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Validation of the French version of the preschool form of the social responsiveness scale-second edition (SRS-2-P)

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Competing Interests

3 The authors have no conflicts of interest to declare.

4

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9

Author Contributions

10 MCP, JL, CM and AB conceived the study, contributed to the collection, analysis, and
11 interpretation of the data, and drafted the manuscript. AB is the PI of the ELENA cohort. MCP,
12 CM and AB analyzed and interpreted the data and revised it critically. All authors read and
13 approved the final version to be published.

14

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20 proofreading our article.

21

22

1 **Abstract**

2 *Objectives:* To evaluate the psychometric properties of the French form of the Preschool Social
3 Responsiveness Scale-2 (SRS-2-P-Fr).

4 *Participants:* A sample of French children aged 2 to 4 years comprising a group of 93 children
5 with Autism Spectrum Disorder (ASD) and a community control group of 201 children.

6 *Materials and Methods:* Study of internal consistency using Cronbach's α coefficient,
7 convergent validity using correlations with the ADI-R and ADOS-2, and diagnostic accuracy
8 using the receiver operating characteristic curve to determine the best threshold scores useful
9 for screening ASD in preschool children.

10 *Results:* Good internal consistency (0.78 to 0.98) according to Cronbach's alpha coefficients for
11 the total score and the sub-scores of the SRS-2-P scale. The study of convergent validity showed
12 strong correlations with the total score of the ADOS-2 Toddlers and the communication and
13 reciprocal social interaction sub-scores of the ADI-R. Diagnostic accuracy indicated that the
14 best cut-off score for detecting ASDs was 56 (area under the curve = 0.97, sensitivity 0.925,
15 specificity 0.98).

16 *Conclusion:* The SRS-2-P-Fr is a valid instrument for the early detection of ASD in preschool
17 children in France and can facilitate diagnosis.

18

19 **Keywords** Diagnostic accuracy, preschool, SRS-2-P-Fr, validation study

20 **Résumé**

21

22 *Objectifs :* Évaluer les propriétés psychométriques de la version française de l'échelle de
23 réciprocité sociale – forme préscolaire (SRS-2-P-Fr).

1 Participants : Un échantillon d'enfants français âgés de 2 à 4 ans comprenant un groupe de 93
2 enfants atteints de Trouble du Spectre de l'Autisme (TSA) et un groupe contrôle de 201 enfants.

3 *Matériels et méthodes* : Étude de la cohérence interne à l'aide du coefficient α de Cronbach, de
4 la validité convergente à l'aide des corrélations avec l'ADI-R et l'ADOS-2, et de la précision
5 diagnostique à l'aide de la courbe caractéristique d'exploitation du récepteur afin de déterminer
6 les meilleurs scores seuils utiles pour le dépistage des TSA chez les enfants d'âge préscolaire.

7 *Résultats* : Nous avons trouvé une bonne cohérence interne (0,78 à 0,98) selon les coefficients
8 alpha de Cronbach pour le score total et les sous-scores de l'échelle SRS-2-P. L'étude de la
9 validité convergente a montré de fortes corrélations avec le score total de l'ADOS-2 Toddlers
10 et les sous-scores de communication et d'interaction sociale réciproque de l'ADI-R. La précision
11 diagnostique a indiqué que le meilleur score seuil pour détecter les TSA était de 56 (aire sous
12 la courbe = 0,97, sensibilité 0,925, spécificité 0,98).

13 *Conclusion* : Le SRS-2-P-Fr est un instrument valide pour la détection précoce des TSA chez
14 les enfants d'âge préscolaire en France et peut ainsi faciliter le diagnostic.

15

16 *Mots clés* : précision diagnostique, préscolaire, SRS-2-P-Fr, étude de validation

17

1 **Introduction**

2 Autism spectrum disorder (ASD) is a prevalent and clinically diverse neurodevelopmental
3 condition [1]. Various diagnostic tools have been developed for identifying symptoms in
4 different populations. One commonly used screening tool is the Social Responsiveness Scale
5 (SRS), originally created in the US [2-4]. It assesses autistic social impairment in children aged
6 4 to 18 years. A revised version, SRS-2, based on DSM-5, expands its applicability from 2 years
7 6 months to adulthood [5-7]. SRS-2 is a screening questionnaire completed by parents or
8 teachers, includes a preschool module for children under 4.

