Development of the Macquarie Anxiety Behavioural Scale (MABS): A Parent Measure to assess anxiety in children and adolescents including young people with Autism Spectrum Disorder

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Anxiety disorders are common in young people with Autism Spectrum Disorder (ASD; White, Oswald, Ollendick, & Scahill, 2009), affecting about 40% of children with ASD (van Steensel, Bögels, & Perrin, 2011). The majority of measures currently used to assess anxiety are not validated for young people with ASD (Kendall & Kearns, 2012; Storch et al., 2012). To our knowledge, only one ASD-specific anxiety measure has been developed to date, namely the Anxiety Scale for Children - ASD, Parent and Child versions (ASC-ASD; Rodgers, Wigham, McConachie, Freeston, Honey, & Parr, 2016). The ASC-ASD has shown promising psychometric properties; however, the stability and robustness of the measure requires further investigation.

In a recent study by Magiati et al. (2017), measurement properties of the widely used Spence Children's Anxiety Scale-Parent Version (SCAS-P; Spence, 1999) in a large international sample of young people with ASD were assessed. Confirmatory Factor Analysis (CFA) revealed a poor fit for the six-correlated factor structure. Further, the SCAS-P (Spence, 1999) was recently found to differ (i.e., measurement variance) across a group of children with anxiety disorders and children with ASD (Toscano, Hudson, Baillie, Lyneham, Kelly, & Kidd, 2020). One of the possible difficulties with the use of the SCAS-P, in children with ASD is a lack of items focusing on clearly behavioural and observable anxiety symptoms. Some studies in typically developing children have reported stronger parent-child agreement on anxiety symptoms that are more observable (e.g., apparent avoidance or clingy behaviour; Blakeley-Smith, Reaven, Ridge, & Hepburn, 2012; Ooi, Weng, Magiati, Ang, Goh, Fung, & Sung, 2016). Unless a child is able to verbally articulate worries, parents are often required to interpret their child's behaviour to determine whether a stimulus, event or situation elicits anxiety. Particularly for children with ASD, parents may not always be aware of some of the anxiety symptoms

exhibited by their children or their severity and frequency (Glod, Creswell, Waite, Jamieson, McConachie, South, & Rodgers, 2017). Inherent ASD-related traits including poor insight, impaired affect recognition, communication difficulties, and rigidity in thinking exacerbate challenges associated with accurate identification of anxiety in ASD (e.g. Lickel, MacLean, Blakeley-Smith, & Hepburn, 2012). Furthermore, anxiety in minimally verbal individuals with ASD is commonly apparent through problem behaviours (Cohen, Yoo, Goodwin, & Moskowitz et al. 2011; Moskowitz, Mulder, Walsh, McLaughlin, Zarcone, Proudfit, & Carr, 2013), which are not captured by the SCAS-P subscales.

The present study aimed to address measurement variance found in the SCAS-P (Toscano et al., 2020) by developing an improved parent measure to assess anxiety in children and adolescents that is suitable for young people with and without ASD. The Macquarie Anxiety Behavioural Scale (MABS) was designed to be consistent with Diagnosis and Statistical Manual of Mental Disorders (5th ed., DSM–5; APA, 2013) anxiety categories. The measure aimed to focus on more observable physiological, cognitive and behavioural indicators of anxiety and to reduce the reliance on cognitive aspects of anxiety in items within the parent measure. We also aimed to develop a measure that assesses anxiety that is separate to ASD symptomatology. In view of communication and emotion recognition difficulties in the ASD population, we focused on development of a parent measure of anxiety rather than a self-report measure.

The aims of the current study were threefold. First, we attempted to replicate a study by Toscano et al. (2020) which found evidence of measurement variance for the SCAS-P. We assessed whether similar findings still hold when using a different sample. The present study utilised a sample of parents of children and adolescents with ASD and children without ASD (clinical and community sample). Second, we developed a new parent measure of anxiety (the

MABS) that is suitable for clinical and community populations of children including children with ASD. We also determined the factor structure of the MABS in a sample of children and ensured adequate fit for the data to consider invariance. Third, measurement invariance techniques were utilised to determine whether the MABS and its items function in the same way in children with and without ASD (who may or may not also have an anxiety disorder). Multiple indicator multiple cause (MIMIC) structural equation modelling was utilized to analyse the data and test for measurement invariance across the ASD and non-ASD groups. We hypothesised that on comparing the newly developed MABS with the already established SCAS-P across a group of children with and without ASD (with or without anxiety), greater measurement invariance across the two groups would be present when using the MABS; that is, the MABS will perform more similarly across the two groups than the SCAS-P and therefore be more suitable for young people with ASD.

