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Subcategories of restricted and repetitive behaviors in children with autism spectrum disorders

Somer L. Bishop, Ph.D.,
Weill Cornell Medical College

Vanessa Hus, MSc,
University of Michigan

Amie Duncan, Ph.D.,
Cincinnati Children's Hospital Medical Center

Marisela Huerta, Ph.D.,
Weill Cornell Medical College

Katherine Gotham, Ph.D.,
Vanderbilt University

Andrew Pickles, Ph.D.,
King's College

Abba Kreiger,
The Wharton School

Andreas Buja,
The Wharton School

Sabata Lund, and
University of Michigan

Catherine Lord
Weill Cornell Medical College

Abstract

Research suggests that restricted and repetitive behaviors (RRBs) can be subdivided into repetitive sensory motor (RSM) and insistence on Sameness (IS) behaviors. However, because the majority of previous studies have used the Autism Diagnostic Interview-Revised (ADI-R), it is not clear whether these subcategories reflect the actual organization of RRBs in ASD. Using data from the Simons Simplex Collection (n=1825), we examined the association between scores on the ADI-R and the Repetitive Behavior Scale-Revised (RBS-R). Analyses supported the construct validity of RSM and IS subcategories. As in previous studies, IS behaviors showed no relationship with IQ. These findings support the continued use of RRB subcategories, particularly IS behaviors, as a means of creating more behaviorally homogeneous subgroups of children with ASD.

Keywords

Autism spectrum disorders; repetitive behaviors; subcategories; repetitive sensory motor; insistence on sameness

Restricted and repetitive behaviors (RRBs) associated with autism spectrum disorders (ASD) comprise a heterogeneous group of behaviors, but research during the last decade suggests that they can be divided into at least two dimensions or subcategories. Repetitive Sensory Motor (RSM) behaviors include motor mannerisms, sensory seeking behaviors, and repetitive use of objects, whereas Insistence on Sameness (IS) behaviors are characterized by compulsions and rituals and difficulties with changes in routine (Cuccaro et al., 2003). Behavioral subcategories such as these are of particular interest to researchers investigating biological processes that may underlie ASD, because they provide a means by which to organize the larger ASD population into smaller groups of individuals with more similar behavioral profiles. Ultimately, it is hoped that identifying more phenotypically homogenous subgroups will facilitate efforts to understand etiologies of ASD.

IS behaviors have been suggested as an especially promising grouping variable (Hus, Pickles, Cook, Risi, & Lord, 2007). Whereas RSM behaviors have been found to be negatively related to age and IQ in some children with ASD, IS behaviors have shown either no relationship or positive relationships with these variables (Bishop, Richler, & Lord, 2006; Cannon et al., 2010; Cuccaro, et al., 2003; Richler, Huerta, Bishop, & Lord, 2010; Szatmari et al., 2006). Thus, as opposed to other ASD symptoms that are strongly related to general developmental level (and that might therefore be more related to intellectual disability than to ASD specifically), IS behaviors may represent a construct more directly associated with biological pathways relevant to ASD. Indeed several studies have identified a variety of genotypic expressions that appear to be associated with high levels of IS or rigid-compulsive behaviors (Buxbaum et al., 2001; Cannon, et al., 2010; McCauley et al., 2004; Shao et al., 2003; Silverman et al., 2008; Sutcliffe et al., 2005). Other studies have found evidence of familiarity for IS behaviors (Abramson et al., 2005; Silverman et al., 2002; Szatmari, et al., 2006), again suggesting that these behaviors are associated with specific genetic susceptibilities. Imaging studies have also shown that high levels of IS behaviors are associated with certain structural differences, such as increased right caudate volume (Hollander et al., 2005).

Evidence of RSM and IS subcategories within the larger category of RRBs has come from multiple large samples that span different age ranges (Bishop, et al., 2006; Cuccaro, et al., 2003; Georgiades, Papageorgiou, & Anagnostou, 2010; Honey, McConachie, Randle, Shearer, & Le Couteur, 2008; Honey, McConachie, Turner, & Rodgers, 2012; Richler, Bishop, Kleinke, & Lord, 2007; Szatmari, et al., 2006). However, the majority of studies have relied on factor analyses of the RRB items from the Autism Diagnostic Interview-Revised (ADI-R: Rutter, Le Couteur, & Lord, 2003). Thus, it is not entirely clear whether the RSM and IS subcategories that have emerged across studies are reflective of the actual organization of RRBs in ASD, or whether they are unique to the factor structure of the ADI-R. Determining whether these subcategories exist independently of the ADI-R is critical to establishing the construct validity of RSM and IS behaviors.

An alternative to the ADI-R for measuring RRBs in ASD is the Repetitive Behavior Scale-Revised (RBS-R: Bodfish, Symons, Parker, & Lewis, 2000). The RBS-R is a questionnaire that focuses exclusively on RRBs. It includes 43 items rated on a four-point Likert scale: 0=behavior does not occur; 1=behavior occurs and is a mild problem; 2=behavior occurs and is a moderate problem; and 3=behavior occurs and is a severe problem. Items are grouped into 6 conceptually derived subscales: Stereotyped Behavior; Self-injurious Behavior; Compulsive Behavior; Ritualistic Behavior; Sameness Behavior; and Restricted Behavior. Two raw scores can be calculated for each subscale, one based on the summed item scores within each subscale, and one based on the total number of items endorsed (i.e.,

scores of 1,2, and 3 are collapsed). An overall total raw score and a total number of items score are also calculated for the whole measure.

A number of recent analyses of the RBS-R have indicated that the empirical factor structure of the instrument is not entirely consistent with the 6 conceptually derived subscales. Lam & Aman (2007) conducted the first independent examination of the RBS-R, with 307 parents/caregivers of individuals with ASD (ages 3 to 48) from the South Carolina Autism Society completing mailed questionnaire packets containing the RBS-R. Results supported a five-factor solution that overlapped with five of the six subscales proposed by the original authors (Bodfish, et al., 2000) but did not include a Ritualistic subscale. The revised five subscales included 38 of the original 43 items and demonstrated acceptable levels of internal consistency. Following this, Esbensen et al.(2009) reported high internal consistency using the Lam & Aman (2007) subscales in a study of 712 individuals with ASD ages 2 to 62.