9 The SRS-2 demonstrates strong psychometric properties in both clinical and non-clinical
10 samples [8, 9], validated against “gold standard” ASD diagnostic measures, the Autism
11 Diagnostic Interview-Revised [10], and the Autism Diagnostic Observation Schedule [10, 11].
12 In ASD, high internal consistency, reliability, and concurrent validity with the SCQ-Lifetime
13 (Social Communication Questionnaire - Lifetime form) were reported by Channell et al. [12].
14 With a quick administration, it efficiently identifies ASD symptoms. While culturally adapted
15 and widely used in various countries [13-16], it lacks validation in France.

16 The study primarily aimed to assess the psychometric properties of the French adapted SRS-
17 2 preschool form, including internal consistency, construct validity, discriminant validity, its
18 validity compared to three other diagnostic tools, as well as diagnostic accuracy. Our secondary
19 objective was to study how associated psychiatric issues affect SRS-2 scores.

20 **Patients and Methods**

21 *Design study*

22 This case-control study of diagnostic validation was conducted between January 2016 and July
23 2020 at the Montpellier University Hospital. It was approved by the research Ethics Committee

1 on the Research of Human Subjects at Marseille Mediterranean, and the National Commission
2 for Computing and Liberties (CNIL. number DR-2015-393).

3 *Participants*

4 The ASD Group consisted of parents of 93 children aged 2-4 years, part of the on-going ELENA
5 cohort longitudinal study of children with confirmed ASD recruited through referral centers
6 across France. Detailed protocol and methodology have been published elsewhere [17]. The
7 diagnosis of ASD was confirmed by a multidisciplinary assessment involving ADI-R, ADOS-
8 2, VABS-II, and IQ tests administered by trained staff under clinical supervision.

9 The Control group comprised parents of 201 children aged 2 -4, recruited from
10 kindergartens and nurseries in a 1,200,000 inhabitant area (Hérault, South of France). Parents
11 confirmed no knowledge of any neurodevelopmental disorders.

12 *Measures and procedures*

13 *The SRS-2 [6]*

14 *Cross cultural adaptation of the SRS-2*

15 Three French-speaking psychologists or child psychiatrists, members of our research team,
16 translated the English version of the SRS-2 into French. Then, when they reached consensus,
17 professionals from the US publishing editions (WPS, USA) translated the questionnaire back
18 into English without the help of the original version. Afterwards, the original version and the
19 back-translated version were compared to limit errors and to obtain a final French version,
20 which was then presented to a panel of parents of children followed in the child psychiatry
21 department for clarity assessment and minor adjustments.

22 *Subdomains of SRS-2*

1 The SRS-2 was completed by the parents. The 65 items focus on the child’s behavior over the
2 past six months using a Likert scale from 1 (Not true) to 4 (Almost Always True). Items are
3 clustered into five subdomains that correspond to the overarching 2-factor structure of the
4 DSM-5 diagnostic domains: Social Communication and Interaction (SCI), and Restricted
5 Interest and Repetitive Behaviors (RIRB). [6, 18] The RIRB contains only one subdomain,
6 while the SCI has four - defined by Constantino and Gruber [6] as follows: 1. Social
7 Awareness – the “ability to pick up on social cues” and “the sensory aspects of reciprocal social
8 behavior”; 2. Social Cognition – the “ability to interpret social cues once they are picked up”
9 and “the cognitive-interpretive aspects of reciprocal social behavior”; 3. Social
10 Communication – “expressive communication” and “the ‘motoric’ aspects of reciprocal social
11 behavior”; and 4. Social Motivation – “generally motivated to engage in social-interpersonal
12 behavior; elements of social anxiety, inhibition, and empathic orientation are included”. For
13 each of these 5 subdomains, raw scores were converted to T-scores based on chronological age
14 (normative population mean = 50, SD = 10). Composite T-scores were also provided for the
15 domains of SCI, and RIRB, as well as for an overall Total T-score. Higher scores indicated
16 more ASD-like behaviors. T-scores greater than or equal to 60 indicated elevated ASD
17 symptomatology and need for further evaluation. Symptomatology scores (Total T-score) were
18 further categorized into ‘Mild’ (60–65), ‘Moderate’ (66–75), and ‘Severe’ (76+) ranges. The
19 scale takes approximately 15 to 20 minutes to complete.

20 *Diagnosis of ASD:*

21 *ADOS-2*

22 ASD symptom severity was examined using the Autism Diagnostic Observation Schedule
23 second version (ADOS-2) [19], a semi-structured observation protocol, administered by trained
24 psychologists. We used the ADOS-2 calibrated severity score of 1–2 to indicate minimal-to-no

1 evidence of symptoms, scores of 3–4 to indicate a low level of symptoms, 5–7 a moderate level,
2 and 8–10 a high level.

