Social anxiety in adult males with autism spectrum disorders - Spain, D et al

Abstract

Background

Psychiatric conditions, notably anxiety, commonly co-occur with autism spectrum disorders (ASD).

Method

This study investigated self-reported behavioural, cognitive and affective symptoms of social anxiety (SA) in 50 adult males with ASD. Associations between SA, core ASD symptoms and facets of neuropsychological functioning were also examined.

Results

Twenty-six participants (52%) endorsed levels of SA that exceeded the suggested caseness threshold for social anxiety disorder. Categorical and dimensional data analyses indicated that there were no relationships between SA symptoms, present-state or childhood ASD symptom-severity, or measures of socio-emotional processing in this sample.

Conclusions

Study findings suggest that severity of SA is not merely a reflection of ASD symptom-severity. Further research is needed to ascertain the prevalence of SA in adult ASD epidemiological samples, and identify causal and maintaining mechanisms for these co-morbid symptoms.

1. Introduction

Psychiatric disorders are frequently and consistently found to co-occur with autism spectrum disorders (ASD) (e.g. Lever & Geurts, 2016; Russell et al., 2016; Simonoff et al., 2008). High rates and levels of social anxiety, in particular, have been reported in children and adolescents with ASD (e.g. Bellini, 2004; Kuusikko et al., 2008; Melfsen, Walita, & Warnke, 2006; Russell & Sofronoff, 2005). Data obtained from self- and informant-report instruments suggest that up to 50% of young people with ASD may score above normative levels for social anxiety, although ratings from different informants do not always correlate significantly (Bellini, 2004).

Relatively little is known about social anxiety disorder (SAD) in adults with ASD, despite this being the most common anxiety disorder in the typically developing adult population, with high rates of co-morbid depression, other anxiety disorders, substance use, and increased risk of suicide (NICE, 2013). Cross-sectional studies that have examined general rates of psychiatric co-morbidity in adults

with ASD, recruited via community (n = 172, Lever & Geurts, 2016) and clinical settings (n = 122, Hofvander et al., 2009; n = 63, Joshi et al., 2013; n = 474, Russell et al., 2016), have estimated that between 12% and 56% of adults meet diagnostic criteria for SAD. Three studies to date, have focused specifically on SAD in adults with ASD. Cath, Ran, Smit, van Balkom, and Comijs (2008) examined similarities and differences in self-reported SAD, obsessive compulsive disorder (OCD), and affective symptoms in 12 adults with ASD, compared to matched clinical and non-clinical controls. Participants completed several questionnaires including the Liebowitz Social Anxiety Scale, one of the most widely used self-report social anxiety measures (LSAS: Liebowitz, 1987). Comparable levels of anxiety were found in the SAD, and ASD and SAD groups. Bejerot, Eriksson, and Mortberg (2014) found that 28% of adults with ASD (n = 14 of 50) met the criteria for SAD using the clinician-administered MINI International Neuropsychiatric Interview (M.I.N.I.: Sheehan et al., 1998), as well as the LSAS. Finally, Maddox and White (2015) investigated SAD in three adult samples; individuals with ASD (n = 28), individuals with SAD but no ASD (n = 26), and non-clinical controls (n = 25). Using self-report questionnaires and an objective assessment of anxiety, their findings indicated that 50% of individuals with ASD presented with clinically significant SAD as measured by the Anxiety Disorders Interview Schedule (ADIS-IV: Brown, DiNardo, & Barlow, 1994), and the Social Interaction Anxiety Scale (SIAS: Mattick & Clarke, 1998). By contrast, there were no differences between the ASD and ASD + SAD groups on the Brief Fear of Negative Evaluation Scale (Brief FNE: Leary, 1983).

The notion of co-morbid social anxiety in ASD is, however, inherently complex in several respects. First, there is a clear overlap between the symptom profiles of these two disorders (White et al., 2012). ASD is characterised, for example, by qualitative impairments in reciprocal social interaction (WHO, 1992), while hallmark features of SAD also include difficulties with initiating and maintaining interactions and conversations, as well as social avoidance. Second, similar impairments in neuropsychological functioning have been observed in individuals with ASD and those with SAD, such as emotion and face processing deficits (Brunsdon & Happé, 2014; Morrison & Heimberg, 2013; Wong, Beidel, Sarver, & Sims, 2012); again rendering it difficult to demarcate one disorder from the other. Third, both conditions can impair and restrict attainment and independence; symptoms typically affect peer and social relationships, schooling, and employment.

