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Autism spectrum conditions among children and adolescents: A new profiling tool

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Abstract

There is considerable debate about the sociocognitive features of autism spectrum conditions (ASC), and a tool for profiling the sociocognitive profiles of children and adolescents with ASC is needed. The aim of this research was to evaluate the psychometric properties of a new questionnaire—The Australian Scale for Autism Spectrum Conditions (ASASC). Three hundred twenty-two parents of children on the ASC spectrum, including autistic disorder ($n = 76$), Asperger's disorder ($n = 188$), and pervasive developmental disorder not otherwise specified ($n = 21$), and a clinical group of children with subclinical ASC features and no ASC diagnosis ($n = 37$). Measures include an initial scale measuring eight potential dimensions of ASC, a related screening tool for autism, and two previously validated social skills questionnaires. The questionnaires were administered online. The ASASC was factor-analysed, internal and test–retest reliabilities (for a randomly selected 84 parents) were calculated, and preliminary tests of convergent and divergent validity were conducted. The resulting measure (44 items) contained five coherent and reliable dimensions: understand and express emotion, fact orientation, sensory sensitivity, social communication, and rigidity. The questionnaire had good test–retest reliability and convergent/divergent validity. The ASASC enables profiles of ASC symptomatology that should be useful in adjusting interventions to individual needs.

Key words: Asperger's syndrome, autism spectrum conditions, psychometric validation, symptom profile, symptomatology

INTRODUCTION

Autism spectrum conditions (ASC)[1] have long been characterised as involving major difficulties with conversation and formation of friendships (Asperger, 1944, 1979). Children with ASC have difficulty understanding and using the rules governing social behaviours (Wing, 1981, 1991), and interpreting nonverbal social and conversational cues (Ehlers & Gillberg, 1993; Gillberg & Gillberg, 1989; Szatmari, Bremner, & Nagy, 1989). Children with ASC may be over-literal in interpretation (Ehlers & Gillberg, 1993), often display intense, narrow, and specific interests (Attwood, 2003), and have highly ritualised behaviour that results in distress when small changes in routine occur (Attwood, 2006). Hyper- or hyposensitivity to sensory inputs are also commonly reported (Dunn, Myles, & Orr, 2002; Rogers & Ozonoff, 2005), and there may be motor coordination problems (Gillberg & Gillberg, 1989). Prevalence studies indicate that ASC affects 1 in 88 children (Centers for Disease Control and Prevention, 2012).

Historically, there has been general consistency in the literature that ASC includes three domains: social interaction, communication, and restricted and repetitive behaviours and interests (Happé & Ronald, 2008). The recently released *Diagnostic and Statistical Manual of Mental Disorders* (DSM5; American Psychiatric Association (APA), 2013) emphasises two symptom domains—social and communication problems (problems with social-emotional reciprocity, nonverbal communication, and developing and maintaining relationships), and fixated interests and repetitive behaviour (stereotyped or repetitive actions, excessive/ritualised adherence to routines, restricted and intensely focused interests, and reactivity to sensory input). Across individuals with ASC, there is considerable variation in sociocognitive strengths and weaknesses (Charman et al., 2011; Georgiades et al., 2013; Munson et al., 2008). Given the diversity of presenting symptoms in children and adolescents with ASC, clinical settings require a brief and psychometrically valid and reliable measure that profiles ASC symptomatology. While several screening and diagnostic measurement tools are available, such profiling measures are relatively rare. A profiling tool would be useful for

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clinicians and other health professionals because it could be used to identify strengths and weaknesses that could be prioritised in intervention programmes.