3 ***ADI-R***

4 The Autism Diagnostic Interview - Revised (ADI-R) [20] is a standardized, investigator-based,
5 semi-structured interview, adapted in French. [21] It provides dimensional measures with cut-
6 offs for reciprocal social interaction, language and communication, stereotyped repetitive
7 behaviors or interests, and age-of-onset criteria. Meeting these criteria qualifies for a diagnosis
8 of “F84.0 Childhood Autism” [22] or “299.00 Autistic Disorder” [23].

9 ***VABS-II***

10 Adaptive functioning was assessed using the Vineland Adaptive Behavior Scales second edition
11 (VABS-II) [24]. This standardized caregiver interview of 297 items measures adaptive
12 behaviors from childhood to adulthood in the subdomains of communication, daily living skills,
13 and socialization. We used the standard scores of the three subdomains.

14 ***Best-estimate IQ***

15 A best-estimate IQ was calculated for each child to assess their intellectual functioning level,
16 using appropriate psychometric scales (Kaufman and Kaufman, 2004; Lezine and Brunet, 1950;
17 Wechsler, 2014) carefully selected based on the age and developmental level of each child
18 (Baghdadli et al., 2019a; Howlin et al., 2014).

19

20 ***Psychiatric comorbidities***

21 The **Child Behavior Checklist** (CBCL) for preschool children is a norm-referenced checklist
22 measure - completed by parents - that assesses a wide range of emotional and behavioral
23 disorders in children and adolescents. They consist of five different DSM-oriented scales

1 (DOS): affective problems, anxiety problems, pervasive developmental problems, attention
2 deficit/hyperactivity problems, as well as opposition and defiant problems. In our study, we
3 used the borderline clinical elevation cut-off score (T score ≥ 60 for summary scale and T score
4 ≥ 65 for DSM-oriented scale, according to previous studies on screening [25-28].

5

6 *Procedure*

7 All the parents participating in our survey responded to the SRS-2 translated into French version
8 (SRS-2-P-Fr - preschool form). Children with ASD are those followed in the ELENA cohort
9 whose parents completed the SRS-2 online on a secure platform dedicated to the completion of
10 parental questionnaires in the framework of the ELENA cohort at inclusion. All assessment
11 tools used in this study (ADOS 2, ADI-R, VABS-II, and CBCL) were completed at the same
12 time, at inclusion. The parents of 93 children completed the preschool module (Fig.1). The
13 children of the control group were recruited in the Hérault area in order to obtain a
14 representative sample of 201 children in the preschool age group. The teachers of the preschool
15 children sent an information note about the survey to the parents. Before filling out the SRS-2
16 electronically (by logging on to an email address mentioned in the information note), these
17 parents had to give their consent on the SPHINX software in an anonymous manner. They had
18 to indicate the age, sex, and class of their child, as well as the relationship of the respondent
19 (father or mother).

20 [INSERT Fig1]

21

22 *Statistical analyses (More details in supplementary file: "Supplemental analysis plan")*

23 The ASD/Control groups were described by mean and standard deviation for quantitative

1 variables, and by frequencies for qualitative variables. Quantitative variables were compared
2 using the non-parametric Kruskal-Wallis test. Data analyses were performed with SAS, version
3 9.3 (SAS institute, Cary, NC). The significance level was defined as $p < 0.05$ for all tests. The
4 validation study method was based on part of the COSMIN checklist [29, 30].

5 First, the acceptability and quality of the item are tested using the percentage of complete
6 questionnaires. Second, internal consistency validity, an indication of how the items within the
7 “SRS-2 Preschool Form” (SRS-2-P-Fr) are related, was also assessed using Cronbach’s α
8 coefficient. [31] Validity was tested for various aspects by assessing construct validity (factor
9 structure), interpretability (correlations between the SRS-P-2 and the other instruments that
10 measure similar attributes (i.e., CBCL, VABS II)), convergent validity (with ADI-R sub-scores
11 and with the ADOS CSS score). Diagnostic accuracy was tested using logistic regression to
12 determine the optimal cut-off for the diagnosis of ASD. A ROC (receiver operating
13 characteristic) curve was drawn by plotting the sensitivity versus $1 -$ the specificity of each
14 possible cut-off.

15

16 **Results**

17 The total sample for the SRS-2 preschool-form included 294 children: 93 diagnosed ASD, and
18 201 controls. The sex ratio was 1 girl for 5 boys for the ASD group vs. 1:1 for the controls. The
19 ASD group had an average intellectual level of 61.4 ± 21.7 , i.e., 58.4% with a best IQ < 70 .

