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Validation of the Repetitive Behavior Scale-Revised in Spanish-Speakers Participants with Autism Spectrum Disorder

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Abstract Restricted and repetitive behavior (RRB) is one of the two key diagnostic features of autism spectrum disorder (ASD). DSM-5 highlights the importance of severity-based diagnostic modifiers assigned on the basis of intensity of needed supports. Therefore, there is a need for available measures that assess the severity of RRB. The repetitive behavior scale-revised (RBS-R) is probably the most used informant-based rating scale for the assessment of RRB and interests observed in ASD. The present study examined the psychometric properties of the Spanish version of the RBS-R in a sample of 233 participants with ASD, aged 3 to 63 years. Results revealed a six-factor model, good internal consistency, and concurrent-divergent validity. These findings suggest the utility of the Spanish version of RBS-R.

Keywords Repetitive behavior · Autism spectrum disorder · Factor structure · Reliability · Validity

Introduction

The American Psychiatric Association states in its fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) that the Autistic Spectrum Disorder (ASD hereinafter) is characterized by the presence of two main groups of symptoms: (1) persistent deficits in social communication and social interaction (social-emotional reciprocity and non-verbal communication in social interaction across multiple contexts, as manifested in the current or past symptoms); and (2) restricted and repetitive behavior (RRB hereinafter) (APA 2013). The scientific community has recently agreed to measure both ASD diagnostic criteria based on the level of severity (APA 2013).

In ASD, scientific interest has traditionally focused on assessing language and communication problems (DSM-IV-TR 2000). However, in recent years, partly due to the publication of DSM-5 and the production of publications on repetitive behavior, a great amount of interest has aroused in the repetitive and restrictive symptomatology of ASD (APA 2013). Thus, the DSM-5 emphasizes the importance of using diagnostic specifiers or subtypes based on severity, which are assigned based on the intensity of the support needed. This need for support is determined by the severity of ASD, which is usually conceptualized in terms of deficits in social communication and language and RRB.

The RRBs are activities or interests that occur regularly and interfere with daily performance. These behaviors are manifested in the form of repetitive motor phenomena such as stereotypies, circumscribed interests, compulsions and serious behavioral problems (Bodfish et al. 2000). In addition, the RRB may appear as symptoms in other disorders such as mental retardation, obsessive–compulsive disorder, schizophrenia, Parkinson's disease, Sydenham's chorea or Gilles de la Tourette syndrome (Bodfish et al. 2000; Eddy and Cavanna 2014; Liew et al. 2014; Neil and Sturmey 2014; Ruzzano et al. 2015). Therefore, the RRB can be considered a transdiagnostic or common variable for various neurological and neurodevelopmental disorders.

International studies have noted the need to use measures for the differential diagnosis and assessment of the severity of ASD (Mehling and Tassé 2016), among which the most

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used is repetitive behavior scale-revised (RBS-R; Bodfish et al. 2000). The RBS-R is a 43-item informant-based rating scale intended to assess the occurrence and severity of a variety of restricted and repetitive behaviors and interests observed in ASD, which are grouped into six different dimensions. These factors are: stereotypic, self-injurious, compulsive, ritualistic, sameness and restrictive behavior (Bodfish et al. 2000). Items are classified using a four-point Likert scale ranging from 0, which refers to a repetitive behavior that does not occur, to a score of 3, which is comparable to a very serious repetitive behavior. The assessment of repetitive behaviors is performed based on the observations and interactions during the past month of a family member, caregiver or professional who knows the person well. This aspect makes this test a measure with broad support for its validity, as it was developed partly based on the specific feedback on RRBs observed by parents and clinicians closest to the people with ASD (Mehling and Tassé 2016).

The RBS-R has excellent psychometric properties amongst people with ASD, with its six-factor structure, adequate reliability and concurrent-divergent validity in different countries such as USA, Canada, Peru, Greece, Japan and Italy (Esbensen et al. 2009; Fulceri et al. 2016; Georgiades et al. 2010; Inada et al. 2012, 2015; Lam and Aman 2007; Mirenda et al. 2010; Richler 2007; Rojahn et al. 2013). Moreover, it has been used to evaluate therapeutic change (measure of outcome) in very recent studies (e.g., Boyd et al. 2014; Rios-Alhambra et al. 2016; Ventola et al. 2016).

Specifically, the rate of affirmative responses to items in the RBS-R in international studies ranges between 17.30 and 80.40% (Lam and Aman 2007); although this percentage is lower in European populations, for example amongst a Greek population the range is between 9 and 68% (Georgiades et al. 2010). Previous studies have suggested rejecting items whose response rate is too low (less than 10% of the sample shows the symptom) or too high (over 90% of the sample) (Lam and Aman 2007). However, most authors have maintained all items of the RBS-R despite the lower response rate of some of its items (Georgiades et al. 2010).

Numerous studies have confirmed that the RBS-R has a five-factor structure (considering the ritualistic and sameness subscales as a single dimension) or a six-factor structure. However, the most accepted structure is the six-factor structure as it respects the original structure of the questionnaire (Georgiades et al. 2010; Inada et al. 2012, 2015; Lam and Aman 2007; Mirenda et al. 2010).

As for the correlations between the subscales and the total score of the RBS-R, previous studies have found correlations between 0.63 in self-injurious and 0.88 in ritualistic (Lam and Aman 2007). In short, studies indicate moderately strong relationships between all factors of the RBS-R (Mirenda et al. 2010), although some studies have found lower correlations between the items and the total RBS-R (Inada et al. 2015).

The internal consistency of the RBS-R is between 0.78 and 0.91 on an American sample (Lam and Aman 2007); above 0.72 in all scales on a Canadian sample (Mirenda et al. 2010); between 0.75 and 0.92 on a Greek sample (Georgiades et al. 2010); or between 0.69 and 0.93 on Japanese samples (Inada et al. 2012, 2015). Furthermore, in all cases, the lowest estimates of internal consistency have been obtained for the restricted behaviors subscale (e.g., Inada et al. 2015; Lam and Aman 2007).

In turn, recent studies have analyzed the evidence of convergent validity of the RBS-R (Inada et al. 2015), showing appropriate values. However, most studies have not analyzed the divergent validity of the measure (Georgiades et al. 2010; Inada et al. 2012, 2015; Lam and Aman 2007).

Despite the good psychometric properties of the RBS-R, a recent review by Mehling and Tassé (2016) points out that the evidence regarding the factorial structure of the scale is controversial and presents certain doubts regarding the use and interpretation of the scores of the scales. Accordingly, on the basis of certain inconsistencies of the scale in terms of its factorial structure and the lack of a Spanish version, despite being the second most spoken language in the world for non-native speakers and the third overall, this paper's main objective is to analyze the psychometric properties of the RBS-R scale on Spanish speaking people with ASD.

Methods

Participants

The characteristics of the 233 people with ASD within the sample are shown in Table 1. Their age ranged between 3 years and 63 years with a mean of 13.34 ($M = 13.00$; $SD = 9.79$). There was a higher percentage of men in the sample ($n = 181$; 77.70%). The samples provided within this case study were all previously diagnosed with ASD by the mental health service and referred to the specific centers.

Procedure

The Spanish version of the RBS-R was reviewed by a group of experts to analyze whether differences or difficulties exist in the comprehension of a reading text among Spanish participants. The translation and back translation process was carried out with the supervision of the creator of the scale to be as faithful to the original version (Bodfish et al. 2000). Therefore in conclusion, the Spanish Version of the RBS-R assesses the identical content as the original version.

Causal or incidental sampling was used. Thus, participants from 18 centers belonging to the Spanish southeast

Table 1 Sociodemographic and diagnostic characteristics

Demographic and diagnostic variables	N	%
Age		
0–5 years	32	13.70
5–12 years	119	51.10
13–15 years	26	11.20
16–20 years	14	6
21 years and older	42	18
Gender (male/female)	181/52	77.70/22.30
Race		
Caucasian	183	78.50
African American	8	3.40
Asian	1	0.40
Hispanic	36	15.50
Other	5	2.10
Reported diagnosis		
Autism	70	30.00
PDD-NOS	122	52.40
Asperger´s Syndrome	41	17.60
Severity of autism spectrum disorder		
Mild	66	28.30
Moderate	76	32.60
Severe	40	17.20
Do not know	51	21.90
Intellectual disability		
Mild	47	21.20
Moderate	60	27.00
Severe	38	17.10
No diagnosis	77	34.70
Context (missing = 2)		
Regular class in a regular school	77	33
Special class in a regular school	46	19.70
Special school	61	26.20
Residence	26	11.20
Other	20	8.60

PDD-NOS pervasive developmental disorder-not otherwise specified

were included, specifically 13 from the autonomous community of Murcia and five from the province of Alicante (Valencia). Four centers were specific special education schools; two were residencies for people with intellectual disabilities; seven were day care centers; three were early intervention centers; and two were regular schools with open classrooms. The sample belonged to different sized urban areas, with a representation from both rural and urban areas. All schools with support classes were mixed, except for a private center which was exclusively for boys. Half of the special education centers were public and the other half were state-funded private schools. All residences and daycare centers were managed by associations of people with disabilities, which had an agreement with the public administration. Accordingly, the social-economic status of the sample was broad and representative of such communities.

The study was prospectively approved by the Ethical Committees of the University of Alicante (Spain) and the Consejería de Educación y Universidades de la Región de Murcia (Spain). Written informed consent was obtained from the parents/caregivers and schools, residences, etc. The tests were applied by the researchers to the expert psychologists and similar professionals regarding the observations and knowledge of the person with ASD (psychopedagogues, special education teachers, psychologists) from the participating institutions that were accustomed with the person with ASD. The first section of this protocol "The *Social-demographic Questionnaire"* developed ad-hoc (Lam and Aman 2007) was solely completed by expert psychologists while the remainder of the protocol questionnaires were completed by the centers professionals who had greater daily contact with the person with ASD All the participating centers had a training session organized by the researchers in order to explain the goal of the study, the tests used and the instructions on how to perform the tests. Subsequently, centers were selected at random for the re-test. The professionals that performed the re-test after one month of the first application of the protocol were the same professionals that had made the initial evaluation.