In recent years, many new ASC measures have been published, but the primary orientation of these has been to assist in the screening and diagnosis of ASC. Examples of these measures include the Childhood Autism Spectrum Test (CAST; Scott, Baron-Cohen, Bolton, & Brayne, 2002; Williams et al., 2008), the Autism Spectrum Quotient (ASQ-Child; Auyeung, Baron-Cohen, Wheelwright, & Allison, 2008), and the Autism Spectrum Disorders-Diagnostic for Children (Matson & González, 2007). Some were not developed as a multidimensional measure but have been subsequently subjected to factor analysis (e.g., Autism Spectrum Screening Questionnaire (ASSQ); Ehlers, Gillberg, & Wing, 1999; Posserud et al., 2008; CAST; Ronald et al., 2006). With some exceptions (e.g., ASQ-Child), psychometric studies have often been based on relatively small samples of people with ASC, with most samples ranging from 20 to 150. While there is considerable consistency across questionnaires on some factors, the limited sample sizes mean some inherent restrictions in the number of items that can be subjected to factor analysis, the likely internal reliability of factor subscales, and the number of factors that are likely to be detected.

The aim of this research was to develop a clinically useful tool for profiling ASC symptomatology. Our reviews of the literature indicated considerable debate about whether a range of other symptom clusters are characteristic of the milder forms of ASC, including executive functioning (e.g., Smyrnios, 2002; Verte, Geurts, Roeyers, Oosterlaan, & Sergeant, 2006), sensory sensitivities (e.g., Baranek, David, Poe, Stone, & Watson, 2005), and motor clumsiness (e.g., Attwood, 1998, 2006; Green et al., 2002; Wing, 1981, 1991). The aim of the study was to assess the first-order factor structure of the new measure (subsequently termed the *Australian Scale for Autism Spectrum Conditions*—ASASC), in particular to assess the relative coherence and independence of dimensions, and to test the extent to which the factors load onto a core latent construct of ASC symptomatology. We anticipated eight potential dimensions of ASC symptomatology, namely social abilities, emotional comprehension and expression, communication abilities, specific interests, motor skills, cognitive skills, routines, and sensory sensitivity. The test–retest reliability and convergent/divergent validity of the questionnaire were also evaluated.

METHOD

Sample

All parents included in the study had been referred to two clinics specialising in autism spectrum conditions for diagnostic assessment. Parents were included in the study if their child had received an ASC diagnosis from a clinical psychologist (one of the first two authors) (autistic disorder ($n = 76$), Asperger's disorder ($n = 188$), pervasive developmental disorder not otherwise specified (PDDNOS) ($n = 21$)) (see the Diagnostic Process section). To further maximise the variability in *ASC symptomatology* scores, the analysis sample also included a small number of clinically referred children who were elevated on at least some ASC dimensions but were not in the clinically significant range for ASC ($n = 37$). Parents were included if their child was between 6 and 16 years of age. The mean age of identified children in the total sample was 10.9 years (standard deviation (SD) = 2.9), the mean number of siblings was 1.6 ($SD = 2.9$), and the mean socioeconomic status (SES) was 2.8 ($SD = 1.6$) (see *Materials and Intruments*). Differences in the sociodemographic and family variables according to gender and diagnostic group (*autistic disorder*, *Asperger's disorder*, *PDDNOS*, *other/none*) were tested using two-way analysis of variance (ANOVA). The main effects and interaction terms were nonsignificant for age, number of siblings, and SES.

For the purposes of this research, formal intelligence testing and diagnosis of other comorbid conditions would have required a further clinic visit; this was not feasible for many of the participants, and testing/diagnosis would likely have substantially reduced participation and generalisability of results. Instead, for consenting parents, the study relied on parental report of previous clinical diagnoses (see the Diagnostic Process section). Eighteen per cent of parents participating in the study reported that their child had received a diagnosis of intellectual impairment. Chi-square testing revealed significant differences in proportions of intellectually impaired children across groups, with 29%, 8%, 33%, and 14% of children in the *autistic disorder*, *Asperger's disorder*, *pervasive developmental disorders not otherwise specified (PDDNOS)*, and the *clinical non-ASC* groups, respectively, reported as being intellectually impaired, χ^2 (3) = 42.0, $p = .001$. Comparatively few children in the four diagnostic groups had received a formal diagnosis of conduct disorder (0–6.5%) or Tourette syndrome (4–5.7%). Learning disability was diagnosed in 14% of the sample, with no significant differences across diagnostic categories. A diagnosis of obsessive–compulsive disorder was more prevalent in the *Asperger's disorder* group and other/none group (10%) than in the *autism* category (1.1%). Anxiety disorders were more prevalent in the *Asperger's disorder* and the *clinical non-ASC* groups (14.1% and 21.7%, respectively) compared with the *autistic disorder* group (3%). These data must be considered tentative since there was no verification of these parental-reported diagnoses for the purposes of this study.