Assessment of SAD in individuals with ASD poses challenges (Kreiser & White, 2014). Individuals with ASD and/or their significant others (e.g. family members) may not spontaneously seek assessment for social avoidance or social evaluative worries, as these characteristics may be attributed to the core disorder. Even when individuals do present to services, impairments in introspection due to theory of mind deficits (Williams & Happé, 2010), or alexithymia (difficulties labelling own emotions, Bird, Press, & Richardson, 2011) can render it difficult for them to describe physical and cognitive symptoms of anxiety. Further, while some studies suggest that individuals with ASD are able to self-report psychopathology symptoms (e.g. Berthoz & Hill, 2005; Cadman et al., 2015), commonly used social anxiety measures are yet to be validated for the ASD population. Use of multiple measures that focus on a range of behavioural, cognitive and affective characteristics associated with social anxiety may therefore enhance the screening and assessment process (Kreiser & White, 2014; Maddox & White, 2015; Tyson & Cruess, 2012).

Perhaps as a result of these issues, the relationship between ASD and SAD has seldom been explored. As in typically developing populations, psycho-social factors, including adverse social experiences, cognitive processes such as information and attentional biases, and safety behaviours such as social withdrawal and avoidance, are likely implicated as risk, causal and/or maintaining mechanisms (see Clark, 1999; Morrison & Heimberg, 2013). However, it is also plausible that there are ASD-specific factors that serve to increase vulnerability for, and perpetuate, SAD. For example, it may be that core ASD characteristics, such as deficits in social skills, and/or difficulties with engaging reciprocally in social interaction, contribute to anxiety about social situations (e.g. Bellini, 2004; Tyson & Cruess, 2012; White, Oswald, Ollendick, & Scahil, 2009). Similarly, an intolerance of uncertainty (IoU), or hypo- and hyper-sensory sensitivities, have been found to be associated with anxiety symptoms (Boulter, Freeston, South, and Rodgers, 2014; Maisel et al., 2016; Wigham, Rodgers, South, McConachie, & Freeston, 2015) and these may encourage avoidance of social situations, e.g. because these seem unpredictable or overly stimulating. Additionally, facets of neuropsychological functioning (such as impairments in socio-emotional processing) could be implicated in anxiety development in ASD (White et al., 2009), for example, impairments in the ability to recognise and understand others' thoughts and intentions (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), may render social interactions difficult. Finally, poor peer relationships, rejection, and bullying, all of which occur often and repeatedly for young people and adults with ASD (Schroeder et al., 2014), may mean this population is susceptible to developing social evaluative concerns around difference, inferiority, and vulnerability, as well as encouraging social withdrawal, isolation and avoidance.

In summary, research findings indicate high rates and levels of social anxiety in children and young people with ASD, as measured by self- or informant-based instruments. Few studies have explored the frequency or nature of social anxiety in the adult ASD population, particularly adults who do not have a concurrent intellectual disability, and who are potentially more likely to need to face anxiety-provoking situations in the context of employment or independent living tasks. Also, prevalence estimates have varied widely, which may be due to differences in study sampling frames and selection criteria, inclusion/exclusion of individuals with heterogeneous ASD presentations, and assessment of SAD using different measures, not all of which rate cognitive, affective and behavioural characteristics associated with social anxiety. Despite the difficulties with assessing and diagnosing SAD in ASD, there is a clear need to better understand if and why these symptoms might co-occur in order to aid early identification of need, and the development of evidence-based treatments.

The aims of the present study were therefore as follows: (1) to explore the frequency and range of self-reported social anxiety symptoms in a sample of adult males with ASD and no intellectual impairment; (2) to examine the relationship between data from multiple self-report social anxiety questionnaires commonly used in clinical/research fields; (3) to investigate the relationship between anxiety symptoms and ASD symptom-severity given that core impairments may be associated with the development of anxiety; and (4) to examine facets of socio-emotional processing in relation to

social anxiety. We hypothesised there would be high rates of self-reported social anxiety symptoms, and that there would be associations between social anxiety, ASD symptom-severity, and socio-emotional processing.

2. Methods

2.1. Participants

Participants were recruited from a sample of adult males, living across south-east England, who had previously taken part in the Autism-Imaging case-control Multi-site Study (AIMS: Ecker et al., 2012). The original AIMS sampling frame consisted of 100 males recruited from clinical and non-clinical services (e.g. via ASD non-statutory organisations); 51 of the AIMS participants consented to take part in the present study. Inclusion criteria for the AIMS study were: males aged 18 and over; a clinical-research diagnosis of autism (and no concurrent intellectual impairment) or Asperger's syndrome; and verbal, performance and full scale IQ≥70. We solely recruited adults who did not have an intellectual impairment, as this could confound results. Individuals were excluded if they had diagnoses of epilepsy, chromosomal or psychotic disorders.

