

Abstract

Objective

Anxiety symptoms are common in autistic children, however it is difficult to accurately assess the symptoms of anxiety in this population due to a lack of autism-specific anxiety assessment tools. The Anxiety Scale for Children with Autism Spectrum Disorder (ASC-ASD) is a newly developed measure designed to address this need. The ASC-ASD is designed specifically for use with autistic children, and is designed to assess both typical and atypical anxiety symptomatology. This study aimed to provide preliminary data regarding the validity of the ASC-ASD, as well as rates of cross-informant agreement and prevalence of anxiety symptomatology as measured by the ASC-ASD.

Methods

In order to explore the profile of anxiety symptomatology captured by the ASC-ASD, the ASC-ASD and Spence Children's Anxiety Scale (SCAS) were administered to 30 autistic children, ages 10 – 12, and their parents.

Results

High rates of anxiety symptomatology were found, with 46% of the children and 80% of their parents reporting scores in the clinical range on the SCAS. Scores on the SCAS and ASC-ASD were moderately to strongly correlated. Overall, children tended to endorse more items on the ASC-ASD, whereas parents tended to endorse more items on the SCAS.

Conclusions

Findings suggest that autistic children and their parents may have different perceptions of the anxiety symptoms experienced by autistic children. Findings also indicated that the ASC-ASD has promise as an autism-specific assessment of anxiety symptomatology in children, although further research is required in this area.

Keywords

Anxiety, Anxiety Scale for Children with Autism Spectrum Disorder, Assessment, Autism, Spence Children's Anxiety Scale

Key points

- Symptoms of anxiety are common in autistic children, however accurate assessment of these symptoms is hindered by a lack of reliable and valid autism-specific anxiety assessment tools
- This study is the first to explore the level of agreement between a new autism-specific anxiety measure, the Anxiety Scale for Children with Autism Spectrum Disorder, and the Spence Children's Anxiety Scale. Scores on the two scales were moderately to strongly correlated.
- Findings suggest that the Anxiety Scale for Children with Autism Spectrum Disorder has promise as an autism-specific anxiety assessment tool, however further research is required.

An exploration of autism-specific and non-autism-specific measures of anxiety symptomatology in school-aged autistic children

It is well-established that autistic¹ children have high rates of mental illness (Simonoff et al., 2008), with around 40% of the autistic population experiencing clinically significant symptoms of anxiety (van Steensel, Bogels, & Perrin, 2011). Anxiety is known to have negative consequences for autistic children and their families (Ozsivadjian, Knott, & Magiati, 2012), however preliminary evidence indicates that cognitive-behavioural therapies can be beneficial in treating anxiety for autistic children (Vasa et al., 2014).

In order to appropriately treat the symptoms of anxiety in autistic children, it is necessary to first identify those children who experience significant anxiety. However, accurate assessment of anxiety symptomatology in autistic children can be challenging. This is in part due to the potential impact of autistic characteristics on the assessment process; for example, differences between the assessor and autistic individual in terms of communication style or social behaviour may influence the accuracy of the assessment. Similarly, it has been suggested that autistic individuals may experience a lack of insight into their own emotional experiences, which may reduce the reliability and validity of self-reported information (Grondhuis & Aman, 2012; Wood & Gadow, 2010); although recent research indicates that autistic children with $IQ \geq 70$ are able to accurately report depressed and anxious cognitions (Ozsivadjian, Hibberd, & Hollocks, 2014). Additionally, some findings indicate that autistic children may fail to agree with other informants when rating the child's level of anxious symptomatology; for example, parents tend to rate their child's anxiety level significantly higher than the child's self-report (Bitsika, Sharpley, Andronicos, & Agnew, 2015; Blakeley-Smith, Reaven, Ridge, & Hepburn, 2012). However, similar findings have been noted in non-autistic controls (Hurtig et al., 2009), therefore this lack of concordance between different informants in ratings of anxiety may not be limited to autistic children.

Perhaps an even more problematic issue in the accurate assessment of anxiety in autistic individuals relates to the considerable difficulty that can exist in determining whether particular cognitive and behavioural indicators are most accurately interpreted as symptoms of anxiety, or as characteristics of autism. There are often substantial similarities between the symptoms of anxiety and the characteristics of autism, and a failure to properly differentiate the two can lead to diagnostic overshadowing (Grondhuis & Aman, 2012; White, Oswald,

Ollendick, & Scahill, 2009; Wood & Gadow, 2010). For example, an autistic child who avoids situations requiring social interaction may be perceived as being disinterested or lacking skills in social communication; however, the child may in fact dislike social interaction due to a fear of negative evaluation by peers, indicating social phobia. Without careful assessment, this distinction may be overlooked. This failure to provide a diagnosis of anxiety when such a diagnosis is warranted can result in a failure to provide potentially beneficial treatments targeting the symptoms of anxiety, and subsequently produce a poorer outcome for the individual.

To date, anxiety in autistic children has commonly been assessed using standardised self- and / or parent-report questionnaires designed for use with non-autistic children. Research into the appropriateness of these assessments for use with autistic children has generally found that such assessments demonstrate limited sensitivity and specificity in the identification of anxiety in autistic children; poor inter-rater reliability; and poor agreement with a standardised diagnostic interview (Gjevik, Sandstad, Andreassen, Myhre, & Sponheim, 2015; Kaat & Lecavalier, 2015; Kerns et al., 2015). Reliance on measures designed for non-autistic children can thus be problematic when assessing autistic individuals. For further detail regarding the appropriateness of various anxiety assessment measures for use with autistic children, see Grondhuis and Aman (2012) and Moskowitz, Rosen, Lerner, and Levine (2017) .

