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Reliability of the Autism Spectrum Disorder-Diagnostic For Children (ASD-DC)

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Abstract

The reliability of a new scale to assess Autistic Disorder, Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS), and Asperger's Disorder in children was examined. Parents or other caregivers rated symptoms of 207 children between 2 and 16 years of age. The scale, which had 40 items in the final version, correlated highly with DSM-IV-TR and ICD-10 criteria and proved to have good inter-rater reliability and, excellent test–retest, and internal consistency reliability. These data are considered to have clinical utility given the need to establish data-based distinctions between these three subtypes of ASD. Furthermore, the measure is part of a more extensive battery measuring comorbid psychopathology and challenging behaviors. Implications for future research of this comprehensive assessment battery are discussed.

Keywords: Asperger's Syndrome; PDD-NOS; Autism; Test; ASD-DC

Autism Spectrum Disorders (ASD) are a set of neurodevelopmental conditions, that while quite heterogeneous, have overlapping symptoms (Lam, Aman, & Arnold, 2006; Matson, 2007a). Once thought to be rare, the ASD are now considered to be one of the most prevalent of the severe disorders of childhood (Baird et al., 2006; Gillberg, Cederlund, Lamberg, & Zeijlon, 2006). Among the primary core features are social and language impairments, with excessive cognitive rigidity as well as ritualistic and stereotyped behaviors (Balconi & Carrera, 2007; Hilton, Graver, & LaVesser, 2007; Matson & Wilkins, 2007; Ritvo & Freeman, 1977). The clinical diagnostic picture is compounded further by the presence of intellectual disabilities (ID) in a substantial subset of the ASD population (Baird et al., 2006). Both ID and ASD are additional

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risk factors for challenging behaviors and comorbid psychopathology (Cannella, O'Reilly, & Lancioni, 2006; Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Fox, Keller, Grede, & Bartosz, 2007; Matson & Nebel-Schwalm, 2007). Sorting out the various subtypes of ASD, and distinguishing those children with ASD who do or do not have ID and/or challenging behaviors and psychopathology has important implications for treatment effectiveness and long-term prognosis (Ben-Itzchak & Zachor, 2007; Chung et al., 2007; Eisenmajer et al., 1998; Hill & Furniss, 2006; Ingersoll & Gergans, 2007; Towbin, 2003). These issues have considerable implications for real world diagnosis since in practice, parents often have a difficult time finding professionals who can provide an appropriate diagnosis for their child (Siklos & Kerns, 2007). One reason for this is the lack of scaling methods that are brief, and can be used to measure multiple ASD and related problems.

Given the increased number of children being identified with an ASD (Centers for Disease Control and Prevention, 2007), an important step in the direction of better differential diagnosis of children with ASD has been the development of efficient and objective rating scales (Matson, Nebel-Schwalm, & Matson, 2007). The Childhood Autism Rating Scale (CARS) (Schopler, Reichler, & Renner, 1988) and Autism Behavior Checklist (ABC) (Krug, Arick, & Almond, 1979) are among these. More recently, with the emphasis on very early intervention, instruments such as the Checklist for Autism in Toddlers (CHAT) (Baron-Cohen, Allen, & Gillberg, 1993) were developed, and efforts to establish how early these conditions could be identified and treated were made (Ben-Itzchak & Zachor, 2007; Matson & Smith, in press; Matson, Wilkins, & Gonzalez, 2007; Symes, Remington, Brown, & Hastings, 2006). However, with the emphasis on ASD as a spectrum of conditions, measures that could be used to assess multiple ASD have been recognized as important. Attempts to develop such measures have been limited to date, with the Diagnostic Interview for Social and Communication Disorders-Version 10 (DISCO-10) (Wing, Leekam, Libby, Gould, & Larcombe, 2002) and the Pervasive Developmental Disorders Behavior Inventory (Cohen, Schmidt-Lackner, Romanczyk, & Sudhalter, 2003) being perhaps the most prominent.

The purpose of the current paper was to report on an ASD scale designed to measure Autistic Disorder, Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS), and Asperger's Disorder. Additionally, the scale was constructed not only as a primary aide in diagnosis, but as part of a three component battery, the other two measures being designed to measure comorbid psychopathology and challenging behaviors, all in a quick and efficient manner. A variant of these scales has already been developed, and psychometric properties established with an adult ASD, ID population (Matson & Boisjoli, 2007a; Matson & Rivet, in press; Matson, Wilkins, & González, in press). The present paper provides reliability data on the children's version of the diagnostic scale, which included children within the average to ID ranges of intellectual abilities.