2.2. Materials

2.2.1. Autism spectrum diagnosis

Data pertaining to ASD diagnosis (autism, Asperger syndrome) were obtained from the AIMS dataset. ASD diagnosis was made according to ICD-10 research criteria (WHO, 1992), and confirmed with the ADI-r (Lord, Rutter, & LeCouteur, 1994). ADI-r scores needed to meet threshold on two of the three domains of ASD (reciprocal social interaction, communication, and restricted and repetitive patterns of interest and behaviour). Scores could fall below threshold by one point only in one domain (Ecker et al., 2012) given the potential problems with recall when using the ADI-r with adult samples. Present-state assessment of ASD symptomatology was confirmed using the Autism Diagnostic Observation Schedule-generic (ADOS-G: Lord et al., 2000). Clinical and diagnostic assessments were undertaken by psychiatrists or clinical-researchers experienced in working with individuals with ASD; ADI-r and ADOS-G administration were undertaken by reliability-trained clinical-researchers. Participants were also asked to complete the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) prior to their initial AIMS appointment.

2.2.2. Social anxiety

Four self-report social anxiety measures were completed. All measures have been validated for non-ASD samples. As normative thresholds have not yet been established for individuals with ASD, we relied on suggested cut-off scores (i.e. denoting clinically significant symptoms) from non-ASD samples, as has been the case for most other studies using self-report measures of psychopathology symptoms in ASD. The primary social anxiety outcome measure for the present study was the Liebowitz Social Anxiety Scale-SR (LSAS-SR: Liebowitz, 1987), as used in two previous studies of SAD

in adults with ASD (Bejerot et al., 2014; Cath et al., 2008). The LSAS-SR is a self-report 24 item questionnaire comprising six sub-scales, measuring the extent to which individuals experience fear/anxiety in, and avoid, common social interaction or performance situations, for example "telephoning in public; meeting strangers; and eating in public places". Items are rated on a four point Likert-scalewith a total score of 60 or more suggestive of generalised social anxiety and a maximum score of 144 (Liebowitz, 1987). The LSAS-SR has good psychometric properties in non-ASD samples; internal consistency is high for the total score (α 0.95), and subscale scores (total fear/anxiety subscale α 0.91; fear/anxiety in social interaction subscale α 0.89; fear/anxiety in performance situations subscale α 0.79; total avoidance subscale α 0.92; avoidance of social interaction subscale α 0.89; and avoidance of performance situations subscale α 0.84) (Baker et al., 2001).

Three further social anxiety questionnaires were administered in order to investigate the range of cognitive, affective and behavioural characteristics associated with social anxiety. The Brief Fear of Negative Evaluation Scale (Brief FNE: Leary, 1983), used in one previous ASD study (Maddox & White, 2015), is a self-report questionnaire rating the strength of belief in cognitions associated with social anxiety, for example "When I am talking to someone, I worry about what they may be thinking of me". Items are rated on a five point Likert-scale. A higher score indicates greater social evaluative concerns. There are two principal versions of the Brief FNE: the original version has 12 items (including eight straightforward items and four reversed-scored items), and a more recent eight item version which includes the straightforward items only (Carleton et al., 2011). Participants in the present study completed the 12 item version, although results for the straightforward eight items were calculated and are also reported below. Internal consistency for the 12 item Brief FNE is high in non-ASD samples (α 0.90) (Leary, 1983).

The Social Phobia Scale (SPS: Mattick & Clarke, 1998; Mattick et al., 1989) is a 20 item self-report questionnaire measuring fear associated with being evaluated by others, including items such as "I fear that I may blush when I am with others [and] I am worried people will think my behaviour is odd". The Social Interaction Anxiety Scale (SIAS: Mattick & Clarke, 1998) is a 20 item self-report questionnaire rating behavioural, affective and cognitive responses during social interaction, for example "I feel tense if I am alone with just one person [and] when mixing socially, I feel uncomfortable". The SPS and SIAS are typically administered together, although in one recent ASD study, the SIAS was used in isolation (Maddox & White, 2015). Items for both questionnaires are rated on a five point Likert-scale. A higher score suggests greater social anxiety, with a maximum score of 80. The SPS and SIAS clinical cut-off scores suggested by Peters (2000), of >36 and >26 respectively were used. Internal consistency for both measures in (non-ASD) SAD samples is high (SPS α 0.89 and SIAS α 0.93) (Mattick & Clarke, 1998).

2.2.3. General mood and anxiety

Participants also completed a general screening measure of depression and anxiety. The Hospital Anxiety and Depression Scale (HADS: Zigmond & Snaith, 1983) is a self-report 14 item questionnaire measuring anxiety and depression. Items are rated on a four point Likert-scale. A score of eight or more in either subscale indicates caseness, with a maximum score of 21. The English version of the HADS has been used extensively to screen anxiety and depression in non-clinical and clinical samples (but not in ASD samples specifically), with internal consistency ratings of at least α 0.76 (anxiety subscale) and α 0.72 (depression subscale) in non-ASD samples (Bjelland et al., 2002).