Reviews have indicated that, of the standardised assessments commonly used with autistic children, the Spence Children's Anxiety Scale (SCAS) appears to be a useful self-report measure (Grondhuis & Aman, 2012; Wigham & McConachie, 2014). A number of studies (Glod et al., 2017; Jitlina et al., 2017; Magiati et al., 2017) have failed to find support for the original six-factor structure of the SCAS in autistic samples, reinforcing the need for an autism-specific measure of anxiety symptomatology in order to accurately describe anxiety symptoms in this population. Despite this, the above studies (Jitlina et al., 2017; Magiati et al., 2017) found that the SCAS demonstrated acceptable to excellent internal consistency, reliability, and convergent and discriminant validity in autistic samples, while Zainal et al. (2014) also found promising psychometric characteristics for the SCAS in a sample of autistic youth.

Although research indicates that the SCAS may be a useful tool for the assessment of anxiety in autistic children, preliminary research indicates that anxiety assessments designed

for use with the non-autistic population may fail to capture *atypical* symptoms of anxiety. (Kerns et al., 2015). Kerns and Kendall (2012) proposed the concept that autistic individuals may experience two distinct forms of anxiety: *typical* anxiety, referring to symptoms of anxiety which are consistent with those symptoms experienced by the non-autistic population; and *atypical* anxiety, referring to symptoms of anxiety which are unique to the autistic population and related to the core characteristics of autism; for example, a fear of changes to their schedule or environment. In a subsequent study, Kerns et al. (2014) examined anxiety rates in a sample of autistic youth and found that, of the 63% who experienced significant anxiety, only 17% experienced purely typical anxiety symptoms, while 31% experienced both typical and atypical anxiety symptoms, and 15% experienced atypical anxiety only. This finding suggests that, in order to accurately gauge the level of anxiety experienced by autistic individuals, it may be necessary to use an assessment tool that measures both typical and atypical symptoms of anxiety.

In an attempt to produce an autism-specific anxiety assessment which meets this need, Rodgers et al. (2016) developed the Anxiety Scale for Children - Autism Spectrum Disorder (ASC-ASD). The ASC-ASD is a 24-item questionnaire designed to assess both typical and atypical symptoms of anxiety, and is available in both self-report and parent-report versions. The ASC-ASD is a recently developed instrument, and as such it remains relatively untested. Two recent studies have explored the profile of parent-reported anxiety symptoms endorsed on the ASC-ASD in Australian samples of young and school-aged autistic children (den Houting, Adams, Roberts, & Keen, 2018; Keen, Adams, Simpson, den Houting, & Roberts, 2017). However, to date the only data available regarding the convergent validity of the ASC-ASD is that from the original development and pilot testing of the assessment (Rodgers et al., 2016); this is also the only study to date to have assessed child-reported anxiety symptoms using the ASC-ASD. As the ASC-ASD is currently the only brief informant-report tool designed specifically for the assessment of anxiety symptoms in autistic children, and only limited (primarily parent-reported) published data from this measure is available, the current study is exploratory in nature and directional hypotheses are not posed. Instead, the current study aimed to provide preliminary, independent data regarding the validity of the ASC-ASD as a measure of anxious symptomatology in autistic children. In particular, the study aimed to:

1. Provide a preliminary exploration of concurrent validity of the ASC-ASD by exploring the level of agreement between the ASC-ASD and an established measure of anxiety symptomatology, the SCAS;
2. Explore cross-informant agreement by documenting the level of concordance between child self-report and parent-report on the above measures of anxiety symptomatology;
3. Document the discriminant validity of the anxiety measures by exploring whether these measures discriminate between symptoms of anxiety and autistic characteristics; and
4. Investigate the relative rates at which the above measures identified clinically significant levels of anxiety symptomatology.

Methods

This study combines data collected online as part of the second year of a longitudinal study, the Longitudinal Study of Australian Students with Autism (LASA), with additional assessments conducted specifically for this study. The LASA is a six-year study designed to investigate educational and participatory outcomes for Australian autistic students, following two cohorts of autistic children (aged 4 – 5 and 9 – 10 years at initial recruitment) and their families, with a total sample of 272 children. A detailed description of the LASA methodology is available in Roberts et al. (2018). Ethical approval for the longitudinal study was obtained from participating universities and health authorities, and for the additional data from Griffith University Human Research Ethics Committee.

Participants

All participants from the older cohort (aged 9 – 12 years) of the LASA who lived within the South-East and Central Queensland region at the time of data collection were invited via email to participate in this study by completing additional assessments. This resulted in a total of 54 families who were invited to participate. Of these 54, 32 (59%) families agreed to complete the additional assessments. The older LASA cohort was selected for this study as the child-report anxiety measures used in this study are designed for children aged eight and above. Two families were excluded due to scores below the autistic cut-off of 11 on the Social Communication Questionnaire (SCQ), resulting in a total sample of 30 families. Two

children were unable to complete the self-report assessments, therefore only parent-report data are available for these families. Six parents opted not to complete the online questionnaire during the second year of the longitudinal study, therefore ASC-ASD-P data was not available for these families. No significant differences existed between participants with and without ASC-ASD-P data in terms of SCAS scores. Participant children were aged 10 to 12 years ($\bar{x} = 11.2$, $SD = 0.62$) at the time of data collection, and 83% were male. The most commonly reported autism diagnosis was Autism Spectrum Disorder ($n = 12$, 40%), and the most common parent-reported co-morbid diagnoses were ADD / ADHD ($n = 10$, 33%) and anxiety ($n = 7$, 23%). At the time of recruitment into the longitudinal study, 67% of parents reported having completed tertiary education, and 73% reported being in full- or part-time employment.

Additional Data Collection

Online data collection took place from March – December 2016, and additional data collection took place from October 2016 – March 2017, with an average of approximately three months between online and in-person data collection. The additional data collection took place either at the family home ($n = 25$), or at a suitable alternative location ($n = 5$) such as a local library. During this session, parents completed the SCAS-PV in hard-copy. Children completed the SCAS-CV and ASC-ASD electronically on the researcher's iPad under the supervision of the first author. If required, participants were provided assistance in comprehending (but not responding to) items. As 12 items from the ASC-ASD are identical to items in the SCAS-CV, these items were administered only once; children therefore responded to a total of 50 items assessing symptoms of anxiety. ASC-ASD-P and SCQ data were obtained from the online questionnaire.

Parents provided informed consent for their own and their child's participation in the study, and children provided informed assent. Parents received a AUD\$15 gift card in exchange for participation, and children received a sensory toy (approximate value AUD\$5).

Measures

The Anxiety Scale for Children with Autism Spectrum Disorder (ASC-ASD) is a recently developed scale designed to assess symptoms of anxiety in autistic children aged eight and above. It is freely available, and can be accessed through the website of Newcastle University's Neurodevelopment and Disability Team (<https://research.ncl.ac.uk/neurodisability>). The ASC-ASD was adapted from the Revised

Children's Anxiety and Depression Scale (RCADS), and is comprised of 12 items retained from the RCADS, three items adapted from the RCADS, and nine new items developed by the ASC-ASD authors (Rodgers et al., 2016). As indicated by the ASC-ASD authors (Rodgers et al., 2016), in this study the nine newly developed items were considered to measure atypical anxiety symptoms (e.g., *"I always need to be prepared before things happen"*; *"My child worries about being in certain places because it might be too loud, or too bright, or too busy"*), and the remaining 15 items were considered to measure typical anxiety symptoms (e.g., *"I suddenly feel as if I can't breathe when there is no reason for this"*; *"My child feels afraid that he / she will make a fool of him / herself in front of people"*).

The ASC-ASD is available in both child self-report (ASC-ASD) and parent-report (ASC-ASD-P) versions; both versions were used in this study. Both the self- and parent-report versions of the ASC-ASD are comprised of 24 items, each measured on a four-point scale ranging from never (0) to always (3), resulting in a maximum possible score of 72. Two indicative cut-off points for both the ASC-ASD and ASC-ASD-P total scales have been put forward by the authors: Scores ≥ 20 suggest "significant anxious symptomatology", and scores > 24 are considered to be a "more specific indication of significant anxiety" (Rodgers et al., n.d.). T-scores are not yet available for this measure. The ASC-ASD includes four subscales: Uncertainty (eight items); Performance Anxiety (five items); Separation Anxiety (five items); and Anxious Arousal (six items). The scale has good to excellent reliability and validity, and is significantly correlated with the Screen for Child Anxiety Related Emotional Disorders (SCARED; Birmaher et al., 1999; Rodgers et al., 2016). In the current study, Cronbach's alpha indicated that internal consistency was excellent for both the ASC-ASD total scale, $\alpha = .92$, and the ASC-ASD-P total scale, $\alpha = .92$. Internal consistency was good to very good for all subscales of the ASC-ASD (Uncertainty $\alpha = .80$; Performance Anxiety $\alpha = .71$; Separation Anxiety $\alpha = .78$; Anxious Arousal $\alpha = .89$) and the ASC-ASD-P (Uncertainty $\alpha = .85$; Performance Anxiety $\alpha = .86$; Separation Anxiety $\alpha = .78$; Anxious Arousal $\alpha = .89$).

The Spence Children's Anxiety Scale (SCAS; Spence, 1998) is an established measure designed to assess symptoms relating to DSM-IV anxiety disorders in non-autistic children aged eight and above. The SCAS is available in both child self-report (SCAS-CV) and parent-report (SCAS-PV) versions, and both versions were used in this study. Both the SCAS-CV and SCAS-PV consist of 38 items measuring specific symptoms of anxiety; the SCAS-CV includes an additional six positive filler items. Each item is measured on a four-

point scale ranging from never (0) to always (3), resulting in a maximum possible score of 114 for the 38 anxiety items. T-scores are available for both the SCAS-CV and SCAS-PV, with a t-score above 60 considered to indicate significant symptoms of anxiety. The SCAS includes six subscales: Obsessive Compulsive Disorder (OCD; 6 items); Social Phobia (6 items); Panic / Agoraphobia (9 items); Separation Anxiety (6 items); Physical Injury Fears (5 items); and Generalised Anxiety Disorder (GAD; 6 items). The SCAS demonstrates good psychometric properties (Nauta et al., 2004), and has previously been identified as a promising measure for the assessment of anxiety in autistic children and youth (Grondhuis & Aman, 2012; Wigham & McConachie, 2014; Zainal et al., 2014). In the current study, Cronbach's alpha indicated that internal consistency was excellent for both the SCAS-CV total scale, $\alpha = .93$, and the SCAS-PV total scale, $\alpha = .94$. Internal consistency was acceptable to very good for all subscales of the SCAS-CV (OCD $\alpha = .66$; Social Phobia $\alpha = .78$; Panic / Agoraphobia $\alpha = .78$; Separation Anxiety $\alpha = .69$; Physical Injury Fears $\alpha = .69$; GAD $\alpha = .81$) and the SCAS-PV (OCD $\alpha = .86$; Social Phobia $\alpha = .73$; Panic / Agoraphobia $\alpha = .85$; Separation Anxiety $\alpha = .80$; GAD $\alpha = .79$), with the exception of the SCAS-PV Physical Injury Fears subscale which had poor internal consistency, $\alpha = .44$.

The Social Communication Questionnaire Lifetime version (SCQ; Rutter, Bailey, & Lord, 2007) consists of 40 items which ask parents about the presence of social, communicative, and stereotyped behaviours. It is well-researched and validated as a screening assessment for autism. While some concerns have been identified regarding the psychometric properties of the SCQ Current Version, the SCQ Lifetime Version is free of any such concerns (Wei, Chesnut, Barnard-Brak, & Richman, 2014). Although the recommended cut-off score on the SCQ for this age group is 15, a cut-off score of 11 has been recommended in younger age groups (Lee, David, Rusyniak, Landa, & Newschaffer, 2007). In this participant group, four participants scored in the range 11 – 14 on the SCQ. Community-based documentation confirming autism diagnosis was available for all four of these participants, therefore a score of 11 or greater on the SCQ was used as an inclusion criterion for this study. For included participants, scores on the SCQ ranged from 11 to 34, with a mean of 21.8 (SD = 6.1).

Pre-existing diagnoses of any anxiety disorder were determined based on parents' responses to an item included in the LASA online questionnaire, which read "Does your child have any other medical conditions / disabilities?". Parents responded by entering the specific medical condition or disability in a free-text box. Any response of "anxiety",

“anxiety disorder”, or a specific anxiety disorder diagnosis was considered to indicate a pre-existing diagnosis of an anxiety disorder.

Data Analyses

To investigate anxious symptomatology in the sample, mean scores were calculated for the SCAS-PV, SCAS-CV, ASC-ASD, and ASC-ASD-P. Frequency of item endorsement across subscales was also considered, with subscale scores presented as mean score per item to allow for comparison between subscales that include different numbers of items. The number of participants scoring above the relevant indicative cut-off points for each measure was also considered.

Data screening was conducted on all ASC-ASD raw score scales and subscales, and all SCAS t-score scales and subscales. Screening showed normal distribution of scores (skewness and excess kurtosis within the range ± 1) for all total scales and the majority of subscales. Subscales that deviated from normality were the SCAS-PV Separation Anxiety subscale (skewness -1.09, excess kurtosis 1.63); the SCAS-PV Social Anxiety subscale (skewness -1.18, excess kurtosis 2.56); the SCAS-CV Separation Anxiety subscale (skewness .88, excess kurtosis 1.40); the ASC-ASD-PV Anxious Arousal subscale (skewness 2.14, excess kurtosis 6.72); and the ASC-ASD Anxious Arousal subscale (skewness 1.40, excess kurtosis 2.04). Further screening of the data identified one outlier score each in the SCAS-PV Social Anxiety subscale, the ASC-ASD-PV Anxious Arousal subscale, and the ASC-ASD Anxious Arousal subscale. Outliers were winsorized using the value modification method (Kwak & Kim, 2017). Following winsorization, the SCAS-PV Social Anxiety subscale and ASC-ASD Anxious Arousal subscale showed skewness and excess kurtosis within the range ± 1 , while the ASC-ASD-PV Anxious Arousal scale remained slightly platykurtic (skewness .354, excess kurtosis -1.07). Given that Pearson’s correlations have been found robust in slightly to moderately nonnormal distributions (Bishara & Hittner, 2012), parametric analyses were used in this paper.

Level of agreement on the anxiety measures between child and parent participants was examined by calculating Pearson’s correlations between SCAS-CV and SCAS-PV scores, and also between ASC-ASD and ASC-ASD-P scores. Pearson’s correlations were also calculated between SCAS-CV and ASC-ASD scores, and SCAS-PV and ASC-ASD-P scores, to explore the level of concordance between the two measures of anxiety symptomatology; and between SCQ scores and the various anxiety measures, to examine any

relationship between level of autism characteristics and level of anxiety symptomatology. Given the exploratory nature of this study, an alpha level of .05 was used as advocated by Perneger (1998).

Agreement between the various anxiety measures and parent-reported anxiety diagnostic status was also explored, by considering the number and percentage of participants with and without a reported anxiety diagnosis who were correctly identified as having / not having significant symptoms of anxiety by each of the included anxiety measures.

Results

Profile of scores on the SCAS

Total raw scores on the SCAS-PV ranged from 13 to 74, out of a possible total of 114. The mean raw score was 40.3 (SD = 19.28, $n = 30$), equating to a t-score of approximately 65 (based on SCAS-PV t-scores for boys aged 10 – 13 years). Of the 30 participants who completed the SCAS-PV, 24 (80%) produced a t-score of 60 or greater.

Total raw scores on the SCAS-CV ranged from 2 to 83, out of a possible total of 114. The mean raw score was 36.6 (SD = 18.95, $n = 28$), equating to a t-score of approximately 58 (based on SCAS-CV t-scores for boys aged 8 – 11 years). Of the 28 participants who completed the SCAS-CV, 13 (46%) produced a t-score of 60 or greater.

Correlation coefficients were calculated to explore relationships between the parent-report and child-report versions of the SCAS. Scores on the Separation Anxiety subscale ($r = .56, p < .005$) and the Physical Injury Fears subscale ($r = .54, p < .005$) were moderately correlated, while scores on the Generalised Anxiety Disorder subscale ($r = .38, p < .05$) were weakly correlated, and scores on the Panic Disorder / Agoraphobia ($r = .28, p > .05$), Social Anxiety ($r = .16, p > .05$), and Obsessive-Compulsive Disorder ($r = .13, p > .05$) subscales were not significantly correlated. Total scores on the parent-report and child-report versions of the SCAS were weakly – moderately correlated, $r = .41 (p < .05)$.