Method

Participants

The sample consisted of 734 parents (715 mothers = 97.4% and 19 fathers = 2.6%) of children aged 3 to 19 years (M = 9.7, SD = 3.34). Parents of the younger participants (3-5 years, n = 23) were included in our overall sample to allow for greater variability within our study. All parents completed formal schooling (Year 10 or above) with the majority of parents also completing further study following high school completion. Ethics approval to conduct the present study was obtained from Macquarie University Human Research Ethics Committee, Sydney, Australia.

Participants were recruited Australia-wide from three different groups, namely a community (control) group (429 parents = 58.4%), a clinical group seeking help for anxiety (64 parents = 8.7%) and an ASD group (parents of children with a primary diagnosis of ASD, with and without anxiety, 242 parents = 32.9%). We utilised an over-sampling strategy for the anxious and ASD groups to ensure adequate coverage for these two groups within our overall sample. Table 1 presents demographic characteristics and frequency of mental health and neurodevelopmental disorders.

The control sample was recruited via advertisements posted on online parenting groups and forums and a parenting magazine. The anxious sample was recruited from the Centre for Emotional Health Clinic (CEHC), Macquarie University, Sydney, Australia. This group consisted of parents whose children were aged 6-18 years, who sought assessment and treatment and participated in randomized clinical trials for childhood anxiety at the CEHC. Anxiety diagnoses and clinical severity ratings were assigned based on the Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent versions (ADIS-IV-C/P; Silverman & Albano, 1996), administered by graduate students in clinical psychology or qualified clinical psychologists. The ASD group was recruited through advertisements placed with local ASD service providers and online advertising through the Autism Spectrum Australia (ASPECT) website. Two participants within the ASD group were recruited from the CEHC, Macquarie University; they presented for assessment and treatment at the CEHC.

Parents from all three groups were encouraged to participate if they had a child who met any of the following criteria: a child with or without emotional or developmental problems; a child who struggles with fears, worries and anxiety; a child who has an Autism Spectrum Disorder (who may or may not also struggle with anxiety). Children with a diagnosis of an

anxiety disorder or ASD (with or without anxiety) appearing anywhere in the child's profile were included in the study. Separate web addresses were provided to the Community and ASD groups for online questionnaire completion.

Participating parents were allocated to the ASD group if their children met both of the following criteria: (i) had a parent reported community acquired diagnosis of ASD (including Autistic Disorder, Asperger's Syndrome and PDD-NOS) and (ii) met or exceeded total score cut offs on the Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2010, *see description below*) as per instructions in the ASRS manual, that is a T-score of ≥ 60. A total of 257 participants formed the ASD group. It was not possible to conduct structured diagnostic interviews for this study therefore we relied on community acquired diagnoses of ASD. As a precaution we also ensured that community diagnoses were supported by high ASRS scores. Participants who did not meet either of these criteria (n = 330) formed the non-ASD group whilst the remaining participants who only met one of these two criteria (n = 147) were excluded from further analyses. A conservative approach to participant group allocation was adopted to minimize possible diagnostic overlap and therefore improve study design. Data from the final subgroup of participants (n = 587) as defined above were utilised to test measurement invariance of the SCAS-P and the MABS across parents of children in the ASD group versus parents of children in the non-ASD group (control and clinical group, with and without anxiety). Children with comorbid conditions such as Attention Deficit/Hyperactivity Disorder or Depression were not excluded from the study due to the high prevalence of comorbid conditions in ASD (e.g. Ozonoff and Rogers, 2003). Parents were excluded from this study if they did not understand and speak English fluently.

Measures

Spence Children's Anxiety Scale – Parent Report

The Spence Children's Anxiety Scale for Parents (SCAS-P; Spence, 1999) was used to evaluate parent-reported symptoms of a child's anxiety and to establish convergent validity with the newly developed MABS. The SCAS-P consists of 38 items that assess frequency of child anxiety symptoms across six domains: separation anxiety, generalized anxiety, social phobia, panic/agoraphobia, obsessive–compulsive disorder, and fear of physical injuries. Items are scored from 0 (never) to 3 (always). Reliability coefficients of the subscales are satisfactory to excellent (0.81 to 0.90 in the normal control group and from 0.83 to 0.92 in the clinical group) and it has also demonstrated convergent and divergent validity in typically developing samples (Nauta et al., 2004);.

Strengths and Difficulties Questionnaire – Parent Report

The Strengths and Difficulties Questionnaire – Parent Form (SDQ-P; Goodman, 1997) is a brief behavioural screening measure that was used to assess externalising behaviour. The SDQ comprises 5 scales of 5 items each (25 items total), namely the Emotional Symptoms Scale, Conduct Problems Scale, Hyperactivity Scale, Peer Problems Scale and Prosocial Scale. In the current study, the SDQ was used as a reliable tool to establish divergent validity with the MABS. Reliability of the SDQ has been reported as satisfactory (internal consistency - mean Cronbach's alpha: 0.73, cross-informant correlation - mean: 0.34, and retest stability after 4 to 6 months - mean: 0.62).