2.2.4. IQ

Data pertaining to IQ were obtained from the AIMS dataset. The Wechsler Scale of Intelligence (WASI) was used to estimate verbal, performance, and full scale IQ (Wechsler, 1999).

2.2.5. Socio-emotional processing

We included three measures of socio-emotional processing in the present study, which had also been administered as part of the AIMS study.

The Karolinska Directed Emotional Faces (KDEF: Lundqvist et al., 1998) is a test of emotion recognition comprising 140 natural faces showing happiness, sadness, anger, disgust, fear, surprise, or a neutral expression. Each face is presented with the seven emotion words underneath, and participants are asked to decide which emotion best describes what the person is feeling. Reaction times and the number of correct responses were recorded. The KDEF stimuli have been validated in a non-ASD sample (Goeleven et al., 2008).

The Reading the Mind in the Eyes Task (RMET: Baron-Cohen, Wheelwright, Skinner et al., 2001): Participants completed an online version of the RMET, comprising 36 photographs of eyes with a choice of four words, from which participants choose the one that best describes what the person in the picture is thinking or feeling. Reaction times and accuracy are recorded. A recent systematic review of the RMET's psychometric properties reported mixed findings in the literature, but the same authors found good internal consistency and test-retest stability in their own validation study (Vellante et al., 2013).

The Frith-Happé Animations Test (FHA: Castelli et al., 2000; Castelli et al., 2002): This test of mental state attribution ('theory of mind') shows silent animations (39–42 s long) of two triangles interacting. Participants were asked to describe what happened in each animation. Data from the 'theory of mind' animations are reported; these are designed to evoke explanations in terms of intentions to deceive, persuade, and so forth. The verbal responses were coded for "intentionality", the degree of mental state attribution (0–5, with absence of mental state language at one pole and elaborate use of mental state language at the other), and "appropriateness" (0–3 with incorrect at one extreme and highly appropriate explanations at the other). Although (good) inter-rater reliability

is typically reported in studies using the FHA, the psychometric properties of this experimental measure have not been reported to date.

2.3. Procedure

Participants recruited to the AIMS study completed tasks in the following order: the AQ (and other self-report measures not reported here) were administered via a secure website prior to the initial appointment; the ADI-r was completed by a parent if this had not already been conducted elsewhere; the ADOS-G and WASI were undertaken at the outset of the testing appointment; and psychometric tasks were completed by participants in a randomised order for counter-balancing purposes (see Wilson et al., 2014 for a comprehensive overview of task administration). The present study used a cross-sectional design. AIMS participants who had consented to be re-contacted for research purposes were asked to complete five self-report questionnaires via a postal survey undertaken between April and August 2010. Attempts to increase the survey response rate included ensuring that the format and readability of questionnaires was clear, along with provision of stamped addressed envelopes, and reimbursement for participation (Edwards et al., 2009). Ethical approvals (REC ref Q0102/26) and informed consent were obtained.

2.4. Statistical analyses

Data were analysed using SPSS, version 19 (SPSS Inc.). Continuous variables were assessed with regard to assumptions underlying parametric tests. First, we estimated the reliability (internal consistency) of the social anxiety self-report measures using Cronbach's alpha. We then investigated the frequency and range of social anxiety symptoms for the whole sample. Using correlational analyses, we examined the inter-relation between the different self-report social anxiety questionnaires, and their relationship to ASD symptom-severity as measured by the ADOS-G and ADI-r (clinician-ratings of present-state and childhood ASD symptoms) and the AQ (self-reported ASD symptoms). We also investigated dimensionally the associations between the social anxiety measures and socio-emotional processing. Then, using the LSAS-SR as the primary outcome measure, we divided participants into those scoring above versus below the suggested SAD caseness threshold of 60, and explored whether these groups differed in (1) participant characteristics (age and IQ), (2) ASD symptom-severity, (3) socio-emotional processing, and (4) depression and anxiety scores between the two groups. As no ASD-specific thresholds for SAD on the LSAS-SR have been published, we used current accepted thresholds for the general population to split our ASD participants into those with versus without SAD. Two-sided pvalues are reported throughout.

3. Results

3.1. Response rate

Fifty-one males consented to complete the questionnaires. Data were excluded for one responding-participant due to missing diagnostic data. There were some missing questionnaire data for a further

four participants although we included these individuals in the analyses where possible. We were unable to ascertain reasons for non-participation in the study, nor were we able to establish the proportion of individuals who were under the care of clinical services. Baseline sample characteristics were compared between individuals who did and did not return questionnaires (see Table 1). There was a significant difference in age between the two groups ($t = 2.80$, $df = 83.42$, $p = 0.006$): individuals who did not complete questionnaires were older, on average. There were however, no significant differences in IQ, ADI-r or ADOS-G mean scores ($p > 0.05$, $d < 0.38$) between study participants and those who did not participate.

Table 1. Sample characteristics for autism-imaging case-control multi-site study (AIMS) cohort by response to current study.

	Non-responders n = 49 mean (s.d.)	Responders n = 50 mean (s.d.)
Age	30.3 (8.1)	26.3 (5.8)**
IQ		
Verbal IQ	110 (14.0)	108 (14.9)
Performance IQ	109 (15.8)	105 (15.8)
Full scale IQ	111 (14.6)	108 (14.7)
ADI-r		
Reciprocal social interaction	17.5 (5.0)	19.2 (5.5)
Communication	13.8 (4.3)	14.0 (4.1)
Repetitive behaviours	5.2 (2.4)	4.9 (2.4)
ADOS-G		
Communication	2.9 (1.8)	3.4 (1.7)
Reciprocal social interaction	5.8 (2.9)	6.7 (3.3)
Total ADOS-G score	8.7 (4.1)	10.2 (4.7)

Repetitive behaviours	1.4 (1.5)	0.9 (1.1)+				
BAI	12.5 (10.7)	11.0 (10.8)				
BDI	12.4 (10.1)	12.1 (10.8)				

ADI-r = Autism Diagnostic Interview-Revised; ADOS-G = Autism Diagnostic Observation Schedule; BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory.

3.2. Participant characteristics

Sample characteristics for the 50 male participants are summarised in Table 2. The mean age was 26 years (range 19–42). Full scale IQ for the sample overall was within the average range (IQ = 107). Most participants described their ethnicity as 'White European'. A third of participants (n = 17) were unemployed, 22% (n = 11) were employed, and 28% (n = 14) were students. Participants with a diagnosis of Asperger's syndrome did not differ from those with anautism diagnosis on any participant characteristics shown in Table 2, with the exception of higher verbal IQ (mean 113 versus 102), full scale IQ (112 versus 102) and lower ADI-r 'reciprocal social interaction' impairment scores (17 versus 22).

Table 2. Participant characteristics.

	Sample	LSAS-SR ≤59	LSAS-SR≥ 60	t	p	d
	n = 50	n = 19	n = 26			
Age	26.3 (5.8)	26.4 (4.8)	26.8 (6.8)	−0.02	0.986	−0.07
IQ						
Verbal IQ	108 (14.9)	109 (16.3)	109 (14.6)	0.05	0.961	0
Performance IQ	105 (15.8)	109 (17.0)	102 (14.6)	1.36	0.18	0.44
Full scale IQ	107 (14.7)	110 (16.0)	106 (14.5)	0.69	0.495	0.26
ADI-r						
Rec Soc Int	19.2 (5.5)	19.4 (5.4)	18.7 (5.6)	0.38	0.704	0.13
Communication	14.0 (4.1)	14 (4.6)	13.7 (3.7)	0.28	0.783	0.07
Rep behaviours	4.9 (2.4)	5.2 (2.7)	4.5 (2.0)	0.96	0.343	0.29

ADOS-G						
Communication	3.4 (1.7)	3.6 (1.5)	3.1 (1.5)	1.09	0.283	0.33
Rep Soc Int	6.7 (3.3)	6.8 (3.4)	6.2 (3.1)	0.62	0.542	0.18
Total ADOS-G score	10.1 (4.7)	10.4(4.8)	9.3 (4.1)	0.8	0.428	0.25
Rep behaviours	0.9 (1.1)	1.0 (1.2)	1.0 (1.1)	−0.04	0.967	0
AQ	29 (9.2)	26 (10.4)	31 (7.7)	−1.58	0.123	−0.55
LSAS-SR						
Total score	67 (28.5)	40 (12.1)	87 (17.9)	−10.04	0.000***	
−3.08						
Total Fear/Anxiety	35 (15.4)	21 (8.0)	44 (12.1)	−7.1	0.000***	
−2.24						
Total avoidance	33 (15.1)	18 (6.5)	43 (9.7)	−9.72	0.000***	
−3.03						
Brief FNE						
12 items	24 (10.9)	19 (6.8)	28 (11.6)	−3.06	0.004**	−0.95
8 items	14 (8.7)	10 (5.7)	18 (8.7)	−3.66	0.001***	
−1.09						
SPS	25 (16.5)	14 (9.6)	34 (16.2)	−4.71	0.000***	
−1.47						
SIAS	39 (16.0)	26 (10.4)	49 (12.2)	−6.72	0.000***	
−2.03						
HADS						
Anxiety	10 (5.1)	7.6 (4.3)	12.5 (4.8)	−3.52	0.001***	
−1.08						