20 There was a significant intergroup difference for sex, with more girls among the controls
21 (48.3% vs. 17.2%), but no significant intergroup difference for age (ASD: $m = 3.1 \pm 0.5$ years;
22 control $m = 3.0 \pm 0.7$ years).

23 ***Acceptability and Quality of the item***

1 The analysis of the distribution of the SRS-2-P items showed an inconsistency issue with item
2 56 ("Walks in between two people who are talking."). In contrast to what was expected, the
3 mean scores obtained on this item by the children in the control group (n = 201) were higher
4 than those obtained by the group of children with ASD (n = 93) (1.33 vs. 0.62). This
5 inconsistency was due to an inaccurate translation of this item when switching to the French
6 version. Consequently, item 56 was excluded from the preschool-form of the French version of
7 the SRS2. Thus, 64 items (not 65) were included in the analysis. Supplemental Table S1
8 presents the floor and ceiling effects by items and subscales, in other words, the percentage of
9 children who scored $\leq 5\%$ or $\geq 95\%$ number of points.

10 ***Reliability***

11 *Internal Consistency*

12 In the total population, Cronbach's alpha coefficients for SRS-2-P total score (0.98) and for the
13 six subscales (Social Awareness (0.78), Social Cognition (0.89), Social Communication (0.93),
14 Social Motivation (0.87), Social Communication and Interaction (0.97), and Restricted Interests
15 and Repetitive Behavior (0.93)) showed strong correlations between the items and suggested
16 that each measures the same construct. Cronbach's alpha coefficient for each dimension did not
17 increase after the removal of each item one by one. Cronbach's alpha coefficients need to be
18 >0.70 or greater to confirm the fidelity of an instrument.

19 We ran the analyses for the two groups (ASD/Controls) separately to more accurately judge the
20 internal consistency relative to other studies. Cronbach's coefficient alpha for the SRS-P total
21 score was 0.95 for the ASD group and 0.88 for the control group. The internal consistency for
22 specific subscales by groups ranged from 0.33 to 0.93 (Table 1).

23 [INSERT TABLE 1]

24 [INSERT Fig S1]

1 **Validity**

2 *Construct validity: Multi-trait, Multi-item analysis*

3 We conducted an item analysis to explore the functioning within each dimension (Sup. Mat. 2).
4 Initially, our analysis of item redundancy revealed strong correlations between items across the
5 dimensions of communication, social motivation and restricted Interests and repetitive
6 behavior. However, none of the items displayed correlation coefficients above 0.70 for the
7 dimensions of social awareness and social cognition. Secondly, Item-internal consistency (IIC)
8 within each dimension ranged from 0.13 to 0.78 (details in Sup. Mat. 2). Thirdly, the Item
9 discriminant validity analysis showed that items were correlated with multiple dimensions. A
10 few items correlated better with other dimensions, but with rather similar correlation
11 coefficients (not shown). Finally, the standard deviations (SD) of the items were comparable
12 across all items in the entire sample, indicating uniform information levels (details in Sup. Mat.
13 2). High inter-domain correlations (>0.70) between the various subscales suggest a lack of
14 independence among the six subscales of SRS-2-P.

15 *Structure Factor analysis*

16 The 2-factor model (DSM-5 Model) and the 5-factor model (original structure) have an
17 equivalent fit ($\chi^2/df = 2.3, p < 0.001$) (supplemental table S1). The fit of the 2-factor model was
18 considered as acceptable according to the descriptive indices (RMSEA = 0.068; SMMR=0.056)
19 and the parsimony indices (AGFI = 0.6 and CFI = 0.80 - good fit > 0.90). The 2-factor model
20 was finally retained because the Chi² test of fit is sensitive to sample size (and therefore often
21 significant for large samples), and the descriptive fit indices gave acceptable values.

22 An exploratory factor analysis, performed using polychoric correlation coefficients and oblimin
23 rotation, identified an alternative 2-factor structure based on a parallel analysis and the screen-
24 test. The variance explained by factor 1 (dim SCI) was 34%, and by factor 2 (dim RIRB) it was

1 3.1%. For SCI, 50/54 items are on factor1 (of which 4 have a low loading factor) and 4/54 are
2 on factor 2 (items 46, 53, 61 et 62). For RIRB, there are only 2/12 items on factor 2 (items 28
3 and 31) and 10 on factor 1.

4 *[INSERT TABLE 1]*

5

6 *Convergent Validity*

7 To determine how the SRS-2-P-Fr scores converge on the other autism measures such as the
8 ADI-R or ADOS, the correlations were examined for 93 children diagnosed with ASD who
9 were fully assessed using these measures. We found strong and significant correlations between
10 the ADOS-2 Toddlers total score ($r = 0.50$, $p = 0.004$) and the two communication and reciprocal
11 social interaction sub-scores of the ADI-R (respectively, $r = 0.54$; $r = 0.46$; $p = 0.0002$). In
12 contrast, we found very low correlations between the ADOS comparison score, the Module 1
13 ADOS total score, and the sub-scores ADI-R for restricted behavior, nonverbal, and
14 developmental abnormalities areas (Table 2).

15 *[INSERT TABLE 2]*

16

17 *Interpretability*

18 *Sex-related Differences*

19 In the ASD group, there were no sex-related differences for the SRS-2-P total score and the
20 subscales scores. In the Control group, girls obtained significantly lower scores than boys for
21 the SRS-2-P-Fr total score and for 3 treatment subscales (Social Awareness, Social
22 Communication, and Social Communication and Interaction) (Table 3).

23 *[INSERT TABLE 3]*

1

2 *VABS-II*

3 In the ASD group, there was a negative correlation of $r = -0.54$ ($p < 0.0001$) for the composite
4 score and the SRS-2-P score total, with correlations ranging from -0.36 to -0.56 ($p < 0.05$) for
5 the 4 subscales (Table 4).

6 *[INSERT TABLE 4]*

7

8 *CBCL preschool version*

9 As seen in Table 5, in the ASD group, all CBCL DSM-oriented subscales were significantly
10 associated with an increasing total SRS-2-P-Fr score (all $P < 0.05$). Total SRS-2-P-Fr scores
11 were higher in children with an over borderline clinical range of DOS.

12 *[INSERT TABLE 5]*

13 *Diagnostic Accuracy (Sensitivity and Specificity)*

14 ROC analyses revealed a high ability to distinguish children with ASD against control children,
15 with an AUC of 0.97 (95% CI: 0.94–0.99). A raw score of 56 on the SRS-2-P total score had a
16 sensibility of 0.925 and a specificity of 0.98 (False Negative = 7 and False Positive = 4). The
17 sensibility value indicates that the scale identifies 92% of the children affected. The specificity
18 value indicates that 98% of the children not affected will not be identified by the SRS-2-P-Fr
19 as affected.

20

21 **Discussion**

22 ASD is a significant source of disability, and early screening and referral to tailored, evidence-
23 based interventions are crucial for improving outcomes. However, limited research focuses on

1 psychometric qualities of ASD screening tools for very young children. This study explores the
2 properties of the French version of the SRS2 preschool form, a valuable parent questionnaire-
3 based screening tool for young children. [30]

4 Our study extends the evidence on the SRS-2 performance in preschool-aged children with
5 ASD across various countries and cultures, establishing its validity for use in French children.
6 Strengths include a confirmed diagnosis of ASD, comprehensive diagnostic and severity
7 assessments, and a control group matched for age.

8 We conducted a comprehensive assessment covering diagnostic accuracy, internal consistency,
9 convergent validity, interpretability and confirmatory factor analysis for the SRS-2-P-Fr,
10 following COSMIN recommendations of [29, 31].

11 Our French adaptation retained 64 of the original 65 items (with item 56 removed from the
12 “Social Awareness” scale), resulting in a substantial improvement in alpha Cronbach from 0.65
13 to 0.78, aligning with findings in Japanese and Turkish versions.

14 The internal consistency in the French SRS-2-P-Fr version was robust, with Cronbach’s alpha
15 values of 0.98 for the total score and 0.78 to 0.97 for subscales. These findings, similar to those
16 of the Japanese and Turkish versions [13, 16], suggest that the French version reliably assesses
17 ASD symptoms in children. We underline that the lowest internal consistency coefficient
18 observed for the French version belonged to Social Awareness, as previously reported [13].

19 Convergent validity analysis showed strong correlations between the French SRS2-P and ADI
20 and ADOS scores, exceeding original [6] and some international versions [13, 15, 16].