Short Mood and Feelings Questionnaire – Parent Report

The Short Mood and Feelings Questionnaire - Parent Form (SMFQ-P; Angold, Costello, Messer, Pickles, Winder, & Silver, 1995) consists of 13 items used to assess child depressive symptoms. Each item asks parents to rate whether the provided item is indicative of their child's feelings and actions ("Not True", "Sometimes", or "True") over the timeframe of the previous two weeks. The SMFQ-P has shown good internal consistency in parent-reports (Cronbach's alpha = 0.87) and sensitivity and specificity of 0.78 (Angold et al., 1995; Wood, Kroll, Moore, & Harrington, 1995). The SMFQ-P was used in our study to establish divergent validity.

Autism Spectrum Rating Scales

The Autism Spectrum Rating Scales (ASRS) is comprised of 71 designed to identify symptoms, behaviours, and associated features of ASD in children (Goldstein & Naglieri, 2010). The ASRS has good to excellent psychometrics properties (e.g. internal consistency: 0.85–0.98, inter-rater reliability—parents: 0.73–0.92, test– retest reliability: 0.72–0.93, and sensitivity and specificity 0.90–0.92) in ASD versus general population. Caregivers indicate how often their child demonstrated a specific behaviour over the previous four weeks; items are scored from 0 (never) to 4 (very frequently). In the present study, the ASRS was used to establish divergent validity, identify ASD-related symptoms and behaviours as well as determine participant allocation to the ASD group based on a T-score of ≥ 60.

Scale Development – Macquarie Anxiety Behavioural Scale (MABS)

We set out to develop a new parent measure that fit the following design specifications: (i) included a set of items that covered a range of response types provided by all parents that completed the measure (avoiding floor and ceiling effects), (ii) a total number of items that

would make the measure clinically useful (approximately the same number of items as the SCAS-P), (iii) a measure that is disorder specific in line with anxiety disorders as per DSM-V (APA, 2013) and (iv) a measure that assesses anxiety that is not confounded by ASD symptomatology and traits.

An initial pool of 56 items was generated based on a review of literature related to anxiety, ASD and the presentation of anxiety in ASD; interviews with 3 professionals who routinely work with children and adolescents with ASD and by adapting items from the ADIS-IV-C/P (Silverman and Albano, 1996) and other already established measures of anxiety such as the SCAS-P (Spence, 1999). Adaptation of items and wording was necessary to reflect observable behaviours that represent underlying anxiety. Novel items were also generated.

Next, expert feedback on the revised set of items from clinicians who regularly work with young people with anxiety and ASD was gathered in two different stages. All feedback obtained was reviewed, item readability assessed using the Gunning Fog Index (Gunning, 1944) to ensure a suitable readability level for all parents and items were selected, edited or discarded based on 75% clinician agreement and a mean of 3.5 on best fit (1 = very poor fit, 5 = very good fit) for both anxiety type and observable symptoms (cognitive, behavioural or physiological). Additional items were also developed to further reflect feedback obtained and to ensure sufficient coverage across different anxiety symptoms in line with DSM-5 anxiety disorders diagnostic criteria (APA, 2013).

We then pilot tested the items with a small group of parents (3 parents of children with anxiety and 3 parents of children with ASD, with and without anxiety) through face-to-face interviews to assess comprehension and establish alternate wording as needed. Feedback was used to make final edits to our set of items and the pilot measure consisting of 57 items prepared

for online data collection. A survey battery including demographic questions, the parent measures listed above and the new pilot measure was distributed to parents across Australia.

Items were then screened for similarities and differences in the overall distribution of responses across the three different groups. Using Spearman's Rho, Item Total Correlations (ITC), convergence with the SCAS-P and divergence from the ASRS, SMFQ-P and SDQ-P were analysed. Further reduction in the item pool in line with our design specification was conducted; items were retained or dropped based on low values of skewness, convergent and divergent validity and internal consistency. The final item set consisted of 23 anxiety related questions covering all anxiety disorders except for Selective Mutism. Throughout the development phase, items corresponding to Selective Mutism diagnostic criteria as per DSM-5 (APA, 2013) were developed, however, initial analysis revealed high correlation with the ASRS indicating potential overlap with ASD traits. As such, we were unable to put Selective Mutism-related items forward for further analysis; these items were excluded from our parent measure. Table 2 provides a list of the final set of items that form the Macquarie Anxiety Behavioural Scale (MABS).

Statistical Analysis

Stage 1: Establishing factor structure of the MABS

To examine the factor structure of the MABS, confirmatory factor analysis (CFA) was conducted using the software package Lavaan (versions 0.5.18 to 0.5.22, Rosseel, 2012) in open source software R (R Core Team, 2012). No data were missing for responses on the MABS. CFA testing different factorial structures was utilised to confirm a simple factor structure of the newly developed parent measure. CFA was chosen over exploratory factor analysis as a factor structure that was in line with DSM-5 (APA, 2013) anxiety disorders diagnostic criteria (as

outlined in the MABS scale development section above) was central to the MABS throughout the development phase. Using our data set, we tested model fits for five model options based on hypotheses derived from previous research in anxiety and ASD. The five models tested were as follows: One Factor, two factor - Distress and Fear, five correlated factors based on DSM, five correlated DSM Factors with correlated errors and five hierarchical DSM factors.

Stage 2: Multiple-Indicators-Multiple-Causes (MIMIC) Analysis

Differences in factor structure of the SCAS-P as well as the MABS between parents of children with ASD and their counterparts without ASD (all with or without anxiety) were examined using MIMIC (multiple-indicators-multiple-causes) modelling. In view of our sample size, MIMIC modelling (also known as Confirmatory Factor Analysis with covariates) was deemed suitable to examine invariance across both groups. MIMIC modelling entails regressing the latent variables and indicators onto a covariate that represent group membership (Diagnosis: 0 = no ASD, 1 = ASD). Using MIMIC modelling, we tested whether ASD impacts the way parents answer items on the SCAS-P and the MABS and if differences were detected, we identified where such differences lay. Missing data for responses on the SCAS-P (1.1%) was managed by using maximum likelihood estimation method of data imputation. Also, although we recruited samples to provide a full range of responses, the maximum likelihood method is robust to mild/moderate violations of normality.

Brown's (2015) MIMIC modelling guidelines were followed. When using MIMIC modelling, a single input matrix containing variances and covariance's of both the latent variable indicators and the covariates that denote group membership is used. The first step involves using a viable measurement model using the full sample (collapsing across groups). In our case, the

full sample represents the subgroup containing parents of children with ASD and those without ASD as described earlier. Second, one or more covariate/s are added to the model to examine the direct effects of the covariate/s on the factors and selected indicators. A population can be deemed heterogeneous when a significant direct effect of the covariate on the factor is observed. Measurement variance is present when a significant direct effect of the covariate on an indicator of a factor is present. That is, when the factor is held constant, the means of the indicator are different at different levels of the covariate, indicating differential item (indicator) functioning. Model fit was evaluated using established recommendations based on prior research (Brown 2015; Hu & Bentler 1999). Cut-off criteria for goodness of fit statistics included the comparative fit index (CFI; >0.95), root mean squared error of approximation (RMSEA; <0.06), and standardised root mean square residual (SRMR; <0.08). Smaller RMSEA and SRMR values indicate a better fitting model. Nested models were compared using the Chi square difference test.

In the current study, the internal structure of the SCAS-P was assumed to be a six-correlated factor model corresponding with DSM-IV (APA, 1994) anxiety disorders (Arendt et al. 2014; Ishikawa et al. 2013; Li et al. 2011; Nauta et al. 2004). The internal structure of the MABS was based on the best fitting model identified earlier during the CFA stage (Stage 1) and described in more detail in the Results section below. MIMIC analysis for both measures in the present study (SCAS-P and MABS) involved three steps (outlined below). As suggested by Brown's model (2015), modification indices were examined at each step, before moving on to the following step.

Step 1: First, a baseline model (Model 1, Table 4) with a specific number of factors (subscales) and total number of items per scale with regression of group variable (ASD

diagnosis) to latent factor (anxiety) set at zero was fit. This model assumed no difference between the two groups under investigation, that is, no difference between the ASD and non-ASD groups. Step 2: Next (Model 2, Table 4), modification indices for the regression of group (ASD versus non-ASD) on subscale were examined to test whether a difference between the ASD and non-ASD groups existed at the factor (subscale) level and if so, where such differences lie. Step 3: The third and final step (Model 3, Table 4), involved examination of the modification indices for the regression of group (ASD, non-ASD) on the individual items of the respective parent measures to identify whether differences also lie at the item level and where (if any) differential item functioning can be found. Table 4 presents a summary of model fits for the three MIMIC models described above.

Results

Stage 1: MABS Factor Structure

A comparison of Confirmatory Factor Analysis (CFA) model fits for the MABS using the entire sample (N = 734) is presented in Table 3. CFA suggested that a solution of five correlated DSM factors with correlated errors provided the best fit for the data. With every model that was tested, model fit improved until we reached Model 4 which revealed a worse fit compared to Model 3a. As such, Model 3a (five correlated DSM Factors with 10 correlated errors) was deemed the best model for this study. We are aware of limitations surrounding the inclusion of correlated error terms (e.g. Hermida, 2015), however, we believe that the covariance in the present study can be explained by the way anxiety presents in ASD, the elimination of the cognitive component in a number of the items as well as violations of local independence related to the use of complex (long) items that also include a series of examples (see Appendix B for

examples). In using such items, similarity and overlap between the items is more likely, hence the inclusion of correlated errors in our best fitting model. Using this method, we were able to achieve a simple factor structure for the MABS. In light of historical and more recent debates in the literature around the structure of psychopathology (e.g. Clark & Watson, 1991; Krueger & Markon, 2006), we also tested a bi-factor model looking at the common variance across the MABS items and DSM-specific anxiety disorders. A poorer model fit was obtained when we tested the bi-factor model therefore this model was not analysed further.