Depression	6 (3.8)	4.6 (3.5)	7.3 (3.2)	−2.71	0.010**	−0.81

3.3. Internal consistency of measures

To examine reliability, we estimated Cronbach's alpha for the social anxiety self-report measures used. Internal consistency was high for all the measures: the LSAS-SR (total score α 0.96; total fear/anxiety subscale α 0.94; fear/anxiety in social interaction subscale α 0.92; fear/anxiety in performance situations subscale α 0.86; total avoidance subscale α 0.92; avoidance of social interaction subscale α 0.86; and avoidance of performance situations subscale α 0.86); the Brief FNE (12 item version α 0.90; 8 item version α 0.91); the SPS (α 0.93); and the SIAS (α 0.92). All coefficients are comparable to those reported for typically developing samples.

3.4. Analyses for total ASD sample

3.4.1. Frequency of self-reported social anxiety symptoms

Mean scores for each of the four social anxiety questionnaires are outlined in Table 2. Sample scores indicated high levels of self-reported behavioural, cognitive and affective social anxiety symptoms, across all the questionnaires. Using the LSAS-SR as the primary outcome measure, the mean total LSAS-SR score for 46 participants with complete data was 67.3 (s.d. 28.5, range 9–124). The proportion of participants scoring above the LSAS-SR social anxiety threshold was comparable in those diagnosed with autism (65%) and those diagnosed with Asperger's syndrome (52%).

3.4.2. Associations between participant characteristics and social anxiety

There were no significant associations found between the social anxiety measures (total score or subscales of the LSAS-SR, BFNE, SPS or SIAS), and age (all $r < 0.26$; $p > 0.05$), or verbal, performance, or full scale IQ (all $r < 0.18$; $p > 0.05$).

3.4.3. Associations between multiple self-report measures of social anxiety

Highly significant correlations were found between the sub-scales of the LSAS-SR (all $r > 0.60$; $p < 0.005$); and between all other social anxiety measures (all $r > 0.55$; $p < 0.05$).

3.4.4. Associations between ASD symptom-severity and social anxiety

There were no significant correlations between the social anxiety questionnaires (LSAS, Brief FNE, SPS or SIAS), and domains of the ADI-r (all $r < 0.18$; $p > 0.05$), or total and subscale scores of the ADOS-G (all $r < 0.10$; $p > 0.05$) However, relationships between the AQ and all social anxiety measures were significant (all $r > 0.38$; $p < 0.04$).

3.4.5. Associations between socio-emotional processing and social anxiety

There were no significant correlations between any of the four social anxiety questionnaires, and the socio-emotional tests (KDEF, RMET and FHA) (all $r < 0.24$; $p > 0.05$).

3.5. Group differences between ASD participants scoring above versus below the SAD caseness threshold

The sample was divided according to LSAS-SR scores: a threshold score of 60 or more (the suggested threshold for typically developing adult populations) was used to dichotomise the group. Characteristics for individuals with versus without clinical levels of social anxiety on the LSAS-SR are shown in Table 2.

3.5.1. Participant characteristics

Comparing groups scoring above and below the LSAS-SR caseness threshold, there were no significant differences in age ($t = -0.02$, $df = 42$, $p=0.986$, $d = -0.07$), verbal IQ ($t = 0.05$, $df = 43$, $p=0.961$, $d = 0$), performance IQ ($t = 1.36$, $df = 43$, $p=0.180$, $d = 0.44$), or full scale IQ ($t = 0.69$, $df = 43$, $p=0.495$, $d = 0.26$).

3.5.2. Associations between ASD symptom-severity and social anxiety

There were no statistically significant differences in mean ASD symptom-severity scores on the ADI-r between groups scoring above versus below the LSAS-SR social anxiety caseness threshold: reciprocal social interaction ($t = 0.38$, $df = 43$, $p=0.704$, $d = 0.13$); communication ($t = 0.28$, $df = 43$, $p=0.783$, $d = 0.07$); restricted, repetitive and stereotyped behaviours and patterns of interest ($t = 0.96$, $df = 43$, $p=0.343$, $d = 0.29$). Differences in the total and subscale scores of the ADOS-G were also not significant: communication ($t = 1.09$, $df = 43$, $p=0.283$, $d = 0.33$); reciprocal social interaction ($t = 0.62$, $df = 43$, $p=0.542$, $d = 0.18$), total score ($t = 0.80$, $df = 43$, $p=0.428$, $d = 0.25$); or stereotyped behaviours and repetitive interests ($t = -0.04$, $df = 43$, $p=0.967$, $d = 0$). Similarly, mean scores on the AQ did not differ significantly between groups ($t = -1.58$, $df = 41$, $p=0.123$, $d = -0.55$).