Procedure

Recruitment for the main study

This research was approved by the Human Research Ethics Committee of The University of Queensland. Parent ratings of child behaviour were chosen above other ratings (e.g., child self-report) because of the potential limited reliability of self-report data from children who have ASC (Capps, Yirmiya, & Sigman, 2006). The main parent sample was recruited from prior and continuing client lists from two large ASC clinics in Brisbane, Australia. Demographic and diagnostic information from past client lists were reviewed by the clinic directors, and 1,100 cases met the criteria for potential inclusion in the study. Attempts were made to contact all families by telephone. In 310 cases, the number was no longer current. In these cases, the family name was consulted in the telephone directory over the Internet, and in 66 cases the family was located. If parents expressed interest in participation, they were advised that the questionnaires could be completed on a secure web site, or that they could request that a hard copy be sent to them. Parents who agreed to participate in the study were sent a covering letter and information sheet on negotiating the web site. The secure web site was designed so that people without a PIN number and password were unable to access the web site, and the password uniquely identified the research participant. A randomly selected subset of participants ($n = 84$) were invited via telephone to recomplete the ASASC 2 weeks after their initial completion to obtain test–retest data.

In total, 856 families were successfully contacted. Initial agreement was excellent, with 850 parents agreeing to participate. If families agreed to participate but had not completed the questionnaires within 1 month a reminder telephone call was made. Questionnaire completion rates following telephone agreement was 51%, 46%, 37%, and 46% for families in which the child had a diagnosis of *autistic disorder*, *Asperger's disorder*, *PDDNOS*, and the *clinical non-ASC* group, respectively.

Diagnostic process

ASC diagnoses were based on a semi-structured diagnostic interview conducted by one expert clinical psychologist with the child and primary caregiver/s, observation of the child in the clinic, review of previous reports written by health professionals and school personnel, and in some cases interview with the class or learning support teacher. The formal diagnosis was based on the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (text revision) (DSM-IV-TR) criteria (American Psychiatric Association, 2000) for autistic disorder, PDDNOS, and non-ASC diagnoses. The DSM-IV-TR criteria for Asperger's disorder have been broadly criticised as being too restrictive (e.g., Ghaziuddin & Ghaziuddin, 1992; Mayes, Calhoun, & Crites, 2001), overly reliant on early developmental history that may be difficult or impossible to attain (Attwood, 2006), and not sensitive enough to the unique communication profile of the person with Asperger's disorder (Leekam, Libby, Wing, Gould, & Gillberg, 2000), leading some researchers to modify the criteria for their research (e.g., Klin, Pauls, Schultz, & Volkmar, 2005). Additionally, Gillberg's (1991) criteria were used for Asperger's disorder because these criteria are the longest standing criteria in prevalence studies (Leekam et al., 2000); the criteria include behavioural features covered in other criterion systems (Szatmari et al., 1989; Tantam, 1988) and more closely match Hans Asperger's original descriptions (Asperger, 1944; Attwood, 2006). Gillberg's criteria for Asperger's disorder (Gillberg, 1991; Gillberg & Gillberg, 1989) were used because these six criteria cover speech and language peculiarities, nonverbal communication problems and motor difficulties, as well as social impairment, narrow interests, and repetitive routines. Agreement on each diagnosis was checked by review of assessment notes by the second diagnostician (also a clinical psychologist) and/or agreement following joint interview of the child/parents. The two expert diagnosticians collectively had some 50 years of experience in the diagnosis and treatment of ASC.