21 Our study, like the Turkish one, conducted exploratory factor analysis, suggesting a satisfactory
22 two- or five-factor structure with average significant factor weights (except for items 43 and
23 49). Although, we chose the more user-friendly two factor model, consistent with the original

1 American version [2, 18], where factor 1 (Social Communication and Interaction) encompasses
2 50/54 items, and factor 2 (restricted interest and repetitive behaviors) covers 2/12 items. Factor
3 2 in the SRS2-P-Fr differs from the original American version due to our selection of items
4 with weights exceeding 0.4, following guidelines. [32, 33]

5 Interpretability analysis found gender differences (affecting both the total score and the 6
6 subscores) in the control group but not in the ASD group, with negative correlations between
7 SRS-2-P total score and the composite VABS-II score ($r = -0.54$, $p < 0.0001$) as well as the
8 VABS-II subscores ($r = -0.36$ to -0.56 ; $p < 0.05$) indicating stronger correlations than previously
9 reported. [10, 34] As in previous findings, CBCL-DSM-oriented subscales were significantly
10 associated with an increase in total SRS-2-P score [2, 34] suggesting caution in interpreting
11 positive ASD screenings with SRS in children with behavioral problems.

12 Our diagnostic accuracy assessment revealed a 92% correct classification rate using a threshold
13 of 56, surpassing the Korean [14] and Japanese versions [16] but slightly below the original
14 American version [6].

15 This study has some limitations, including a small group of children with ASD ($n=93$), [35, 36]
16 , difficulty in test-retest reliability due to data collection logistics for the control group without
17 ASD in kindergarten, and a control group limited to children from the general population.
18 Future research could involve clinical comparison groups with other neurodevelopmental
19 disorders. Finally, children with ASD have a slightly higher symptom severity than in previous
20 studies, which may have overestimated the sensitivity of the French version of the SRS-2 scale.

21 In conclusion, rating scales like the SRS-2 are valuable for early screening and diagnosis of
22 ASD. The parent-reported SRS-2-Preschool is especially advantageous for assessing children
23 in naturalistic setting. Our results provide further validity evidence to support its use in
24 diagnostic screening and assessment for culturally and linguistically diverse children.

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Declarations

Ethical Approval

The study and informed consent procedure were approved by the Ethics Committee on the Research of Human Subjects at Marseille Mediterranean and the National Commission for Computing and Liberties (CNIL. number DR-2015-393).

Informed Consent

All participating families signed an informed consent form.

Competing Interests

The authors have no conflicts of interest to declare.

Availability of data and material

Not applicable

Code availability

Not applicable

Patient and public involvement

Neither patients nor the public were involved in the design, conduct, reporting or dissemination of our research

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40

1 *Table 1: Distribution of SRS-2-P-Fr total score and treatment subscale scores for the two*
 2 *study groups*

SRS-2 preschool form	ALL (N=294)		ASD (N=93)		Controls (N=201)		P-value ^α	ASD- Control	Internal
	Mean	SD	Mean	SD	Mean	SD		(effect size [95%CI])*	consistency ALL (ASD/Control)
<i>DSM-5 subscale</i>									
Social Communication and Interaction	42.4	30.4	80.3	23,8	24,8	10,8	0.0001	3.4 [3.1;3.8]	0.97 (0.93/0.84)
Social Awareness	7.1	4.3	11.7	3.5	4.9	2.5	0.0001	2.4 [2.1;2.7]	0.78 (0.60/0.33)
Social cognition	9.8	8.0	19.45	6.6	5.4	3.3	0.0001	3.05[2.7;3.4]	0.89 (0.79/0.58)
Social communication	16.4	13.1	32.9	10.2	8.9	4.6	0.0001	3.5[3.1;3.8]	0.93 (0.84/0.70)
Social Motivation	8,9	6.6	16.2	6.1	5.5	3.3	0.0001	2.4[2.1; 2.7]	0.87 (0.78/0.65)
Restricted Interests and repetitive Behavior	7.2	8.1	16.9	7.3	2.8	2,7	0.0001	3.0 [2.7;3.4]	0.93 (0.82/0.70)

3 *effect size: d Cohen=mean difference/pooled SD: An effect size of 2 and above indicates that 98% or more of the control
 4 group is below the mean value obtained in the experimental group. ^α Mann and Whitney test

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1 *Table 2: Spearman correlations of SRS-2-P-Fr total score and ADI-R and ADOS-2 (Score total and*
 2 *comparison score (CSS)) in ASD group*

	Coefficient of correlation*	p-value
ADOS 2 comparison score (n = 55)	0.1	0.4
ADOS 2 Toddler Score Total V0 (n = 36)	0.5	0.004
ADOS 2 Module 1 Score Total V0 (n = 55)	0.15	0.3
ADI-R non verbal communication(n =13)	0.53	0.06
ADI-R verbal communication (n = 43)	0.54	0.0002
ADI-R reciprocal social interaction (n = 59)	0.46	0.0002
ADI-R repetitive & stereotyped behavior (n = 59)	0.2	0.2
ADI-R abnormality of development (n = 50)	-0.1	0.4