Profile of scores on the ASC-ASD

Total raw scores on the ASC-ASD-P ranged from 7 to 53, out of a possible total of 72. The mean score on the ASC-ASD-P was 27.4 (SD = 12.39, $n = 24$). Of the 24 parents who completed the ASC-ASD-P, 18 (75%) rated their child's level of anxiety symptoms as falling

above the primary indicative cut-off point of 20, and 12 (50%) rated their child above the secondary indicative cut-off point of 24.

Total raw scores on the ASC-ASD ranged from 4 to 53, out of a possible total of 72. The mean score on the ASC-ASD was 26.2 (SD = 13.20, $n = 28$). Of the 28 children who completed the ASC-ASD, 19 (68%) rated their level of anxiety symptoms as falling above the primary indicative cut-off point, and 16 (57%) rated their symptoms as falling above the secondary indicative cut-off point.

Correlation coefficients were calculated to explore relationships between the parent-report and child-report versions of the ASC-ASD. Scores on the Separation Anxiety subscale were weakly – moderately correlated ($r = .44, p < .05$), while scores on the Uncertainty ($r = .36, p > .05$), Performance Anxiety ($r = .34, p > .05$), and Anxious Arousal ($r = .37, p > .05$) subscales were not significantly correlated. Total scores on the parent- and child-report versions of the ASC-ASD were moderately correlated, $r = .54 (p < .01)$.

Concordance between SCAS and ASC-ASD

In order to undertake a preliminary exploration of the concurrent validity between the SCAS and ASC-ASD and to explore levels of cross-informant agreement, Pearson's correlations were conducted using both parent-report and child-report data. Correlation coefficients for the parent measures, based on data from the 24 parents who completed both the SCAS-PV and the ASC-ASD-P, are shown in Table 1. Total scores on the SCAS-PV and ASC-ASD-P were moderately to strongly correlated. The ASC-ASD-P Separation Anxiety subscale was moderately to strongly correlated with all subscales of the SCAS-PV, including a strong correlation with the SCAS-PV Separation Anxiety subscale. Each subscale of the ASC-ASD-P was moderately correlated with at least one subscale of the SCAS-PV. These analyses were repeated, controlling for time (in days) between completion of the ASC-ASD and SCAS-PV. All correlations remained significant, with the exception of the relationship between ASC-ASD-P Performance Anxiety and SCAS-PV GAD, which fell below statistical significance. Additionally, the relationship between ASC-ASD-P Anxious Arousal and SCAS-PV GAD became significant, with a weak – moderate correlation, $r = .42 (p < .05)$.

++ Insert Table 1 here ++

Correlation coefficients for the child measures, based on data from the total sample of 28 children, are shown in Table 2. Total scores on the SCAS-CV and ASC-ASD were strongly correlated. Scores across all sub-scales of the ASC-ASD were moderately to strongly correlated with all sub-scales of the SCAS-CV, with the exception of the ASC-ASD Uncertainty and Performance Anxiety sub-scales, neither of which was significantly correlated with the SCAS-CV OCD subscale.

++ Insert Table 2 here ++

Concordance between SCAS / ASC-ASD scores and autistic characteristics

In order to explore the ability of the ASC-ASD and SCAS to discriminate symptoms of anxiety from characteristics of autism, Pearson's correlations were calculated between SCQ (Lifetime) total scores and total scores for each of the anxiety measures. As shown in Table 3, SCQ total scores were not significantly correlated with scores on any of the anxiety measures.

++ Insert Table 3 here ++

Concordance between SCAS / ASC-ASD scores and anxiety diagnostic status

Of the 30 participant children in this study, 7 (23%) had a parent-reported diagnosis of anxiety, while the remaining 23 (77%) did not have a parent-reported anxiety diagnosis. Scores on each anxiety measure were considered in relation to the child's parent-reported anxiety diagnostic status, and the indicative cut-off scores for each measure, in order to determine the rate at which each anxiety measure correctly identified children according to anxiety diagnostic status. As shown in Table 4, 100% of children with a parent-reported anxiety diagnosis produced a t-score above 60 on the SCAS-PV, while only 54% of this group produced a t-score above 60 on the SCAS-CV. In contrast, 100% of children with a parent-reported anxiety diagnosis scored above the primary cut-off of 20 on the child-report

ASC-ASD, and 71% of this group scored above the primary cut-off on the parent-report ASC-ASD-P.

++ Insert Table 4 here ++

Of the 24 parents who completed all anxiety measures, 19 (79%) rated their child as experiencing elevated levels of anxiety symptomatology according to the SCAS-PV. Of these 19, 15 (79%) parents scored their child at 20 or greater on the ASC-ASD-P, and 11 (58%) scored their child above 24 on the ASC-ASD-P. Of the five children who were not rated as experiencing elevated levels of anxiety according to the SCAS-PV, three scored 20 or greater on the ASC-ASD-P, and one scored above 24.

Of the 28 children who completed all anxiety measures, 13 (46%) rated themselves as experiencing elevated levels of anxiety symptomatology according to the SCAS-CV. Of these, all 13 children scored above 24 on the ASC-ASD. Of the remaining 15 children who did not rate themselves as experiencing elevated levels of anxiety on the SCAS-CV, six scored 20 or greater on the ASC-ASD, and three scored above 24.