In contrast, using a Greek translation of the RBS-R with the parents of 205 Greek individuals with ASD ages 2 to 48, Georgiades, Papageorgiou, and Anagnostou (2010) argued for a 2-factor solution that closely resembled the 'lower order' (i.e., RSM) and 'higher order' (i.e., IS) subcategories yielded by analyses of the ADI-R RRB items. These findings provide support that the RSM and IS subcategories are not simply related to characteristics of the ADI-R but are also reflected in the factor structure of the RBS-R. This is also consistent with a study using another parent report measure of repetitive behaviors, the Repetitive Behavior Questionnaire (RBQ; Honey, et al., 2012), which found evidence for a 'lower order' factor consisting of sensory-motor behaviors and a 'higher order' factor that included both insistence on sameness behaviors and circumscribed interests (Honey, et al., 2012; see also Turner, 1999).

Recently, Mirenda and colleagues (2010) administered the RBS-R to parents of 287 preschoolers with ASD and employed confirmatory factor analysis to compare six different structural models, including the five-factor model in Lam & Aman (2007) and the two-factor solution from Georgiades et al. (2010). Unlike other investigations using the RBS-R, children in the study underwent comprehensive diagnostic evaluations for ASD, thus making it the first study to date that has allowed for a direct comparison between the RBS-R and other clinical measures collected simultaneously. Best-performing models included the five-factor model described above, and a three-factor model comprised of Compulsive/Ritualistic/Sameness behaviors, Self-injurious behaviors, and Restricted/Stereotyped behaviors. In both solutions, subscale scores were significantly positively correlated with ADI-R RRB total algorithm scores. Unlike earlier reports of a relationship between IQ and RSM using the ADI-R, RBS-R subscales were not significantly associated with age or with IQ measured by the Merrill-Palmer-Revised Scales of Development (Roid & Sompers, 2004).

Results of the Mirenda et al. (2010) study suggest that RBS-R scores are significantly related to ADI-R RRB algorithm scores. However, absence of information about how RBS-R scores map onto RSM and IS subscale scores from the ADI-R (as opposed to total scores) leaves questions about whether other measures besides the ADI-R support the organization of RRBs into RSM and IS subcategories. This information is also needed to determine whether the RBS-R, a parent-report questionnaire that is substantially faster and easier to administer than the ADI-R, could be used to collect data about repetitive behaviors in place of the ADI-R in situations where administration of the ADI-R is not feasible or economical (e.g., certain large scale genetics studies of individuals with established ASD diagnoses that do not include a detailed phenotyping component).

The purpose of the current study was to assess the extent to which RSM and IS subcategories of RRBs proposed on the basis of previous investigations of the ADI-R are reflected in the factor structure of the RBS-R. We also investigated whether RBS-R subscales demonstrate similar relationships with age, IQ, and/or ADOS scores as those on the ADI-R. If the two instruments are indeed measuring similar constructs, then we would expect them to be similarly related (or unrelated) to other measures relevant to the study of RRBs. Untangling relationships between subscale scores and age and IQ has not been possible in the majority of RBS-R studies to date, because of the methods by which participants were ascertained (e.g., survey methodology) and the lack of high quality phenotypic data needed to examine these relationships. In addition, previous investigations of the RBS-R have either included samples that span extremely wide age ranges (e.g., 2–62 years), or relatively narrow age ranges (e.g., preschoolers), making it difficult to interpret some of the findings about factor structure and relationships with other variables. The current study involved a large sample of children with ASD ages 4 to 18 who underwent carefully monitored, comprehensive diagnostic assessments as part of the Simons Simplex Collection (SSC), thus providing a unique opportunity to investigate the organization of RRBs in school-aged children with ASD based on multiple measures of RRBs administered simultaneously.

Method

Participants were recruited from 12 university-based sites into the SSC, a genetic study limited to families with one child with ASD (the proband) who had no first, second or third degree relatives with ASD (Fischbach & Lord, 2010). Of 1,887 probands, 81% also had an unaffected sibling enrolled in the study.

Participants

All probands met criteria for ASD or autism on the Autism Diagnostic Observation Schedule (ADOS: Lord, Rutter, DiLavore, & Risi, 1999), Collaborative Programs for Excellence in Autism (CPEA) ASD or autism criteria (Lainhart et al., 2006) on the ADI-R, and had a nonverbal mental age of at least 18 months (see Fischbach & Lord, 2010). Children with significant hearing, vision or motor problems, known genetic syndromes (e.g., Fragile X, Tuberous Sclerosis, Down Syndrome) or significant early medical histories (e.g., very low birth weight, significant pregnancy or birth complications) were not included. Families were also excluded if the sibling was reported to have substantial language or psychological problems possibly related to ASD.

Complete RBS-R data were available for 1825 probands with ASD. For all sites combined, specific ASD diagnoses were as follows: autism (69.9%); Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS, 20.8%), and Asperger's Disorder (9.3%). Demographics and general proband descriptives are presented in Tables 1 and 2, respectively.

Procedures

Procedures were in accordance with the requirements of Institutional Review Boards at each university. Children participated in approximately four hours of direct assessment, which included the ADOS and cognitive testing. Parents were interviewed using the ADI-R and the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II: Sparrow, Cicchetti, & Balla, 2005). Parents also completed questionnaires, including the RBS-R.

All ADOS and ADI-R examiners affiliated with the SSC attended standard research trainings, achieved research reliability with project consultants, and maintained their

reliability with six-month checks throughout the data collection period. The senior clinician for each case (clinical psychologist, child psychiatrist, developmental pediatrician, or clinical geneticist) used information obtained during the assessment to determine whether or not to assign a diagnosis of ASD (i.e., autism, Asperger's Disorder, or PDD-NOS) or non-ASD. Participants were only included in the SSC database if they received a diagnosis of ASD and met CPEA criteria on the ADI-R and ASD or autism cut-offs on the ADOS.

Measures

For a complete description of measures administered to participants in the SSC, see www.SFARI.org. In addition to the RBS-R (described above), the current study used scores from the ADI-R, ADOS, and standardized IQ tests. The ADI-R and ADOS are well-established ASD diagnostic instruments that have been used in multiple large-scale investigations of children with ASD and that have been shown to have excellent validity and reliability (Risi et al., 2006). Nonverbal IQ (NVIQ) and verbal IQ (VIQ) scores were derived primarily from the Differential Ability Scales, 2nd Edition (DAS-II: Elliott, 2007), the Mullen Scales of Early Learning (MSEL: Mullen, 1995), the Wechsler Intelligence Scale for Children, 4th Edition (Wechsler, 2003), or the Wechsler Abbreviated Scale of Intelligence (WASI: Wechsler, 1999). See Fischbach & Lord (2010) for information about the IQ test hierarchy. In the current sample, 89% of participants were administered the DAS-II, 6% were administered the MSEL, and 5% were administered the WISC-IV or the WASI. Ratio IQs were calculated when norm-referenced standard scores could not be calculated due to the age and/or developmental level of the participant. Ratio scores were calculated by dividing the child's mental age (using age equivalents) by his/her chronological age and multiplying by 100 (see Bishop, Guthrie, Coffing, & Lord, 2011).

Analyses

Analyses were conducted using Mplus (Muthén & Muthén, 1998–2011) and SPSS 17.0 (Norusis, 2007). Given the large sample size and multiple comparisons, significance level was set at $p = .001$.

Exploratory Factor Analysis using promax rotation was conducted separately for the ADI-R RRB items and the RBS-R items. EFAs were conducted using Mplus in order to account for the ordinal nature of ADI-R and RBS-R item data. Factors emerging from these analyses dictated the selection of items for each measure's subscales, which were used in subsequent analyses. As in previous factor analyses of the ADI-R and RBS-R (Cuccaro, et al., 2003; Lam & Aman, 2007; Lam, Bodfish, & Piven, 2008), we employed a cutoff of 0.30 for including an item on a factor and required that the loading be at least 0.10 higher than the loading on any other factor. We used "current" ADI-R items because of our interest in examining the relationships between ADI-R factors and scores on the RBS-R, which are completed based on current behaviors, as well as our interest in the effect of chronological age and current IQ on these scores. In line with ADI-R algorithm scoring conventions, scores of 3 were converted to 2, and scores of 6, 7, and 8 were converted to 0. For analysis of the RBS-R, the full range of item scores (0–3) was retained.

Correlations were run to examine relationships between ADI-R RRB subscales, RBS-R subscales, chronological age, IQ, and selected ADOS item scores.

Results

Exploratory Factor Analysis of the ADI-R RRB Items

Previous investigations of the factor structure of the ADI-R RRB domain have differed slightly with respect to the specific items included. For example, Szatmari et al. (2006) and

Cuccaro et al. (2003) did not include *Self injury* but did include *Rocking*. Honey et al. (2008) also included *Unusual Fears*. The *Rocking* and *Unusual Fears* items appeared in earlier versions of the ADI but were omitted from the most recent version published by Western Psychological Services (WPS) because of poor specificity to ASD. We made the decision to include *Self injury* in our analyses, because it is thought to have a repetitive component and because the RBS-R includes an entire subscale devoted to self-injurious behaviors. Some previous investigations (Bishop, et al., 2006; Cuccaro, et al., 2003; Richler, et al., 2010) have also been unable to include *Circumscribed Interests*, because the item was missing for a large proportion of the sample (earlier versions of the ADI only asked about Circumscribed Interests for children 10 years or older). However, this item was available for all participants in the SSC and was therefore included in the EFA.

Table 3 shows the results of the EFA and the frequency of endorsement for each item. A 2-factor solution provided a satisfactory fit to the data (Chi Square (53)=106.92, $p<.001$; RMSEA=0.02) (Hu & Bentler, 1999). Five items loaded on Factor 1, and 6 items loaded on Factor 2. Loadings on Factor 1 (the RSM subscale) ranged from 0.39 to 0.64. Loadings on Factor 2 (the IS subscale) ranged from 0.33 to 0.75.

RSM and IS subscale scores were calculated by summing the scores from items in each factor. RSM and IS scores had similar distributions that spanned the full range of possible scores (i.e., 0–10 for RSM, 0–12 for IS). For the whole sample, the mean RSM score was 3.68 ($SD=2.42$; Median=3), and the mean IS score was 4.96 ($SD=2.69$; Median=5). RSM and IS subscale scores were correlated at $r=0.26$, $p<.001$.

Because of previous literature suggesting that restricted interests may constitute an additional type of repetitive behavior that should be considered separately (Lam, et al., 2008; Szatmari, et al., 2006), we further examined the *Circumscribed Interests* item to determine whether it differed from other items on the IS subscale. In addition to being more commonly endorsed than other IS behaviors, *Circumscribed Interests* was the only item on Factor 2 that showed any potentially meaningful correlation with NVIQ or VIQ ($r=0.20$, $p<.001$; $r=0.23$, $p<.001$, respectively). None of the correlations between NVIQ/VIQ and the other IS behaviors exceeded $r=0.10$. Therefore, although we ultimately included it in the IS subscale based on the results of the EFA, we ran correlations for the ADI-R IS sub-scale both with and without the *Circumscribed Interests* (CI) item given that, as in previous studies, this item was found to have somewhat different properties than other IS behaviors in our sample.

Exploratory Factor Analysis of the RBS-R Items

Results of the EFA and the frequency of endorsement for each item are presented in Table 4. A 5-factor solution provided a satisfactory fit to the data (Chi Square (698)=3303.42; RMSEA=0.05) (Hu & Bentler, 1999). The factor structure was generally similar to that reported by Lam & Aman (2007). Discrepancies between our subscales (i.e., factors) and the original subscales, as well as between our subscales and those proposed by Lam & Aman (2007), are outlined in Table 4. Factor 1 (Sensory-Motor) was similar to the original Stereotypy subscale. Factor 2 (Restricted Interests) included two items from the original Restricted subscale. Factor 3 (Self injury) was identical to the original Self injury subscale. Factor 4 (Compulsive) was almost identical to the original Compulsive subscale, except for one item omission and two item additions from the original Ritualistic and Sameness subscales. Factor 5 (Ritualistic/Sameness) included nearly all the items from the original Sameness subscale plus two items from the original Ritualistic subscale. The most notable difference between our subscales and those proposed by Lam & Aman (2007) had to do with which items were included or omitted. Based on factor loadings, we omitted certain items that were included in their subscales, and vice versa.

Revised subscale scores were calculated by summing the item scores within each factor: Sensory Motor, $M=4.80$, $SD=3.66$, Median=4 (range: 0–19); Self injury, $M=2.03$, $SD=2.86$, Median=1 (range=0–21); Compulsive, $M=5.51$, $SD=5.05$, Median=4 (range=0–27); Ritualistic/Sameness, $M=7.10$, $SD=5.91$, Median=6 (range=0–33); Restricted Interests, $M=2.40$, $SD=1.81$, Median=2 (range=0–6). Distributions were skewed to the left (i.e., toward lower subscale scores). Items on the Self injury subscale were the least frequently endorsed, with 41% of the sample receiving a total score of 0 on this subscale. As shown in Table 5, scores on all of the RBS-R subscales were moderately to highly correlated, including correlations of $r=0.67$ between Ritualistic/Sameness and Compulsive, and $r=.51$ between Ritualistic/Sameness and Restricted Interests. These high correlations lend some support to the 3-factor model of the RBS-R in Mirenda et al.(2010), in which items from the original Compulsive, Sameness, and Restricted subscales were combined into one factor.

Comparisons between ADI-R and RBS-R Subscales

Table 5 presents direct comparisons between the ADI-R and RBS-R subscales, with the most highly correlated between-measure comparison for each subscale in bold type. ADI-R RSM scores were most highly correlated with RBS-R Sensory-Motor ($r=0.57$), whereas ADI-R IS scores were most closely related to RBS-R Ritualistic/Sameness ($r=0.47$) and RBS-R Compulsive ($r=0.39$). The ADI-R includes only a single item about self-injurious behaviors, but this item exhibited its highest correlation with the RBS-R Self injury subscale ($r=0.49$).

ADI-R and RBS-R Subscales: Relationships with Age, NVIQ, and ADOS Scores

Table 5 includes correlations between ADI-R and RBS-R subscale scores, age, and NVIQ.¹ As expected based on previous literature, ADI-R RSM scores were significantly negatively correlated with NVIQ ($r=-0.32$). RBS-R Sensory-Motor scores were similarly correlated with NVIQ ($r=-0.29$). On the other hand, ADI-R IS scores exhibited no meaningful relationship with NVIQ ($r=0.09$), nor did RBS-R Ritualistic/Sameness scores ($r=-0.004$).

Based on the observed similarities between the ADI-R RSM and RBS-R Sensory-Motor subscales, and between the ADI-R IS and RBS-R Ritualistic/Sameness subscales, analyses were conducted to determine whether RSM and/or IS scores across the two measures would exhibit similar relationships with scores derived from a third measure of repetitive behaviors. Using scores from the ADOS, we approximated an RSM behavior grouping by summing the scores from D1, *Unusual Sensory Interests*, and D2, *Hand, Finger, and Other Complex Mannerisms*. These items were selected because they are included in all four ADOS Modules, and because the behaviors coded in these items are similar to behaviors previously conceptualized as belonging in the RSM subcategory (i.e., unusual sensory interests and repetitive motor mannerisms). Item D4, which assesses a variety of repetitive or stereotyped behaviors and excessive or unusual interests, was not included in this score because it differs substantially between Modules 1/2 and 3/4, and because it captures both behaviors that could be considered RSM (e.g., repetitive use of objects), as well as those that pertain specifically to restricted interests. Unfortunately, it was not possible to use ADOS scores to approximate an IS behavior grouping, because the only RRB item on the ADOS that could be considered a relatively “pure” IS behavior is D5, *Compulsions or Rituals*, which is only included in Modules 3 and 4. As shown in Table 5, ADOS “RSM” scores were correlated similarly with ADI-R RSM ($r=0.39$) and RBS-R Sensory-Motor ($r=0.33$) scores. In contrast, there was no meaningful relationship between ADOS RSM scores and scores on the ADI-R IS subscale or any of the other RBS-R subscales.

¹Results did not change when analyses were run using VIQ instead of NVIQ.

Discussion

Findings from the current study contribute further evidence that the behavioral domain of restricted and repetitive behaviors and interests is comprised of at least two subcategories. In children with ASD, these subcategories are significantly correlated with each other, but they also exhibit different relationships with other child characteristics (e.g., IQ, age), suggesting that they do in fact represent different constructs. As in previous investigations of the RRB items from the ADI-R, our factor analysis yielded an RSM factor and an IS factor. Factor analysis of the RBS-R supported a 5-factor model, with the Sensory-Motor and Ritualistic/Sameness subscales of the RBS-R exhibiting significant relationships with the RSM and IS subscales of the ADI-R, respectively.

Both in terms of direct relationships between the subscales, as well as their relationships with other variables, our findings indicate that the ADI-R RSM subscale and the RBS-R Sensory-Motor subscale measure RSM behaviors. These subscales showed the strongest cross-measure correlation of any other subscales at $r=0.57$, and they exhibited nearly identical relationships with age, IQ, and our prototypical “ADOS RSM score.” Likewise, the ADI-R IS and RBS-R Ritualistic/Sameness subscales showed clear similarities with each other and with other comparable variables, indicating that they measure a similar insistence on sameness construct. Both of these subscales were also moderately to highly correlated with the RBS-R Compulsive subscale. However, the RBS-R Ritualistic/Sameness and ADI-R IS subscales showed no relationship with NVIQ, and the RBS-R Compulsive scores showed a very small negative correlation with IQ. This finding stands in stark contrast to previous studies of IS behaviors indicating that, if anything, IS scores would be expected to show a *positive* relationship with IQ. Therefore, for assessing IS behaviors with the RBS-R, the Ritualistic/Sameness subscale appears to be a more appropriate measure than the Compulsive subscale. Future research will be necessary to better understand how compulsive-like behaviors are related to IS or other repetitive behaviors in ASD.

The current study provides some support for the existence of additional subcategories of RRBs besides RSM and IS. The ADI-R includes a single item devoted to self-injurious behaviors, and this item failed to load with either RSM or IS behaviors in previous factor analyses of the ADI-R (Bishop, et al., 2006). Similarly, in investigations of the RBS-R, items measuring self-injurious behaviors have clearly loaded onto their own subscale. Our results were consistent with these findings. Moreover, the Self injury item from the ADI-R was significantly correlated with the Self injury sub-scale from the RBS-R, suggesting that self-injurious behaviors constitute their own behavioral subcategory that can be measured consistently across instruments.

Another question about additional RRB subcategories pertains to the area of restricted interests (Lam, et al., 2008). Although, the *Circumscribed Interests* item from the ADI-R loaded with the other IS items in our analysis of the ADI-R, RBS-R items having to do with restricted interests loaded onto their own factor. Furthermore, unlike any of the other ADI-R IS items, *Circumscribed Interests* showed a small positive correlation with IQ, indicating that it may not be as independent of IQ as other items on the IS factor. Because the SSC sample is relatively high functioning as a whole, this relationship might be expected to be even more pronounced in samples with a higher proportion of children at the lower end of the IQ range. Thus, for researchers interested in a more “pure” measure of IS behaviors that is completely unrelated to IQ, it may be safest to exclude *Circumscribed Interests* when deriving an IS score from the ADI-R. It is also notable that *Circumscribed Interests* on the ADI-R and *Fascination, preoccupation with one subject or activity* on the RBS-R were the most commonly endorsed items on the two instruments (70% and 81%, respectively), which suggests that circumscribed interests may transcend the established RRB subcategories and

measure something different than other IS behaviors that are less commonly endorsed. Evidence from other samples has also suggested that this behavior should be considered separately. For example, Szatmari et al. (2006) excluded *Circumscribed Interests* from factors derived from the ADI-R because it loaded positively on the IS factor but negatively on the RSM factor, whereas Lam et al. (2008) found that Circumscribed Interests loaded with Unusual Preoccupations to create another sub-domain separate from RSM and IS behaviors. Taken together, these findings indicate the need for more research to determine how restricted/intense interests should be conceptualized within the larger RRB domain. As of now, “Fixated interests” constitutes its own symptom grouping in the proposed DSM-5 criteria (American Psychiatric Association, 2011), but empirical support for this is still limited.

Because of widespread interest in the use of RSM and IS scores in genetic investigations of ASD, another question is whether the RBS-R could be used in place of the ADI-R to measure RRBs. The RBS-R is a parent questionnaire that is significantly shorter and less labor intensive to administer than a semi-structured interview, making it a more appealing choice than the ADI-R for many large scale studies that cannot include an extensive face-to-face phenotyping component. Our results show that the ADI-R and RBS-R both appear to measure an RSM and an IS construct. However, it is clear from the relatively modest correlations that these two instruments, even when given during the same assessment occasion, do not elicit exactly the same information. The ADI-R is a diagnostic instrument, so each RRB item is intended to assess a relatively broad range of behavioral manifestations relevant to the ASD RRB diagnostic criteria. For example, Repetitive Use of Objects is a single ADI-R item that inquires about a range of specific behaviors, from attending to particular parts of objects to playing with toys in unusual ways. On the other hand, the RBS-R is a questionnaire focused only on repetitive behaviors, so there are many more items, and each individual item tends to focus on a fairly specific aspect of behavior. Therefore, while sub-scales across the two measures exhibited reasonable levels of convergent validity, had the RBS-R been used in place of the ADI-R in previous investigations of IS behaviors, it is not clear how results would have differed. It will be important to directly explore this issue by testing whether RBS-R IS scores exhibit similar genetic associations as ADI-R IS scores. Given that the SSC has archived genetic material for all participants, as well as scores on the ADI-R and RBS-R for all participants, this question could actually be tested on the sample described in the current study. To facilitate these explorations, syntax for generating the revised RBS-R subscales and ADI-R RSM and IS scores described here are available from the authors.

It will be important for future research to examine the convergent validity of the ADI-R and RBS-R subscales, as well as to explore the construct validity of RSM, IS, and other potential RRB subcategories, in other samples. The SSC is limited to school-aged children from simplex families who have uncomplicated early medical histories, and many, though not all, probands in the SSC have relatively high cognitive abilities. These special features of the sample should be taken into account when considering how our findings apply to other groups of children with ASD. Future research may also benefit from examining RRB subcategories in diagnostic sub-groups of children with ASD. Because of the poor reliability of DSM-IV specific ASD diagnoses (e.g., autistic disorder vs. PDD-NOS) within the SSC (see Lord et al., 2011), we chose to look at all children with ASD together rather than separating by specific clinical diagnosis. Nevertheless, it will be informative for future studies to explore how RRB subcategories and RRB profiles differ in children with ASD who share certain other phenotypic similarities.

In conclusion, several authors have argued that the identification of more behaviorally homogeneous subgroups will facilitate efforts to understand the biological processes

involved in ASD. RRB subcategories, particularly IS behaviors, show promise as an organizing structure by which to define subgroups. However, before conclusions can be drawn about the utility of any given behavioral dimension, it is critical to ensure that the dimension is not merely a byproduct of how it was measured. The results of the current study support the construct validity of at least two subcategories of RRBs, RSM and IS behaviors, measurable through two different methods, interview and questionnaire, thus providing additional rationale for the use of these variables in future sub-phenotyping research efforts. In the future, using comprehensive RRB measures like the RBS-R that inquire about a full range of RRBs, rather than relying exclusively on diagnostic measures like the ADI-R or ADOS to assess RRBs, will likely be important in gaining a more complete understanding of RRB factors beyond (or within) the RSM and IS subcategories.