1. Method

1.1. Participants

Parents or other relatives or caregivers of 207 children with and without ASD served as participants. Parents were recruited through various clinic and school settings. Parents of children with ASD were recruited from mental health outpatient clinics, specialized schools, and advocacy/community groups. Participants came from sites in California, Connecticut, Michigan, New York, Georgia, and Louisiana. All parents completed informed consent materials and the study was approved by the LSU Institutional Review Board for research.

Children were assessed with a composite symptom checklist from the Diagnostic and Statistical Manual of Mental Disorders-Text Revision, Fourth Edition (DSM-IV-TR) (American Psychiatric Association, 2000) and International Classification of Diseases, Tenth Edition (World Health Organization, 1992). Research criteria were set to clearly define the designation of ASD. For ASD, two deficits in social interaction and one in another area of functioning (e.g., communication or repetitive behaviors/interests) were required. These data were used along with clinical consensus, the gold standard in differential diagnosis of ASD, to arrive at the final diagnosis (Prior et al., 1998). There were 102 children who met criteria for ASD, while 105 children constituted the control group. One hundred and twenty-three (59%) children had one or more previous diagnoses given by a mental health/medical professional prior to their participation of the study. Children who were in the ASD group (99%) reported the following previous diagnoses: Autistic Disorder, Asperger's Disorder, PDD-NOS, Nonverbal Learning Disability, Anxiety Disorders, Attention Deficit Hyperactivity Disorder (ADHD), Bipolar Disorder, Depression, Developmental Delay, Down Syndrome, Fetal Alcohol Syndrome, Fragile X Syndrome, Iodine Deficiency Disorder, Learning Disorder, Seizure Disorder, Stereotypic Movement Disorder, Tics, Selective Mutism, Psychosis NOS, and Psychopathology (unspecified). Whereas, children in the control group (22%) reported the following previous diagnoses: ADHD, Depression, Anxiety Disorders, Turner's Syndrome, Developmental Delay, Dyslexia, and Psychopathology (unspecified). The remainder were typically developing children. Six of the children were identified by informants as having an intellectual disability, and five were identified as having seizures or epilepsy (all of whom met criteria for the ASD group). Fifty-seven (28%) of the children (45 were in the ASD group) were prescribed one or more psychotropic medications at the time the measures were completed.

Mean number of endorsed items for the ASD group on the DSM-IV-TR/ICD-10 checklist was 11.76 out of 19 items with a range of 4–19. Control group children averaged .67 endorsed items on the checklist with a range of 0–10. Inter-rater (ASD $n = 32$; control $n = 34$) and test–retest (ASD $n = 28$; control $n = 23$) reliability were obtained on subsets of the sample. In addition, the internal consistency of the items ($n = 197$) were calculated for the DSM-IV-TR and ICD-10 criteria subscales and total. The results proved to be robust ($r = .89$; $r = .96$; $\alpha = .95$). Table 1 lists reliability coefficients for the DSM-IV-TR/ICD-10 checklist.

Children ranged in age from 2 to 16 with a mean age of 8 years. An independent *t*-test revealed that the ASD and control groups did not differ significantly in terms of age. Seventy-nine percent of children were Caucasian. Chi-square analysis did not reveal group differences in ethnicity. The majority of children were male (67%), though there were significantly more females in the control group than the ASD group, χ^2 (1, $n = 207$) = 14.70, $p < .001$. Ninety-three percent of children were verbal, with significantly more nonverbal children in the ASD group, χ^2 (1, $n = 206$) = 12.43, $p < .001$. Table 2 provides age, gender, ethnicity, and verbal ability information for children by group.

1.2. Test materials and procedures

1.2.1. DSM-IV-TR/ICD-10 checklist

As defined in DSM-IV-TR (APA, 2000), the checklist included symptoms from the three core areas of autism: impairments in social interaction, impairments in communication, and restricted, repetitive, and stereotyped patterns of behavior. Social impairments included the following items: ''marked impairment in nonverbal behaviors such as eye-to-eye gaze''; ''failure to develop peer relationships''; ''lack of spontaneous seeking to share enjoyment, interests with others''; and