Materials and instruments

To meet the objective of developing a profiling tool for ASC, an initial field of 139 items was generated by the first two authors. The field of items was based on factor analyses of existing measures, expert input and clinical experience, clinical case studies, narrative reviews, and DSM-IV-TR (APA, 2000) and other criteria. The initial items measured social abilities (33 items), emotional comprehension and expression (19 items), communication abilities (24 items), specific interests (10 items), motor skills (9 items), cognitive skills (18 items), routines (8 items), and sensory sensitivity (16 items). The response format for each item was a 5-point scale rating from 0 'very much less than a typical child' to 5 'very much more than a typical child'. The initial ASASC was reviewed by two independent and internationally known ASC experts not directly associated with the present study. The questionnaire was judged by these experts as likely to have high construct validity and to be comprehensive. In addition, the provisional questionnaire was pilot-tested with a group of seven parents of a child with an ASC, and each item was discussed or modified based on focus group discussion of item face validity.

For the purposes of evaluating the convergent validity of the ASASC, questionnaires measuring theoretically related and unrelated measures were administered. For the former, the 27-item ASSQ (Ehlers et al., 1999) was used to check for agreement in elevated total scores across individuals. The

ASSQ has good test–retest reliability (0.96 parent and 0.94 teacher) and adequate specificity (0.9 parent and 0.91 teacher; Ehlers et al., 1999). Two social skills and social competence questionnaires were administered: the Social Competence Questionnaire-Parent (SCQ-P) and the Social Skills Questionnaire-Parent (SSQ-P; Spence, 1995). These measures have excellent reliability and internal consistency (Spence, 1995). For the purposes of this research, a derived measure of intellectual impairment was based on the presence/absence of a formal IQ test score of less than 70, as reported by the parent. The SES was measured using Congalton and Daniel's (1976) 7-point scale, which ranges from '1' unemployed to '7' professional.

RESULTS

Of the 368 participants who consented to involvement in the study, 46 participants failed to complete the initial version of the ASASC. To test for differences in those who completed the ASASC ($n = 322$) versus those who did not ($n = 46$), one-way ANOVAs were conducted on demographic and key variables. Noncompleters had children who were significantly older than completers ($M = 13.1$ years ($SD = 4.3$), $M = 11.7$ years ($SD = 3.6$), for noncompleters and completers, respectively, $F(1, 412) = 5.63$, $p = .026$). Chi-square tests on completers versus noncompleters were nonsignificant for gender, diagnostic group, and prior diagnosis of intellectual impairment (yes/no).

Because of the large number of ASASC items relative to the number of participants, item total correlations were used to cull items that had very low to negligible correlations with the overall ASASC score. A cut-off item total correlation of 0.30 was adopted to ensure that the subject/variable ratio reached the minimum for reliable factor analyses (ratio of 6; Child, 1990). This resulted in the retention of 61 items. A principal component analysis using varimax rotation and Kaiser normalisation converged in 13 iterations. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.91, indicating excellent sampling adequacy of the model (Tabachnick & Fidell, 1996). In the rotated solution, 12 factors had eigenvalues greater than 1, and a scree plot pointed to a five-factor solution (see Fig. 1). A five-factor solution accounted for 45.7% of the variance, and the last seven factors explained only a further 15.7% of the variance. On the basis of the scree plot and the small amount of variance explained by factors beyond the fifth factor, a five-factor solution was chosen. The initial and rotated loadings are presented in Table 1.