3.5.3. Associations between socio-emotional tasks and social anxiety

Performance of participants scoring above versus below the LSAS cut-off for SAD was examined across the three tests of emotion and social cognition. Table 3 shows the scores for these subgroups. There were no significant differences between mean scores on these measures between the groups: KEDF (RT $t = 0.86$, $df = 37$, $p=0.398$, $d = 0.27$; Correct $t = -0.09$, $df = 37$, $p=0.927$, $d = 0$); RMET (RT $t = 0.12$, $df = 39$, $p=0.864$, $d = 0.05$; Correct $t = 0.29$, $df = 39$, $p=0.773$, $d = 0$); and FHA (Intentionality score $t = -1.18$, $df = 30$, $p=0.247$, $d = -0.5$; Appropriateness score $t = -0.60$, $df = 30$, $p=0.550$, $d = 0$).

Table 3. Neuropsychological functioning results by caseness on Liebowitz Social Anxiety Scale (LSAS-SR).

	LSAS-SR ≤59	LSAS-SR ≥60
KEDF	(n = 16)	(n = 23)
RT	3044 (1122)	2793 (707)

Corr	79 (10)	79 (10)
RMET	(n = 18)	(n = 23)
RT	6878 (2429)	6744 (2504)
Corr	22 (4)	22 (7)
FHA	(n = 13)	(n = 19)
Int	9 (2)	10 (2)
App	3 (2)	3 (2)

3.5.4. General anxiety and depression scores

Comparing the groups scoring above and below the LSAS-SR caseness threshold, significant differences were found in HADS depression scores ($t = -2.71$, $df = 43$, $p=0.010$, $d = -0.81$), and anxiety scores ($t = -3.52$, $df = 43$, $p=0.001$, $d = -1.08$). A significant association was also found between caseness on the LSAS-SR total score and caseness for depression ($\chi2 = 6.76$, $df = 1$, $p=0.009$), and anxiety on the HADS ($\chi2 = 7.21$, $df = 1$, $p=0.007$). Of those scoring in the clinical range for self-reported SAD, 88% (n = 23) also scored in the clinical range for general anxiety and 54% (n = 14) in the range for depression.

4. Discussion

While several studies have investigated social anxiety in adults with ASD, there has been limited attention given to potential associations between core ASD characteristics, facets of neuropsychological functioning and social anxiety. The present study investigated social anxiety symptoms, dimensionally and categorically, in a sample of males with ASD. The study also aimed to explore the frequency and range of self-reported social anxiety symptoms in males with ASD, and examine relationships between multiple self-report social anxiety questionnaire measures, and between social anxiety symptoms, ASD symptom-severity and socio-emotional functioning.

First, we found that a significant proportion of participants self-reported social anxiety symptoms across a range of measures. Fifty-two percent of the sample (n = 26) scored above the suggested caseness threshold on the LSAS-SR. The high self-ratings of social anxiety in our sample are comparable to those reported in younger ASD populations (e.g. Bellini, 2004; Kuusikko et al., 2008), a recent adult ASD clinic sample (Joshi et al., 2013), and a combined clinic and community adult sample (who were not reported to be specifically treatment-seeking) (Maddox & White, 2015). These rates are considerably higher than the rates of 7–12% found in epidemiological studies of typically developing (i.e. non ASD) individuals (NICE, 2013). In relation to previous ASD studies that have employed the LSAS-SR, we found that self-reported social anxiety symptoms were higher in our sample, compared to those reported by Bejerot et al. (2014), who found that the mean LSAS-SR score for their sample was 78, and that 28% of participants (n = 14) had clinically significant

symptoms. Conversely, Cath et al. (2008) reported a mean LSAS-SR score of 107 in their sample of 12 adults.

Are the high levels of social anxiety found in this population simply part and parcel of ASD? Might ratings on social anxiety questionnaires simply be tapping core autism-spectrumfeatures such as impairments in social interaction? The present data suggest not. First, using standardised measures, not all individuals with ASD reached the caseness threshold for social anxiety, despite potential concerns about symptom overlap. Second, measures of social anxiety did not correlate significantly with clinician-rated measures of autism-spectrum symptomatology, nor did ASD symptom-severity on the ADI-r or ADOS-G differ between subgroups scoring above and below caseness threshold for SAD on the LSAS-SR. This tallies broadly with results from a study of psychiatric co-morbidity in children, in which Simonoff et al. (2008) concluded that autism-severity did not appear to be predictive of co-morbidity (including social phobia). We did find a significant correlation between measures of SAD and the AQ, like Bejerot et al. (2014) but unlike that study, we did not find that AQ scores differed in those passing clinical cut-off for SAD on the LSAS-SR. Why the AQ shows a different pattern to the ADOS-G and ADI-r is uncertain; since the AQ is a self-report measure, common methods variance may be relevant, or SAD may influence self-perceptions of social skills. Indeed, Tonge, Rodebaugh, Fernandez, and Lim (2016) recently reported elevated AQ scores in (non-ASD) adults with SAD, largely accounted for by items tapping social skills (Tonge et al., 2016). Overall, our results suggest that SAD can co-occur in people with ASD, and be measured beyond the ASD-defining social impairments (although see limitations section below).