Table 1
Reliability coefficients for the DSM-IV-TR/ICD-10 checklist

Item[a]	Inter-rater (n = 57)	Test–retest (n = 40)	Internal consistency[b] (n = 128)
Social interaction[c]	*.82*	*.92*	*.85*
a. Impairment in the use of multiple nonverbal behavior, such as eye-to-eye gaze (e.g., eye contact), body posture, or gestures	.76	.89	
b. Failure to develop peer relationships appropriate to developmental level (e.g., little to no interest in forming friendships or lack understanding of how to interact socially with others)	.74	.95	
c. Lack of spontaneous seeking to share enjoyment, interest or achievements with others (e.g., not showing, bringing, or pointing out objects of he/she finds interesting)	.52	.68	
d. Lack of social or emotional reciprocity (e.g., not actively participating in social play or games, preferring solitary activities)	.61	.94	
e. Rarely seeking or using others for comfort in times of stress or offering comfort or affection to others in stress	.43	.57	
Communication[c]	*.81*	*.91*	*.86*
a. Delay in development or lack of spoken language (i.e., not accompanied by an attempt to communicate through alternative ways to communicate such as gestures or mime)	.92	.84	
b. In those with adequate speech, impairment to initiate or sustain conversations with others	.74	.58	
c. Stereotyped and repetitive use of language or idiosyncratic language (e.g., using words in a peculiar or odd way)	.71	.73	
d. Lack of varied, spontaneous make-believe play (e.g., pretend play) or social imitative play (e.g., imitating adults) appropriate to developmental level	.77	.71	
e. Lack of emotional response to others' verbal or non-verbal communication	.60	.69	
f. Lack of variation in the rhythm or emphasis of speech (e.g., speech is monotone; without change)	.73	.37	
g. Impaired use of gestures to aid spoken communication	.53	.54	
Restricted, repetitive, and stereotyped patterns of interest or behavior[c]	*.79*	*.92*	*.85*
a. Preoccupation with one or more stereotyped and restricted patterns of interest of abnormal intensity or focus (e.g., few interests)	.71	.89	
b. Inflexible adherence to specific, nonfunctional routines or rituals	.60	.94	
c. Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or other complex whole-body movements such as rocking, dipping or swaying)	.64	.87	
d. Persistent preoccupation with parts of objects (e.g., buttons, parts of the body)	.61	.59	
e. Specific attachments to unusual objects (e.g., string)	.24	.63	
f. Distress over changes in small, non-functional details of the environment	.61	.84	
Delays or abnormal functioning in at least one of the previous areas (#1–3) was present prior to age of 3.	*.73*	*.85*	
Total checklist[c]	*.90*	*.97*	*.95*

[a] Item inter-rater and test-retest reliabilities were calculated with kappa coefficients.
[b] Scale and subscale internal consistency was calculated using Cronbach's alpha.
[c] Scale and subscale inter-rater and test-retest reliabilities were calculated with Pearson's *r*.

Table 2
Demographic characteristics of children ($n = 207$)

	Group			
	ASD group ($n = 102$)		Control group ($n = 105$)	
	n	%	*n*	%
Age				
2–5 years (preschool)	25	25	25	24
6–11 years (child)	59	58	73	70
12–16 years (adolescent)	17	17	7	6
Gender				
Male	81	79	57	54
Female	21	21	48	46
Ethnicity				
Caucasian	77	78	79	81
African American	12	12	11	11
Hispanic	5	5	5	5
Other	5	5	3	3
Verbal ability				
Yes	88	86	103	99
No	14	14	1	1

"lack of social/emotional reciprocity." Communication impairments included the following items: "delay in the development of spoken language"; "impairment in the ability to initiate or sustain conversation with others"; "repetitive or idiosyncratic language"; and "lack of varied spontaneous make believe play or social imitative play appropriate to developmental level." Restricted and stereotyped patterns of behavior included the following items: "preoccupation with one or more stereotyped or restricted patterns of interests"; "inflexible adherence to nonfunctional routines"; "stereotyped and repetitive motor mannerisms"; and "persistent preoccupation with parts of objects." Criteria listed on the ICD-10 (WHO, 1992) that are not included on the DSM-IV-TR were also listed, such as "rarely seeking or using others for comfort in times of stress or comforting others when they are stressed"; "lack of emotional response to other verbal or nonverbal communication"; "lack of variation in speech"; "impaired use of gestures to aid spoken communication"; "specific attachments to unusual objects"; and "distress over changes in small, nonfunctional details in the environment." To aid in the participant's understanding of the items, most symptoms were accompanied with examples taken from the texts. An item inquiring if delays or abnormalities in one of the three core areas were noted prior to age 3 was also included.