The resulting measure had 44 items, and these are listed in Table 2. Items with a factor loading of less than 0.4 were discarded (one item on the first factor). The highest loading items on the first factor were the following: 'Does the child have difficulty "reading" the signs of someone being embarrassed?' 'Does the child have difficulty "reading" the signs of someone's facial expression', and 'Does the child have difficulty "reading" the signs of someone being bored?' Further items reflected the ability to appropriately express emotion. This factor was interpreted as *understand and express emotion*. This factor had an eigenvalue of 6.66 in the rotated solution, consisted of eight items, and accounted for 10.9% of the total variance (see Table 1). On the second factor, the highest loading items were the following: 'Is the child primarily interested in facts?' 'Is the child interested in cataloguing information?' and 'Is the child interested in statistics?' This factor was named *fact orientation*. This factor had an eigenvalue of 5.92, consisted of nine items, and accounted for 9.7% of the total variance. The third factor had an eigenvalue of 5.3, consisted of nine items, and accounted for 8.85% of the total variance. On the third factor, the highest

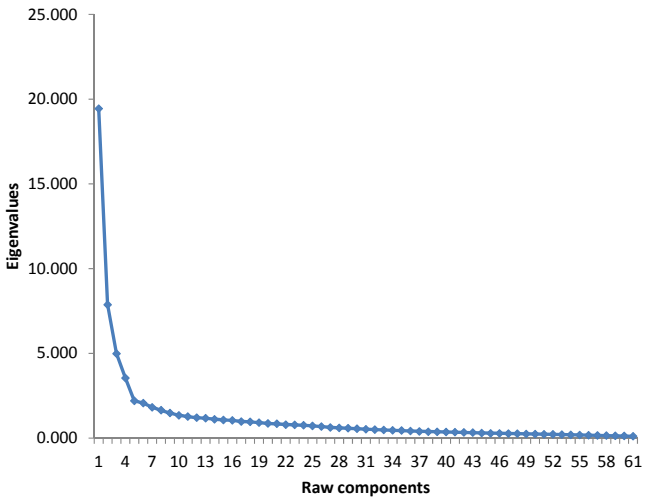

Figure 1 Scree plot for ASASC response.

Table 1 Variance explained for ASASC responses

	Initial eigenvalues			Rotation sums of squared loadings		
Factor	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	19.44	26.60	26.60	6.66	10.93	10.92
2	7.87	10.77	37.36	5.92	9.70	20.62
3	4.98	6.82	44.18	5.34	8.85	29.47
4	3.54	4.85	49.03	5.18	8.48	37.95
5	2.2	3.01	52.04	4.75	7.78	45.73