Measures

Social-demographic Questionnaire

This instrument was developed ad-hoc and was adapted from the original version (Lam and Aman 2007). It contains a series of social-demographic (age, sex, country of origin) and diagnostic questions; type of pervasive developmental disorder, severity, presence and severity of mental retardation, type of school context, occurrence and severity of other concomitant disorders, medication and history of psychological problems within the family (see Table 1).

Repetitive Behavior Scale-Revised (RBS-R)

This scale has been extensively described in the introduction.

Social Communication Questionnaire, SCQ form B (SCQ-B)

The SCQ-Form B (Rutter et al. 2003; Spanish adaptation by Pereña and Santamaria (2005) is a scale orientated towards parents or caregivers, with a total of 40 items that determine the possible presence of ASD. It provides an overall total score and three possible additional scores (Social Interaction Problems, Communication Difficulties and restricted, Repetitive and Stereotyped Behaviors). The duration of its

administration was 10 min. In the present study, the Form B of the scale was used, which had to be considering the behavior of the past three months. Scores above 15, the cut-off, suggest the individual is likely to have ASD and a more extended evaluation should be undertaken. The scale presented adequate psychometric properties. For this sample, the internal consistency values were: 0.87 for social interaction problems; 0.64 for communication difficulties; 0.78 for restricted, repetitive and stereotyped behavior and 0.90 for the total overall score.

Leiter International Performance Scale-Revised (Leiter-R): Social-Emotional Rating Scale—Teacher Version

Leiter's International Performance Scale-R (Roid and Miller 2011) consists of a battery of tests that measure the level of non-verbal intelligence, making it a very useful tool to assess deaf children and children with ASD. It can be administered to ages ranging between 4 and 20 years. The Leiter scale incorporates measures within the areas of Visualization, Reasoning, Attention and Memory. The Leiter-R incorporates four social-emotional scales (examiner, parent, self-rating and teacher). The Social-Emotional Rating Scale-Teacher version evaluates the emotional and regulatory dimension (including Regulatory, Temperament, Reactivity and Adaptation subscales) and the social-cognitive dimension (including Attention, Impulse Control, Activity Level and Social Abilities) in children within an educational context. The test provides scalar scores of each of the sub-scales according to three age groups: from 2 to 4 years, from 4 to 6 years and over 7 years. All of them indicate positive aspects of a person's performance. The psychometric properties of the instrument were also appropriate. The Cronbach's alphas for this sample were: attention (0.90); impulsivity (0.86); activity level (0.92); social skills (0.90); regulation (0.79); temperament (0.79); reactivity (0.66) and adaptation (0.84).

Data Analysis

The exploratory factor analysis (EFA hereinafter) was performed using *FACTOR 10.3.01* (Lorenzo-Seva and Ferrando 2006). Regarding the metric study of the items and the dimensionality of the scale, descriptive analyses of the items and the RBS-R were performed, using the unweighted least squares (ULS) and the direct oblimin extraction methods. The ULS method is suitable for the determination of the latent factors underlying the shared variance of the items. The direct Oblimin method is suitable when the correlation between the analyzed factors is assumed or known (Worthington and Whittaker 2006). The adequacy of the matrix used to perform the EFA was tested through the Kaiser–Meyer–Olkin (KMO) test and Bartlett's sphericity test.

Similarly, the six-factor model proposed by Bodfish et al. (2000) was contrasted through a confirmatory factor analysis using the *EQS 6.2*. program (Bentler 2006) The goodness of fit measures used were the following (Dimitrov 2006; Hu and Bentler 1999): CFI (*Comparative Fit Index*) greater than 0.95; GFI (*LISREL Goodness of Fit Index*) greater than 0.90; AGFI (*Adjusted Goodness-of-Fit Index*) greater than 0.85; SRMR (*Standardized Root Mean Square Residual*) and RMSEA (*Root Mean Square Error of Approximation*) equal or lower than 0.08; the $\chi 2$ /gl Ratio lower than 2, in addition to the Satorra-Bentler Chi square and the AIC (*Akaike's Information Criterion*). The TPI (*Turning Point Index*) was used to compare the goodness of fit between models (Satorra and Bentler 2001).

In addition, the internal consistency data of the total score and the subscales of the RBS-R were obtained using the *FACTOR 10.3.01* program (Lorenzo-Seva and Ferrando 2006) as well as data on the temporal stability (test–retest reliability) using the *IBM SPSS-Statistics 22* for Windows program (IBM Corp. 2013).

With regards to the evidence of concurrent-divergent validity, the correlation coefficients between the score of the RBS-R and the rest of the measures were calculated. Cohen's (1988) criteria were used to evaluate the Effect Sizes (ES) of the correlations. In this case, the ES was considered small when the correlation was below 0.10, medium when it was between 0.10 and 0.30 and large when it was greater than 0.50 (Cohen 1988; Lipsey and Wilson 2001).

Results

The characteristics of the 233 people with ASD in the sample are shown in Table 1. Their age ranged between 3 and 63 years with a mean age of 13.34 ($M = 13$; $SD = 9.79$). A higher percentage of men was found within the sample ($n = 181$; 77.70%). Most of the samples were Caucasian or European. The results indicate that there was a very similar percentage in the frequency of diagnosis based on sex ($\chi^2 = 3.99$; $gl = 3$; $p = .26$). Thus, 100% of participants reported an ASD diagnosis of autism, non-specific autism or Asperger's Syndrome (see Table 1).

Before carrying out an exploratory factor analysis, the rate of items that could be accepted ("*rate of item endorsement*") was examined in order to analyze whether there were items that had to be eliminated due to an excessively low (less than 10% of the sample) or an excessively high (more than 90% of the sample) response rate. The frequency of affirmative responses to the items was calculated by dichotomizing the measure. To do so, an item was considered not present when the score was zero, while an item was considered present when it was scored between 1 and 3, following

the criteria of previous articles (Georgiades et al. 2010; Lam and Aman 2007).

The frequency of positive responses to the items ranged between 6.90% (item 11: Pulling hair/skin, and item 19: counting) and 50.20% (item 28: communication and social interactions). Although when items with a response rate lower than 10% were found, it was decided to include them in the analysis in order to preserve the original version of the RBS-R, similarly to earlier European studies (Georgiades et al. 2010). The positive response indexes or frequency of endorsement can be found in Table 2.

The results show that all response options were chosen in all items except for item 4, where response 5 was never chosen. The average item response was situated 0.67 points below the theoretical average of the questionnaire and the standard deviations ranged between 0.66 and 1.19. Therefore, an adequate variability of scores can be assumed.

The index of sampling adequacy (KMO = 0.87) and Bartlett's test of sphericity ($\chi^2 = 5338.40$; $gl = 903$; $p < .0001$) indicated the suitability of the data to perform a factor analysis. As the sampling distribution was not normal, the *Unweighted Least Squares* (ULS) was used as the extraction method with the Normalized Quartimax oblique rotation. The parallel analysis (PA) recommends six factors, whose Eigen values range between 6.27 and 1.70, and explain 43% of the total variance. Table 3 shows the factor loadings of the items for each of the selected factors.

In Table 4, the results of the confirmatory factor analysis of the RBS-R in our sample are presented. As can be seen, the goodness of fit indices indicated that the data fits reasonably well both the five factor model (considering the ritualistic and sameness subscales as a single dimension) and the six factors correlated or related model.

The ratio between χ^2 and the degrees of freedom (χ^2/gl) reflected a score lower than 2, the CFI was greater than 0.90 and the RMSEA was less than 0.05, indicating an excellent fit for both models. However, the six factors related model presented the best fit of all the analyzed models.

Table 5 shows the correlations between factors or subscales. High correlations were obtained between stereotypic behavior with self-injurious, compulsive, ritualistic, sameness and restricted behavior; between ritualistic behavior, sameness and restricted behavior; and between sameness and restricted behavior.

The item-total correlations were also calculated. Each of the 43 items of the RBS-R were correlated with the scores of the RBS-R subscales of Stereotypic, Self-Injurious, Compulsive, Ritualistic, Sameness and Restricted Behavior. The results indicate that the items of each subscale had a high correlation with the scale suggested by the CFA. Overall, the item-total correlations of the RBS-R ranged between 0.50 and 0.80. Similarly, the correlations between the subscales and the RBS-R were very high (between 0.68 and 0.88).

Table 2 Frequency of endorsement (affirmative answer) for the items of the RBS-R

Item	Frequency of endorsement (%)
Stereotypy subscale	
1. Body movements	31.80
2. Head movements	24
3. Finger movements	46.80
4. Locomotion	32.60
5. Object usage	37.30
6. Sensory	41.60
Self-injurious subscale	
7. Hits w/body	24
8. Hits against surface	15.90
9. Hits w/object	9.40
10. Bites self	19.70
11. Pulls hair/skin	6.90
12. Rubs/scratches	18.50
13. Inserts finger/object	9
14. Picks skin	10.70
Compulsive subscale	
15. Ordering	34.30
16. Completeness	24
17. Washing	10.70
18. Checking	7.30
19. Counting	6.90
20. Hoarding	24.50
21. Repeating	28.30
22. Needs to touch/tap	28.80
Ritualistic subscale	
23. Eating/mealtime	36.90
24. Sleeping/bedtime	39.10
25. Selfcare routine	28.30
26. Transportation routine	26.20
27. Play/leisure routine	46.80
28. Communication	50.20
Sameness subscale	
29. Placement of objects	25.30
30. No new places	24.50
31. No interruption	44.60
32. Walks certain way	13.70
33. Sits certain place	28.80
34. Appearance/behavior of others	25.80
35. Uses certain door	7.70
36. Videotapes	40.80
37. Difficult transitions	37.30
38. Insists on routine	36.90
39. Insists on time	34.30
Restricted subscale	
40. Preoccupation with subject	48.50
41. Attached to object	25.30

Table 2 (continued)

Item	Frequency of endorsement (%)
42. Preoccupied with part of object	26.60
43. Preoccupation with movement	17.20

The rate of endorsement was calculated on the basis of dichotomous (present/not present) data

Therefore, all items were highly correlated with subscale to which they belonged (see Table 6).

The alpha coefficients for the Total RBS-R and for each of its subscales were generally high. Psychometric data indicates that the internal consistency was high for most subscales: Stereotypic Behavior (α= 0.86), Self-Injurious (α= 0.83), Compulsive (α= 0.70), Ritualistic (α= 0.80), Sameness (α= 0.88) and the Total RBS-R (α= 0.93). These internal consistency values were considered to be moderately high and high when they were equal or greater than 0.80. Moreover, the restricted behavior subscale showed a moderate internal consistency (α = 0.65) as it ranged between 0.57 and 0.65 (Nunnally and Bernstein 1994).

Intraclass correlations (ICC) were calculated to examine the temporal stability of the RBS-R test after 1 month by assessing a sample of 113 participants with ASD. The results indicate that the Total RBS-R had an α = 0.97, which is equivalent to a very high test–retest correlation; stereotypic (ICC = 0.97), self-injurious (ICC = 0.98), compulsive (ICC = 0.97), ritualistic (ICC = 0.96), sameness (ICC = 0.97), and restricted behavior subscales (ICC = 0.95). In all cases p was less than 0.001.

The correlations between the restricted, repetitive and stereotypic behavior subscales of the SCQ-B and all the subscales of the RBS-R, including the total score, ranged between a medium–high and a high effect size (r = .42-0.68). Furthermore, a significant relationship between the Social Interaction Problems Subscale and the communication difficulties subscale were found, as well as between the total SCQ-B score and the RBS-R scores, although the effect sizes were between small and medium (see Table 7). It should be mentioned that the average for the SCQ-B total score in our sample was 15.83 (SD = 9.91), a score slightly above the cut-off suggested by authors of 15. The mean scores for the remaining subscales of SCQ-B can be seen in Table 7.

As for the correlations between the RBS-R and the teacher rating scale (Leiter-R scale), significant negative correlations were found in virtually all associations. Only the relationship between stereotypic behavior of RBS-R and level of activity and adaptation of the Leiter-R scale obtained large effect sizes and the relationship between stereotypic and self-injurious behavior and all scales of the Leiter-R obtained medium effect sizes. The moderate relationship between sameness and restrictive behaviors and the reactivity and adaptation of Leiter-R is also noteworthy (see Table 8).

Discussion

The aim of this study was to examine the psychometric properties of the Spanish version of the RBS-R on a sample of people with ASD. The contrast of good psychometric properties of the heteroinformed scale could provide a well-established test, which would be widely used internationally, and which would assess the severity of repetitive and stereotypic behaviors of people with ASD. This would enable a better differential diagnosis.

Regarding the social-demographic variables it can be noted that the sample used in this study was similar to those used in previous studies which included between 200 and 300 subjects with ASD (Georgiades et al. 2010; Lam and Aman 2007; Mirenda et al. 2010). Similarly, to previous psychometric validation studies of the RBS-R, the present sample included both children and adults (Esbensen et al. 2009; Fulceri et al. 2016; Georgiades et al. 2010; Inada et al. 2015; Lam and Aman 2007). In relation to the sex variable, the percentage of males was higher than that of women with ASD (one-third), as stated in DSM-5 (APA 2013), which is consistent with validation studies performed with the RBS-R.

The percentages of severity of ASD obtained were similar to those found in previous studies. For example, in Lam and Aman's study (2007), 33.90% had mild ASD, 38.80% showed moderate ASD and 2.5% were people with severe ASD.

The response rate to the items of the RBS-R was lower than that found in studies with American populations with ASD, which was between 17.30 and 80.40% (Lam and Aman 2007). No coincidences were found between the response frequency for each of the items or subscales and any of the findings reported in other studies (Lam and Aman 2007). However, the response rate in our study was similar to that found in European populations, such as the Greeks, whose response rate was between 9 and 68% (Georgiades et al. 2010). Although some items in the Spanish version of the RBS-R have shown a response rate lower than 10%, the results lead to the conclusion that all items in the Spanish version of the RBS-R must be maintained in line with previous studies of the RBS-R validation that suggest maintaining the original structure of the scale (Georgiades et al. 2010).

Similarly, to previous studies, the results confirm the six factors related structure of the Spanish version of the RBS-R (Fulceri et al. 2016; Georgiades et al. 2010; Inada et al. 2012, 2015; Lam and Aman 2007; Mirenda et al. 2010).

Table 3 Six-factor solution for the structure of the RBS-R in a Spanish sample with ASD

Item	F1	F2	F3	F4	F5	F6	h^2
1	0.48	0.18	−0.09	0.02	−0.04	0.02	0.28
2	0.50	0.18	0.01	0.00	−0.03	−0.00	0.29
3	0.68	−0.03	−0.00	−0.00	0.04	0.03	0.47
4	0.56	0.11	−0.00	0.04	0.07	−0.01	0.34
5	0.71	0.03	0.09	0.00	0.10	−0.01	0.53
6	0.47	0.02	0.01	0.01	0.03	0.04	0.22
7	0.26	0.69	−0.04	0.05	0.04	−0.03	0.56
8	0.26	0.64	−0.01	0.11	0.11	−0.12	0.53
9	0.20	0.74	0.06	0.10	0.08	−0.00	0.62
10	0.26	0.43	0.07	0.00	0.02	−0.06	0.26
11	−0.01	0.46	0.31	−0.08	−0.02	0.09	0.33
12	0.00	0.57	0.10	−0.03	0.04	0.04	0.34
13	0.11	0.24	0.36	0.01	0.00	−0.02	0.20
14	0.03	0.67	0.34	−0.01	−0.04	0.12	0.59
15	0.00	−0.06	0.24	0.20	0.06	0.42	0.28
16	0.07	−0.08	0.35	0.02	0.13	0.36	0.28
17	−0.06	0.11	0.49	0.16	−0.08	0.07	0.30
18	0.05	0.16	0.56	−0.05	0.03	0.09	0.36
19	−0.04	0.14	0.21	0.19	0.01	0.14	0.13
20	−0.00	0.05	0.09	0.11	−0.04	0.61	0.40
21	0.16	0.08	0.32	0.12	0.19	−0.06	0.19
22	0.44	0.07	0.19	−0.01	0.01	−0.11	0.25
23	0.11	−0.05	0.09	0.47	0.06	−0.03	0.25
24	0.05	0.09	0.08	0.58	0.02	0.00	0.35
25	−0.03	0.02	0.16	0.79	0.12	0.17	0.71
26	−0.01	−0.01	0.05	0.41	0.12	0.13	0.20
27	0.03	−0.04	−0.02	0.24	0.31	0.32	0.26
28	−0.00	0.00	−0.03	0.10	0.00	0.07	0.01
29	−0.00	0.06	0.28	0.19	0.33	0.57	0.57
30	−0.05	0.06	−0.06	0.28	0.28	0.07	0.17
31	0.03	0.02	−0.01	−0.01	0.49	0.05	0.25
32	0.19	0.25	0.20	0.05	0.37	−0.09	0.29
33	−0.01	0.00	0.32	0.09	0.38	0.12	0.28
34	−0.03	0.13	0.04	0.22	0.45	0.09	0.28
35	0.27	0.05	0.67	0.14	0.34	0.02	0.67
36	0.15	−0.06	−0.02	−0.02	0.38	0.14	0.19
37	0.06	0.09	−0.04	−0.02	0.70	0.06	0.51
38	0.03	−0.07	0.22	0.24	0.61	0.11	0.50
39	−0.01	0.02	0.31	0.30	0.56	0.19	0.55
40	0.00	0.00	−0.06	0.05	0.07	0.31	0.11
41	0.08	0.00	0.05	−0.08	0.24	0.50	0.33
42	0.41	0.11	0.14	0.08	0.25	0.11	0.29
43	0.28	0.12	0.07	−0.03	0.09	0.09	0.12

F1 stereotypy subscale, *F2* self-injurious subscale, *F3* compulsive subscale, *F4* ritualistic subscale, *F5* sameness subscale, *F6* restricted subscale

The results of the present study show high correlations between the factors or subscales of the RBS-R. These correlations were higher than those observed in other international studies which only found correlations between the ritualistic-sameness factor and the compulsive subscale (Lam and Aman 2007). Regarding the correlations between the subscales and the total RBS-R, the present data is consistent with previous studies, where correlations between

Table 4 Goodness-of-fit indices of the hypothesized latent-factor models of the RBS-R

	Satorra-Bentler's χ^2	*gl*	χ^2/gl	RMSEA (I.C. 90%)	CFI	SRMR	AIC	GFI	AGFI
Model 1	1959.09	860	2.27	0.07 (0.07–0.07)	0.93	0.16	239.09	−34.01	−37.51
Model 5 related Factors	107.87	850	1.26	0.03 (0.02–0.03)	0.98	0.10	−629.12	−16.72	−18.73
Model 5 non-related Factors	1372.20	860	1.59	0.05 (0.04– 0.05)	0.96	0.30	−347.79	−27.86	−3.75
Model 6 non-related Factors	1473.39	860	1.71	0.05 (0.05–0.06)	0.96	0.32	−246.60	−26.92	−29.71
Model 6 related factors	1026.23	845	1.21	0.03 (0.02–0.04)	0.98	0.10	−663.76	−15.70	−17.70

RMSEA root mean square error of approximation, *CFI* comparative fit index, *SRMR* standardized root mean square residual, *AIC* akaike's information criterion, *GFI* LISREL goodness of fit index, *AGFI* adjusted goodness-of-fit index

Table 5 Inter-factor correlations of RBS-R

RBS-R subscales	1	2	3	4	5	6
1. Stereotypic	–	–	–	–	–	–
2. Self-injurious	0.54	–	–	–	–	–
3. Compulsive	0.44	0.32	–	–	–	–
4. Ritualistic	0.35	0.30	0.61	–	–	–
5. Sameness	0.47	0.47	0.68	0.67	–	–
6. Restricted Interests	0.47	0.32	0.55	0.52	0.62	–

RBS-R repetitive behavior scale-revised

0.63 in Self-Injurious and 0.88 in Ritualistic were found (Lam and Aman 2007).These correlations were higher than those found in Japanese populations (Inada et al. 2015). In summary, the present results confirm the findings of previous studies that found high correlations between factors, between factors and the total score and between the items and the total score of the RBS-R (Inada et al. 2012, 2015; Lam and Aman 2007; Rojahn et al. 2013).

As for the reliability of the RBS-R, the present results indicate a high internal consistency of the total score of the RBS-R and of the subscales being lower for the Restricted Behaviors Subscales (Georgiades et al. 2010; Inada et al. 2015; Lam and Aman 2007). The test–retest reliability of the RBS-R in a Spanish population with ASD is very high and equivalent to that found in a study with Peruvian children (Rojahn et al. 2013). It should be noted that the stability of these behaviors in this population may explain such high values of temporal stability, as well as the fact that the time between each measurement is relatively short and that test and re-test were administered by the same individuals.

Finally, regarding the concurrent-divergent validity of the RBS-R, the present results confirm the significant association (of a medium–high size) between the subscales and the total RBS-R and the restricted, repetitive and stereotypic behavior subscale of the SCQ-B form, which is consistent with previous studies (Inada et al. 2015). Similarly, a significant but smaller (medium–low) association was found between the RBS-R and other subscales that do not measure repetitive behavior, but certain aspects of ASD, such as measures of Social interaction problems and communication difficulties (SCQ-B), or emotional regulation measures (regulation, temperament, reactivity, adaptation) and social-cognitive performance (attention, impulse control, activity level and social skills) of the social emotional rating scale-teacher version of the Leiter-R Scale. These results support the validity of the scale and are consistent with findings from previous studies (Fulceri et al. 2016; Georgiades et al. 2010; Inada et al. 2012, 2015; Lam and Aman 2007; Rojahn et al. 2013).

In short, the present results on the factor structure, the reliability estimates and the evidence of concurrent-divergent validity support the idea that the Spanish version of the RBS-R can be considered a valid instrument for use on Spanish-speaking people with ASD.

However, some limitations of this article are noteworthy. It is advisable that future studies should examine the normative data by age, gender, intellectual disability, educational context, amongst others. Moreover, although the sampling employed guaranteed the representativeness of the recruited sample with regards to the target population, the results found in this study cannot be generalized for each age group, as the samples by age group are small. Future research should confirm whether the results found for the RBS-R differ or are maintained when the sample is increased and diversified for each age group. Future studies should research and analyze the inter-rater reliability .

Table 6 Item-total correlations for the 6 subscales and total RBS-R

Item	1	2	3	4	5	6	Total score
1. Stereotypy subscale							0.72**
1. Body movements	0.74**	0.43**	0.17**	0.14*	0.25**	0.24**	
2. Head movements	0.70**	0.43**	0.23**	0.15*	0.24**	0.34**	
3. Finger movements	0.82**	0.39**	0.38**	0.25**	0.36**	0.39**	
4. Locomotion	0.77**	0.43**	0.33**	0.34**	0.41**	0.33**	
5. Object usage	0.79**	0.42**	0.45**	0.37**	0.46**	0.46**	
6. Sensory	0.73**	0.37**	0.39**	0.29**	0.39**	0.37**	
2. Self-injurious subscale							0.68**
7. Hits w/body	0.48**	0.80**	0.35**	0.24**	0.35**	0.24**	
8. Hits against surface	0.43**	0.75**	0.33**	0.23**	0.35**	0.24**	
9. Hits w/object	0.36**	0.71**	0.26**	0.18**	0.28**	0.17**	
10. Bites self	0.43**	0.70**	0.29**	0.18**	0.33**	0.20**	
11.Pulls hair/skin	0.19**	0.52**	0.22**	0.15*	0.27**	0.23**	
12. Rubs/scratches	0.35**	0.72**	0.32**	0.19**	0.35**	0.21**	
13. Inserts finger/object	0.29**	0.44**	0.38**	0.28**	0.29**	0.17**	
14. Picks skin	0.30**	0.70**	0.37**	0.19**	0.31**	0.27**	
3. Compulsive subscale							0.80**
15. Ordering	0.15*	0.14**	0.70**	0.49**	0.49**	0.43**	
16. Completeness	0.27**	0.20**	0.68**	0.40**	0.46**	0.41**	
17. Washing	0.52	0.24**	0.53**	0.34**	0.26**	0.09	
18. Checking	0.23**	0.32**	0.50**	0.13*	0.30**	0.14*	
19. Counting	−0.03	0.19**	0.38**	0.27**	0.26**	0.14*	
20. Hoarding	1.35*	0.22**	0.56**	0.44**	0.43**	0.54**	
21. Repeating	0.40**	0.39**	0.64**	0.39**	0.48**	0.28**	
22. Needs to touch/tap	0.56**	0.40**	0.52**	0.23**	0.33**	0.27**	
4. Ritualistic subscale							0.75**
23. Eating/mealtime	0.39**	0.23**	0.45**	0.71**	0.44**	0.33**	
24. Sleeping/bedtime	0.31**	0.36**	0.45**	0.75**	0.45**	0.36**	
25. Self care routine	0.16*	0.25**	0.54**	0.78**	0.56**	0.35**	
26. Transportation routine	0.23**	0.17**	0.37**	0.66**	0.47**	0.35**	
27. Play/leisure routine	0.28**	0.26**	0.53**	0.70**	0.60**	0.51**	
28. Communication	0.09	0.05	0.28**	0.63**	0.33**	0.31**	
5. Sameness subscale							0.88**
29. Placement of objects	0.23**	0.34**	0.66**	0.50**	0.68**	0.49**	
30. No new places	0.21**	0.20**	0.23**	0.48**	0.55**	0.33**	
31. No interruption	0.34**	0.34**	0.39**	0.43**	0.71**	0.43**	
32. Walks certain way	0.35**	0.45**	0.37**	0.31**	0.53**	0.34**	
33. Sits certain place	0.28**	0.29**	0.53**	0.43**	0.70**	0.39**	
34. Appearance/behavior of others	0.27**	0.30**	0.40**	0.45**	0.66**	0.36**	
35. Uses certain door	0.33**	0.29**	0.51**	0.32**	0.51**	0.31**	
36. Videotapes	0.43**	0.26**	0.39**	0.44**	0.65**	0.48**	
37. Difficult transitions	0.38**	0.36**	0.44**	0.40**	0.76**	0.44**	
38. Insists on routine	0.37**	0.34**	0.56**	0.56**	0.80**	0.47**	
39. Insistson time	0.29**	0.37**	0.58**	0.58**	0.79**	0.53**	
6. Restricted subscale							0.73**
40. Preoccupation with subject	0.15*	0.07	0.34**	0.45**	0.45**	0.71**	
41. Attached to object	0.29**	0.21**	0.44**	0.35**	0.47**	0.72**	
42. Preoccupied with part of object	0.51**	0.40**	0.48**	0.40**	0.51**	0.73**	
43. Preoccupation with movement	0.44**	0.26**	0.27**	0.24**	0.30**	0.64**	