1.2.2. Autism Spectrum Disorder-Diagnostic for Children (ASD-DC)

The ASD-DC was a newly developed informant-based assessment scale designed to assess symptoms of Autistic Disorder, PDD-NOS, and Asperger's Disorder. Scale items were generated through a series of steps suggested by Crocker and Algina (1986) and DeVellis (1991). This approach included a comprehensive research review of the ASD literature and current diagnostic guidelines (i.e., DSM-IV-TR; ICD-10), as well as critical incidents and observations noted by clinical psychologists with experience working with this population. Expert review generated additional items, and suggestions for minor item revisions. Items were then edited and adjusted to

ensure that they were understandable to persons unfamiliar with mental health terminology. Subsequently, the ASD-DC was piloted with adult caregivers before finalizing item content.

1.3. Procedures

Informants rated items as 0 (not different; no impairment), 1 (somewhat different; mild impairment), or 2 (very different; severe impairment) following directions printed at the top of the scale. Some scales were completed on-site, while other parents completed the materials at their home and returned via mail. Research assistants, who were doctoral level students in clinical psychology, made follow-up phone calls/emails to resolve any questions or issues parents had in completing the materials.

Inter-rater ($n = 67$) and test–retest ($n = 56$) reliability were evaluated. Participants self-selected to participate in inter-rater and test–retest reliability studies. Inter-rater participants were other adults who knew the child well such as parents, grandparents, or close relatives residing in the home. Reliabilities were calculated using weighted kappa, which has been suggested for use with ordinal type assessment instruments so that different kinds of disagreements between raters can be weighted differently (Cicchetti, 1994; Cicchetti & Sparrow, 1981). Further, it has been suggested that weighted kappa is more appropriate than Cohen's kappa for dichotomous-ordinal type data in clinical rating scales (Cicchetti & Sparrow, 1981; Cicchetti, Volkmar, Sparrow, & Cohen, 1992; Jakobsson & Westergren, 2005). Linear weighting is the most common method used, recommended for data that has both nominal and ordinal features, and was used in this analysis (Cicchetti et al., 1992). Cicchetti and Sparrow (1981) suggest that item coefficients below .40 have poor clinical significance, from .40 to .59 fair clinical significance, from .60 to .74 good clinical significance, and from .75 to 1.00 are considered excellent. Cicchetti and Sparrow's (1981) guidelines propose that a stringent but simple criterion is to retain items that have good to excellent reliability (i.e., coefficients greater than or equal to .60). Therefore, all items with test–retest or inter-rater reliabilities with coefficients less than .60 were removed from the scale.

Next, an item analysis was conducted including inter-item correlations, item-scale correlations, item variances, and item means. Coefficient alpha was then computed with the retained items to give an estimate of the internal consistency of the scale. Good estimates of internal consistency are those with alpha greater than .80 (Cicchetti, 1994; Clark & Watson, 1995).

Finally, the mean sum of item endorsements for the retained ASD-DC items was examined in an independent *t*-test between the ASD and control groups. Chi-square analyses were computed between ASD and control groups on each individual ASD-DC item. Last, a correlation between the total sum of retained items and the total number of endorsements on the DSM-IV-TR/ICD-10 Checklist was calculated.

2. Results

Mean item inter-rater reliability among the 71 items was $\kappa_\omega = .58$ (range = .21 to .79). There were 37 items that had $\kappa_\omega > .60$. Mean item test–retest reliabilities among the 71 items was $\kappa_\omega = .72$ (range = .45 to .88). There were six items (all of which also had inter-rater reliability coefficients $< .60$) that had test–retest coefficients of $\kappa_\omega < .60$. The 34 items with $\kappa_\omega < .60$ for inter-rater and/or test–retest reliability were removed from the scale; thus, 37 items were retained. Table 3 displays the weighted kappa coefficients and percent agreement for the inter-rater and test–retest reliability of the original 71 items of the ASD-DC.

Table 3
Weighted kappa and percent agreement values for inter-rater and test–retest reliability

ASD-DC item number and description	Inter-rater (n = 65)		Test–retest (n = 56)	
	%	κ_ω	%	κ_ω
1. Communication skills[a]	.91	.79	.94	.86
2. Intellectual abilities (i.e., as smart as others his/her age)	.82	.52	.88	.70
3. Age appropriate self-help and adaptive skills (i.e., able to take care of self)[a]	.85	.62	.86	.64
4. Engages in repetitive motor movements for no reason (e.g., hand waving, body rocking, head banging, hand flapping)[a]	.89	.70	.90	.76
5. Verbal communication[a]	.87	.71	.92	.82
6. Prefers clothing of a certain texture	.84	.49	.91	.73
7. Prefers foods of a certain texture or smell[a]	.85	.64	.93	.82
8. Ability to recognize the emotions of others	.85	.59	.88	.71
9. Maintains eye contact	.84	.59	.91	.78
10. