study was the a priori work completed on ensuring selected

measures were validated and different from one another on their use of questions. Additional analysis was completed on the BAPQ and LSAS-SR, assessing whether they were measuring different constructs. Lastly, additional factors such as childhood trauma was not assessed within this study, which has a known impact on experiences of psychosis (Varese et al., 2012).

Clinical Implications and Future Directions

This is the first study to date to look at the associations between autistic traits, sensory processing, PLE, social anxiety, and psychological distress in the general population. It is also the first study to assess how much these variables separately and together can explain the variance in social anxiety and psychological distress in the general population. These findings are therefore novel and important to the fields of mental health, autism, and PLE. These findings will help to guide and shape future theories, research, psychological understanding, and interventions, by bringing together a shared understanding across experiences. In assessment, clinicians are better placed to hold a more holistic view of social anxiety and distress, considering aspects of autistic traits, sensory processing and PLE in individual presentations, which current models of mental health difficulties do not consider. Formulating and intervening with ASD traits, PLE and sensory processing in mind, will help individuals to feel more understood, thus improving outcomes. Furthermore, this research has enabled greater understanding of the relationship between autistic traits and PLE in the general population, thus supporting individuals, clinicians, and services to consider the possibility of comorbidity and assess and intervene accordingly. Overall, social anxiety is something that can be improved with support (NICE, 2013); interventions should be developed with the consideration of autistic traits, PLE and sensory processing.

Future research may theorise and study the contribution of sensory processing to social anxiety further (e.g., does social anxiety result in sensory processing difficulties or vice versa), which may lead to the development of broader theories and models of social anxiety, thus resulting in more holistic interventions.

Finally, this study has been one of the first studies exploring sensory processing within PLE in the general population, finding a significant positive relationship between the two. Exploratory post-hoc mediation analyses found evidence of a partial mediation between autistic traits, sensory processing and PLE. Research should explore this further, along with other possible explanations and risk factors (e.g., trauma).

Conclusions

This study aimed to establish whether sensory processing difficulties, autistic traits and PLE were predictors of, and explained unique variance, in both social anxiety and psychological distress, in the general population. The results found two highly significant models for both social anxiety and psychological distress, with all variables being significant predictors of both outcome variables, aside from autistic traits which was not a significant predictor of psychological distress when sensory processing was present in the model. PLE scores were the biggest predictor in both models. Social anxiety scores across age and gender were significantly different, and PLE scores were significantly different across gender, age, and ethnicity. Psychological distress scores were significantly different across the demographic of age.

Participants who reported a formal diagnosis of ASD scored significantly higher on all study measures. Furthermore, all continuous variables were significantly correlated. Sensory processing was found to be fundamental to social anxiety, psychological distress, autism traits and PLE; these findings should be expanded upon in research, exploring the relevance of sensory processing in other mental health difficulties and neurodevelopmental conditions. Results of the study should be interpreted with caution, taking consideration of the methodological limitations. Future studies should replicate these findings in clinical populations and extend them by investigating subtypes of sensory difficulties and considering further life experiences, such as childhood trauma.

References

- Albantakis, L., Brandi, M. L., Zillekens, I. C., Henco, L., Weindel, L., Thaler, H., Schliephake, L., Timmermans, B., & Schilbach, L. (2020). Alexithymic and autistic traits: relevance for comorbid depression and social phobia in adults with and without autism spectrum disorder. *Autism, 24*(8), 2046-2056. <https://doi.org/10.1177/1362361320936024>
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). <https://doi.org/10.1176/appi.books.9780890425596>
- Anticevic, A., Haut, K., Murray, J. D., Repovs, G., Yang, G. J., Diehl, C., McEwen, S.C., Bearden, C.E., Addington, J., Goodyear, B., Kadenhead, K.C., Mirzakhani, H., Cornblatt, B., Olvett, D., Mathalon, D.H., McGlashan, T., Perkins, D.O., Belger, A., Seidman, L.J., ... Cannon, T. D. (2015). Association of thalamic dysconnectivity and conversion to psychosis in youth and young adults at elevated clinical risk. *Journal of American Medical Association of Psychiatry, 72*(9), 882–891. <https://doi.org/10.1001/jamapsychiatry.2015.0566>
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*(2), 176-181. <https://doi.org/10.1037/1040-3590.10.2.176>
- Arad, G., Shamai-Leshem, D., & Bar-Haim, Y. (2021). Social distancing during a COVID-19 lockdown contributes to the maintenance of social anxiety: A natural experiment. *Cognitive Therapy and Research, 45*(4), 708-714. <https://doi.org/10.1007/s10608-021-10231-7>
- Aron, E. N., Aron, A., & Jagiellowicz, J. (2012). Sensory processing sensitivity: A review in the light of the evolution of biological responsivity. *Personality and Social Psychology Review, 16*(3), 262-282. <https://doi.org/10.1177/1088868311434213>

- Asher, M., Asnaani, A., & Aderka, I. M. (2017). Gender differences in social anxiety disorder: A review. *Clinical Psychology Review, 56*, 1-12. <https://doi.org/10.1016/j.cpr.2017.05.004>
- Aunjitsakul, W., McGuire, N., McLeod, H. J., & Gumley, A. (2021). Candidate Factors Maintaining Social Anxiety in the Context of Psychotic Experiences: A Systematic Review. *Schizophrenia Bulletin, 47*(5), 1218-1242. <https://doi.org/10.1093/schbul/sbab026>
- Baker, A. E., Lane, A., Angley, M. T., & Young, R. L. (2008). The relationship between sensory processing patterns and behavioural responsiveness in autistic disorder. *Journal of Autism and Developmental Disorders, 38*, 867 – 865. <https://doi.org/10.1007/s10803-007-0459-0>
- Baron-Cohen, S., Ashwin, E., Ashwin, C., Tavassoli, T., & Chakrabarti, B. (2009). Talent in autism: hyper-systemizing, hyper-attention to detail and sensory hypersensitivity. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*(1522), 1377-1383. <https://doi.org/10.1098/rstb.2008.0337>
- Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The autism-spectrum quotient (AQ): Evidence from Asperges syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*(1), 5–17
- Beggiato, A., Peyre, H., Maruani, A., Scheid, I., Rastam, M., Amsellem, F., Gillberg, C.I., Leboyer, M., Bourgeron, T., Gillberg, C., & Delorme, R. (2017). Gender differences in autism spectrum disorders: Divergence among specific core symptoms. *Autism Research, 10*(4), 680-689. <https://doi.org/10.1002/aur.1715>
- Bejerot, S., Eriksson, J. M., & Mörtberg, E. (2014). Social anxiety in adult autism spectrum disorder. *Psychiatry Research, 220*(1-2), 705-707. <https://doi.org/10.1016/j.psychres.2014.08.030>

- Bellini, S. (2006). The development of social anxiety in adolescents with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 21*(3), 138-145. <https://doi.org/10.1177/10883576060210030201>
- Benham, G. (2006). The highly sensitive person: Stress and physical symptom reports. *Personality and Individual Differences, 40*(7), 1433-1440. <https://doi.org/10.1016/j.paid.2005.11.021>
- Bevan Jones, R., Thapar, A., Lewis, G., & Zammit, S. (2012). The association between early autistic traits and psychotic experiences in adolescence. *Schizophrenia Research, 135*(1-3), 164–169. <https://doi.org/10.1016/j.schres.2011.11.037>
- Birchwood, M., Trower, P., Brunet, K., Gilbert, P., Iqbal, Z., & Jackson, C. (2007). Social anxiety and the shame of psychosis: a study in first episode psychosis. *Behaviour Research and Therapy, 45*(5), 1025-1037. <https://doi.org/10.1016/j.brat.2006.07.011>
- British Psychological Society (June, 2021). *Ethics guidelines for internet-mediated research*. The British psychological society. <https://www.bps.org.uk/news-and-policy/ethics-guidelines-internet-mediated-research>
- Butler, R. M., Horenstein, A., Gitlin, M., Testa, R. J., Kaplan, S. C., Swee, M. B., & Heimberg, R. G. (2019). Social anxiety among transgender and gender nonconforming individuals: The role of gender-affirming medical interventions. *Journal of Abnormal Psychology, 128*(1), 25. <https://doi.org/10.1037/abn0000399>
- Carden, L. J., Saini, P., Seddon, C., Watkins, M., & Taylor, P. J. (2020). Shame and the psychosis continuum: A systematic review of the literature. *Psychology and Psychotherapy: Theory, Research and Practice, 93*(1), 160-186. <https://doi.org/10.1111/papt.12204>
- Chrobak, A. A., & Soltys, Z. (2017). Bergmann Glia, long-term depression, and autism spectrum disorder. *Molecular Neurobiology, 54*(2), 1156–1166. <https://doi.org/10.1007/s12035-016-9719-3>

- Chisholm, K., Lin, A., Abu-Akel, A., & Wood, S. J. (2015). The association between autism and schizophrenia spectrum disorders: A review of eight alternate models of co-occurrence. *Neuroscience and Biobehavioral Reviews*, *55*, 173–183.
<https://doi.org/10.1016/j.neubiorev.2015.04.012>
- Clark, D. M., Wells, A. (1995). A cognitive model of social phobia. In R. Heimberg, M. Liebowitz, D. A. Hope, & F. R. Schneier (Eds.), *Social phobia: Diagnosis, assessment, and treatment*. New York: Guilford Press.
- Clemmensen, L., van Os, J., Skovgaard, A. M., Væver, M., Blijd-Hoogewys, E. M., Bartels-Velthuis, A. A., & Jeppesen, P. (2014). Hyper-theory-of-mind in children with psychotic experiences. *Plos One*, *9*, e113082. <https://doi.org/10.1371/journal.pone.0113082>
- Clemmensen, L., Van Os, J., Drukker, M., Munkholm, A., Rimvall, M. K., Vaever, M., Rask, C.U., Bartels-Velthuis, A.A., Skovgaard, A.M., & Jeppesen, P. (2016). Psychotic experiences and hyper-theory-of-mind in preadolescence—a birth cohort study. *Psychological Medicine*, *46*(1), 87-101. <https://doi.org/10.1017/S0033291715001567>
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155-159.
- Constantino, J. N., & Todd, R. D. (2003). Autistic traits in the general population. *Archives of General Psychiatry*, *60*(5), 524. <https://doi.org/10.1001/archpsyc.60.5.524>
- Crane, L., Goddard, L., & Pring, L. (2009). Sensory processing in adults with autism spectrum disorders. *Autism*, *13*(3), 215-228. <https://doi.org/10.1177/1362361309103794>
- Croen, L. A., Zerbo, O., Qian, Y., Massolo, M. L., Rich, S., Sidney, S., & Kripke, C. (2015). The health status of adults on the autism spectrum. *Autism*, *19*(7), 814–823.
<https://doi.org/10.1177/1362361315577517>

- Cruwys, T., Haslam, S. A., Dingle, G. A., Haslam, C., & Jetten, J. (2014). Depression and social identity: An integrative review. *Personality and Social Psychology Review, 18*(3), 215–238. <https://doi.org/10.1177/1088868314523839>
- Demetriou, E.A., Song, C.Y., Park, S.H., Pepper, K.L., Naismith, S.L., Hermens, D.F., Hickie, I.B., Thomas, E.E., Norton, A., White, D., & Guastella, A.J. (2018). Autism, early psychosis, and social anxiety disorder: a transdiagnostic explanation of executive function cognitive circuitry and contribution to disability. *Translational Psychiatry, 8*(1), 200. <https://doi.org/10.1038/s41398-018-0193-8>
- Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. *Infants and Young Children, 9*, 23-35.
- Elwin, M., Ek, L., Kjellin, L., & Schröder, A. (2013). Too much or too little: Hyper-and hypo-reactivity in high-functioning autism spectrum conditions. *Journal of Intellectual and Developmental Disability, 38*(3), 232-241. <https://doi.org/10.3109/13668250.2013.815694>
- Engel-Yeger, B., & Dunn, W. (2011). The relationship between sensory processing difficulties and anxiety level of healthy adults. *British Journal of Occupational Therapy, 74*(5), 210-216. <https://doi.org/10.4276/030802211X13046730116407>
- Espelöer, J., Hellmich, M., Vogeley, K., & Falter-Wagner, C. M. (2021). Brief report: Social anxiety in autism spectrum disorder is based on deficits in social competence. *Journal of Autism and Developmental Disorders, 51*(1), 315-322. <https://doi.org/10.1007/s10803-020-04529-w>
- Field, A. (2009). *Discovering statistics using SPSS*. Sage Publications.
- Field, A. (2017). *Discovering statistics using IBM SPSS statistics* (5th edition). SAGE Publications Ltd. <https://in.sagepub.com/en-in/sas/discovering-statistics-using-ibmspss-statistics/book25767>

- Fox-Wasylyshyn, S. M., & El-Masri, M. M. (2005). Focus on Research Methods Handling Missing Data in Self-Report Measures. *Research in Nursing & Health*, 31(4), 341– 354.
<https://doi.org/10.1002/nur>
- Fonseca-Pedrero, E., Ortuño-Sierra, J., Mason, O. J., & Muñiz, J. (2015). The oxford–liverpool inventory of feelings and experiences short version: further validation. *Personality and Individual Differences*, 86, 338-343. <https://doi.org/10.1016/j.paid.2015.06.041>
- Freeman, D., Pugh, K., Antley, A., Slater, M., Bebbington, P., Gittins, M., Dunn, G., Kuipers, E., Fowler, D., & Garety, P. (2008). Virtual reality study of paranoid thinking in the general population. *The British Journal of Psychiatry*, 192(4), 258-263.
<https://doi.org/10.1192/bjp.bp.107.044677>
- Freeman, D., Gittins, M., Pugh, K., Antley, A., Slater, M., & Dunn, G. (2008). What makes one person paranoid and another person anxious? The differential prediction of social anxiety and persecutory ideation in an experimental situation. *Psychological Medicine*, 38(8), 1121-1132. <https://doi.org/10.1017/S0033291708003589>
- Freeth, M., Bullock, T., & Milne, E. (2012). The distribution of and relationship between autistic traits and social anxiety in a UK student population. *Autism*, 17(5), 571-581. <https://doi.org/10.1177/1362361312445511>
- Fresco, D. M., Coles, M. E., Heimberg, R. G., Liebowitz, M. R., Hami, S., Stein, M. B., & Goetz, D. (2001). The Liebowitz social anxiety scale: A comparison of the psychometric properties of self-report and clinician-administered formats. *Psychological Medicine*, 31(6), 1025– 1035. <https://doi.org/10.1017/s0033291701004056>
- Haddock, G., & Lewis, S. (2005). Psychological interventions in early psychosis. *Schizophrenia Bulletin*, 31(3), 697-704. <https://doi.org/10.1093/schbul/sbi029>

- Haslam, C., Cruwys, T., Haslam, S. A., Dingle, G., & Chang, M. X.-L. (2016). Groups 4 Health: Evidence that a social-identity intervention that builds and strengthens social group membership improves mental health. *Journal of Affective Disorders, 194*, 188– 195. <https://doi.org/10.1016/j.jad.2016.01.010>
- Heimberg, R. G., Horner, K. J., Juster, H. R., Safren, S. A., Brown, E. J., Schneier, F. R., & Liebowitz, M. R. (1999). Psychometric properties of the Liebowitz social anxiety scale. *Psychological Medicine, 29*(1), 199– 212. <https://doi.org/10.1017/s0033291798007879>
- Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 44*(2), 227–239. <https://doi.org/10.1348/014466505X29657>
- Hofmann, S. G., & Bitran, S. (2007). Sensory-processing sensitivity in social anxiety disorder: Relationship to harm avoidance and diagnostic subtypes. *Journal of Anxiety Disorders, 21*(7), 944-954. <https://doi.org/10.1016/j.janxdis.2006.12.003>
- Horder, J., Wilson, C. E., Mendez, M. A., & Murphy, D. G. (2014). Autistic traits and abnormal sensory experiences in adults. *Journal of Autism and Developmental Disorders, 44*(6), 1461–1469. <https://doi.org/10.1007/s10803-013-2012-7>
- Houran, J., Wiseman, R., & Thalbourne, M.A. (2002). Perceptual-personality characteristics associated with naturalistic haunt experiences. *European Journal of Parapsychology, 17*, 17-44.
- Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M.-C., & Mandy, W. (2017). “Putting on my best normal”: Social camouflaging in adults with autism spectrum conditions. *Journal of Autism and Developmental Disorders, 47*(8), 2519– 2534. <https://doi.org/10.1007/s10803-017-3166-5>

- Hurley, R.S.E., Losh, M., Parlier, M., Reznick, J.S., & Piven, J. (2007). The broad autism phenotype questionnaire. *Journal of Autism and Developmental Disorders*, 37(9), 1679-1690. <https://doi.org/10.1007/s10803-006-0299-3>
- Irwin, H. J., Schofield, M. B. & Baker, I. S. (2014). Dissociative tendencies, sensory processing sensitivity and aberrant salience as predictors of anomalous experiences and paranormal attributions. *Journal for the Society of Psychical Research*, 78, 193–206.
- Jager, J., Putnick, D. L., & Bornstein, M. H. (2017). More than just convenient: The scientific merits of homogeneous convenience samples. *Monographs of the Society for Research in Child Development*, 82(2), 13–30. <https://doi.org/10.1111/mono.12296>
- Jefferies, P., & Ungar, M. (2020). Social anxiety in young people: A prevalence study in seven countries. *PLoS One*, 15(9), e0239133.
- Kanai, C., Iwanami, A., Hashimoto, R., Ota, H., Tani, M., Yamada, T., & Kato, N. (2011). Clinical characterization of adults with Asperger's syndrome assessed by self-report questionnaires based on depression, anxiety, and personality. *Research in Autism Spectrum Disorders*, 5(4), 1451– 1458. <https://doi.org/10.1016/j.rasd.2011.02.005>
- Kenny, L., Hattersley, C., Molins, B., Buckley, C., Povey, C., & Pellicano, E. (2016). Which terms should be used to describe autism? Perspectives from the UK autism community. *Autism*, 20(4), 442–462. <https://doi.org/10.1177/1362361315588200>
- Kilroy, E., Aziz-Zadeh, L., & Cermak, S. (2019). Ayres theories of autism and sensory integration revisited: What contemporary neuroscience has to say. *Brain Sciences*, 9(3), 68. <https://doi.org/10.3390/brainsci9030068>
- Kincaid, D. L., Doris, M., Shannon, C., & Mulholland, C. (2017). What is the prevalence of autism spectrum disorder and ASD traits in psychosis? A systematic review. *Psychiatry Research*, 250, 99-105. <https://doi.org/10.1016/j.psychres.2017.01.017>

- King, B. H., & Lord, C. (2011). Is schizophrenia on the autism spectrum? *Brain Research, 1380*, 34-41. <https://doi.org/10.1016/j.brainres.2010.11.031>
- Kinnealey, M., Koenig, K. P., & Smith, S. (2011). Relationships between sensory modulation and social supports and health-related quality of life. *American Journal of Occupational Therapy, 65*(3), 320-327. <https://doi.org/10.5014/ajot.2011.001370>
- Kreiser, N.L., & White, S.W. (2013). ASD in females: are we overestimating the gender difference in diagnosis? *Clinical Child and Family Psychology Review, 17*(1), 67-84. <https://doi.org/10.1007/s10567-013-0148-9>
- Liss, M., Mailloux, J., & Erchull, M. J. (2008). The relationships between sensory processing sensitivity, alexithymia, autism, depression, and anxiety. *Personality and Individual Differences, 45*(3), 255-259. <https://doi.org/10.1016/j.paid.2008.04.009>
- Little, R. J. (1992). Regression With Missing X's: A Review. *Journal of the American Statistical Association, 87*(420), 1227. <https://doi.org/10.2307/2290664>
- Martinez, A. P., Wickham, S., Milne, E., Rowse, G., & Bentall, R. (2020). "Robust association between autistic traits and psychotic-like experiences in the adult general population: epidemiological study from the 2007 Adult Psychiatric Morbidity Survey and replication with the 2014 APMS." *Psychological Medicine, 51*(15), 2707-2713. 7. <https://doi.org/10.1017/>
- Mason, O., Linney, Y., & Claridge, G. (2005). Short scales for measuring schizotypy. *Schizophrenia Research, 78*(2-3), 293-296. <https://doi.org/10.1016/j.schres.2005.06.020>
- Mennin, D. S., Fresco, D. M., Heimberg, R. G., Schneier, F. R., Davies, S. O., & Liebowitz, M. R. (2002). Screening for social anxiety disorder in the clinical setting: using the Liebowitz Social Anxiety Scale. *Journal of Anxiety Disorders, 16*(6), 661-673. [https://doi.org/10.1016/S0887-6185\(02\)00134-2](https://doi.org/10.1016/S0887-6185(02)00134-2)

- Metz, A. E., Boling, D., DeVore, A., Holladay, H., Liao, J. F., & Vlutch, K. V. (2019). Dunn's model of sensory processing: an investigation of the axes of the four-quadrant model in healthy adults. *Brain Sciences*, *9*(2), 35. <https://doi.org/10.3390/brainsci9020035>
- Michail, M. (2013). Social anxiety disorder in psychosis: A critical review. In F. Durbano (Eds.), *New insights into anxiety disorders*. (pp. 173-189). Intech.
- Michail, M., Birchwood, M., & Tait, L. (2017). Systematic review of cognitive-behavioural therapy for social anxiety disorder in psychosis. *Brain Sciences*, *7*(5), 45. <https://doi.org/10.3390/brainsci7050045>
- Michail, M., & Birchwood, M. (2009). Social anxiety disorder in first-episode psychosis: incidence, phenomenology and relationship with paranoia. *The British Journal of Psychiatry*, *195*(3), 234-241. <https://doi.org/10.1192/bjp.bp.108.053124>
- Michail, M., & Birchwood, M. (2013). Social anxiety disorder and shame cognitions in psychosis. *Psychological Medicine*, *43*(1), 133-142. <https://doi.org/10.1017/S0033291712001146>
- Milne, E., Dickinson, A., & Smith, R. (2017). Adults with autism spectrum conditions experience increased levels of anomalous perception. *PloS One*, *12*(5), e0177804. <https://doi.org/10.1371/journal.pone.0177804>
- Milton, D., & Sims, T. (2016). How is a sense of well-being and belonging constructed in the accounts of autistic adults? *Disability & Society*, *31*(4), 520–534. <https://doi.org/10.1080/09687599.2016.1186529>
- Moore, H. L., Brice, S., Powell, L., Ingham, B., Freeston, M., Parr, J. R., & Rodgers, J. (2021). The Mediating Effects of Alexithymia, Intolerance of Uncertainty, and Anxiety on the Relationship Between Sensory Processing Differences and Restricted and Repetitive Behaviours in Autistic Adults. *Journal of Autism and Developmental Disorders*, 1-13. <https://doi.org/10.1007/s10803-021-05312-1>

- Morgan, C., Fisher, H., Hutchinson, G., Kirkbride, J., Craig, T. K., Morgan, K., Dazzan, P., Boydell, J., Doody, G.A., Jones, P.B., Murray, R.M., & Fearon, P. (2009). Ethnicity, social disadvantage and psychotic-like experiences in a healthy population based sample. *Acta Psychiatrica Scandinavica*, *119*(3), 226-235. <https://doi.org/10.1111/j.1600-0447.2008.01301.x>
- National Institute of Clinical Excellence (NICE). (2013). *Social anxiety disorder: Recognition, assessment and treatment*. NICE. <https://www.nice.org.uk/guidance/cg159/resources/social-anxiety-disorder-recognition-assessment-and-treatment-pdf-35109639699397>
- Oakman, J., Van Ameringen, M., Mancini, C., & Farvolden, P. (2003). A confirmatory factor analysis of a self-report version of the Liebowitz social anxiety scale. *Journal of Clinical Psychology*, *59*(1), 149– 161. <https://doi.org/10.1002/jclp.10124>
- Office for National Statistics. (2020, October 2). *Coronavirus and the social impacts on Great Britain*. Open Government Licence. <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandwellbeing/bulletins/coronavirusandthesocialimpactsongreatbritain/2october2020>
- Oh, H., Yang, L. H., Anglin, D. M., & DeVlyder, J. E. (2014). Perceived discrimination and psychotic experiences across multiple ethnic groups in the United States. *Schizophrenia Research*, *157*(1-3), 259-265. <https://doi.org/10.1016/j.schres.2014.04.036>
- Olson, L. (2011). *Sensory modulation disorder and schizophrenia: Linking behavioral measures*. Scholars Compass. <https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=3463&context=etd>
- Parham, L. D., Roush, S., Downing, D. T., Michael, P. G., & McFarlane, W. R. (2019). Sensory characteristics of youth at clinical high risk for psychosis. *Early Intervention in Psychiatry*, *13*(2), 264-271. <https://doi.org/10.1111/eip.12475>

- Park, S. H., Song, Y. J. C., Demetriou, E. A., Pepper, K. L., Thomas, E. E., Hickie, I. B., & Guastella, A. J. (2020). Validation of the 21-item Depression, Anxiety, and Stress Scales (DASS-21) in individuals with autism spectrum disorder. *Psychiatry Research*, *291*, 1–8. <https://doi.org/10.1016/j.psychres.2020.113300>
- Pellicano, E., Dinsmore, A., & Charman, T. (2014). What should autism research focus upon? Community views and priorities from the United Kingdom. *Autism: The International Journal of Research and Practice*, *18*(7), 756–770. <https://doi.org/10.1177/1362361314529627>
- Raymond, M. R. (1986). Missing Data in Evaluation Research. *Evaluation & the Health Professions*, *9*(4), 395–420. <https://doi.org/10.1177/016327878600900401>
- Robertson, A.E., & Simmons, D.R. (2013). The relationship between sensory sensitivity and autistic traits in the general population. *Journal of Autism and Developmental Disorders*, *43*(4), 775–784. <https://doi.org/10.1007/s10803-012-1608-7>
- Scott, J., Welham, J., Martin, G., Bor, W., Najman, J., O'Callaghan, M., William, G., Aird, R., & Mcgrath, J. (2008). Demographic correlates of psychotic-like experiences in young Australian adults. *Acta Psychiatrica Scandinavica*, *118*(3), 230–237. <https://doi.org/10.1111/j.1600-0447.2008.01214.x>
- Shah, A. & Frith, U. (1983). An islet of ability in autistic children: a research note. *Journal of Child Psychology and Psychiatry*, *24*(4), 613– 620. <https://doi.org/10.1111/j.1469-7610.1983.tb00137.x>
- Smith, R. S., & Sharp, J. (2013). Fascination and isolation: A grounded theory exploration of unusual sensory experiences in adults with Asperger syndrome. *Journal of Autism and Developmental Disorders*, *43*(4), 891–910. <https://doi.org/10.1007/s10803-012-1633-6>
- Smolewska, K. A., McCabe, S. B., & Woody, E. Z. (2006). A psychometric evaluation of the Highly Sensitive Person Scale: The components of sensory-processing sensitivity and their

relation to the BIS/BAS and “Big Five”. *Personality and Individual Differences*, 40(6), 1269-1279. <https://doi.org/10.1016/j.paid.2005.09.022>

Spain, D., Happé, F., Johnston, P., Campbell, M., Sin, J., Daly, E., Ecker, C., Anson, M., Chaplin, E., Glaser, K., Mendez, A., Lovell, K., & Murphy, D. G. (2016). Social anxiety in adult males with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 32, 13– 23. <https://doi.org/10.1016/j.rasd.2016.08.002>

Spain, D., Sin, J., Linder, K. B., McMahon, J., & Happé, F. (2018). Social anxiety in autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, 52, 51-68. <https://doi.org/10.1016/j.rasd.2018.04.007>

Stagg, S. D., & Vincent, J. (2019). Autistic traits in individuals self-defining as transgender or nonbinary. *European psychiatry*, 61, 17-22. <https://doi.org/10.1016/j.eurpsy.2019.06.003>

Stainton, A., Chisholm, K., Woodall, T., Hallett, D., Reniers, R. L., Lin, A., & Wood, S. J. (2021). Gender differences in the experience of psychotic-like experiences and their associated factors: A study of adolescents from the general population. *Schizophrenia Research*, 228, 410-416. <https://doi.org/10.1016/j.schres.2021.01.008>

Stephens, L.M., Milne, E., & Rowse, G. (2022). Social anxiety in autistic adults: A systematic review and meta-analysis [Unpublished manuscript]. Faculty of Clinical Psychology, University of Sheffield.

Suarez, M. A. (2012). Sensory processing in children with autism spectrum disorders and impact on functioning. *Pediatric Clinics*, 59(1), 203-214. <https://doi.org/10.1016/j.pcl.2011.10.012>

Tyson, K. E., & Cruess, D. G. (2012). Differentiating high-functioning autism and social phobia. *Journal of Autism and Developmental Disabilities*, 42(7), 1477–1490. <https://doi.org/10.1016/j.rasd.2011.01.023>

- van Os, J., Linscott, R. J., Myin-Germeys, I., Delespaul, P., & Krabbendam, L. (2009). A systematic review and meta-analysis of the psychosis continuum: Evidence for a psychosis proneness–persistence–impairment model of psychotic disorder. *Psychological Medicine*, *39*(2), 179–195. <https://doi.org/10.1017/s003329170800381>
- van Os, J., Hanssen, M., Bijl, R. V., & Vollebergh, W. (2001). Prevalence of psychotic disorder and community level of psychotic symptoms. *Archives of General Psychiatry*, *58*(7), 663. <https://doi.org/10.1001/archpsyc.58.7.663>
- Varese, F., Smeets, F., Drukker, M., Lieverse, R., Lataster, T., Viechtbauer, W., Read, J., Van Os, J., & Bentall, R. P. (2012). Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective-and cross-sectional cohort studies. *Schizophrenia Bulletin*, *38*(4), 661-671. <https://doi.org/10.1093/schbul/sbs050>
- Verdoux, H., Van Os, J., Maurice-Tison, S., Gay, B., Salamon, R., & Bourgeois, M. (1998). Is early adulthood a critical developmental stage for psychosis proneness? A survey of delusional ideation in normal subjects. *Schizophrenia Research*, *29*(3), 247-254. [https://doi.org/10.1016/S0920-9964\(97\)00095-9](https://doi.org/10.1016/S0920-9964(97)00095-9)
- Warrier, V., Greenberg, D. M., Weir, E., Buckingham, C., Smith, P., Lai, M. C., Allison, C., & Baron-Cohen, S. (2020). Elevated rates of autism, other neurodevelopmental and psychiatric diagnoses, and autistic traits in transgender and gender-diverse individuals. *Nature Communications*, *11*(1), 1-12. <https://doi.org/10.1038/s41467-020-17794-1>

Appendices

Appendix A

Online Study Advert

ONLINE SURVEY

PARTICIPANTS NEEDED



Are you somebody who is sensitive to your surroundings?

Do you think you have any traits of autism spectrum conditions or experience things that other people don't e.g. noises?

Even if you haven't answered yes to the above questions, you can still take part for a chance to win a £25 Amazon voucher!

WHAT IS IT ABOUT?

Some people are more sensitive to their surroundings than others, this is sometimes called Sensory Sensitivity. Some people can become distressed when they experience things such as loud noises and bright lights, which can impact on other parts of their lives, such as social situations, and on their mental health. Previous research has suggested that sensory sensitivity and traits of autism spectrum conditions can be related and also that sensory sensitivity and psychotic-like experiences can be related. We hope to find out more about if there is a link between sensory sensitivity, psychotic-like experiences, traits of autism spectrum conditions and worries about social situations. However, even if you don't experience any of the above, you can still take part in the study.

WHO CAN TAKE PART?

These experiences can be felt by anyone, therefore, anybody aged 18 years or over and who can read and understand English can take part in this study.

WHAT DO I HAVE TO DO?

Complete an online survey taking approximately 20 minutes.

This project has been granted ethical approval from the University of Sheffield's Psychology Research Ethics Committee.

Researcher Contact Details: INSERT QR CODE HERE!

Lucy Stephens (Trainee Clinical Psychologist)
lstephens4@sheffield.ac.uk

Amrit Sinha (Research support officer)
a.sinha@sheffield.ac.uk

Supervised by Dr Georgina Rowse

Appendix B

Email sent to Charities for Recruitment

Subject Line: Clinical Psychology Doctorate Thesis Research

Dear (charity),

My name is Lucy Stephens and I am a Trainee Clinical Psychologist at the University of Sheffield. I am emailing about my Doctoral Thesis Project that may be of interest to the charity.

Information about the project:

The title of the project is “The Relationship Between Sensory Sensitivity and Social Anxiety, across the Spectrum of traits of Autism Spectrum Conditions and Psychotic-like Experiences”.

Some people are more sensitive to their surroundings than others, this is sometimes called Sensory Sensitivity. Some people can become distressed when they experience things such as loud noises and bright lights, which can impact on other parts of their lives, such as social situations, and on their mental health. This study hopes to investigate the relationship between sensory sensitivity and worries about social situations.

Previous research has suggested that sensory sensitivity and traits of autism spectrum conditions can be related and also that sensory sensitivity and psychotic-like experiences can be related. We hope to find out more about if there is a link between sensory sensitivity, psychotic-like experiences, traits of autism spectrum conditions and worries about social situations.

What it involves:

Individuals are asked to complete a set of questionnaires online via a link sent in an email, or via scanning a QR code on an advert. The project can also be accessed via social media platforms.

I am writing to ask for your permission and your support in sharing the project amongst the individuals that you support.

For further information, please see attached the participant information sheet, consent form, advert and debrief form.

If you have any questions, please feel free to ask.

I look forward to hearing from you and hopefully working with you on this.

Kind regards,

Lucy Stephens

Trainee Clinical Psychologist

lstephens4@sheffield.ac.uk

Under the supervision of:

Dr Georgina Rowse

Programme Director DClinPsy, University of Sheffield

Appendix C

BAPQ questionnaire removed to comply with copyright requirements

Appendix D

SO-LIFE questionnaire removed to comply with copyright requirements

Appendix E

GSQ questionnaire removed to comply with copyright requirements

Appendix F

DASS-21 questionnaire removed to comply with copyright requirements

Appendix G

LSAS-SR questionnaire removed to comply with copyright requirements

Appendix H

Demographics

Demographic Information

Please complete the following questions. The information collected is for the purpose of data analysis only and your responses will not be used for any other purposes.

1. Age

2. Which gender do you most identify as?
 - Female
 - Male
 - Transgender Female
 - Transgender Male
 - Non-Conforming
 - Other.....
 - Do not wish to answer

3. Ethnicity

4. Your highest level of qualification:
 - No formal qualifications
 - GCSE (or equivalent)
 - A-Level (or equivalent)
 - Undergraduate Degree
 - Post-graduate Qualification
 - Other

5. Do you have any formal mental health diagnoses?
 - Yes, please specify.....
 - No

6. Do you have any of the following:

- Hearing loss
- Ageusia (loss of taste)
- Anosmia (loss of smell)

Appendix I

Participant Information Sheet



PARTICIPANT INFORMATION SHEET

Title: The Relationship Between Sensory Sensitivity and Social Anxiety, across the Spectrum of traits of Autism Spectrum Conditions and Psychotic-like Experiences

Invitation

You are being invited to take part in a research project. Before you decide whether you wish to take part, please read the information below to help you to understand the purpose of the project and what it will involve. Please read the information below carefully and discuss it with others if you wish. Please ask us any questions that you may have or if you need any more information. Please take the time to decide whether or not you wish to take part. Thank you for reading.

What is the purpose of the study?

Some people are more sensitive to their surroundings than others, this is sometimes called Sensory Sensitivity. Some people can become distressed when they experience things such as loud noises and bright lights, which can impact on other parts of their lives, such as social situations, and on their mental health. This study hopes to investigate the relationship between sensory sensitivity and worries about social situations.

Previous research has suggested that sensory sensitivity and traits of autism spectrum conditions can be related and also that sensory sensitivity and psychotic-like experiences can be related. We hope to find out more about if there is a link between sensory sensitivity, psychotic-like experiences, traits of autism spectrum conditions and worries about social situations. However, even if you don't experience any of the above, such as sensitivity to your surroundings and worries

in social situations, you can still take part in the study.

What the Project Involves

If you choose to participate, this will involve completing some online questionnaires about your personal characteristics and sensory experiences. It should take around 20 minutes to complete. The study may ask about topics that you may find upsetting, as for example some questions will be about sensory experiences and other questions will be about social situations and mental health. It is important that you look after yourself during completing the survey, and you do not need to answer any questions that you don't want to. If you become upset by anything in the survey, please contact your GP or see the resources below:

NHS Direct

www.nhsdirect.nhs.uk

Mind, the mental health charity

<https://www.mind.org.uk/about-us/contact-us/>

Samaritans

Tel: 116 123

<https://www.samaritans.org/>

Who can take part?

The aim of the project is to explore the link between sensory experiences, traits of autism spectrum conditions, psychotic-like experiences and worries about social situations. These experiences can be felt by anyone, therefore, anybody aged 18 years or over and who can read and understand English can take part in this study.

What will happen to my data?

If you agree to take part, you may be asked if you would like to provide your email address for the researcher to send you a link to complete the questionnaires, or the link may already have been provided to you. You will also be asked if you would like to enter a prize draw for a chance to win a £25 Amazon voucher, which means sharing your email address. This email will be stored in a secure file that only the main researcher can access, and it will be deleted at the end of the study when the prize draw has taken place (approximately June 2022). No other personal information

will be collected from you during this study. All data collected will be anonymous and stored confidentially.

The University of Sheffield is the Data Controller for this study, which means that they are responsible for ensuring the safety of your information. The anonymous data set may be made available for future authorised research purposes should this be deemed essential to the progress of psychological research.

If you exit the study without completing the survey and pressing the 'submit' button, then your data will not be saved.

What will happen to the results of the study?

The data will be put into a report that will contribute to a Doctor of Clinical Psychology Thesis, which will be read by assessors at the University of Sheffield. It is also helpful for these reports to get published in a scientific journal. Any data presented will be anonymised.

Ethical Approval

The project has been ethically approved via the University of Sheffield's Ethics Review Procedure, as administered by the Psychology Department.

Do I Have to Take Part?

Participation within the research is entirely voluntary. You may decide not to participate. If you choose to participate, you do not have to answer any questions you do not wish to, and you can withdraw from the survey by closing the webpage. Once you have completed the survey and once your responses have been submitted, you will be unable to withdraw.

Contact Details for Further Information or Questions

This research is being conducted by Lucy Stephens (project lead), a trainee clinical psychologist, as part of the Doctoral programme at the University of Sheffield. Amrit Sinha is the research support officer at the University of Sheffield. The project is being supervised by Dr Georgina Rowse. If you have any concerns about this study or wish to make a complaint please contact one of us at the below email addresses:

Lucy Stephens email address: lstephens4@sheffield.ac.uk

Amrit Sinha email address: a.sinha@sheffield.ac.uk

Dr Georgina Rowse email address: g.rowse@sheffield.ac.uk

Thank you for reading this information sheet. If you have any questions, please feel free to contact the project lead.

Appendix J

Consent



PARTICIPANT CONSENT FORM

Title: The Relationship Between Sensory Sensitivity and Social Anxiety, across the Spectrum of traits of Autism Spectrum Conditions and Psychotic-like Experiences

Please read the following paragraphs and if you are happy to continue to participate in the research, please sign below where indicated.

You can choose to withdraw your consent at any point in the process

Please read and answer the statements below.

Please tick the appropriate boxes	Yes	No
I have read and understood the project information sheet or the project has been fully explained to me (if you answer 'No' to this question please do not proceed. Please go back to the information sheet and only proceed when you are fully aware of what your participation will involve).		
I confirm that I am aged 18 years or above.		
I have been given the opportunity to ask questions about the project.		
I understand that taking part in the project will include completing a set of questionnaires.		
I consent to participate in the project.		
I understand that taking part is voluntary and that I can exit the survey at any time.		
I understand that once I have submitted my responses, I will not be able to withdraw my data.		
I do not have to give any reasons for why I no longer wish to participate. I understand that not taking part will not result in any adverse consequences.		
I understand that my personal details such as my email address will not be revealed to anybody outside of the project.		
I understand that the results of this study may be published, but confidentiality and anonymity must remain if so.		
I understand and agree that other authorised researchers may access this data in other studies, reports and publications, but confidentiality and anonymity must remain if so.		

Please sign if you consent to participate in the project:

Name:

Signature:

Appendix K

Study Debrief Form

PARTICIPANT DEBRIEF SHEET

Title: The Relationship Between Sensory Sensitivity and Social Anxiety, across the Spectrum of Autism Spectrum Conditions and Psychotic-Like Experiences

Your Participation

Thank you for taking part in this research.

Some people are more sensitive to their surroundings than others, this is sometimes called Sensory Sensitivity. Some people can become distressed when they experience things such as loud noises and bright lights, which can impact on other parts of their lives, such as social situations, and on their mental health. This study hopes to investigate the relationship between sensory sensitivity and worries about social situations.

Previous research has suggested that sensory sensitivity and traits of autism spectrum conditions can be related and also that sensory sensitivity and psychotic-like experiences can be related. We hope to find out more about if there is a link between sensory sensitivity, psychotic-like experiences, traits of autism spectrum conditions and worries about social situations. It is hoped that the results of this research will provide some new information about these links to increase our understanding of these experiences, so we can learn about how people can cope better with any worries they may have.

During your participation, you were asked to complete a series of questionnaires that asked about your personal characteristics, sensory experiences and mental health. These results will now be analysed to help answer the study aims.

The Impact of the Study

If you feel distressed by any of the questions that you have been asked, please seek additional support through your GP or from any of the following organisations:

NHS Direct

www.nhsdirect.nhs.uk

Mind, the mental health charity

<https://www.mind.org.uk/about-us/contact-us/>

Samaritans

Tel: 116 123

<https://www.samaritans.org/>

Please also feel free to contact the researchers:

Lucy Stephens email address: lstephens4@sheffield.ac.uk

Amrit Sinha email address: a.sinha@sheffield.ac.uk

Dr Georgina Rowse email address: g.rowse@sheffield.ac.uk

Appendix L

Ethics Approval



Downloaded: 15/02/2021
Approved: 15/02/2021

Lucy Stephens
Registration number: 190217965
Psychology
Programme: DCLinPsy

Dear Lucy

PROJECT TITLE: The Relationship Between Sensory Sensitivity and Social Anxiety, across the Spectrum of traits of Autism Spectrum Conditions and Psychotic-like Experiences
APPLICATION: Reference Number 037697

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 15/02/2021 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 037697 (form submission date: 02/02/2021); (expected project end date: 29/05/2022).
- Participant information sheet 1085575 version 2 (02/02/2021).
- Participant consent form 1085576 version 2 (02/02/2021).

If during the course of the project you need to [deviate significantly from the above-approved documentation](#) please inform me since written approval will be required.

Your responsibilities in delivering this research project are set out at the end of this letter.

Yours sincerely

Department Of Psychology Research Ethics Committee
Ethics Administrator
Psychology

Please note the following responsibilities of the researcher in delivering the research project:

- The project must abide by the University's Research Ethics Policy: <https://www.sheffield.ac.uk/rs/ethicsandintegrity/ethicspolicy/approval-procedure>
- The project must abide by the University's Good Research & Innovation Practices Policy: https://www.sheffield.ac.uk/polopoly_fs/1.6710661/file/GRIPPpolicy.pdf
- The researcher must inform their supervisor (in the case of a student) or Ethics Administrator (in the case of a member of staff) of any significant changes to the project or the approved documentation.
- The researcher must comply with the requirements of the law and relevant guidelines relating to security and confidentiality of personal data.
- The researcher is responsible for effectively managing the data collected both during and after the end of the project in line with best practice, and any relevant legislative, regulatory or contractual requirements.

Appendix M

Normality Tests Outputs

SO-LIFE

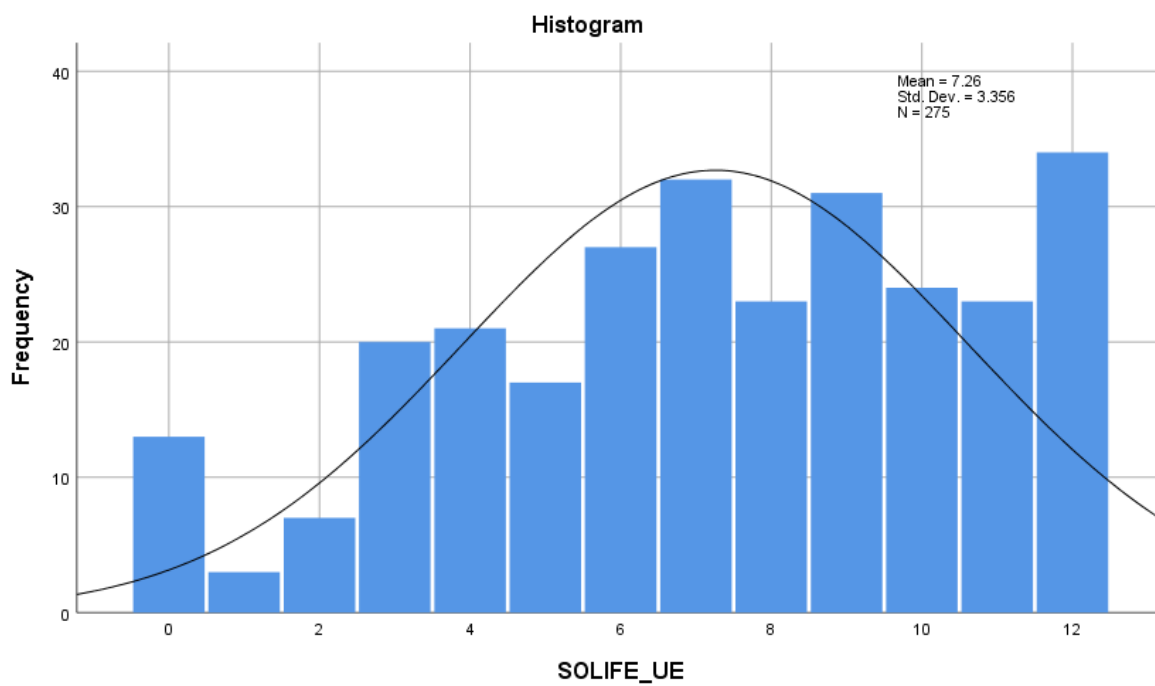
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SOLIFE_UE	.105	275	.000	.950	275	.000
SOLIFE_CD	.106	275	.000	.971	275	.000
SOLIFE_IA	.158	275	.000	.917	275	.000
SOLIFE_IN	.189	275	.000	.934	275	.000
SOLIFE_total	.049	275	.200*	.986	275	.009

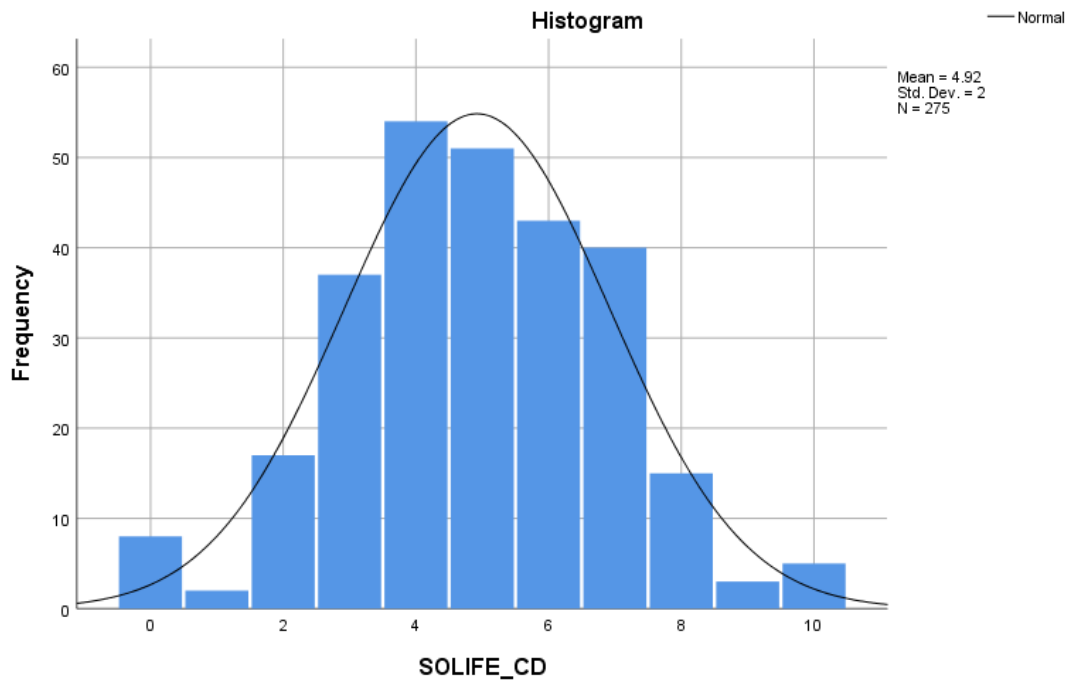
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

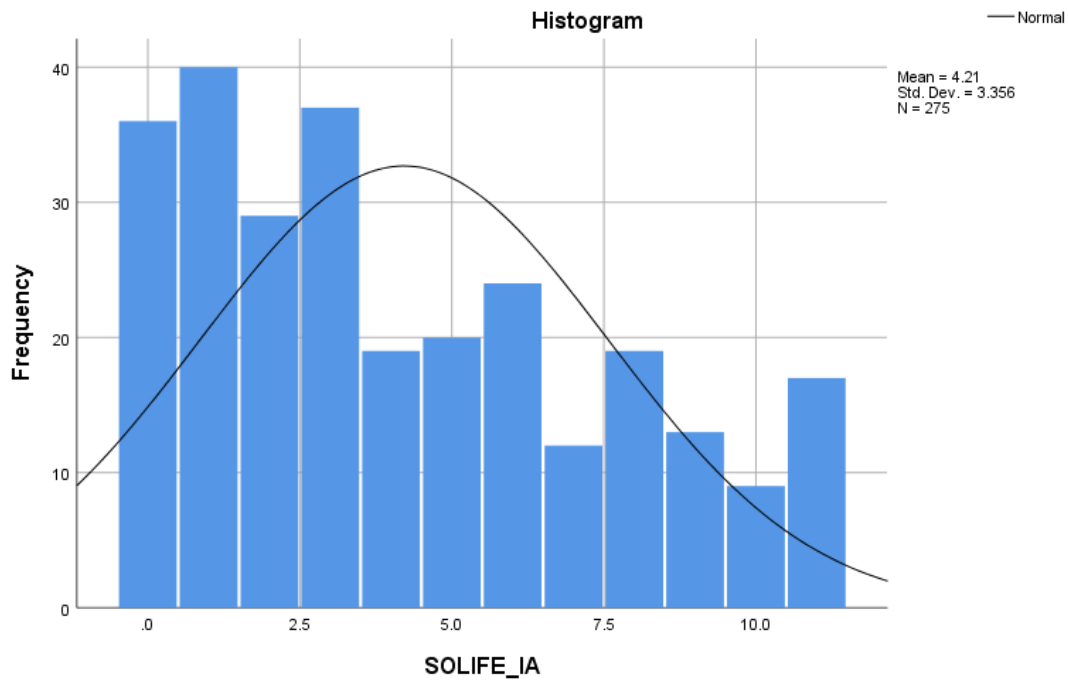
Unusual Experiences Subscale



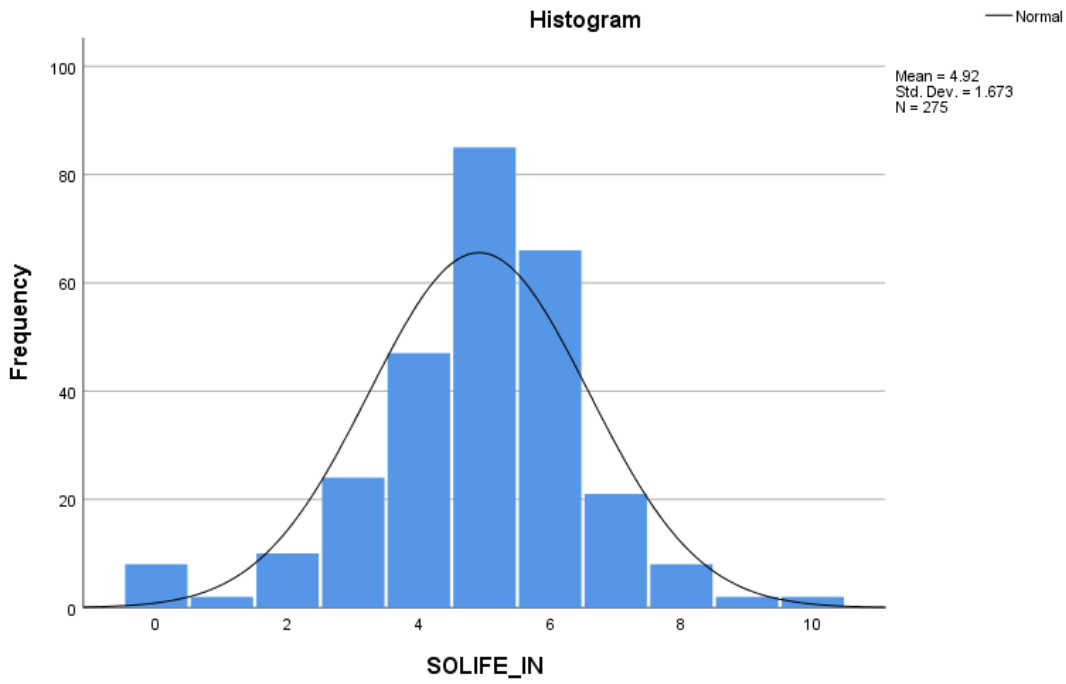
Cognitive Distortions Subscale



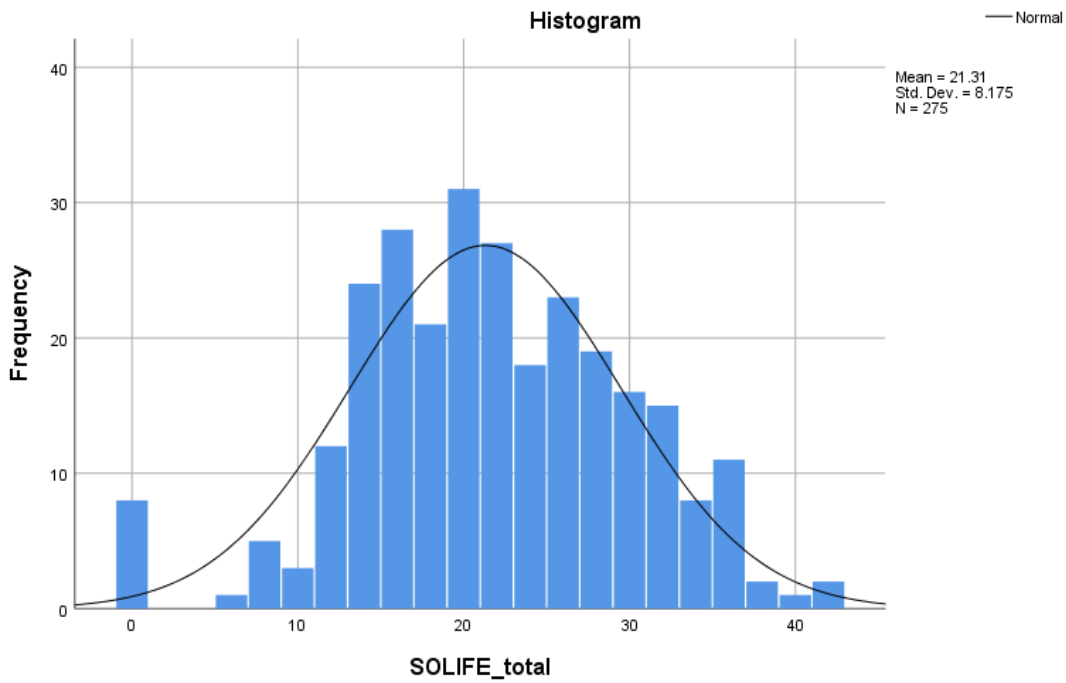
Introvertive Anhedonia Subscale



Impulsive Nonconformity Subscale



SOLIFE Total



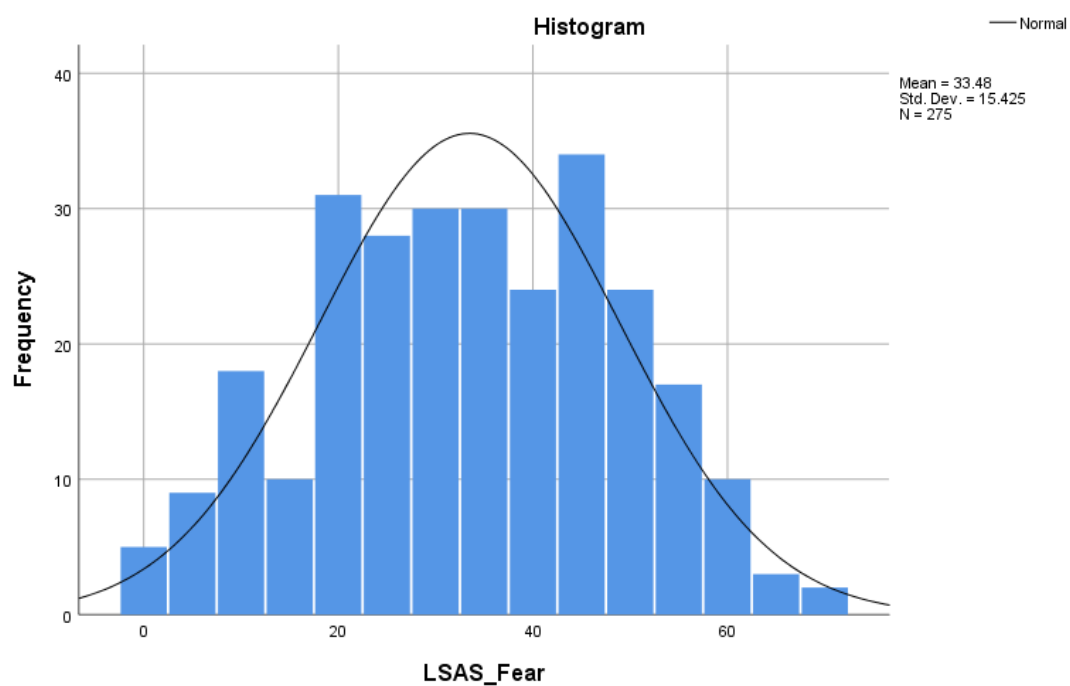
LSAS

Tests of Normality

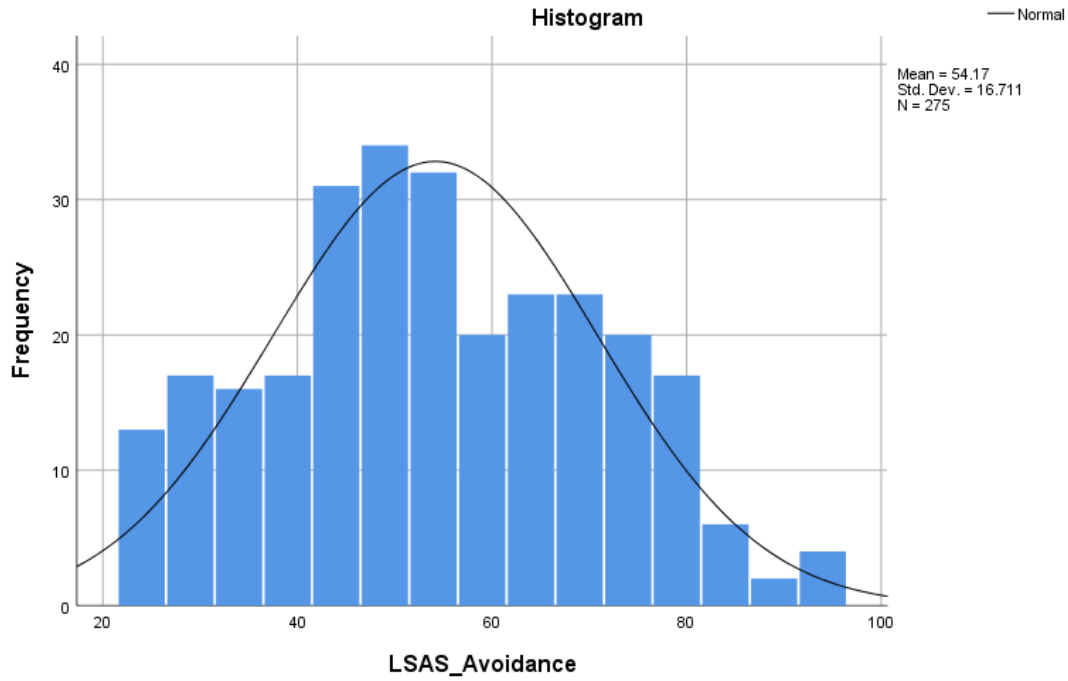
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LSAS_Fear	.059	275	.023	.989	275	.042
LSAS_Avoidance	.058	275	.024	.982	275	.002
LSAS_Total	.062	275	.012	.987	275	.013

a. Lilliefors Significance Correction

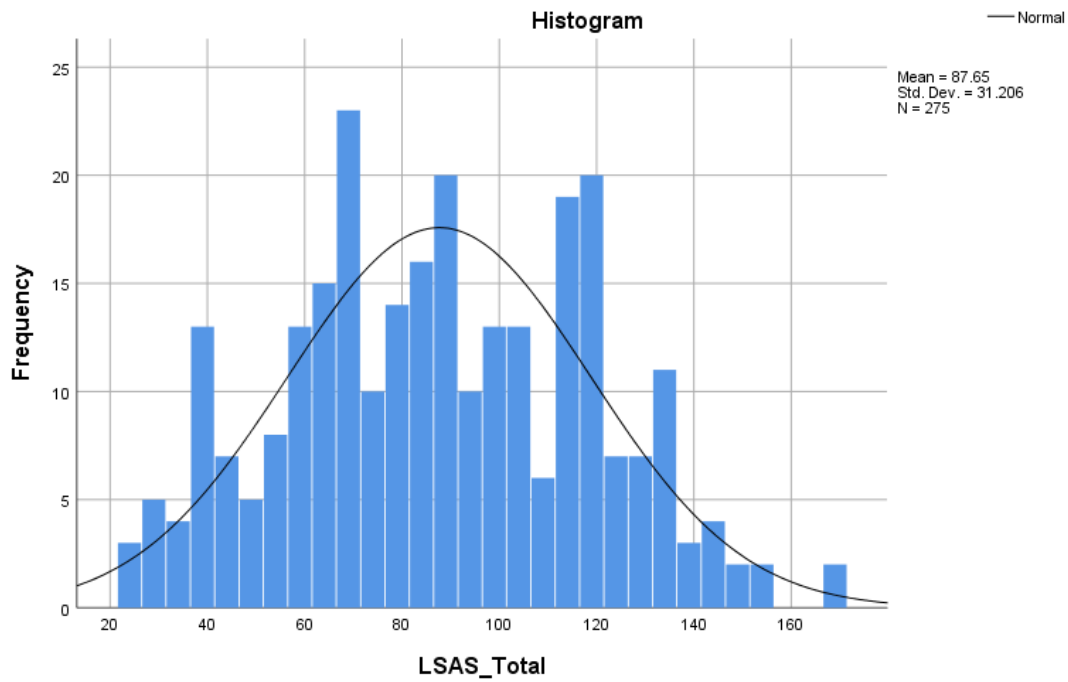
LSAS Fear Subscale



LSAS Avoidance Subscale



LSAS Total

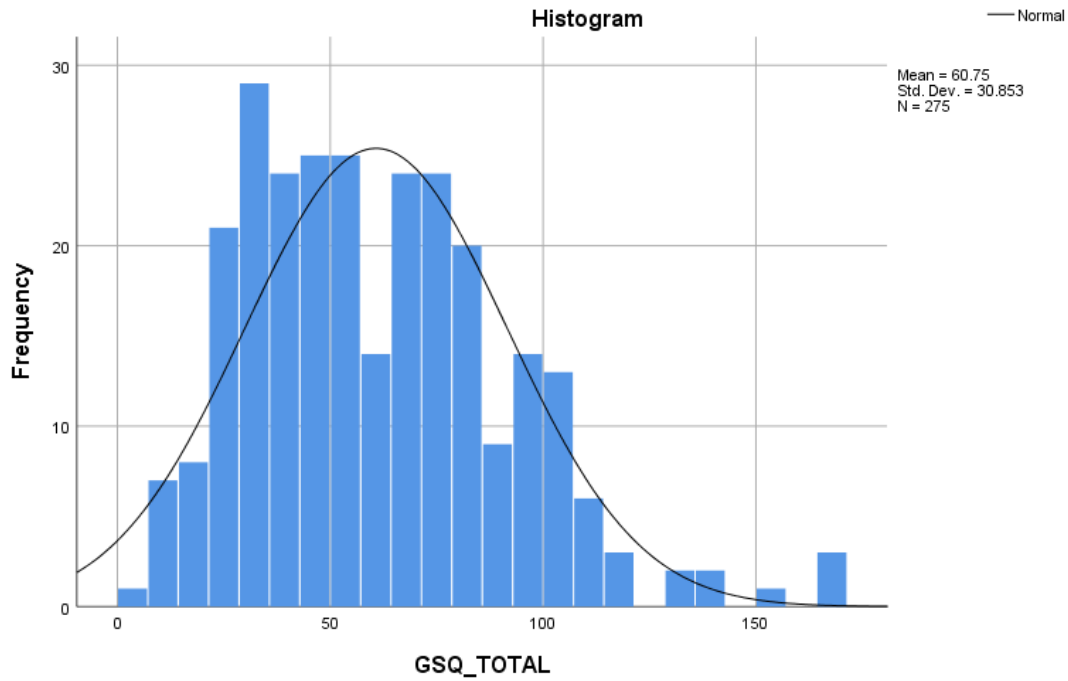


GSQ

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
GSQ_TOTAL	.084	275	.000	.961	275	.000

a. Lilliefors Significance Correction



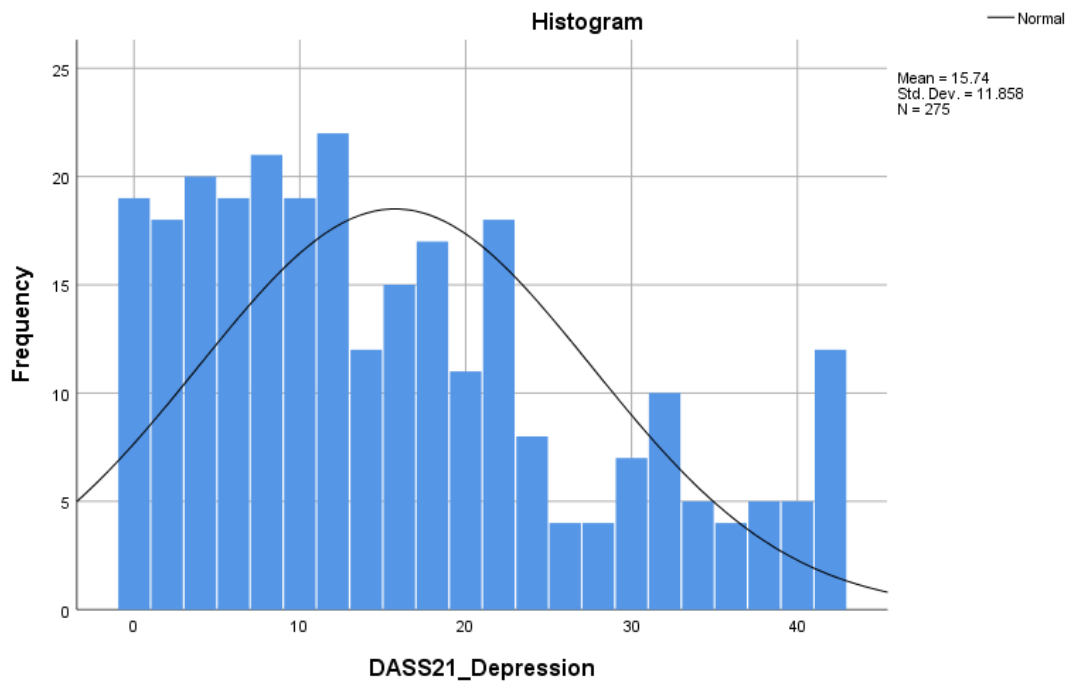
DASS-21

Tests of Normality

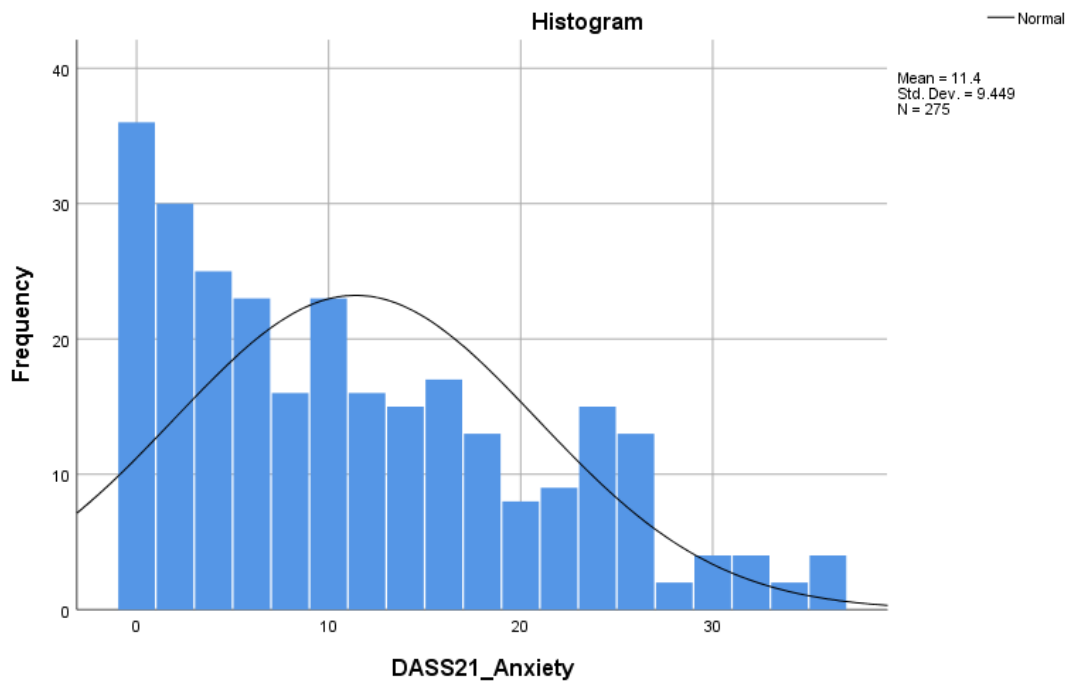
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
DASS21_Depression	.126	275	.000	.927	275	.000
DASS21_Anxiety	.131	275	.000	.923	275	.000
DASS21_Stress	.062	275	.012	.974	275	.000
DASS21_Total	.083	275	.000	.963	275	.000

a. Lilliefors Significance Correction

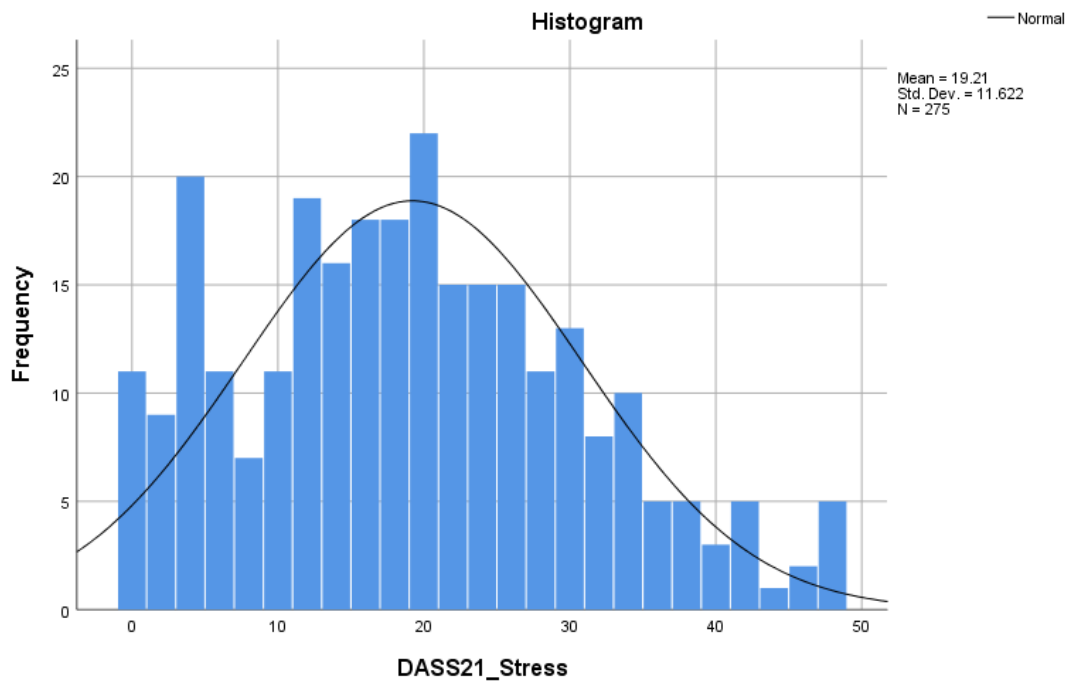
DASS-21 Depression Subscale



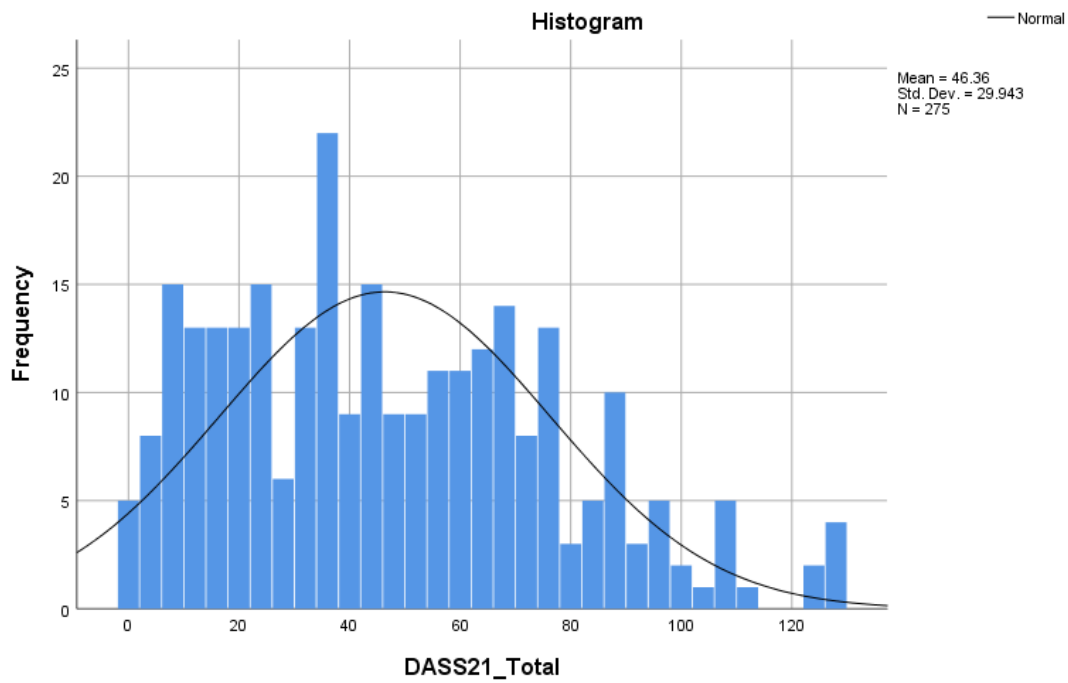
DASS-21 Anxiety Subscale



DASS-21 Stress Subscale



DASS-21 Total



BAPQ

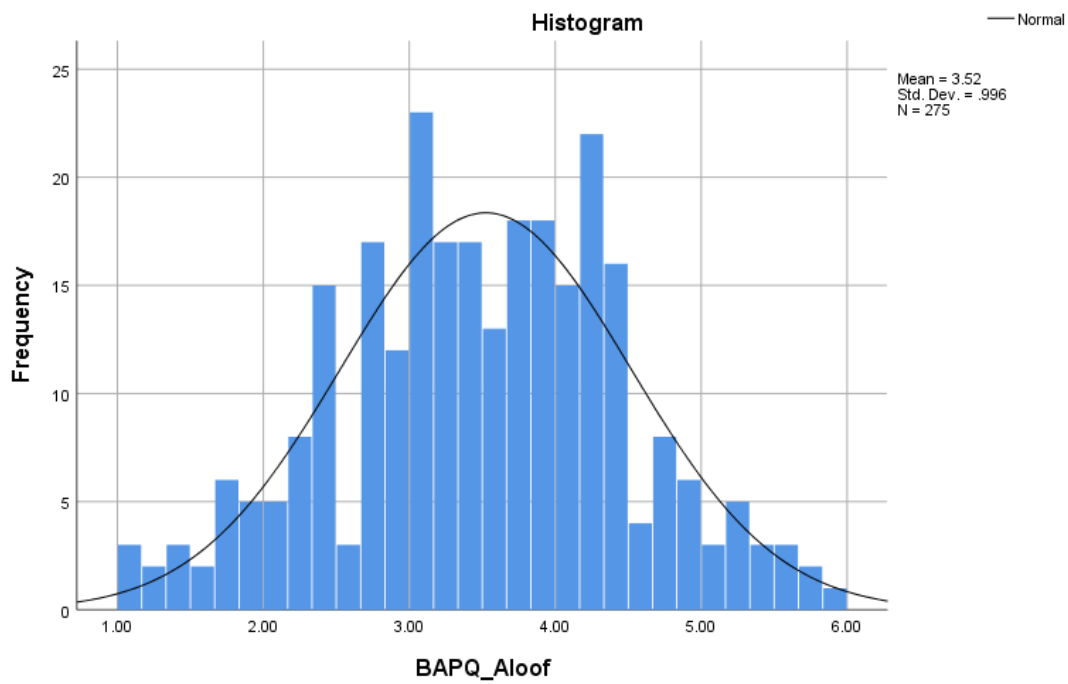
Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
BAPQ_Aloof	.041	275	.200*	.993	275	.256
BAPQ_PragmaticLanguage	.051	275	.079	.991	275	.091
BAPQ_Rigid	.046	275	.200*	.995	275	.591
BAPQ_Total	.031	275	.200*	.998	275	.960

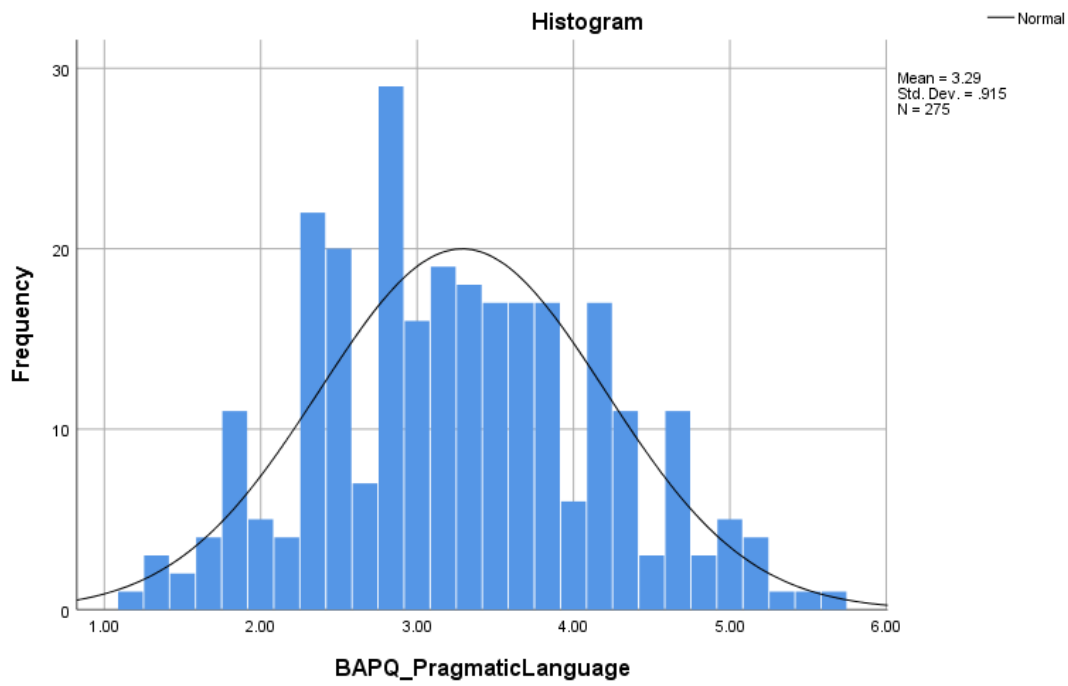
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

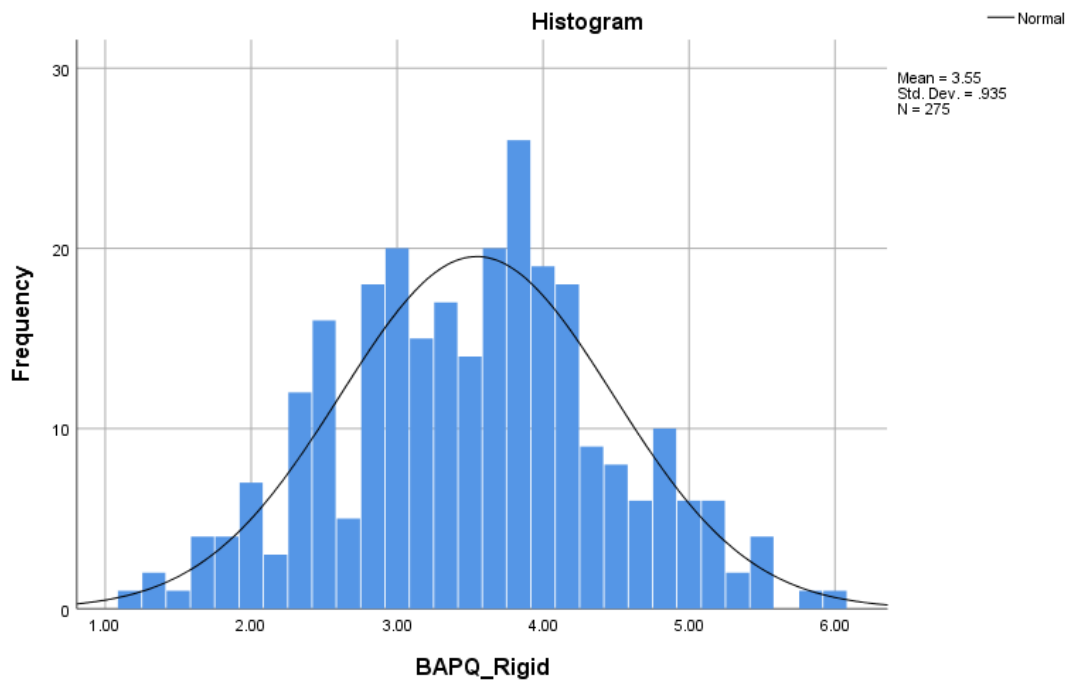
BAPQ Aloof Subscale



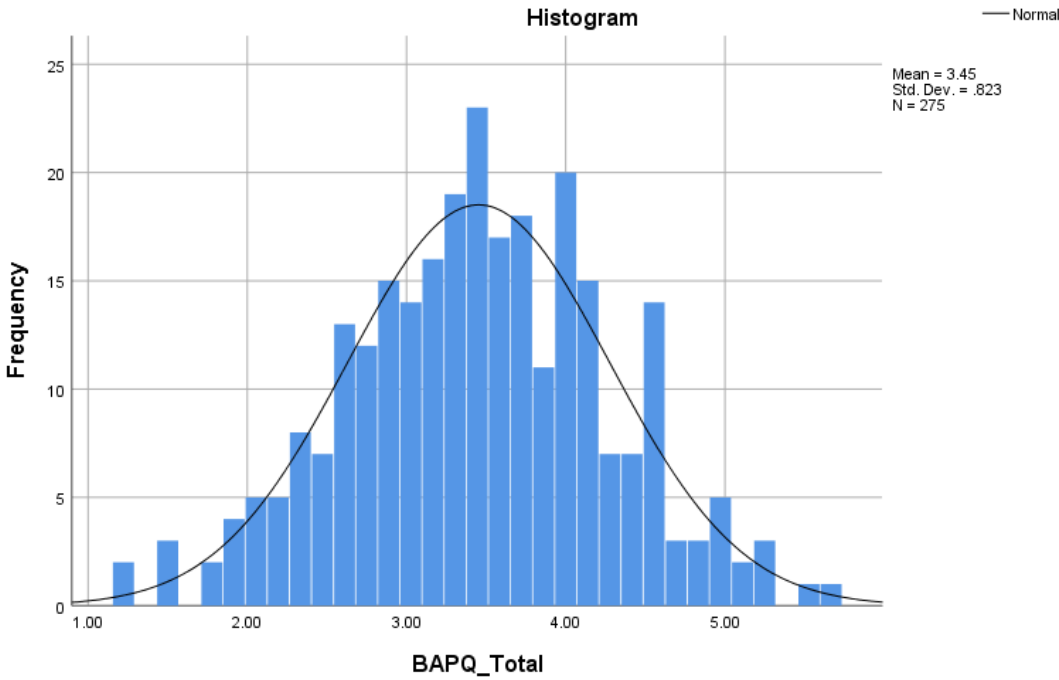
BAPQ Pragmatic Language Subscale



BAPQ Rigid Subscale

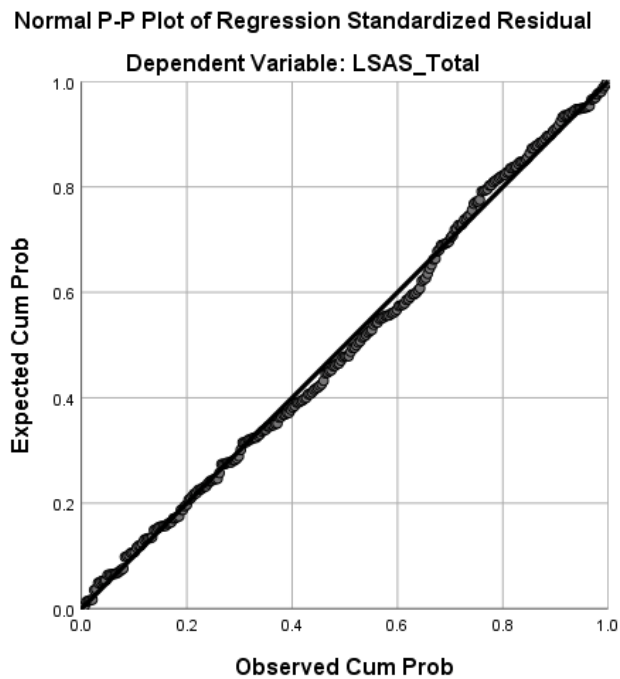
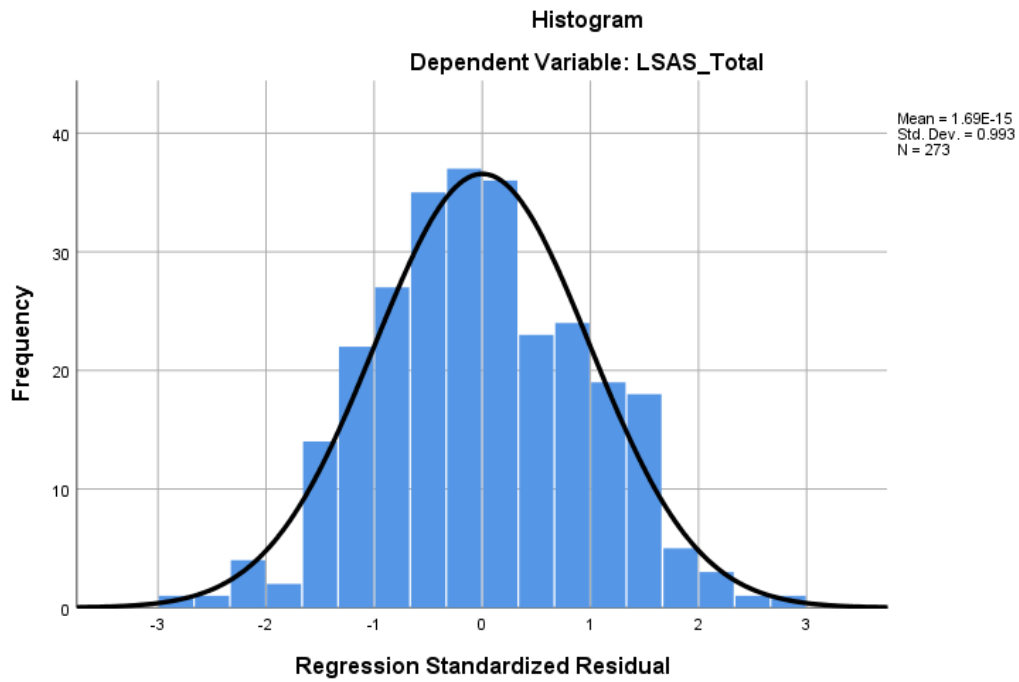


BAPQ Total

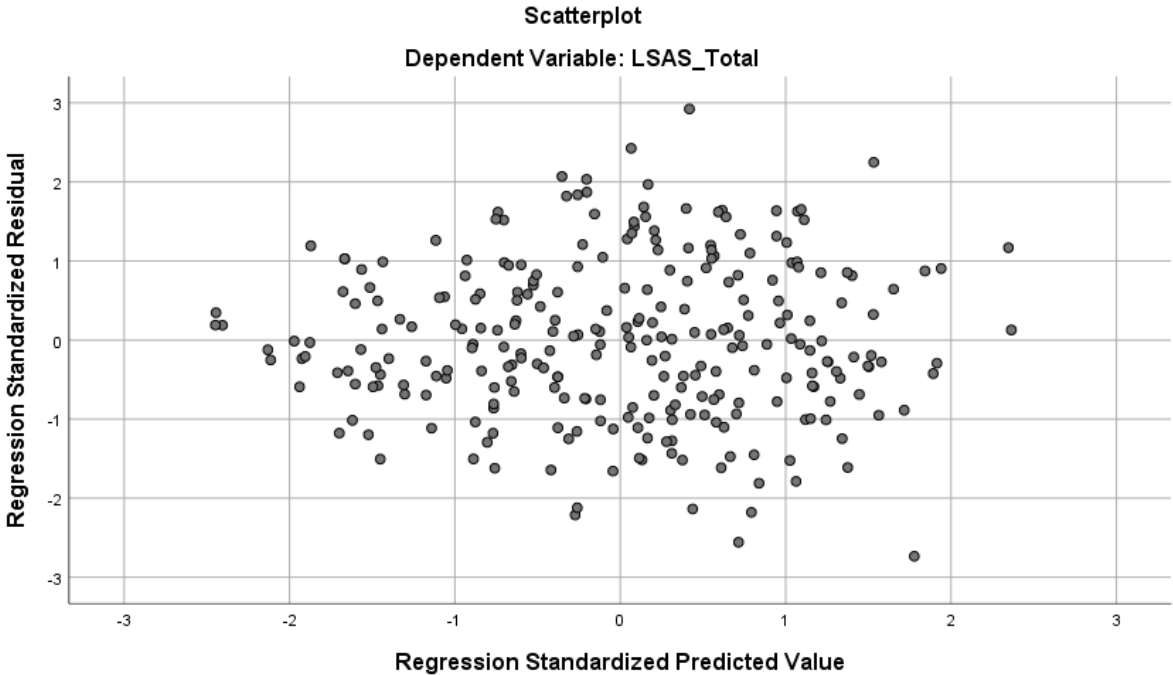


Appendix N

Histogram of standardised residuals, normal P-P plot of standardised residuals, and scatterplot of standardised residuals for Social Anxiety

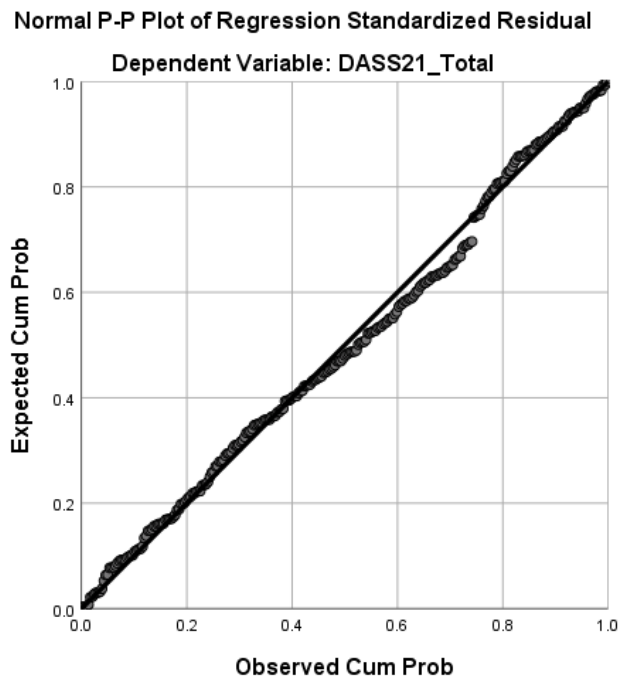
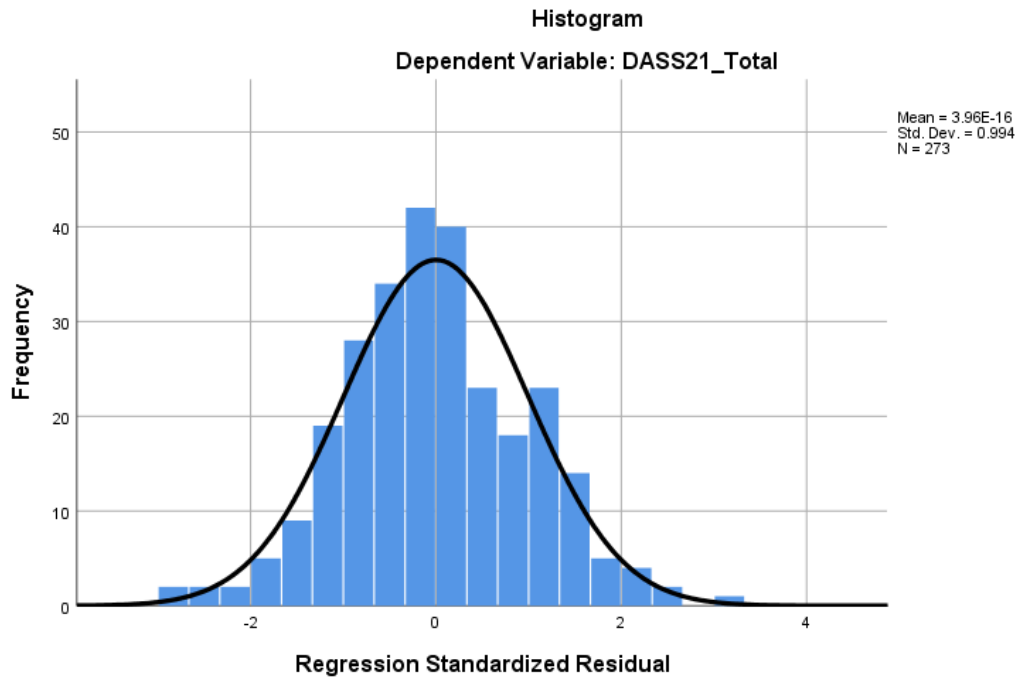


Heteroscedasticity:

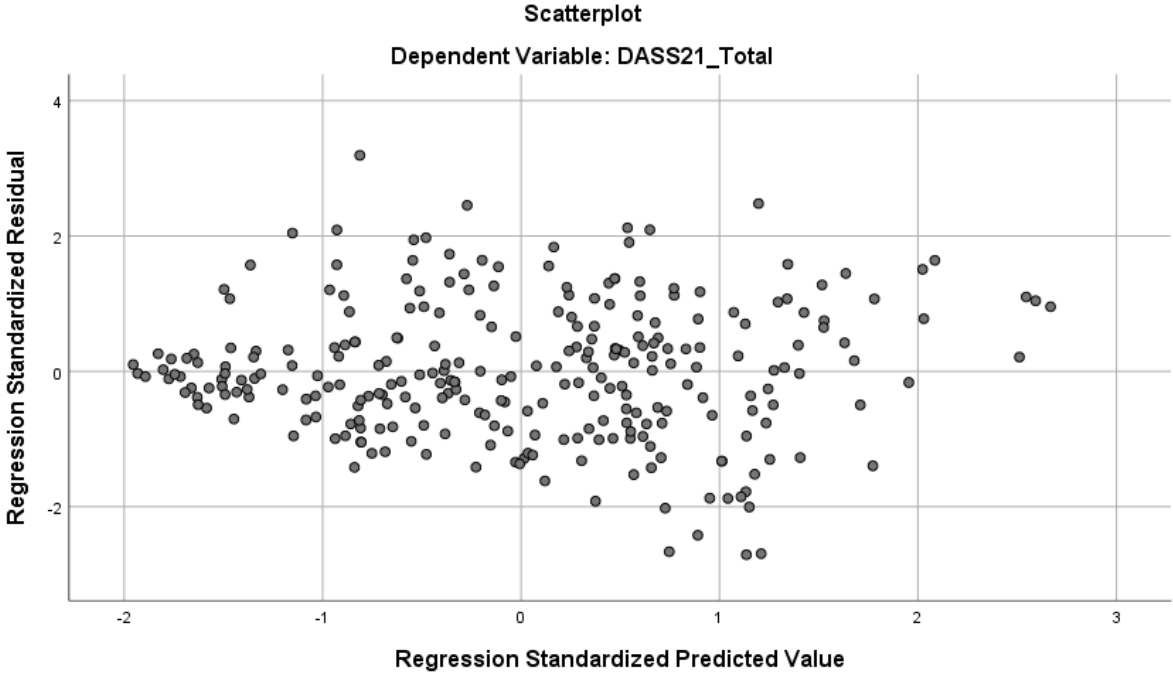


Appendix O

Histogram of standardised residuals, normal P-P plot of standardised residuals, and scatterplot of standardised residuals for Psychological Distress



Heteroscedasticity:



Appendix P

Social Anxiety Regression with Insignificant Demographics; Coefficients Table

		Coefficients^a				
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	-.331	13.514		-.024	.980
	Male	-16.909	8.738	-.238	-1.935	.054
	Female	-15.917	8.528	-.246	-1.866	.063
	Transgender	-16.736	11.151	-.086	-1.501	.135
	NonBinary	-8.939	9.870	-.064	-.906	.366
	AGECOLLAPSED	1.458	2.776	.020	.525	.600
	Do you have any formal mental health diagnoses? - Selected Choice	-.657	2.524	-.010	-.260	.795
	Do you have a diagnosis of an autism spectrum disorder?	8.656	3.209	.110	2.698	.007
	BAPQ_Total	14.479	2.001	.383	7.236	.000
	SOLIFE_total	1.432	.224	.384	6.389	.000
	GSQ_TOTAL	.150	.058	.149	2.591	.010

a. Dependent Variable: LSAS_Total

Appendix Q

Psychological Distress Regression with Insignificant Demographics

Model		Unstandardized Coefficients		Standardized Coefficients	Coefficients ^a	
		B	Std. Error	Beta	t	Sig.
2	(Constant)	-11.469	11.482		-.999	.319
	AGECOLLAPSED	-3.873	2.906	-.055	-1.333	.184
	ETHNICITY COLLAPSED	.361	3.036	.005	.119	.906
	Do you have any formal mental health diagnoses? - Selected Choice	.238	2.585	.004	.092	.927
	Do you have a diagnosis of an autism spectrum disorder?	1.510	3.322	.020	.454	.650
	BAPQ_Total	2.849	2.060	.078	1.383	.168
	SOLIFE_total	1.477	.232	.415	6.369	.000
	GSQ_TOTAL	.331	.060	.341	5.486	.000

a. Dependent Variable: DASS21_Total

Appendix R

Psychotic-Experiences

Results provided evidence of a significant difference between mean ranks of psychotic-like experiences and gender ($H(6) = 16.67, P=.01$). Pairwise comparisons were carried out for each pair of groups, finding a significant difference between male and non-binary, male and transgender male, and female and non-binary. Results were also significant for ethnicity ($H(10) = 26.25, P=.003$), with pairwise comparisons finding significant differences between a variety of groups including Black African and White British, White European, White Irish, Asian British, Black Caribbean and Asian and Asian British. Kruskal-Wallis also found a significant difference of psychotic-like experience scores across age ($H(6) = 24.19, P=.000$) and educational level ($H(5) = 26.13, P=.000$). Mann Whitney U tests revealed significant differences on psychotic-like experience scores between the dichotomous variables of mental health diagnosis ($U = 5454, P=.000$) and ASD diagnosis ($U = 3018, P=.000$).

ASD and Social Anxiety

To further explore the relationship between the BAPQ and LSAS-SR, 5 questions on the BAPQ that were related specifically to social anxiety were removed (Questions 1, 9, 16, 31 and 36). This was to test whether the measures were measuring different constructs. Following this, the BAPQ and LSAS-SR were still significantly positively correlated ($r=.680, p=.000$), the BAPQ remained a significant predictor of social anxiety ($R^2_{\text{adjusted}} = .494, R^2_{\text{change}} = .496$), and the regression model was highly significant ($F(3,269) = 144.18, R^2_{\text{adjusted}} = .612, p < .001$ (Appendix R).

Analyses with questions removed from BAPQ

Questions removed:

Item 1: I like being around other people

Item 9: I enjoy being in social situations

Item 16: I look forward to situations where I can meet new people

Item 31: I prefer to be alone rather than with others

Item 36: I enjoy chatting with people

Correlations

		LSAS_Total	BAPQ_Total	GSQ_TOTAL	SOLIFE_total
Pearson Correlation	LSAS_Total	1.000	.704	.637	.730
	BAPQ_Total	.704	1.000	.651	.688
	GSQ_TOTAL	.637	.651	1.000	.724
	SOLIFE_total	.730	.688	.724	1.000
Sig. (1-tailed)	LSAS_Total	.	.000	.000	.000
	BAPQ_Total	.000	.	.000	.000
	GSQ_TOTAL	.000	.000	.	.000
	SOLIFE_total	.000	.000	.000	.
N	LSAS_Total	273	273	273	273
	BAPQ_Total	273	273	273	273
	GSQ_TOTAL	273	273	273	273
	SOLIFE_total	273	273	273	273

Model Summary^c

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			Sig. F Change	Durbin-Watson	
					R Square Change	F Change	df1			df2
1	.704 ^a	.496	.494	21.998	.496	266.821	1	271	.000	
2	.785 ^b	.617	.612	19.261	.120	42.246	2	269	.000	1.729

a. Predictors: (Constant), BAPQ_Total

b. Predictors: (Constant), BAPQ_Total, GSQ_TOTAL, SOLIFE_total

c. Dependent Variable: LSAS_Total

ASD Diagnosis

Table 6

Differences in Scores on Measures between ASD diagnosis and ASD non-diagnosis group

Measure	Mean Score (SD) ASD sample (n=52)	Mean Score (SD) Non-ASD sample (n=221)	Differences Between Groups
LSAS-SR	100.06 (30.30)	85.25 (30.47)	U=4199.0, P=.003
DASS-21	63.31 (30.53)	42.71 (28.38)	U=3604.0, P=.000
BAPQ	3.94 (.75)	3.35 (.79)	U=3260.0, P=.000
sO-LIFE	25.29 (6.26)	18.48 (8.20)	U=3018.0, P=.000
GSQ	86.25 (33.16)	54.93 (26.94)	U=2617.0, P=.000

Note. SD= Standard Deviation, U = Mann-Whitney U Test

Appendix S

Post-hoc Exploratory Moderation

Model : 1
Y : DASS_T
X : BAPQ_T
W : GSQ_T

Sample
Size: 273

OUTCOME VARIABLE:
DASS_T

Model Summary

R	R-sq	MSE	F	df1	df2	p
.7187	.5166	435.9073	95.8201	3.0000	269.0000	.0000

Model

	coeff	se	t	p	LLCI	ULCI
constant	46.7967	1.4959	31.2828	.0000	43.8515	49.7419
BAPQ_T	8.1155	2.0351	3.9879	.0001	4.1089	12.1222
GSQ_T	.5425	.0546	9.9434	.0000	.4351	.6500
Int_1	-.0101	.0507	-.1990	.8424	-.1100	.0898