Stage 2: Multiple-Indicators-Multiple-Causes (MIMIC) Analysis

To determine whether parental report of child anxiety differed across the ASD and non-ASD groups, MIMIC modelling was applied using group (ASD versus non-ASD) as the covariate (independent variable). For the SCAS-P, our data indicated evidence for ASD impacting on all six factors on the SCAS-P; that is Physical Injury Fears, Obsessive Compulsive Disorder (OCD), Generalised Anxiety, Social Phobia, Panic/Agoraphobia and Separation Anxiety. Modification indices from Model 2 (where item effects were set to zero) indicated possible item variance in 20 items and each of these were allowed to vary in Model 3. Regression coefficients revealed differential item functioning in 13 of the 38 SCAS-P items with Bonferroni correction for type 1 error (0.05/20=0.0025). For some of these 13 items, ASD was associated with lower ratings (e.g. item 12 had a regression coefficient of -0.231), whilst other items had a higher rating (e.g. item 7 with a regression coefficient of +0.513). This means that the relationship between the individual item scores and the individual factors (subscales) on the SCAS-P is different between groups of parents of children with ASD versus those without ASD. Therefore, similar to findings obtained by Toscano et al. (2020), results using the current data set

indicate different measurement properties for the SCAS-P both at the subscale and item levels across the ASD and non-ASD groups.

Similar results were obtained when MIMIC modelling was applied to the MABS. Data indicated evidence for ASD impacting on all five factors on the MABS; that is Separation Anxiety, Social Anxiety, Generalised Anxiety, Panic and Specific Phobia. Modification indices from Model 2 indicated possible item variance in 12 items and these were freed for Model 3. At the item level, regression coefficients revealed differential item functioning in 5 of the 23 MABS items with Bonferroni correction (0.05/12=0.00417) (Table 5). Similarly, ASD was associated with lower ratings for the same underlying level of anxiety for some items (e.g. an estimate of -0.455 for item 40), but a higher rating for other items (e.g. an estimate of +0.314 for item 10). These results are indicative of differential (variant) performance of the MABS when utilised with populations of young people with ASD compared to those without ASD.

Discussion

The current study reported on the development and evaluation of a new parent measure, the Macquarie Anxiety Behavioural Scale (MABS), to assess anxiety in typically developing children and adolescents as well as children with ASD. Psychometric testing of the MABS revealed that of the five models tested by CFA, the five-factor solution with correlated errors provided the best fit for the data. The MABS is a measure that is disorder specific in line with anxiety disorders as per DSM-5 (APA, 2013).

Replicating findings from an earlier study by Toscano et al. (2020), the current study demonstrated that the factor structure of the SCAS-P across groups of children and adolescents with ASD (with and without anxiety) versus children without ASD, is not identical.

Measurement variance (non-equivalence) was found at both the subscale and item levels when using the SCAS-P with parents of children with ASD and those without ASD, indicating that different constructs are being measured and that parts of the SCAS-P function differently across the two groups. That is, given the same question to assess a child's level of anxiety for a given situation or stimulus and assuming the same base level of anxiety, parents in both groups would answer the same question differently. We can therefore confidently conclude that results from the SCAS-P cannot be interpreted in the same way in an ASD population compared to typically developing children with and without anxiety. On comparing results for the SCAS-P across both studies, differences are noted for MIMIC modelling using the two different samples. Findings from the present study revealed more variance (difference) for the SCAS-P compared to the earlier study. The different findings can be explained by the fact that different criteria for ASD diagnosis were set for the two studies; participants in the original study were allocated to the ASD group based on a structured clinical interview, whilst for the present study, allocation was based on parent report of a community acquired ASD diagnosis and ASRS T-Scores. These methodological differences most likely explain the variance obtained across the two studies.

Assessment of measurement invariance of the newly developed MABS also indicated differential item functioning and variance at the subscale level when the measure was administered to parents of children with ASD versus children without ASD. Similar to the SCAS-P, parents across the two groups (ASD and non-ASD) responded differently to anxiety items on the MABS . Lack of clarity around typical versus atypical anxiety as it presents in ASD as well as overlapping symptoms between anxiety and ASD in children and adolescents (Kerns et al.; 2014, 2016) most likely play a large role in explaining our findings. Despite careful consideration of the literature in our design and amendments of MABS items, the new measure

did not result in items that were invariant across groups of typically developing children and children with ASD (Appendix A provides closer examination of the items that showed differential item functioning on the MABS).