Can standard self-report SAD measures be used to screen or aid assessment in individuals with ASD? The present study suggests that they can. Despite possible concerns about difficulties with introspection, the high inter-correlation of the social anxiety measures seems to suggest that social anxiety in ASD may comprise a range of behavioural, cognitive and affective features, as seen in the non-ASD population (NICE, 2013). In addition, the internal consistency of the measures in this ASD sample closely mirrored those reported from typically developing samples.

In the non-ASD adult population, some associations have been found between SAD and facets of social processing, such as deficits in emotion recognition, although findings are not wholly consistent (Morrison & Heimberg, 2013). In the present study, associations between social and emotional tests and self-reported social anxiety were not statistically significant. This may indicate that anxiety is little affected by (current) social cognitive skills, or that the current tasks were not sufficiently sensitive to tap relevant individual differences (e.g. unable to discriminate task-specific compensation from better general adaptation). Further research, using longitudinal study designs, is needed to investigate whether aspects of socio-emotional functioning may contribute to the development or maintenance of social anxiety.

Higher rates and levels of depressive symptoms were endorsed by the group scoring above the SAD caseness threshold. Studies investigating SAD in the typically developing population report similar

findings. In a large scale prevalence study, Ohayon and Schatzberg (2010), for example, found that approximately 20% of participants with SAD also met criteria for major depressive disorder. Also, Ghaziuddin and Zafar (2008) and Sterling, Dawson, Estes, and Greenson (2009) found that in clinical samples of adults with ASD, depression and anxiety disorders commonly co-occurred. Our findings reiterate the need for future research studies to investigate the potential (inter-dependent) relationships between internalising disorders in the ASD population; for example, do anxiety symptoms contribute to later development of depression, or vice versa?

Several limitations to the study should be noted. First, the sample size, while comparable to previous studies (e.g. Bellini, 2004; Kuusikko et al., 2008), is relatively small. To enhance homogeneity of the sample, we only included males, and hence the results may not be applicable to females with ASD. Also, we only included adults with ASD and no intellectual impairment, and so it remains to be seen whether the findings hold true for adults with intellectual disabilities. Second, it was not possible to ascertain the proportion of participants who may have been in receipt of clinical services at the time of study recruitment; nor were data available about socio-economic or employment status, or independent living skills. This may affect the representativeness of the sample, and future research with larger samples well-characterised in these respects, is desireable. Third, only half of those approached returned questionnaires. We cannot be sure whether study participation was affected by participants' experiences of social anxiety. It was noted that study participants and non-responders differed in age: over-representation of younger adults in this study may have skewed the results, and replication is therefore needed in other age groups. Fourth, despite good psychometric properties of the SAD questionnaires in typically developing samples, they await psychometric validation with the ASD population. Further research is needed to ascertain whether normative thresholds are appropriate for those with ASD, or whether cut-off scores suggestive of clinical caseness should be modified for this group. We also acknowledge that questionnaires were administered in a set order to all participants, and we were therefore unable to explore order effects. Fifth, the study would have been substantially strengthened by use of an objective clinician-administered assessment of SAD, or measures completed by informants (such as parents, carers, or partners). Inclusion of further symptom measures of ASD might also have served to replicate the important finding that SAD symptoms do not appear to be merely a reflection of the severity of ASD symptomatology. Lastly, while correlational analysis provided an estimate of the strength of relationships between measures, causal factors, directions of relationships and confounds could not be assessed in the present study. Future designs, using population-based samples, multiple informants, longitudinal designs and/or intervention trials, could address these issues.

5. Conclusion

This study investigated SAD, using a range of questionnaire measures, in a fairly homogenous sample of adult males with ASD. High rates and levels of social anxiety, general anxiety and low mood were found, corroborating previous findings that internalising disorders are prevalent in this clinical population. Disentangling core ASD characteristics from co-morbid social anxiety symptoms is clearly

a complex endeavour for clinicians, researchers, and individuals with ASD (and their significant others), but a failure to consider the co-occurrence of these disorders in routine clinical practice may well leave important needs unassessed and untreated. Further research is now needed to investigate whether bio-psycho-social causal and maintaining factors for social anxiety (in ASD) are similar or distinct to those described for the typically developing population, and to determine what (if any) factors might serve to protect individuals with ASD from developing these co-morbid symptoms.

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