Table 2 Rotated five-factor solution for the ASASC

Item	Factor loadings 1	2	3	4	5
Factor 1—Understanding emotion					
(1) Does the child have difficulty 'reading' the signs of someone being embarrassed?	**0.87**	0.13	0.04	0.05	0.01
(2) Does the child have difficulty 'reading' the signs of someone's facial expression?	**0.84**	0.06	0.05	0.00	0.06
(3) Does the child have difficulty 'reading' the signs of someone being bored?	**0.84**	0.12	0.03	−0.02	0.05
(4) Does the child have difficulty 'reading' the emotion in someone's eyes?	**0.84**	0.13	0.08	0.05	0.01
(5) Does the child have difficulty 'reading' the signs of someone being annoyed?	**0.8**	0.16	0.04	0.07	0.12
(6) Does the child lack subtlety or maturity in his or her expression of affection?	**0.77**	0.02	0.14	0.11	0.13
(7) Does the child lack subtlety or maturity in his or her expression of anger?	**0.77**	−0.08	0.11	0.13	0.15
(8) Does the child lack subtlety or maturity in his or her expression of sadness?	**0.76**	−0.03	0.14	0.14	0.05
Factor 2—Fact-oriented					
(9) Is the child primarily interested in facts?	0.1	**0.84**	0.12	0.23	0.04
(10) Is the child interested in cataloguing information?	0.1	**0.83**	−0.01	0.04	0.13
(11) Is the child interested in statistics?	0.11	**0.8**	0.01	0.14	0.07
(12) Is the child an expert on a specific topic?	0.03	**0.78**	0.03	0.2	0.1
(13) Does the child avidly read books, primarily for information about their special interest?	−0.01	**0.71**	0.01	0.08	0.07
(14) Does the child's speech give more information or technical detail than you need?	0.07	**0.7**	0.08	0.42	0.06
(15) Is the child's speech overly formal or polite such that they talk like an adult?	0.01	**0.59**	0.11	0.35	−0.03
(16) Does the child have an exceptional long-term memory for events or facts that he or she finds interesting?	0.12	**0.58**	0.08	0.21	0.19
(17) Does the child tend to over focus on details?	0.12	**0.43**	0.18	0.29	0.26
Factor 3—Sensory sensitivity					
(18) Does the child show distress due to noises of a specific pitch, e.g. the sound of a vacuum cleaner?	0.1	0.01	**0.82**	0.04	0.12
(19) Does the child show distress due to noises of a specific volume?	0.06	0.03	**0.8**	0.02	0.08
(20) Does the child show distress due to sudden noises?	0.09	0.05	**0.8**	0.09	0.11
(21) Does the child show distress due to noises in crowded social situations?	0.12	0.01	**0.71**	−0.02	0.25
(22) Does the child show distress due to bright lights?	0.05	0.09	**0.67**	0.11	0.17
(23) Does the child notice sounds that are not heard by others?	0.06	−0.01	**0.65**	0.1	0.24
(24) Does the child startle easily, e.g. when touched from behind, or when hearing sudden noise?	0.03	0.06	**0.62**	0.06	0.16
(25) Does the child show distress due to certain aromas or odours?	0.05	0.18	**0.57**	0.2	0.24
(26) Does the child show distress due to light touch on his or her skin?	0.07	0.09	**0.49**	0.02	0.32
Factor 4—Social communication					
(27) Does the adolescent ask socially embarrassing questions?	0.14	0.23	0.01	**0.76**	0.06
(28) Does the child speak his or her mind irrespective of the social context?	0.03	0.29	0.03	**0.76**	0.07
(29) Does the child make up his or her own rules to a game and then insist that everyone follow those rules?	0.03	0.09	0.16	**0.72**	0.19
(30) Does the child point out other people's mistakes?	0.07	0.3	−0.02	**0.66**	0.1
(31) Does the child make inappropriate but true comments?	0.18	0.29	0.05	**0.6**	0.16
(32) Does the child expect other to see things only from his or her point of view?	0.16	0.2	0.13	**0.6**	0.27
(33) Does the child enforce social rules to other children, i.e. is a social policeman?	−0.04	0.45	0.12	**0.58**	0.09
(34) Does the child often interrupt a conversation?	0.29	0.02	0.17	**0.44**	0.17
(35) Does the child expect you to know what happened at school, even if you were not there to see?	0.14	0.02	0.2	**0.44**	0.17
(36) In social situations is the child likely to intrude on the conversation of others in a clumsy way?	0.15	0.01	0.23	**0.4**	0.04
Factor 5—Rigid adherence to routine					
(37) Do minor changes in routine or expectation cause the child distress?	0.12	0.03	0.2	0.17	**0.8**
(38) Does the child have to be forewarned of minor changes in the daily routine of home or the classroom?	0.08	0.12	0.13	0.15	**0.79**
(39) Do major changes upset the child e.g. moving house or a new teacher?	0.1	0.01	0.21	0.01	**0.74**
(40) Does the child have to do some things a certain way or in a certain order e.g. before going to bed?	0.1	0.1	0.23	0.13	**0.7**
(41) Does the child need an excessive amount of reassurance regarding change?	0.19	0.08	0.24	0.05	**0.68**
(42) Is the child distressed by trivial changes in the environment e.g. rearranged furniture or new cutlery?	0.17	0.14	0.25	0.17	**0.65**
(43) Does the child insist on a limited range of clothing?	−0.03	0.11	0.18	0.11	**0.51**
(44) Do the child's clothes have to be made of a specific fabric?	−0.01	0.13	0.31	0.14	**0.42**

Identified items for the respective factor in bold.

loading items were the following: 'Does the child show distress due to noises of a specific pitch?' 'Does the child show distress due to noises of a specific volume?' and 'Does the child show distress due to sudden noises?' This factor was named *sensory sensitivity*.

The fourth factor had an eigenvalue of 5.18, consisted of 10 items, and accounted for 8.5% of the total variance. On the fourth factor, the highest loading items were the following: 'Does the child ask socially embarrassing questions?' 'Does the child speak his or her mind irrespective of the social context?' and 'Does the child make up his or her own rules to a game and then insist that everyone follow those rules?' This factor was named *social communication*. On the fifth factor, the highest loading items were the following: 'Do minor changes in routine or expectation cause the child distress?' 'Does the child have to be forewarned of minor changes in the daily routine of home or the classroom?' and 'Do major changes in routine upset the child?' This factor was interpreted as *rigidity* and had an eigenvalue of 4.75, consisted of eight items, and accounted for 7.78% of the total variance.

The five-factor solution showed high coherence and independence of items. Specifically, factor loadings were typically above 0.7, and none of the items loaded more than 0.4 on any other factor (see Table 2). Also, there was a high level of internal consistency for each subscale. The Cronbach's α coefficients were as follows: understand and express emotion (α = 0.93), fact orientation (α = 0.9), sensory sensitivity (α = 0.89), social communication (α = 0.88), and rigidity (α = 0.88). Correlations between the five ASASC subscale scores were significantly different from zero ($p < .01$), and the magnitude of correlations was generally in the moderate range (0.2–0.6; see Table 3). Test–retest scores on the ASASC were assessed using intra-class correlation coefficients (ICC; Griffin & Gonzalez, 1995; Shrout & Fleiss, 1979). The ICCs were excellent for four of the subscales (ICC (fact orientation) = 0.83, ICC (sensory sensitivity) = 0.84, ICC (social communication) = 0.85, ICC (rigidity) = 0.90) and the ASASC total score (ICC = 0.86; Griffin & Gonzalez, 1995). The test–retest reliability of the *understand and express emotion* subscale was modest (ICC = 0.52). One-way ANOVA (participants who were retested relative to those not tested) showed that these two groups did not differ significantly on ASASC subscale scores, and the chi-square testing for differing diagnoses across these two groups was nonsignificant.

Table 3 Correlations between ASASC subscale scores

ASAS-R subscale	(1)	(2)	(3)	(4)	(5)
(1) Understanding emotion	–				
(2) Fact-oriented	0.23**	–			
(3) Sensory sensitivity	0.27**	0.25**	–		
(4) Social communication	0.33**	0.59**	0.35**	–	
(5) Rigid adherence to routine	0.26**	0.33**	0.58**	0.43**	–

Note. **Bivariate correlations are significantly different from zero at $p < .01$ (two-tailed).

Convergent and divergent validity was tested by evaluating the degree of overlap with theoretically related and unrelated behavioural constructs. The total ASASC score was correlated with the total scores on the ASSQ using univariate (product moment) correlations. The two questionnaires were found to be significantly correlated, $r = 0.56$ ($p = .001$). Divergent validity was assessed by comparing the ASASC total scores to the scores on the SCQ and the SSQ. Pearson correlation coefficients were calculated, and indicated that the ASASC had a negligible correlation with the SCQ ($r = 0.08$) and only a small correlation with the SSQ ($r = 0.16$). These results suggest that the ASASC total score was significantly correlated with a related measure of ASC, and not meaningfully correlated with measures of social skills and competence, as we would expect for a measure of multiple ASC-specific domains.

To check the construct validity, the capacity of the ASASC to distinguish children with an ASC from typically developing children was examined. The ASASC subscale scores were compared for parents whose child had an ASC with a supplementary convenience sample of 16 parents recruited through an undergraduate psychology course at The University of Queensland. None of these children had an ASC, language impairment, or intellectual impairment, and the supplementary sample was not significantly different from the mean age of the analysis sample. On all scales, the typically developing children were rated by parents as lower than children with an ASC on all five subscales ($p = .001$).

DISCUSSION

The contribution of this study is a new and psychometrically strong measure of ASC symptomatology. The final questionnaire consists of 44 items that can be completed in approximately 10 min, making it suitable for administration in applied settings. The questionnaire has five relatively independent and internally consistent dimensions: *understand and express emotion*, *fact orientation*, *sensory sensitivity*, *social communication*, and *rigidity*. Test–retest reliability is good for most of the subscales, and the questionnaire scores are significantly correlated with closely related questionnaires and had very small correlations with measures of child social skills and competence. The study has several strengths, including a larger sample size than many prior psychometric validation studies in this area, and a sample that is representative of the full range of diagnostic subtypes in the autism area.

While the ASASC was developed as a symptom profiling tool rather than a diagnostic tool, the ASASC factors mapped reasonably well onto the two recently released DSM5 domains for autism spectrum disorder. The ASASC factors *fact orientation*, *sensory sensitivity*, and *rigidity* map onto the DSM5 domain of *restricted and repetitive patterns* (notably

stereotyped or repetitive actions, excessive adherence to routines, restricted and intensely focused interests, and reactivity to sensory input). Notably, the results of the present study are consistent with the inclusion in DSM5 of a criterion related to sensory sensitivity, which was not featured in DSM-IV and is consistent with a broader literature indicating that sensory sensitivities are common in people with ASC (Lane, Young, Baker, & Angley, 2010; Tomchek & Dunn, 2007). The ASASC factor *social communication* maps onto the DSM5 *social and communication* domain, and the ASASC factor *understand and express emotion* has some conceptual overlap with subcriteria relating to deficits in social-emotional reciprocity (sharing of emotions). Future research might focus on the extent to which the ASASC might be helpful in DSM5 diagnosis and screening for the presence of autism spectrum disorder.

The ASASC is likely to be valuable to clinicians working with clients who have disorders on the autism spectrum. Interventions could be uniquely designed for the individual on the basis of the profile on the five subscales. For example, a high score on *sensory sensitivity* may point to the need for environmental modification to reduce exposure or to manage specific sensory overloads (e.g., bright lights, specific sounds). A high score on *understand and express emotion* might indicate that education and training to accurately decode emotion in interpersonal situations might be a priority. A high score on *social communication* might indicate a therapeutic emphasis on social communication training. A high score on *rigidity* might signal the need for parents to prepare children for changes to routine, or help with reinterpretation of apparently oppositional behaviour. The ASASC could potentially be utilised as an indicator of clinical change as part of an intervention programme. For example, once a problem a client has with the understanding of emotion is identified, the ASASC could be re-administered to evaluate intervention-related change. Further research is needed on the extent to which the ASASC is sensitive to interventions targeting ASC symptomatology.

Several limitations of this study should be noted. Findings relied on parental reports of their child's symptomatology. We argued that parents may be better able to reflect on complex, socially oriented constructs than the child with ASC. However, results would have been strengthened by including teacher reports. Parents may have been biased towards overreporting ASC-related problems; however, this effect may be reduced in the current sample because parents were invited to participate after their initial diagnostic contact with the clinic. The study is also limited because formal testing of intelligence and delays in cognitive/language development were not systematically evaluated. The test–retest reliability of the *understand and express emotion* scale was modest, suggesting that this subscale may be unstable across time. The supplementary subsample of typically developing children was relatively small, and a larger gender-matched sample would strengthen the findings on group differences.

CONCLUSION

The study yields a new measure of ASC symptomatology with promising psychometric properties. The measure should be useful to clinicians in profiling ASC symptomatology and guiding the focus of intervention. Independent replication of this validation study would be useful, as well as assessments of the capacity of the ASASC to detect clinically significant change in children and adolescents with ASC.

NOTE

1. We use the term *autism spectrum conditions* because it is perceived by presenting clients and stakeholders as not having the negative connotations of terms like *disorders* or *syndromes*.

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