Specific item and subscale endorsements

A number of items in each anxiety measure were endorsed at very high rates. In the SCAS-PV, the most frequently endorsed items related to worries. 100% of parents endorsed the item “*My child worries about things*” as occurring at least sometimes, while 93% of parents indicated that their child worries about doing badly at school, and 90% indicated that their child worries about being away from their parent(s). At a subscale level, mean scores per item were highest for the Social Phobia ($\bar{x} = 1.38$, $SD = 0.60$) and GAD ($\bar{x} = 1.31$, $SD = 0.61$) subscales, indicating that items from these subscales were endorsed most frequently. In the ASC-ASD-P, the most frequently endorsed item was the atypical anxiety item “*Feeling unsure stops my child from doing most things*”, which was endorsed as occurring at least sometimes by 96% of parents. Worries were also endorsed at high rates in the ASC-ASD-P, with 92% of parents endorsing an atypical anxiety item indicating that their child worries if they don’t know what will happen next. At a subscale level, items from the Performance Anxiety ($\bar{x} = 1.43$, $SD = 0.80$) and Uncertainty ($\bar{x} = 1.42$, $SD = 0.61$) subscales were endorsed most frequently by parents.

Children also tended to endorse items relating to worries and anxious thoughts at high rates, with the two most frequently endorsed items in the SCAS-CV being *“I can’t seem to get bad or silly thoughts out of my head”* (endorsed as occurring at least sometimes by 93% of children) and *“I worry about things”* (endorsed as occurring at least sometimes by 89% of children). The subscales with highest mean scores per item were the OCD ($\bar{x} = 1.35$, $SD = 0.61$) and GAD ($\bar{x} = 1.13$, $SD = 0.67$) subscales. Children’s responses to the ASC-ASD reflected more variation in anxiety symptomatology, however the three most frequently endorsed items all measured atypical anxiety symptoms. *“I always need to be prepared before things happen”* was endorsed as occurring at least sometimes by 96% of participants, while *“I worry when I think I have done poorly at something”* and *“I worry about being in places that are too loud, or too bright, or too busy”* were both endorsed by 93% of participants. Similarly to parent responses, items from the Uncertainty ($\bar{x} = 1.31$, $SD = 0.63$) and Performance Anxiety ($\bar{x} = 1.24$, $SD = 0.68$) subscales were most frequently endorsed by children.

Interestingly, the 12 items which are identical in both SCAS-CV and the ASC-ASD were endorsed at relatively low rates; the most frequently endorsed of these items were *“I worry that I will do badly at my school work”*, *“I worry about being away from my parents”*, and *“I worry that something awful will happen to someone in my family”*, all of which were endorsed as occurring at least sometimes by 75% of participants.

Discussion

This study is the first to explore the newly-developed ASC-ASD in comparison to an established measure of anxiety symptoms in an independent sample of autistic children and their parents. The study identified very high rates of parent-reported anxiety symptomatology, with 80% of parents rating their child in the elevated range on the SCAS-PV. Child-reported anxiety rates were more in line with previous estimates of anxiety prevalence within the autistic population, with 46% of participants scoring in the elevated range on the SCAS-CV. Rates of anxiety identified by the ASC-ASD were also high, with both parent- and child-report versions identifying at least 50% of participants as scoring above the secondary cut-off on this measure. Importantly, where other recent studies exploring this newly developed autism-specific measure of anxiety have focussed upon the

parent-report version (Adams, Simpson, & Keen, 2018; den Houting et al., 2018; Rodgers et al., 2017), this study adds to literature regarding the ASC-ASD by exploring the child self-report version.

Interestingly, 80% of parents reported that their child experienced clinically significant typical symptoms of anxiety as assessed by the SCAS, while 75% of parents indicated that their child's combined typical and atypical anxiety symptomatology met the primary cut-off on the ASC-ASD, and 50% indicated that their child met the secondary cut-off on the ASC-ASD. The high rates of parent-reported anxiety symptoms in this participant group were similar to those reported in a recently published study (Adams, Young, Simpson, & Keen, 2018), in which 89% of parents reported feeling that their autistic child was anxious in at least one setting of the three (home, school, and community) measured.

In contrast, only 46% of children rated themselves as experiencing clinical levels of typical anxiety symptoms as measured by the SCAS, while 68% of children rated their combined typical and atypical anxiety symptomatology as meeting the primary cut-off on the ASC-ASD, and 57% met the secondary cut-off on the ASC-ASD. This finding is comparable to the work of Kerns et al. (2014), who found that 48% of their sample demonstrated typical anxiety symptoms (with or without atypical symptoms), while an additional 15% experienced atypical anxiety symptoms only. These findings suggest that some autistic children may relate more strongly to atypical symptoms of anxiety, and less strongly to typical symptoms of anxiety. This is supported by the observation that the three items most frequently endorsed by children on the ASC-ASD in the current study were all items measuring atypical symptoms of anxiety. This finding is also consistent with a recent study by den Houting et al. (2018), who found frequent parent-report endorsement of atypical anxiety symptoms using the ASC-ASD-P in a sample of 100 autistic children. Also consistent with the work of den Houting et al. (2018) was the finding in the current study that items from the Uncertainty and Performance Anxiety subscales of the ASC-ASD, both of which include a high proportion of items relating to atypical anxiety symptomatology, were the subscales most frequently endorsed by both autistic children and their parents. These findings provide further evidence for the relevance of both typical and atypical anxiety symptoms when considering anxiety symptomatology in autistic children, and further highlight the need for autism-specific assessments of anxiety symptomatology, as assessment tools designed for the non-autistic population are unlikely to capture atypical anxiety symptoms.

Parent and child ratings of anxiety were weakly to moderately correlated on both anxiety symptom measures. This is consistent with findings from previous studies assessing anxiety in autistic samples, which have noted poor agreement between parent and child self-report (Bitsika & Sharpley, 2014; Blakeley-Smith et al., 2012). This discrepancy indicates that parents' perceptions and reporting of their child's symptoms of anxiety differ from the child's own perceptions and reporting. This raises the question of which informant may provide the most accurate description of the child's experience, a question which remains unanswered to date (Blakeley-Smith et al., 2012). The relatively low level of agreement between respondents in the current study provides further evidence for the importance of gathering data from multiple informants when assessing anxiety in autistic children. An alternative option may include the use of objective measures of anxiety such as physiological assessments, as used by Bitsika et al. (2015).