Both the SCAS-P and the MABS demonstrated measurement variance across all subscales, however, this was not so at the item level. For the SCAS-P, results indicated that 25 of the 38 items indeed functioned similarly across the ASD and non-ASD groups. For the MABS, 18 of the 23 items also functioned similarly across the two groups. In line with our predictions, parents of children with and without ASD responded similarly to these 25 and 18 items, respectively. These items can therefore be considered suitable items to assess anxiety in children and adolescents irrespective of presence or absence of ASD.

Identifying items that are invariant is important as it ensures that when the measure is delivered to parents of children regardless of their neurodevelopment, results can be accurately compared and interpreted. By removing items that demonstrated variance across the groups tested, we can ensure that we are measuring the underlying construct of anxiety in a consistent manner across samples despite potentially not capturing the whole experience of anxiety in either population. Furthermore, as our understanding of typical and atypical presentation of anxiety in ASD populations continues to develop, the identification of a set of invariant items provides an additional stepping stone for future research in the assessment of anxiety in children with ASD.

In summary, the Macquarie Anxiety Behavioural Scale (MABS) produced a reasonable fit for the intended factor structure using data from this study. MIMIC results indicated that ASD impacted on parental responding at the subscale and item levels on the MABS. The impact of ASD (as defined by ASRS scores and community acquired diagnosis) on parent reported anxiety using the MABS items seems to be as strong as its impact on the SCAS-P. The MABS was

specifically designed to reflect clearer behavioural items; yet results still suggested differential responding by parents of children with and without ASD. The presence of ASD may be altering the expression of some anxiety symptoms. Children with ASD may differ in their anxiety symptom profile compared to children without ASD. Whether the observed anxious behaviours represent a common underlying aetiology between anxiety disorders and ASD is yet to be determined. In the presence of anxiety, ASD type behaviours such as cognitive rigidity, stereotyped and repetitive behaviours as well as executive functioning difficulties such as difficulty shifting attention, may be exacerbated, giving rise to a distinct type of anxiety that is different to the way anxiety typically presents in young people without ASD.

Limitations and Future Research

Limitations in the present study include the lack of confirmation of parental reported community acquired diagnoses for the control and ASD groups. Another limitation involves the two assessment tools used to establish convergent and divergent validity for the MABS, namely the SCAS-P and the SMFQ-P which were not standardised for some of the age-brackets of the children included in our study (3-5 and 19 years). Finally, it must be noted that in the MIMIC analysis we assumed that differences in the means between the two groups were due to the presence or absence of ASD. Other sources of variability may be operating including different proportions of anxious and non-anxious participants in the samples and different distributions of anxiety symptoms or disorders due to sampling or recruitment rather than a link to ASD.

Future parent assessment tools to assess anxiety in young people may wish to consider using items from the SCAS-P and the MABS that showed invariance across the ASD and non-ASD groups. Another option would be the development of an ‘ASD-testlet’ within a broader

parent measure of anxiety that focuses on items developed specifically to address atypical anxious behavior (e.g. atypical fears) often observed in children with ASD. The sixteen MABS items that demonstrated measurement invariance across the ASD and non-ASD groups in the present study (that is, all MABS items excluding the ones listed in Table 5) could be considered for the ASD-testlet. Ongoing empirical investigation and improvement of currently used measures of anxiety will further refine the assessment process of anxiety and lead to improved treatment and outcomes for children and adolescents with ASD.

Table 1. *Demographic data and diagnoses*

Demographic		*N* = 734
Child gender	% Female	43.2
Child age (years)		M = 9.71 SD = 3.34
Parent age (years)		M = 40.06 SD = 6.70
Child Schooling		
% in Primary School		77.7
% in High School		19.9
% not in school		2.5
Ethnicity		
% Oceanic		71.8
% North-West European		17.1
% Southern and Eastern European		4.8
%Other		6.3
Family type	% Two-parent	79.2
Family income for majority of sample	% $52,000-$124,799	44.3
Parent relationship to child	% Biological parent	98.1
Diagnoses/Disabilities[a]		
% No Diagnosis		34.8
% Anxiety		38.6
% Depression		5.0
% Autistic Disorder		32.2
% Asperger's Syndrome		11.3
% PDD-NOS		3.4
% AD/HD		14.0
% ODD		4.8
% Conduct Disorder		0.1
% Intellectual Disability		4.4
% Other		9.9

Note. PDD-NOS = Pervasive Developmental Disorder - Not Otherwise Specified, AD/HD = Attention Deficit/Hyperactivity Disorder, ODD = Oppositional Defiant Disorder

[a]Diagnoses/Disabilities for the Control and ASD samples were based on parent report. Anxiety Diagnoses for the Anxious sample were confirmed using structured interviews. Total % for Diagnoses/Disabilities ≠ 100% as parents in the Control and ASD samples were asked to select as many diagnoses/disabilities as applicable. 4 of the children within the anxious sample also met criteria for another neurodevelopmental disorder (2 ASD and 2 AD/HD).