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References

- Abramson RK, Ravan SA, Wright HH, Wieduwilt K, Wolpert CM, Donnelly SA, Cuccaro ML. The relationship between restrictive and repetitive behaviors in individuals with autism and obsessive compulsive symptoms in parents. *Child psychiatry and human development*. 2005; 36(2):155–165. [PubMed: 16228144]
- American Psychiatric Association. Proposed Draft Revisions to DSM Disorders and Criteria: A 09 Autism Spectrum Disorder. 2011 from <http://www.dsm5.org/proposedrevision/Pages/Default.aspx>.
- Bishop SL, Guthrie W, Coffing M, Lord C. Convergent validity of the mullen scales of early learning and the differential ability scales in children with Autism Spectrum Disorders. *American Association on Intellectual and Developmental Disabilities*. 2011; 116(5):331–343.
- Bishop SL, Richler J, Lord C. Association between restricted and repetitive behaviors and nonverbal IQ in children with autism spectrum disorders. *Child Neuropsychology*. 2006; 4(5):247–267. [PubMed: 16911971]
- Bodfish JW, Symons FJ, Parker DE, Lewis MH. Varieties of repetitive behavior in autism: Comparisons to mental retardation. *Journal of Autism & Developmental Disorders*. 2000; 30(3): 237–243. [PubMed: 11055459]
- Buxbaum JD, Silverman JM, Smith CJ, Kilifarski M, Reichert J, Hollander E, Davis KL. Evidence for a susceptibility gene for autism on chromosome 2 and for genetic heterogeneity. *American Journal of Human Genetics*. 2001; 68(6):1514–1520. [PubMed: 11353400]
- Cannon DS, Miller JS, Robison RJ, Villalobos ME, Wahmhoff NK, Allen-Brady K, Coon H. Genome-wide linkage analyses of two repetitive behavior phenotypes in Utah pedigrees with autism spectrum disorders. *Molecular Autism*. 2010; 1(1):3. [PubMed: 20678246]
- Cuccaro ML, Shao Y, Grubbs J, Slifer M, Wolpert CM, Donnelly SL, DeLong GR. Factor analysis of restricted and repetitive behaviors in autism using the Autism Diagnostic Interview-R. *Child psychiatry and human development*. 2003; 34(1):3–17. [PubMed: 14518620]
- Elliott, CD. *Differential ability scales*. 2nd Ed.. Harcourt Assessment; 2007.
- Esbensen AJ, Seltzer MM, Lam KSL, Bodfish JW. Age-related differences in restricted repetitive behaviors in autism spectrum disorders. *Journal of Autism and Developmental Disorders*. 2009; 39(1):57–66. [PubMed: 18566881]

- Fischbach GD, Lord C. The Simons simplex collection: A resource for identification of autism genetic risk factors. *Neuron*. 2010; 68(2):192–195. [PubMed: 20955926]
- Georgiades S, Papageorgiou V, Anagnostou E. Brief report: Repetitive behaviours in Greek individuals with autism spectrum disorder. *Journal of Autism and Developmental Disorders*. 2010;1–4. [PubMed: 19633942]
- Hollander E, Anagnostou E, Chaplin W, Esposito K, Haznedar MM, Licalzi E, Buchsbaum M. Striatal volume on magnetic resonance imaging and repetitive behaviors in autism. *Biological Psychiatry*. 2005; 58(3):226–232. [PubMed: 15939406]
- Honey E, McConachie H, Randle V, Shearer H, Le Couteur AS. One-year change in repetitive behaviours in young children with communication disorders including autism. *Journal of Autism and Developmental Disorders*. 2008; 38(8):1439–1450. [PubMed: 16900401]
- Honey E, McConachie H, Turner M, Rodgers J. Validation of the repetitive behaviour questionnaire for use with children with autism spectrum disorder. *Research in Autism Spectrum Disorders*. 2012; 6(1):355–364.
- Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*. 1999; 6(1):1–55.
- Hus V, Pickles A, Cook EH, Risi S, Lord C. Using the Autism Diagnostic Interview—Revised to Increase Phenotypic Homogeneity in Genetic Studies of Autism. *Biological Psychiatry*. 2007; 61(4):438–448. [PubMed: 17276746]
- Lainhart JE, Bigler ED, Bocian M, Coon H, Dinh E, Dawson G, Tager-Flusberg H. Head circumference and height in autism: A study by the collaborative program of excellence in autism. *American Journal of Medical Genetics Part A*. 2006; 140(21):2257. [PubMed: 17022081]
- Lam KSL, Aman MG. The repetitive behavior scale-revised: Independent validation in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders*. 2007; 37(5): 855–866. [PubMed: 17048092]
- Lam KSL, Bodfish JW, Piven J. Evidence for three subtypes of repetitive behavior in autism that differ in familiarity and association with other symptoms. *Journal of Child Psychology And Psychiatry*. 2008; 49(11):1193–1200. [PubMed: 19017031]
- Lord C, Petkova E, Hus VB, Gan W, Lu F, Martin DM, Risi S. A multisite study of the clinical diagnosis of different autism spectrum disorders. *Arch Gen Psychiatry*. 2011
- Lord, C.; Rutter, M.; DiLavore, PC.; Risi, S. *Autism Diagnostic Observation Schedule (ADOS)*. Los Angeles, California: Western Psychological Services; 1999.
- McCauley JL, Olson LM, Dowd M, Amin T, Steele A, Blakely RD, Sutcliffe JS. Linkage and association analysis at the serotonin transporter (SLC6A4) locus in a rigid compulsive subset of autism. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*. 2004; 127(1): 104–112.
- Mirenda P, Smith IM, Vaillancourt T, Georgiades S, Duku E, Szatmari P, Volden J. Validating the repetitive behavior scale-revised in young children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*. 2010;1–10. [PubMed: 19633942]
- Mullen, EM. *Mullen scales of early learning*. Circle Pines, MN: American Guidance Service; 1995.
- Muthén, LK.; Muthén, BO. *Mplus User's Guide*. Sixth Edition. Los Angeles, CA: Muthén & Muthén; 1998–2011.
- Norusis, M. *SPSS advanced statistics*. Vol. 17. Chicago, IL, USA: SPSS; 2007.
- Richler J, Bishop SL, Kleinke JR, Lord C. Restricted and repetitive behaviors in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*. 2007; 37(1):73–85. [PubMed: 17195920]
- Richler J, Huerta M, Bishop SL, Lord C. Developmental trajectories of restricted and repetitive behaviors and interests in children with autism spectrum disorders. *Development and Psychopathology*. 2010; 22:55–69. [PubMed: 20102647]
- Risi S, Lord C, Gotham K, Corsello C, Chrysler C, Szatmari P, Pickles A. Combining information from multiple sources in the diagnosis of autism spectrum disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2006; 45(9):1094–1103. [PubMed: 16926617]
- Roid, GH.; Sampers, JL. *Merrill-Palmer-revised scales of development*. Wood Dale, IL: Stoelting Co.; 2004.

- Rutter, M.; Le Couteur, A.; Lord, C. Autism Diagnostic Interview-Revised (ADI-R). Los Angeles, California: Western Psychological Services; 2003.
- Shao Y, Cuccaro ML, Hauser ER, Raiford KL, Menold MM, Wolpert CM, Donnelly SL. Fine mapping of autistic disorder to chromosome 15q11–q13 by use of phenotypic subtypes. *The American Journal of Human Genetics*. 2003; 72(3):539–548.
- Silverman JM, Buxbaum JD, Ramoz N, Schmeidler J, Reichenberg A, Hollander E, Kryzak LA. Autism related routines and rituals associated with a mitochondrial aspartate/glutamate carrier SLC25A12 polymorphism. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics*. 2008; 147(3):408–410.
- Silverman JM, Smith CJ, Schmeidler J, Hollander E, Lawlor BA, Fitzgerald M, Galvin P. Symptom domains in autism and related conditions: Evidence for familiarity. *American Journal of Medical Genetics*. 2002; 114(1):64–73. [PubMed: 11840508]
- Sparrow, SS.; Cicchetti, DV.; Balla, DA. Vineland adaptive behavior scales, (Vineland-II). Circle Pines, MN: American Guidance Services; 2005.
- Sutcliffe JS, Delahanty RJ, Prasad HC, McCauley JL, Han Q, Jiang L, Blakely RD. Allelic heterogeneity at the serotonin transporter locus (SLC6A4) confers susceptibility to autism and rigid-compulsive behaviors. *The American Journal of Human Genetics*. 2005; 77(2):265–279.
- Szatmari P, Georgiades S, Bryson S, Zwaigenbaum L, Roberts W, Mahoney W, Tuff L. Investigating the structure of the restricted, repetitive behaviours and interests domain of autism. *Journal of Child Psychology And Psychiatry*. 2006; 47(6):582–590. [PubMed: 16712635]
- Turner M. Annotation: Repetitive behaviour in autism: A review of psychological research. *Journal of Child Psychology And Psychiatry*. 1999; 40(6):839–849. [PubMed: 10509879]
- Wechsler, D. Wechsler Abbreviated Scale of Intelligence. San Antonio, TX: Psychological Corporation; 1999.
- Wechsler, D. Wechsler Intelligence Scale for Children–Fourth Edition. San Antonio, TX: Psychological Corporation; 2003.

Table 1

Demographics (n = 1825)

	Percentage
Males	86
Females	14
Race	
White	79
African American	4
Asian	4
More than one race or other	12
Not specified	1
Ethnicity	
Hispanic	11
Non-Hispanic	89
Highest Education Received by Mother	
Graduate school	26
College degree	37
Some college	20
Associate's degree	8
GED or high school diploma	8
Some high school or less	1
Status of Parents' Relationship	
Married	91

Table 2

Age at ADOS, Verbal IQ, Nonverbal IQ, Full Scale IQ, Vineland Adaptive Behavior Composite (n=1825)

	<i>N</i>	Mean (SD)	Range
Age at ADOS administration (in years)	1825	8.9 (3.5)	4.0–18.0
Verbal IQ (VIQ)	1825	79.8 (30.2)	5–167
Nonverbal IQ (NVIQ)	1825	86.5 (25.1)	9–161
Full scale IQ	1824	83.0 (26.9)	7–167
Vineland Adaptive Behavior Composite	1825	74.1 (11.7)	27–115

Table 3

Two-factor solution for the Autism Diagnostic Interview – Revised using PCA with promax rotation; % item endorsement (n=1825)

ADI-R items	% with non-zero scores	Repetitive Sensory Motor (RSM)	Insistence on Sameness (IS)
Unusual preoccupations	25.4	0.394	−0.012
Repetitive use of objects	59.0	0.580	0.036
Hand and finger mannerisms	51.4	0.589	−0.121
Complex mannerisms	45.4	0.552	−0.064
Unusual sensory interests	68.2	0.637	0.006
Compulsions/rituals	43.2	0.161	0.440
Sensitivity to noise	64.7	0.083	0.328
Abnormal/Idiosyncratic response	53.8	0.081	0.497
Difficulties with change	62.8	−0.099	0.751
Resistance to change	19.2	−0.016	0.527
Circumscribed interests	70.4	−0.136	0.401
<i>Self-injurious behaviors</i>	<i>31.1</i>	<i>0.271</i>	<i>0.182</i>
<i>Unusual attachment to objects</i>	<i>19.1</i>	<i>0.188</i>	<i>0.230</i>

Note: Bold font indicates the factor on which each item loaded most heavily and corresponds to the subscale scores used in subsequent analyses. Items in italics did not load clearly and/or were not retained on either factor.

Table 4

Five-factor solution for the Repetitive Behavior Scale-Revised using EFA with promax rotation; % item endorsement (n=1825)

RBS-R items and original Bodfish (2000) subscales	% with non-zero scores	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Stereotypy subscale						
1. Whole body	26.0	0.515	0.109	0.123	-0.055	0.141
2. Head	21.8	0.500	0.031	0.105	-0.002	0.068
3. Hand/finger	56.3	0.604	0.062	0.018	-0.004	-0.008
4. Locomotion	52.6	0.605	0.046	0.098	-0.029	0.075
5. Object usage	45.8	0.625	-0.173	0.060	0.057	-0.089
6. Sensory	72.9	0.466	-0.086	0.141	0.074	0.041
Self-Injury subscale						
7. Hits self with body part	28.1	0.186	0.050	0.717	-0.083	0.037
8. Hits self against surface or object	19.7	0.184	0.003	0.680	-0.064	0.095
9. Hits self with object	12.1	0.131	-0.030	0.794	-0.083	0.067
10. Bites self	15.0	0.120	0.039	0.495	-0.004	0.029
11. Pulls	12.8	-0.030	0.012	0.670	0.062	-0.011
12. Rubs or scratches self	20.9	-0.070	0.012	0.672	0.127	-0.049
13. Inserts finger or object	9.3	0.218	-0.001	0.400	0.134	-0.080
14. Skin picking	25.6	-0.186	-0.069	0.567	0.113	-0.065
Compulsive subscale						
15. Arranging/ordering	55.6	0.018	-0.038	0.016	0.744	-0.071
16. Completeness	48.8	0.085	0.085	-0.011	0.821	-0.056
17. Washing/cleaning	20.9	0.071	0.033	0.126	0.563	-0.078
18. Checking	15.1	0.121	0.099	-0.027	0.675	-0.011
19. Counting	22.6	0.133	-0.047	-0.056	0.488	0.043
20. Hoarding/saving	31.7	-0.201	-0.240	0.143	0.372	0.066
21. Repeating ^a	32.8	0.202	-0.007	-0.071	0.475	0.179
22. Touch/tap ^b	37.7	0.288	-0.001	0.115	0.317	0.005
Ritualistic subscale						

RBS-R items and original Bodfish (2000) subscales	% with non-zero scores	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
23. Eating/mealtimes	58.3	0.029	-0.050	-0.028	0.278	0.292
24. Sleeping/bedtime ^a	55.6	-0.074	-0.094	0.020	0.422	0.292
25. Self-care ^a	34.4	-0.128	0.049	0.027	0.488	0.381
26. Travel/transportation	37.3	0.020	-0.044	-0.032	0.271	0.502
27. Play/leisure	47.7	-0.034	-0.253	-0.042	0.202	0.408
28. Communication/social interactions ^c	67.3	-0.068	-0.365	-0.031	0.046	0.332
Sameness subscale						
29. Insists things remain in same place ^a	42.0	-0.091	0.009	-0.009	0.559	0.354
30. Objects to visiting new places	37.3	0.055	-0.090	0.068	-0.095	0.558
31. Becomes upset if interrupted	76.1	0.070	-0.221	0.110	-0.217	0.685
32. Insists on walking in pattern	15.6	0.283	0.049	-0.085	0.257	0.420
33. Insists on sitting at the same place	35.0	-0.041	0.056	-0.014	0.200	0.626
34. Dislikes changes in other people	31.6	-0.007	-0.033	0.035	0.191	0.542
35. Insists on using a particular door	11.5	0.233	0.071	-0.140	0.279	0.525
36. Likes the same music, movie/video ^d	67.9	0.135	-0.154	-0.018	0.169	0.297
37. Difficulty with transitions	77.2	0.019	-0.141	0.098	-0.271	0.829
38. Insists on same routine	53.1	-0.017	0.123	0.033	0.076	0.894
39. Insists on things at specific times	40.7	-0.070	0.126	0.010	0.083	0.881
Restricted subscale						
40. Fascination with one subject/activity	80.7	0.085	-0.752	0.002	-0.126	0.153
41. Strongly attached to specific object	49.2	0.121	-0.592	0.040	0.058	0.101
42. Preoccupation with part of object ^b	39.8	0.535	-0.490	-0.023	0.164	-0.183
43. Fascination with movement ^b	39.5	0.630	-0.371	-0.131	0.162	-0.168

Note:

^aItem not included in Lam & Aman (2007) revised subscales

^bItem included in Lam & Aman (2007) Stereotypy subscale

^cItem included in Lam & Aman (2007) Ritualistic/Sameness subscale

^dItem included in Lam & Aman (2007) Restricted subscale

Bold-type font indicates the factor on which each item loaded most heavily and corresponds to the subscale scores used in subsequent analyses. Items in italic-type font did not load clearly on any single factor.

Table 5

Correlations between NVIQ, ADOS D1+D2, ADI-R RSM, ADI-R IS, ADI-R IS (not including CI item), ADI-R Self Injury Item, ADI-R Circumscribed Interests Item, RBS-R Sensory Motor, RBS-R Self-Injury, RBS-R Compulsive, RBS-R Ritualistic/ Sameness, and RBS-R Restricted Interests

	NVIQ	ADOS D1 + D2	ADI-R RSM	ADI-R IS	ADI-R IS (not including CI)	ADI-R Self Injury Item	ADI-R Circumscribed Interests Item	RBS-R Sensory Motor	RBS-R Self-Injury	RBS-R Compulsive	RBS-R Ritualistic/ Sameness	RBS-R Restricted Interests
Age at ADOS	-.038	-.215 *	-.198 *	.140 *	.092 *	.054	.184 *	-.159 *	.064	-.001	.054	.027
NVIQ	--	-.389 *	-.319 *	.090 *	.030	-.168 *	.201 *	-.288 *	-.169 *	-.131 *	-.004	-.026
ADOS D1 + D2	--	--	.385 *	-.054	-.015	.066	-.128 *	.327 *	.068	.084 *	-.009	.014
ADI-R RSM			--	.256 *	.284 *	.209 *	.014	.571 *	.211 *	.278 *	.186 *	.209 *
ADI-R IS				--	.951 *	.203 *	.494 *	.182 *	.203 *	.389 *	.474 *	.289 *
ADI-R IS (not including CI)				--	--	.207 *	.199 *	.216 *	.214 *	.417 *	.480 *	.218 *
ADI-R Self Injury Item						--	.060	.208 *	.487 *	.143 *	.150 *	.111 *
ADI-R Circumscribed Interests Item							--	-.031	.040	.059	.152 *	.302 *
RBS-R Sensory Motor								--	.405 *	.432 *	.402 *	.342 *
RBS-R Self-Injury									--	.340 *	.347 *	.248 *
RBS-R Compulsive										--	.672 *	.473 *
RBS-R Ritualistic/Sameness											--	.507 *

Note:

*
p<.001

For each subscale, bold-type font indicates the highest between-measure correlation