This study was the first to compare scores on the ASC-ASD with scores on the SCAS, an established self-report anxiety measure with promising psychometric characteristics in autistic samples. The ASC-ASD-P was significantly, moderately to strongly correlated with the SCAS-PV, and the child versions of the two measures were also significantly, moderately to strongly correlated. This finding adds to previous work which has identified significant correlations between parent and child versions of the ASC-ASD and the SCARED (Birmaher et al., 1999; Rodgers et al., 2016), and between the parent-report ASC-ASD and the School Anxiety Scale – Teacher Report (SAS-TR; Adams, Simpson, et al., 2018; Lyneham, Street, Abbott, & Rapee, 2008), which together provide increasing support for the validity of the ASC-ASD as a measure of anxiety symptomatology in autistic children. At the same time, however, discrepancies do exist between both the parent and child versions of the SCAS and the ASC-ASD, indicating that the two measures are not assessing identical constructs. This discrepancy may reflect that the ASC-ASD is, as intended, measuring atypical symptoms of anxiety as well as the typical symptoms captured by the SCAS; however, it may also indicate that the ASC-ASD is measuring an erroneous construct, such as autistic characteristics.

As has previously been noted, it is often difficult to differentiate between symptoms of anxiety, and characteristics of autism. This is particularly true in the case of atypical symptoms of anxiety, which by definition are closely related to the core characteristics of autism. In attempting to assess atypical symptoms of anxiety, it is important that a measure does not instead simply assess an individual's level of autistic symptomatology. The current study found that scores on both the parent and child versions of the ASC-ASD were not

significantly correlated with scores on the SCQ. This finding is consistent with den Houting et al. (2018) and Keen et al. (2017), and lends support to the notion that the ASC-ASD does not simply measure autistic characteristics. However, further research is needed to confirm this finding, and in particular future studies should aim to contrast the ASC-ASD with robust autism diagnostic tools such as the Autism Diagnostic Observation Schedule – Second Edition (ADOS-2; Lord et al., 2012) and / or the Autism Diagnostic Interview, Revised (ADI-R; Rutter, Le Couteur, & Lord, 2003).

When participants were grouped by parent-reported diagnostic status, children with a parent-reported anxiety diagnosis scored above the indicative cut-offs for each measure at higher rates than those without an anxiety diagnosis. However, a large proportion of participants without a parent-reported anxiety diagnosis also scored above the indicative cut-offs for anxiety on each measure. This may indicate that the measures included in this study produce a high rate of false positive outcomes (i.e., identifying an individual as experiencing significant anxiety symptomatology when such symptomatology is not present). Alternatively, it is possible that a large proportion of those participants who did not report a diagnosis of anxiety do, in fact, experience significant symptoms of anxiety; this possibility is particularly pertinent given the difficulties inherent in diagnosing anxiety disorders in the context of autism (MacNeil, Lopes, & Minnes, 2009).

Limitations

As 12 items within the ASC-ASD are exact duplications of items within the SCAS-CV, these items were administered to child participants only once, resulting in children responding to 50 items measuring anxiety rather than 62. As participants completed the current anxiety measures as part of a larger assessment battery, this approach was chosen in order to maximise participant engagement and minimise fatigue during the assessment session. Although this approach may have produced an artificial inflation of correlation coefficients between ASC-ASD and SCAS-CV scores, test-retest reliability of the SCAS in non-autistic children is satisfactory over both three and six month timeframes (Spence, 1998; Spence, Barrett, & Turner, 2003), suggesting that participants would have provided similar responses to the duplicate items if these items were administered twice during the assessment session. However, test-retest reliability of the SCAS has not yet been examined in an autistic sample, therefore existing estimates of test-retest reliability may not be applicable to the current participant group. It is also important to note that only child participants who were able to read and comprehend the relevant questions completed the self-report anxiety measures,

therefore these findings are only applicable to autistic children with the intellectual and language abilities to complete such assessments.

It is important to note that this study relied on parent-report as a measure of previous anxiety diagnoses, with a diagnostic assessment for anxiety not undertaken as part of the study. This may limit the accuracy of data regarding previous anxiety diagnoses. In particular, there is a risk that participant children had undiagnosed anxiety disorders; and given the relatively low prevalence of parent-reported anxiety disorders (23%, compared to an average of 40% in autistic children) it seems likely that anxiety disorders were under-diagnosed in the current sample. Given this, conclusions regarding the predictive validity of the ASC-ASD as a screening measure for anxiety should be considered with caution, and future studies would benefit from the inclusion of a gold-standard anxiety diagnostic assessment.

Similarly, the current study relied on the use of the SCQ Lifetime Version as a screening measure for autism. It is noted that this screening tool provides an assessment of lifetime, rather than current, autistic characteristics; in future research it may be useful to employ a measure of current autistic characteristics rather than lifetime traits, to ensure that participants' current levels of anxious symptomatology are being compared to current, and not historical, autistic characteristics. Having said this, concerns have previously been raised regarding the psychometric properties of the SCQ Current Version (Wei et al., 2014); therefore future studies would likely benefit from the inclusion of a gold-standard autism diagnostic assessment.

Although this study included a relatively small participant sample, data were gathered from both parents and children using appropriate versions of the same anxiety assessment measures, which allows for reliable comparisons to be drawn between parent and child ratings of anxiety symptomatology. Additionally, this study is associated with a larger longitudinal study, therefore scope exists for future studies to build upon this paper.

