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Validating the Social Responsiveness Scale for Adults with Autism

Wai Chan[1], **Leann E. Smith**[1], **Jinkuk Hong**[1], **Jan S. Greenberg**[1], and **Marsha R. Mailick**[1]

[1]Waisman Center, University of Wisconsin-Madison, 1500 Highland Avenue, Madison WI 53705, USA

Abstract

Lay Abstract—A diagnosis of autism spectrum disorder currently requires an individual to have symptoms in two core areas, i.e., difficulties in social communication, and a restricted, repetitive pattern of behavior and interests. A screening tool for autism should reflect these two diagnostic criteria in order to provide a valid way for assessing behaviors related to autism. However, since most autism measurement tools were developed for use with children and adolescents, we do not know as much about the applicability of the measurement tools to adults. The present study evaluated the validity of a commonly used measure for autism symptom severity (i.e., Social Responsiveness Scale, SRS). We examined the relationships between the SRS factors (which were consistent with two core symptom areas) and other measures related to autism in adulthood, using data from 237 adults with autism spectrum disorders. Findings showed that the SRS factors were predictive of autism symptoms and behavioral measures. Results also demonstrated that SRS factors were differentially related to measures specific to social or behavioral domains. These results highlighted the importance of taking the two core symptoms into account at the same time to enhance our understanding of autism symptomatology in adulthood.

Scientific Abstract—The Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) is a widely-used measure of autism symptoms, but its application for the study of adults with autism spectrum disorders has not been fully evaluated. Using a factor structure consistent with DSM-V criteria for autism spectrum disorder (Frazier et al., 2014), the primary purpose of the current study was to establish the validity of the SRS with a sample of adults with autism spectrum disorder (N = 237). Correlational analyses indicated that SRS factors were highly associated with autism symptoms and behavioral measures, indicating concurrent and predictive validity. Multiple regression results demonstrated that SRS factors were differentially related to measures specific to social or behavioral domains, indicating convergent and discriminant validity. Implications for future research are discussed.

Keywords

Social Responsiveness Scale (SRS); adults; autism spectrum disorder; validity

Corresponding author: Wai Chan, Waisman Center, University of Wisconsin-Madison, Madison, WI 53705, USA. Phone: (608)890-0752; wchan25@waisman.wisc.edu.

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Introduction

The Social Responsiveness Scale (SRS) is an instrument measuring the continuum of autism symptom severity and has been used most frequently with children and adolescents between the ages of 4 and 18 years (Bölte, Poustka, & Constantino, 2008; Constantino & Gruber, 2005). It consists of 65 items subsumed in five “a priori” content areas of social deficits, i.e., social awareness, social cognition, social communication, social motivation, and autistic mannerisms. This parent- or teacher-completed measure has been used widely in studies of children because of its ease of administration and strong psychometric properties (Constantino et al., 2003). The SRS is now routinely administered as part of comprehensive diagnostic assessments of ASD (e.g., Duku et al., 2013).

The primary purpose of the present study was to validate the SRS for use in research on adults with ASD. A factor structure consistent with DSM-V criteria for ASD was utilized in the current investigation. In addition, differential associations of these SRS factors were explored with multiple measures related to autism, psychopathology, and adaptive behavior. The validation of the SRS with adults with ASD will enhance the research and clinical utility of the measure across the life course.

Current Applications of the SRS

The psychometric properties of the SRS have been established previously using child and adolescent populations. Multiple studies have demonstrated that the SRS has satisfactory reliability and validity for measuring autism symptoms in individuals 18 years of age and younger (e.g., Bölte et al., 2008; Gau, Liu, Wu, Chiu, & Tsai, 2013; Wigham, McConachie, Tandos, & Le Couteur, 2012). It also has good sensitivity for screening purposes (e.g., Aldridge, Gibbs, Schmidhofer, & Williams, 2012; Duvekot, van der Ende, Verhulst, & Greaves-Lord, 2015; Moul, Cauchi, Hawes, Brennan, & Dadds, 2015).