*p < .05, **p < .01

Table 7 Concurrent-divergent validity

SCQ-B	M (SD)	1	2	3	4	5	6	Total score
Reciprocal social interaction	6.07 (4.05)	0.50**	0.30**	0.21**	0.16*	0.25**	0.20**	0.36**
Communication	6.07 (4.05)	0.46**	0.32**	0.16*	0.09	0.21**	0.20**	0.32**
Repetitive, restrictive, and stereotyped behaviors	3.53 (2.47)	0.68**	0.42**	0.50**	0.49**	0.51**	0.61**	0.68**
Total score	15.84 (9.91)	0.60**	0.39**	0.30**	0.25**	0.35**	0.35**	0.48**

SCQ-B social communication questionnaire form B, *RBS-R* repetitive behavior scale-revised, *1* stereotypy subscale, *2* self-injurious subscale, *3* compulsive subscale, *4* ritualistic subscale, *5* sameness subscale, *6* restricted subscale

*p < .05; **p < .01

Table 8 Concurrent-divergent validity

Leiter-R social-emotional rating scale –teacherversion	M (SD)	RBS-R						
		1	2	3	4	5	6	Total score
Attention	19.37 (6.22)	−0.32*	−0.19*	−0.00	−0.01	−0.06	−0.07	−0.15*
Impulse control	11.08 (3.89)	−0.49*	−0.32*	−0.18**	−0.20**	−0.25**	−0.26**	−0.38**
Activity level	14.14 (4.85)	−0.51**	−0.34**	−0.17**	−0.18**	−0.21**	−0.25**	−0.37**
Social skills	19.17 (4.23)	−0.40**	−0.38**	−0.18**	−0.22**	−0.31**	−0.22**	−0.39**
Regulation	7.98 (2.43)	−0.48**	−0.43**	−0.23**	−0.18**	−0.28**	−0.25**	−0.41**
Temperament	11.17 (2.74)	−0.34	−0.34**	−0.16*	−0.12	−0.27**	−0.18**	−0.32**
Reactivity	9.09 (2.16)	−0.40*	−0.36*	−0.27**	−0.23**	−0.37**	−0.34**	−0.44**
Adaptation	15.61 (3.76)	−0.54	−0.45**	−0.26**	−0.29**	−0.43**	−0.36**	−0.52**

RBS-R repetitive behavior scale-revised, *1* stereotypy subscale, *2* self-injurious subscale, *3* compulsive subscale, *4* ritualistic subscale, *5* sameness subscale, *6* restricted subscale

*p < .05, **p < .01

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Author Contributions AEMG research interests are focused on psychometric validation of psychological assessment of OCD and ASD. He was responsible for the following phases of the study: contact the centers, apply instruments, analyze data, discussion and redaction the article. JAP research interests are focused on child and adolescent mental health, psychological assessment, obsessive-compulsive disorder in childhood, and the application of new technologies for assessment and intervention of youth. He was responsible for the following phases of the study: analyze data and redaction the article.

Compliance with Ethical Standards

Conflict of interest Author Agustín Ernesto Martínez-González declares that he has no conflict of interest. Author Jose Antonio Piqueras Rogríguez declares that he has no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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