This study relied on a self-selecting sample of participants recruited from those participants already engaged in the LASA. Participants were informed of the study's focus on anxiety in recruitment materials, therefore it is possible that a highly anxious sample was unintentionally recruited. However, only 23% of participants in this study had a parent-reported diagnosis of anxiety; it is expected that this rate would be higher in a markedly

anxious sample, particularly given that the known prevalence of anxiety in the autistic population is approximately 40%.

It is important to note that parents were administered the ASC-ASD-P as part of an online questionnaire aimed at measuring the child's overall development and wellbeing, whereas the SCAS-PV was administered as part of a sub-study which specifically aimed to investigate anxiety symptomatology. It is possible that these differing contexts influenced parent endorsements of items on the ASC-ASD-P and SCAS-PV; however, scores on these assessments were moderately to strongly correlated, suggesting that any influence of context on responses was minimal.

Conclusion

In this study, self- and parent-reported anxiety symptomatology in autistic children was examined using both an established measure designed for the assessment of anxiety in non-autistic children, and a new measure designed specifically for the assessment of anxiety in autistic children. Findings are consistent with the existing body of literature which reveals high rates of anxiety in autistic children. Moderate to strong correlations were found between parent and child versions of the SCAS and the ASC-ASD, providing support for the ASC-ASD as a measure of anxiety. The results of this study indicate that the ASC-ASD may be an appropriate assessment tool for identifying anxiety symptomatology in autistic children, however future research is required, ideally using gold-standard diagnostic measures for anxiety and autism in order to further establish the reliability and validity of this tool. Although it would be premature to implement clinical use of the ASC-ASD as a formal screening tool for anxiety symptomatology in autistic children, these findings suggest that the ASC-ASD could be used in the clinical setting to inform further assessment and treatment planning for autistic children with suspected anxiety symptomatology.

Children were more likely to rate themselves above the indicative cut-offs for anxiety on the ASC-ASD, while parents were more likely to rate children above the indicative cut-off for anxiety on the SCAS. This suggests that parents and children have different perceptions of the anxiety symptoms experienced by autistic children. Further research regarding autistic children's perceptions of anxiety symptomatology may be useful in order to inform treatment approaches. In the clinical setting, it will be important to gather information regarding anxiety symptomatology not only from parents, but also from the autistic child themselves to ensure thorough understanding of relevant symptomatology. Additionally, research regarding

the impact of anxiety symptomatology on children's daily lives and functioning is limited to date, and increased understanding in this area may also inform approaches to treatment.

Consistent with many previous studies, this paper identified high rates of anxiety symptomatology in the participant sample, across both informant groups and both anxiety assessment tools. Progress towards accurate and appropriate methods for assessing anxiety symptomatology in autistic children is promising, and is an important focus for future research.

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¹ *Autistic person* is the preferred language of many individuals on the spectrum (see Kenny et al., 2016), and will therefore be used throughout this paper.

Table 1

Pearson's correlations between SCAS-PV (t-scores) and ASC-ASD-P (raw scores)

	ASC-ASD-P Total Score	ASC-ASD-P Uncertainty	ASC-ASD-P Performance	ASC-ASD-P Separation	ASC-ASD-P Anxious Arousal
SCAS-PV Total Score	.66***	.57**	.36	.67***	.45*
SCAS-PV Panic	.64**	.66***	.34	.46*	.53**
SCAS-PV Separation	.48*	.36	.07	.73***	.43*
SCAS-PV Physical Injury	.38	.40	.20	.46*	.18
SCAS-PV Social	.54**	.40	.48*	.56**	.14
SCAS-PV OCD	.40	.23	.33	.43*	.24
SCAS-PV GAD	.60**	.59**	.42*	.43*	.40

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

Table 2

Pearson's correlations between SCAS-CV (t-scores) and ASC-ASD (raw scores)

	ASC-ASD Total Score	ASC-ASD Uncertainty	ASC-ASD Performance	ASC-ASD Separation	ASC-ASD Anxious Arousal
SCAS-CV Total Score	.88***	.64***	.71***	.82***	.79***
SCAS-CV Panic	.87***	.66***	.66***	.70***	.91***
SCAS-CV Separation	.77***	.50**	.58**	.91***	.63***
SCAS-CV Physical Injury	.56**	.41*	.46*	.60**	.38*
SCAS-CV Social	.85***	.68***	.89***	.59**	.71***
SCAS-CV OCD	.49**	.28	.24	.61**	.53**
SCAS-CV GAD	.81***	.55**	.62***	.76***	.82***

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

Table 3

Pearson's correlations between SCQ total scores and SCAS / ASC-ASD total scores

	SCAS-CV Total (<i>t</i> score)	SCAS-PV Total (<i>t</i> score)	ASC-ASD Total score	ASC-ASD-P Total score
SCQ Total Score	-.04 (n = 28)	.10 (n = 30)	.10 (n = 28)	.24 (n = 24)

Table 4

Agreement between anxiety measures and parent-reported anxiety diagnostic status

Measure		Parent-reported anxiety diagnosis (n = 7)	No parent-reported anxiety diagnosis (n = 23)
SCAS-CV (Child-report)	t-score ≥ 60	4 (57%)	9 (39%)
	Missing data	0 (0%)	2 (9%)
SCAS-PV (Parent-report)	t-score ≥ 60	7 (100%)	17 (74%)
	Missing data	0 (0%)	0 (0%)
ASC-ASD (Child-report)	Score ≥ 20	7 (100%)	12 (52%)
	Score > 24	5 (71%)	11 (48%)
	Missing data	0 (0%)	2 (9%)
ASC-ASD-P (Parent-report)	Score ≥ 20	5 (71%)	13 (57%)
	Score > 24	4 (57%)	8 (35%)
	Missing data	2 (29%)	4 (17%)