3 *Spearman correlation

4

5

1 Table 3: Comparisons of the SRS-2-P-Fr total score and treatments subscales scores across sex

	ASD			Controls		
	Boys (N=77)	Girls (N=16)	p-value	Boys (N=104)	Girls (N=97)	p-value
Social Communication and Interaction	80.9(23.2) ^a	77.3(27.0)	0.5	26.3(10.9)	23.2(10.6)	0.02
Social awareness	11.8(3.5)	11.2(3.6)	0.2	5.4(2.5)	4.4(2.3)	0.02
Social cognition	19.3(6.4)	20.3(7.6)	0.6	5.5(3.3)	5.2(3.3)	0.4
Social communication	33.1(10.0)	31.9(11.5)	0.5	9.6(4.6)	8.3(4.4)	0.03
Social Motivation	16.6(5.9)	13.9(6.8)	0.1	5.8(3.2)	5.3(3.3)	0.2
Restricted Interests and repetitive Behavior	17.0(7.7)	16.3(5.1)	0.7	3.0(2.9)	2.5(2.4)	0.3
SRS-P total score	97.9(29.8)	93.6(30.9)	0.5	29.4(12.8)	25.7(12.4)	0.03

2 Significant associations (p-value<0.05) are presented in bold; ^a: Mean (Standard deviation)

1 *Table 4: Spearman correlations of SRS-2-P-Fr total score and VABS-II scores*

VABS-II (N=93)	Coefficient of correlation*	p-value
Communication	-0.36	0.0003
Socialization	-0.56	<.0001
Daily living skills	-0.39	0.0001
Motor skills	-0.43	<.0001
Total Composite score	-0.54	<.0001

2 **Spearman correlation*

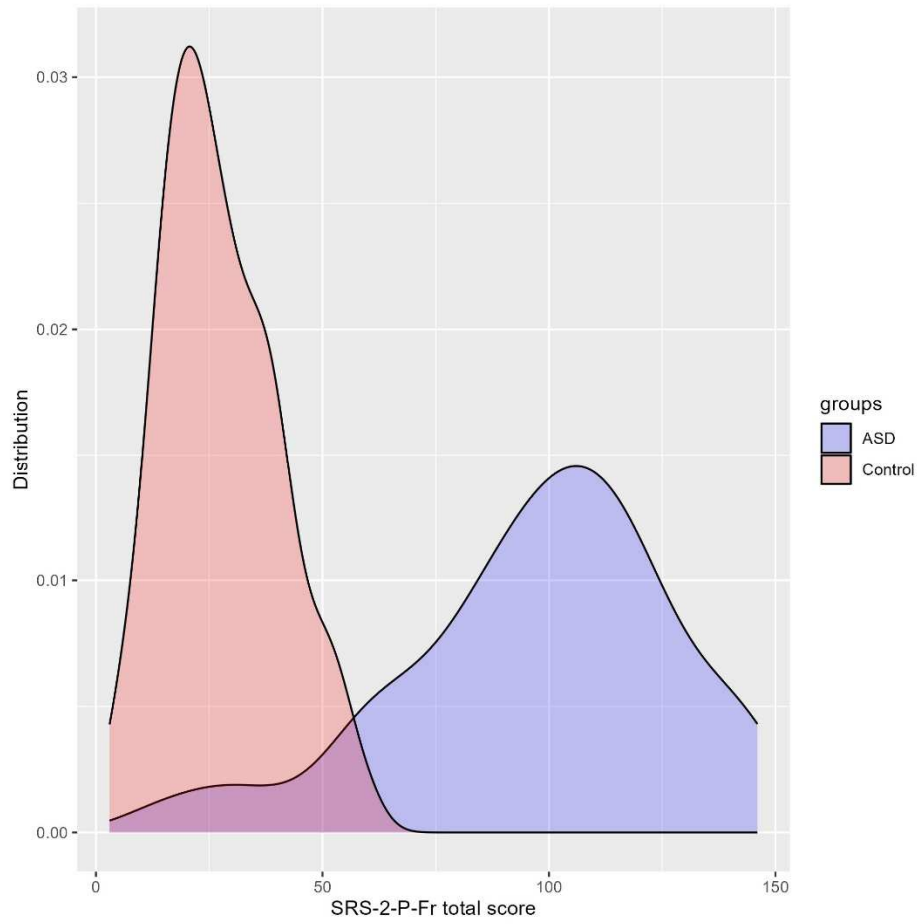
3

1 *Table 5: Comparisons between SRS-P-Fr total score and CBCL preschool version in ASD*
 2 *group*
 3

CBCL 1.5-5years (N=75)	SRS-2-P total score				p-value*
	T-score \leq 65		T-score $>$ 65		
	n after dichotomy	Mean \pm SD	n after dichotomy	Mean \pm SD	
Affective Problems	44	81.4 \pm 30.3	31	112.6 \pm 20.8	0.0001
Anxiety Problems	60	89.7 \pm 30.4	15	112.7 \pm 25.8	0.009
Attention deficit/Hyperactivity Problems	59	89.3 \pm 30.6	16	112.75 \pm 24.1	0.006
Oppositional defiant Problems	63	90.0 \pm 30.6	12	116.6 \pm 20.9	0.005

4 *Analysis of variance (ANOVA)

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1

2 *Fig.S1 Distribution SRS-2-P-Fr total Score*

3

1 Table S1: Results of Confirmatory Factor Analysis (CFA) for the five factor and two factor
 2 structure of the original form of SRS-2-P-Fr

Fit indices	Criteria	One Dimensional Model	Two Dimensional Model	Five Dimensional Model
Chi-square/Degree of Freedom (χ^2/dll)	1-3 very good; 3-5 Good	2.4	2.3	2.3
RMSEA*	<0.005 very good; <0.8 Good	0.0688	0.0705	0.0675
Normed Fit index (NFI)	>0.95 very good; >0.90 good	0.69	0.7	0.7
Comparative Fit index (CFI)	>0.95 very good; >0.90 good	0.79	0.8	0.8
Goodness of Fit Index (GFI)	>0.95 very good; >0.90 good; >0.85 Acceptable	0.59	0.62	0.63
Adjusted Goodness of fit (AGFI)*	>0.95 very good; >0.90 good; >0.85 Acceptable	0.61	0.62	0.6
Root Mean Square Residual	<0.05 Very good ; <0.8 Good	0.047	0.047	0.047
Standardized Root mean square	<0.05 Very good; <0.8 Good	0.056	0.056	0.057
AIC	lower values indicate better model fit.	4912.0	4851.1	4808.1

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4

1 *Supplementary material 2: Construct validity: Multi-trait, Multi-item analysis*

2 Redundancy between items: For communication dimension, strong correlations were found
3 between items 13 and items 16, 18, 22, 35, 37 ($r = 0.7$ to 0.8 ; $p > 0.05$) and between items 37
4 and 16, 18, 35, 36. For social motivation, there was strong correlation between items 11 and 3
5 ($r = 0.73$; $p > 0.0001$). For Restricted Interests and Repetitive Behavior, there were strong
6 correlations between items 8, 20, and 39 (respectively, $r = 0.77, 0.72$), between items 20, 29,
7 and 50 ($r = 0.75, r = 0.75$), and between items 29 and 39 ($r = 0.7$). The inter-item correlations
8 showed that none of the items had a correlation coefficient of above 0.70 for Social Awareness
9 and Social Cognition dimensions.

10 Item-internal consistency (IIC) within each dimension: IIC ranged from 0.36 to 0.55 for Social
11 Awareness, from 0.13 to 0.7 for Social Cognition (item 62 - *Gives unusual or illogical reasons*
12 *for doing things*” which is correlated with no dimension), from 0.27 to 0.78 for Social
13 Communication (lower correlations found for item 46- *Has overly serious facial expressions*,
14 item 51- *Responds to clear, direct questions in ways that don't seem to make any sense* and
15 item 53- *Talks to people with an unusual tone of voice*), from 0.22 to 0.72 for Social Motivation
16 (lower correlation found for item 1- *Seems much more fidgety in social situations than when*
17 *alone* and item 43- *Separates easily from caregivers*), and from 0.4 to 0.75 for Restricted
18 Interests and Repetitive Behavior.

19 Item discriminant validity: in most cases, items are also correlated with other dimensions. A
20 few items correlated better with other dimensions, but with rather close correlation coefficients
21 (not shown).

22 The standard deviations (SD) of items were of the same order of magnitude for all items in the
23 entire sample, providing the same level of information. They ranged from: 0.5 to 1.2 for Social

1 Awareness, 0.4 to 1.1 for Social Cognition, 0.5 to 1.1 for Social Communication, 0.7 to 1.0 for
2 Social Motivation, and 0.8 to 1.1 for Restricted Interests and Repetitive Behavior.

3 High inter-domain correlations (>0.70) exist between the different subscales. The correlations
4 were 0.68 to 0.96, suggesting a lack of independence between the 6 subscales of SRS-2-P.

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