Although the SRS has been increasingly used to assess social deficits of individuals with ASD across a wide range of ages (e.g., Constantino & Todd, 2005; Lyall, Constantino, Weisskopf, Roberts, Ascherio, & Santangelo, 2014), there are few validation studies focused specifically on adults with ASD. Some studies using the SRS with adult samples focused on individuals in the general population or combined a sample from the general population with a sample of adults with ASD (Constantino & Todd, 2005; Frazier, Ratliff, Gruber, Zhang, Law, & Constantino, 2014). However, the sample sizes of adults with ASD in these studies were small. For instance, Bölte (2012) recruited 20 adults with ASD in addition to typically developing samples. Takei and colleagues (2014) included 65 adults with ASD for their examination of the SRS. Lyall et al. (2014) studied 127 adults with ASD. Therefore, more psychometric work with larger samples of adults with ASD is needed.

Additionally, very few studies of the SRS have used longitudinal data to examine its predictive validity. To the best of our knowledge as of the preparation of this report, only four previous studies have focused on longitudinal patterns of SRS data. Constantino and colleagues (2009) reported that the SRS remained highly stable over time in a clinical sample between baseline and a 1-year follow-up (correlation coefficient = .63), indicating good test-retest reliability. Duku et al. (2013) investigated measurement invariance of the

factor structure of the SRS and found that the factors of the SRS were stable across occasions. Marrus and colleagues (2014) conducted a 10-year longitudinal study of risperidone use in children with ASD and found that the SRS was sensitive to detecting change over time. Hasegawa et al. (2015) demonstrated that an increase in parental empathy level was associated with an improvement of autism symptoms as measured by SRS. However, it remains unknown how predictive the SRS is for outcomes such as other psychopathology for adults with ASD. There is a need for additional measurement studies on the SRS using repeated measures longitudinal data from adult samples.

Validating SRS Factors

According to current diagnostic criteria (DSM-V, American Psychiatric Association, 2013), social communication deficits and behavioral symptoms are the two core impairments specific to ASD (e.g., Constantino & Charman, 2016; Lord & Bishop, 2015). An individual must manifest impairments in both social communication and restricted and repetitive behavior to be diagnosed with ASD. Given this change in the DSM-V, researchers have begun to explore whether the factor structure of existing measures aligns with the revised diagnostic criteria for ASD (e.g., Mehling & Tassé, 2016 for a review). In a factor analytic study of the SRS based on data from both children and adults, Frazier and his colleagues (2014a, 2014b) found that a two factor model (i.e., social communication and interaction, “SRS-SCI”, and restricted, repetitive patterns of behavior, “SRS-RRB”), consistent with the new diagnostic criteria, provided a good fit to the data and better incremental validity than the conventional use of SRS total score. Further, Frazier and colleagues (2014a) found that the SRS-SCI and SRS-RRB factors were empirically derived from multiple specific factors. SRS-SCI included emotion recognition (ER), social avoidance (SA), and interpersonal relatedness (IR), whereas SRS-RRB consisted of insistence on sameness (IS), and repetitive mannerisms (RM). These five specific factors served as a more precise analytic conceptualization of SRS (Frazier et al., 2014a), pending for further validation. In this paper, we extend the work of Frazier et al. by examining the validity of the two SRS factors in adults with ASD.

Construct validity is an important psychometric property of a measure, suggesting the extent to which an instrument measures the theoretical construct that it is designed to assess. Good validity is achieved when an instrument is consistently associated with other measures of the same theoretical concept (e.g., convergent validity) or to related outcomes (e.g., concurrent validity, predictive validity; Terwee et al., 2007). In the current study we examined concurrent, predictive, convergent, and discriminant validity to provide a comprehensive validation of SRS factors. Concurrent and predictive validity would be supported if SRS factors are found to be strongly correlated with related outcomes (i.e., behavioral problems, and adaptive behavior), measured at the same occasion (concurrent) and longitudinally (predictive). Particularly, we would expect that SRS-RRB factor should be highly correlated with a measure of behavioral problems both cross-sectionally and longitudinally. Similarly, we would expect that the SRS-SCI factor should be highly correlated with a measure of adaptive behavior concurrently and over time.

In addition to concurrent and predictive validity, the present study also examined convergent and discriminant validity of the SRS. Convergent validity would be established if SRS factors are found to be positively correlated with an independent measure of autism symptoms (i.e., Autism Diagnostic Interview-Revised, ADI-R; Lord, Rutter, & Le Couteur, 1994; Rutter, Le Couteur, & Lord, 2003). Conversely, discriminant validity would be demonstrated if a specific SRS factor is found to be unrelated to a domain of the ADI-R that is theoretically different from the domain of the specific SRS factor (e.g., if SRS-Social Communication/Interaction domain is shown to be unrelated to the repetitive behaviors domain of the ADI-R; if the SRS-Restricted/Repetitive Behavior domain is shown to be unrelated to the social and communicative domains of the ADI-R).

Method

Sample and Procedure

The current investigation used a subsample (n = 237) from a larger longitudinal study of families of adolescents and adults with ASD (N = 406; Seltzer, Greenberg, Taylor, Smith, Orsmond, Esbensen, & Hong, 2011). The inclusion criteria were: (1) the child had an ASD diagnosis (e.g., Autistic Disorder, Asperger's Disorder, or Pervasive Developmental Disorder - Not Otherwise Specified) made by a health or educational professional reported by parents. (2) the child with ASD was 10 years old or older (the age of the individuals with ASD ranged from 10 to 52 years old at the beginning of the study in 1998). Based on the research-administered Autism Diagnostic Interview-Revised (ADI-R), the majority of participants (94.6% of the larger study) met the criteria for an Autistic Disorder diagnosis. Other participants (5.4%) were reviewed on a case-by-case basis to determine that their ADI-R was consistent with an ASD diagnosis. Respondents were recruited from Wisconsin (n = 202) or Massachusetts (n = 204). Identical recruitment protocols were employed across sites. The data analyzed for the present study were obtained during a 2-3 hour in-home visit with the mother and the completion of a self-administered questionnaire. The study was prospectively reviewed and approved by Institutional Review Boards of the universities at which the study was conducted.

The present analyses made use of two waves of the study's ten waves of data (Time 7 and Time 8), with approximately 1.5 years between each wave. The subsample consisted of participants who continued to participate at Time 7 and provided valid data on the SRS. We also compared individuals in our current analytic sample to the original sample at baseline. There were no statistically significant differences between individuals in the current analytic sample and individuals in the original sample at the Time 1 data collection in terms of biological sex, health, lifetime autism symptoms as measured by the ADI-R or behavior problems as measured by the Scales of Independent of Behavior-Revised (SIB-R), although older individuals were less likely to participate at Time 7 than younger individuals (F = 6.69, p = .01).

Similar to the entire sample, a majority of the adults with ASD included in the present analysis were male (75.9%) and were young adults (M = 29.47 years old; SD = 8.81), although they ranged from 18 to 57 years of age at Time 7. More than two-thirds (69.6%) had an intellectual disability. Almost half (46%) continued to live at home with their parents.

The mean household income was between $60,000 and $69,999 at Time 7 (approximately between 10/2007 - 10/2008). A majority of the adults were non-Hispanic White (93.7%). Participant characteristics were summarized in Table 1.

Measures

Social Responsiveness Scale (SRS)—The SRS (Constantino & Gruber, 2005) consists of 65 items measuring severity of autism symptoms. Mothers indicated the extent to which each statement described their adult child's behaviors over the past 6 months on a rating from 1 (*not true*) to 4 (*almost always true*). For analytic purposes, the scoring was recoded from 0 to 3 in order to compute the raw score. Higher scores represented more severe impairment.

Following the factor structure suggested by Frazier et al. (2014a), two factors of the SRS were identified, i.e., Social Communication/Interaction (SCI), and Restricted/Repetitive Behavior (RRB). SCI and RRB consist of 38 and 27 items, respectively. A mean score was calculated for each factor based on raw scores. These factors demonstrated excellent internal consistency (SCI, $\alpha = .90$; RRB, $\alpha = .88$). Scores from Time 7 were used for the present analyses.

Adult Behavior Check List (ABCL)—Problem behaviors were measured using the ABCL (Achenbach & Rescorla, 2003), a widely used assessment of psychopathology. Mothers reported the extent to which their adult child exhibited psychological symptoms over the past 6 months on a scale from 0 (*not true*) to 2 (*very true*). A total problems score was created by summing all problem items. Higher scores indicated greater psychopathology. Raw scores from Time 7 and Time 8 were used for the present analysis.

Autism Diagnostic Interview-Revised (ADI-R)—Autism symptoms were measured by the ADI-R (Lord et al., 1994), a standardized investigator-directed interview conducted with respondents. Interviewers participated in an approved ADI-R training program. Items for the diagnostic algorithm were used reflecting three symptom domains, i.e., impairments in social reciprocity, impairments in non-verbal/verbal communication, and repetitive behaviors and stereotypes interests. Each item was rated on an ordinal scale from 0 (*no abnormality*) to 3 (*severe autistic-type abnormality*). Then, items scored with 3 were converted to 2 (Lord et al., 1994; Shattuck et al., 2007). Higher scores represented greater autism symptoms.

For the present study, two domain scores of the ADI-R were computed, i.e., ADI-R(social) and ADI-R(behavioral), in parallel with SRS factors. ADI-R(social) used a sum score of domains of impairments in social reciprocity and impairments in non-verbal communication. ADI-R(behavioral) was created from the domain score of repetitive behaviors and stereotyped interests. ADI-R data from Time 7 and Time 8 were included in the present analysis.

Vineland Screener (VS)—Current adaptive behavior was assessed by the short form of the Vineland Adaptive Behavior Scales (i.e., Vineland Screener, VS; Sparrow, Carter, & Cicchetti, 1993; Sparrow, Carter, & Cicchetti, 1984). It is a well-validated measure (van

Duijn, Dijkxhoorn, Noens, Scholte, & van Berckelaer-Onnes, 2009) that has been used in other validation studies of ASD-related measures (Bishop & Seltzer, 2012). We calculated a composite standard score based on the communication, socialization, and daily living skills domains from the VS, with higher scores representing higher levels of adaptive behavior. Data from Time 7 and Time 8 were included.

Covariates—As prior studies have found sex (Van Wijngaarden-Cremers, van Eeten, Groen, Van Deurzen, Oosterling, & Van der Gaag, 2014), intellectual disability (ID; Black, Wallace, Sokoloff, & Kenworthy, 2009; Frazier et al., 2014a; Schatz & Hamdan-Allen, 1995), and age (Esbensen, Seltzer, Lam, & Bodish, 2009; Frazier et al., 2014b) to be significant predictors of individual differences in autism symptoms or behavior problems, we controlled for these demographic characteristics in all analyses. Sex was coded 0 = *female*, 1 = *male*, ID was coded 0 = *no*, 1 = *yes.* ID status was determined by multiple standardized measures (the Wide Range Intelligence Test, WRIT; Glutting, Adams, & Sheslow, 2000; Vineland Screener, VS; Sparrow, Carter, & Cicchetti, 1993), consistent with diagnostic guidelines (i.e., ID status was assigned when a score of 70 or below on both measures was attained; Luckasson et al., 2002). A consensus procedure was also used to further clarify ID status when cases with incomplete information on these two measures or cases with either one measure falling within the marginal range (i.e., 71-75). These cases were reviewed by psychologists on a case-by-case basis (see Orsmond, Seltzer, Greenberg, & Krauss, 2006; Shattuck et al., 2007 for details).

Analytic Plan

The validity of the SRS was established by testing hypothesized correlations between the SRS factors and multiple ASD-related measures (i.e., ABCL; ADI-R; VS). Domain or sum of domain scores was used. Zero-order correlations among SRS factors and relevant measures were computed to examine concurrent and predictive validity. Multiple regression models were used to explore differential associations of SRS factors and to provide evidence of convergent and discriminant validity. All predictors (SRS-SCI and SRS-RRB) and covariates (i.e., intellectual disability, gender, and age of individuals with ASD) were entered in one single step for all multiple regression models.

Results

Criterion Validity

Concurrent Validity—Concurrent validity is a type of criterion validity that is established by demonstrating significant relationships between the current assessment of a variable and another validated measure of the same construct, measured at the same point in time (Collins & Sayer, 2000; Mertens, 2005). As can be seen in Table 2, the SRS-SCI was significantly correlated with the VS, suggesting that greater social communicative impairment was inversely related to the social domains measured by the VS. Also, the SRS-RRB was significantly correlated with the ABCL, suggesting that greater social behavioral deficits were related to greater levels of psychopathology. As can be seen in Table 3, the relationships between the SRS-SCI and the VS, and between the SRS-RRB and the ABCL,

still held after controlling for demographics. These findings provide evidence for concurrent validity of SRS factors.

Predictive Validity—Predictive validity is another type of criterion validity that is evaluated by demonstrating the relationship between the measure and a validated outcome measure of the same construct, assessed at a later point in time (Collins & Sayer, 2000; Mertens, 2005). Similar to the results of concurrent validity (see Table 2), the SRS-SCI measured at Time 7 was significantly correlated with the VS measured 18 months later at Time 8. Similarly, the SRS-RRB measured at Time 7 was significantly correlated with the ABCL measured 18 months later at Time 8. As shown in Table 3, these associations were still significant after accounting for covariates. These findings demonstrated strong evidence for predictive validity, suggesting that the SRS factors were able to predict their corresponding aspects of the autism behavioral phenotype across an 18 month period.

Construct Validity

Convergent Validity—Convergent validity is a type of construct validity (Campbell & Fiske, 1959; Messick, 1995; Strauss & Smith, 2009) that is demonstrated by significant associations with other measures of the same theoretical construct. As can be seen in Table 3, the SRS-SCI was highly positively correlated with the social domain of the ADI-R after controlling for the SRS-RRB and demographic characteristics, while the SRS-RRB was correlated with the behavioral domain of the ADI-R, after controlling for the SRS-SCI and demographic characteristics.

Discriminant Validity—Discriminant validity is another type of construct validity that is established by demonstrating that measurements of distinct theoretical domains are in fact not associated with each other (Campbell & Fiske, 1959; Messick, 1995; Strauss & Smith, 2009). As can be seen in Table 3, the SRS-SCI was not associated with the behavioral domain of the ADI-R, after controlling for the SRS-RRB and covariates. Similarly, the SRS-RRB was not associated with the social domain of the ADI-R after controlling for the SRS-SCI and covariates. These findings establish the specificity of the SRS factors.

Discussion

This study provided empirical support for the validity of the SRS in adults with ASD. We examined four types of validity of SRS factors so as to more fully account for the complex structure of social impairment related to ASD in adulthood. SRS factors demonstrated strong associations with various other measures related to ASD. These findings supported the validity of the SRS factors across measurement occasions. To the best of our knowledge, the present investigation is one of the very first validation studies of the SRS in a sample of adults with ASD, and it also is one of the first studies to provide longitudinal data for validity analyses.

Current conceptualizations of ASD, incorporating recent changes to the diagnostic criteria for ASD (e.g., DSM-V; American Psychiatric Association, 2013), indicate that autism is a spectrum of multiple social deficits and behavioral challenges. This conceptualization was well represented by the two-factor structure of the SRS examined in the present analysis.

Building on prior studies of children and adolescents with ASD (e.g., Constantino et al., 2004), we provided additional empirical support for the SRS measurement properties in a sample of adults with ASD.

Specifically, in the present study the SRS not only showed high concurrent associations with multiple instruments assessing the behavioral phenotype of ASD, but it also had strong relationships with outcomes measured at a later time point. Our results are consistent with a prior study focusing on a sample of young children (e.g., Hus, Bishop, Gotham, Huerta, & Lord, 2013), suggesting that this measure is useful for prospectively assessing characteristics related to ASD. Nevertheless, it is noteworthy that correlations among the VS and ABCL were very high across time points, suggesting that the behavioral phenotype of ASD may be relatively stable over the adult life-course. Even though our findings provided good initial support for the validity of the SRS, future studies should further examine the predictive validity of this measure.

The current study also empirically tested for differential associations of the SRS factors. Even though the SRS factors have been found to be highly correlated with each other (Frazier et al., 2012, 2014a, 2014b), each factor (i.e., SCI and RRB) may not necessarily yield the same predictive power for all outcomes. In our study, we found that the two SRS factors each predicted unique outcomes (e.g., the social communication domain of the SRS predicted adaptive behavior as measured by the VS but did not predict psychopathology as measured by the ABCL, while the repetitive behavior domain of the SRS predicted psychopathology as measured by the ABCL but did not predict adaptive behavior as measured by the VS). This suggests that in understanding the developmental course of autism symptoms it may be useful to analyze the two factors of the SRS separately rather than analyzing only a general construct of autism symptoms. It would be ideal to control for SRS factors in the same model and to explore the unique associations of each SRS factor to the outcome.

Importantly, our findings may add new insights to clinical interpretations of the social impairment domains of ASD. A summative scale score of the entire SRS often serves as a conventional way to delineate severity of social impairment. However, the present study suggests that the conventional approach may not be able to clearly account for residual variances specific to SCI and RRB. It is noteworthy that although SCI and RRB are highly correlated with each other and these factors have very good reliability, minimal residuals could be left to the SRS factor after adjusting for another SRS factor in the model. This may explain why SCI and RRB were not able to demonstrate unique contribution to the outcome simultaneously.

Some shortcomings were evident in our analyses. A limitation of the study was the utilization of the initial version of the SRS instead of the updated version (i.e., SRS-2, Constantino & Gruber, 2012; Frazier et al., 2014a). Although the wording for some items of the initial version were not completely appropriate for an adult sample (e.g., “has difficulty ‘relating’ to adults” versus “has difficulty ‘relating’ to family members”, Constantino & Todd, 2005), our results were still able to produce satisfactory measurement properties of the SRS in an adult sample. This may suggest that the SRS can be applied to individuals of

different age groups. Another caveat was the lack of a comparison group, which would have allowed us to examine the specificity and sensitivity of SRS in an adult sample. Future investigations may want to verify our findings in different samples, including typically developing adults, or individuals with other developmental disabilities.

Moreover, the validity of SRS factors was predominantly established with parental reports in this study, and therefore shared method variance may have increased associations. However, a number of studies indicated that SRS data provided by teachers or by adults themselves showed a different pattern of factor structure or poor measurement qualities (e.g., Nelson, Lopata, Volker, Thomeer, Toomey, & Dua, 2016; Nishiyama et al., 2014). The SRS factor structure might be more valid when parents are the respondents than with other types of informants. To further validate SRS factors across groups of informants, future studies should collect SRS data from parents, teachers, as well as individuals with ASD and conduct a comprehensive comparison of measurement properties of SRS factors.

Future researchers should apply other outcome measures that are clearly distinct from SRS to establish better predictive validity (e.g., vocational outcomes, friendship development). Also, there was only approximately 18 months between the SRS data collected and the outcomes measures assessed. It would be ideal for future studies to allow longer time elapsed between assessment occasions for better predictive validity establishment.

In conclusion, this study examined the psychometric properties of the SRS in a large longitudinal study of adults with ASD. The SRS two-factor approach demonstrated acceptable validity, suggesting that the SRS is a robust analytic tool for adults with ASD (e.g., Frazier et al., 2014a). When considering the importance of developing valid instruments for assessing autism symptoms in adulthood, the psychometric excellence of the SRS factors stands out as an exemplar.

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Table 1

Sample Characteristics

Variables	*n*	%	Time 7			Time 8		
			M	***SD***	***n***	***M***	***SD***	***n***
SRS factors								
SCI			1.59	.45	237			
RRB			1.27	.49	237			
VS			46.35	22.91	211	46.43	22.40	190
ABCL			59.45	7.90	229	59.32	8.14	207
ADI-R								
Social			24.06	9.30	218			
Behavioral			4.73	2.47	218			
Gender								
Female	57	24.1						
Male	180	75.9						
ID								
No	72	30.4						
Yes	165	69.6						
Age			29.47	8.81	237			

Notes. SRS = *Social Responsiveness Scale.* SCI = *Social Communication & Interaction factor.* RRB = *Restricted/Repetitive Behavior factor.* ABCL = *Adult Behavior Checklist.* VS = *Vineland Screener.* ADI-R = *Autism Diagnostic Interview-Revised.* ID = *Intellectual disability.*

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Table 2

Correlations matrices across waves

Variables	1	2	3	4	5	6	7	8
SRS factors								
1. SCI	-							
2. RRB	.78***	-						
Concurrent validity (T7)								
3. VS	-.54***	-.40***	-					
4. ABCL	.47***	.58***	-.11	-				
Predictive validity (T8)								
5. VS	-.58***	-.43***	.95***	-.11	-			
6. ABCL	.42***	.54***	-.12	.81***	-.07	-		
Convergent validity (ADI-R at T7)								
7. Social	.61***	.45***	-.64***	.19**	-.64***	.16*	-	
8. Behavioral	.30***	.38***	-.29***	.21**	-.33***	.18*	.37***	-
Covariates								
9. Male	-.06	-.03	-.01	.01	.08	-.02	.01	.03
10. With ID	.39***	.28***	-.73***	.05	-.71***	.05	.49***	.33***
11. Age at T7	.05	-.04	-.12	.01	-.13	-.00	.19**	-.03
M	1.59	1.27	46.35	59.45	46.43	59.32	24.06	4.73
SD	.45	.49	22.91	7.90	22.40	8.14	9.30	2.47
n	237	237	211	229	190	207	218	218

Notes. SRS = *Social Responsiveness Scale*. SCI = *Social Communication & Interaction factor*. RRB = *Restricted/Repetitive Behavior factor*. ADI-R = *Autism Diagnostic Interview-Revised*. T7 = *Time 7*. ABCL = *Adult Behavior Checklist*. VS = *Vineland Screener*. T8 = *Time 8*. ID = *Intellectual disability*.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 3

Multiple regression results

Variables	Concurrent validity (T7)						Predictive validity (T8)						Convergent and Discriminant validity (ADI-R at T7)					
	VS			ABCL			VS			ABCL			Social			Behavioral		
	b	*SE*	β	b	*SE*	β	b	*SE*	β	b	*SE*	β	b	*SE*	β	b	*SE*	β
SRS factors																		
SCI	-15.89	3.78	-.31***	4.08	5.64	.07	-17.48	3.97	-.35***	5.61	6.38	.09	11.51	1.76	.56***	-.58	.57	-.10
RRB	.68	3.39	.01	34.52	5.11	.58***	.42	3.51	.01	28.73	5.65	.49***	-1.05	1.58	-.06	1.98	.51	.39***
Covariates																		
Male	-1.19	2.39	-.02	1.34	3.45	.02	1.68	2.43	.03	1.84	3.94	.03	.73	1.08	.03	.16	.35	.03
With ID	-30.06	2.39	-.61***	-10.65	3.54	-.17**	-27.35	2.50	-.57***	-9.64	4.09	-.15*	5.30	1.11	.27***	1.43	.36	.27***
Age at T7	.02	.12	.01	-.22	.17	-.07	-.03	.12	-.01	-.31	.19	-.10	.14	.05	.13*	-.02	.02	-.06
Adjusted R^2	.60			.37			.60			.28			.46			.19		

Notes. SRS = *Social Responsiveness Scale*. SCI = *Social Communication & Interaction factor*. RRB = *Restricted/Repetitive Behavior factor*. ADI-R = *Autism Diagnostic Interview-Revised*. T7 = *Time 7*. ABCL = *Adult Behavior Checklist*. VS = *Vineland Screener*. T8 = *Time 8*. ID = *Intellectual disability*.

* $p < .05$,

** $p < .01$,

*** $p < .001$