Table 2. *MABS Summary Table (Grouped by Anxiety Type)*

Item No.	Anxiety Type (Factor)	ITC (Item Total Correlation) *Cronbach's Alpha = 0.969*)	*Correlation with SCAS-P (r)*	*Correlation with ASRS (r)*	Factor Loadings from Five correlated DSM factors Model (Estimate)
10	GAD	0.562	0.479	0.257	0.622
16	GAD	0.454	0.417	0.042	0.512
35	GAD	0.637	0.535	0.38	0.680
36	GAD	0.643	0.56	0.31	0.718
44	GAD	0.506	0.425	0.22	0.552
18	PANIC	0.503	0.383	0.286	0.641
23	PANIC	0.630	0.534	0.335	0.675
41	PANIC	0.559	0.434	0.281	0.750
46	PANIC	0.580	0.485	0.223	0.763
51	PANIC	0.488	0.391	0.269	0.687
6	SAD	0.386	0.417	0.233	0.391
20	SAD	0.566	0.498	0.29	0.637

21	SAD	0.624	0.496	0.313	0.681
49	SAD	0.555	0.434	0.423	0.594
13	SOC	0.688	0.565	0.373	0.789
19	SOC	0.682	0.523	0.42	0.733
38	SOC	0.605	0.459	0.377	0.628
40	SOC	0.567	0.485	0.272	0.583
53	SOC	0.612	0.532	0.374	0.707
1	SPEC	0.504	0.393	0.359	0.573
14	SPEC	0.443	0.392	0.217	0.515
17	SPEC	0.584	0.557	0.341	0.658
25	SPEC	0.513	0.442	0.431	0.626

Note. GAD = Generalized anxiety; SAD = Separation anxiety; SOC = Social anxiety; SPEC = Specific Anxiety

Table 3. *Comparison of CFA Model fits for MABS using entire sample (N = 734)*

Model	Description	χ^2	*df*	RMSEA	90% CI	CFI	SRMR	Comparison	χ^2 difference
1	One Factor	2020.04	230	0.103	0.099 0.107	0.738	0.073	-	-
2	Two factor Distress and Fear	1924.03	229	0.100	0.096 0.105	0.752	0.072	1 vs. 2	96.01 (df = 1) p = sig
3	Five correlated DSM factors	1132.12	220	0.075	0.071 0.079	0.867	0.061	2 vs. 3	791.91 (df = 9) p = sig
3a	Five correlated DSM Factors with correlated errors	668.65	210	0.055	0.050 0.059	0.933	0.047	3 vs. 3a	463.471 (df = 10) p = sig
4	Five hierarchical DSM factors	1181.11	225	0.076	0.072 0.080	0.860	0.062	4 vs. 3	48.99 (df = 5) p = sig

Note. RMSEA = root mean squared error of approximation; CFI = comparative fit index; SRMR = standardized root mean square residual. Recommended goodness of fit indices values demonstrating good model fit: RMSEA <0.06, CFI >0.95 and SRMR <0.08 (Brown 2015; Hu and Bentler 1999).

Table 4. *Summary of MIMIC models for SCAS-P (N = 587) and MABS (N = 587)*

Model	Description	χ^2	df	RMSEA	90% CI	CFI	SRMR	Comparison	χ^2 difference
SCAS	Baseline								
1	No diagnosis group effect	3925.715	688	0.090	0.087 0.092	0.712	0.099	-	-
2	Diagnosis group effect on subscale	3782.258	682	0.088	0.085 0.091	0.724	0.085	1 vs. 2	143.46 (df = 6) p = sig
3	Diagnosis group effect on subscale and item	3328.529	662	0.083	0.080 0.086	0.763	0.074	2 vs. 3	453.73 (df = 20) p = sig
MABS	Baseline								
1	No diagnosis group effect	942.727	233	0.072	0.067 0.077	0.879	0.094	-	-
2	Diagnosis group effect on subscale	732.437	228	0.061	0.056 0.066	0.914	0.048	1 vs. 2	210.29 (df = 5) p = sig
3	Diagnosis group effect on item	585.943	216	0.054	0.049 0.059	0.937	0.041	2 vs. 3	146.49 (df = 12) p = sig

Note. RMSEA = root mean squared error of approximation; CFI = comparative fit index; SRMR = standardized root mean square residual. Recommended goodness of fit indices values demonstrating good model fit: RMSEA <0.06, CFI >0.95 and SRMR <0.08 (Brown 2015; Hu and Bentler 1999).

Table 5. *MABS items identified as variant across diagnostic (Anxiety and ASD) groups*

MABS Item no.	Subscale	Estimate	Std. Err	z-value	P(>|z|)
10	GAD	0.314	0.091	3.462	0.001
19	SOC	0.467	0.093	5.007	<0.0005
40	SOC	-0.455	0.116	-3.915	<0.0005
49	SAD	0.568	0.107	5.320	<0.0005

Note. GAD = Generalized anxiety disorder; SOC = Social anxiety; SAD = Separation anxiety.

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Appendix A

Analysis of MABS items that showed differential item functioning.

MABS item 10 includes ‘food refusal’ amongst a group of examples to address generalised worry. As picky or selective eating is commonly reported in children with ASD (Cermak, Curtin, & Bandini, 2010), this specific example may have led parents to focus more on ASD-related food selectivity as opposed to the anxiety symptoms that the item intended to address. Items related to social anxiety, namely item 19 and item 40 may tap into ASD-related challenges associated with social communication, poor social skills and social confusion, more so than the fear of negative evaluation (Clark & Wells, 1995; Rapee & Heimberg, 1997) associated with social anxiety as it presents in children without ASD. As such social anxiety related items that do not clearly differentiate between deficits in social skills and a fear of negative evaluation may not be suitable in assessing ‘traditional’ anxiety that is separate to behaviour typically seen in ASD. Finally, item 49 from the separation anxiety subscale may also be related to a behaviour that is often observed or reported by parents of children with ASD in clinical settings where young children with ASD insist on carrying one or multiple preferred items. The function of this behavior may or may not be related to anxiety and as such, this particular item may not be a very good item to assess anxiety in children with ASD.

The four MABS items that showed differential item functioning and that are listed above, spanned across three of the five anxiety factors that constitute the MABS, namely generalized, separation and social anxiety. Interestingly, no items from the panic and specific phobia factor showed differential item functioning. One possible explanation is the fact that items within the

panic and specific phobia subscales of the MABS used very clear behavioural terms focusing on ‘refusal to engage’ in a said behaviour or situation and ‘avoidance’ of specific situations or stimuli. This is in contrast to other items that included terminology such as ‘my child told me that ….’ or ‘my child talked about …’, which rely upon a child recalling, reporting or expressing anticipatory fear of an event or feared situation.

Appendix B

MABS Items (Grouped by Anxiety Type)

Item No.	Item Text	Anxiety Type (Factor)
10	My child took more care than other children to avoid getting hurt (e.g. refused to eat certain foods, used stairs instead of lift, crossed the road to avoid a dog)	GAD
16	My child took more care than other children to avoid making mistakes or getting in trouble (e.g. checked or redid homework, left home early to get to school, made sure rules were followed)	GAD
35	My child asked many questions about new situations	GAD
36	My child talked about the worst thing that might happen in a situation	GAD
44	My child spent more time or effort than was needed preparing for activities (e.g. took extra pencils to an exam, studied constantly, practised over and over, checked school bag was packed correctly)	GAD
18	My child told me s/he felt s/he was going crazy	PANIC
23	My child told me s/he does not want to participate in certain activities (e.g. sports, visiting new places) for fear of experiencing sudden and extreme symptoms e.g. heart racing, difficulty breathing, feeling faint	PANIC
41	My child suddenly started sweating and/or was unable to breathe even though there was no clear reason	PANIC
46	My child told me that s/he suddenly felt his/her heart racing, felt dizzy or wanted to be sick	PANIC
51	My child told me that s/he suddenly felt numbness or a tingling sensation	PANIC
6	My child was unable to sleep on his/her own	SAD
20	My child talked about something bad that might happen when we're not together	SAD

21	My child checked where I would be before separating or after (e.g. asked repetitive questions, called or texted)	SAD
49	My child insisted on carrying or wearing a special item (e.g. bracelet, toy, blanket, book) when separating from a parent/caregiver	SAD
13	My child either became distressed by or avoided performing (e.g. avoided sports, music, dance or drama performances, tests, exams)	SOC
19	My child avoided interacting with other children despite wanting to have friends (e.g. avoided group work, team sports, parties, playdates, going to movies/hanging out with friends)	SOC
38	My child avoided talking to other people despite talking easily at home (e.g. kept quiet, said very little)	SOC
40	My child talked about being embarrassed, laughed at or about others thinking s/he is stupid	SOC
53	My child became distressed by or avoided reading aloud, speaking or participating in class or during assembly	SOC
1	My child refused to travel in certain means of transport (e.g. train, bus, plane)	SPEC
14	My child refused to be around certain animals or insects (e.g. dogs, spiders)	SPEC
17	My child avoided one or more of the following situations – the dark, crowds, heights, storms or water	SPEC
25	My child refused one or more of the following - going to the doctor, going to the dentist, getting an injection	SPEC

Note : Correlated error terms were included in model 3a for 36 & 20, 16 & 44, 10 & 14 , 6 & 17 , 36 & 40 , 23 & 13 , 35 & 21 , 41 & 51 , 20 & 21 , 19 & 38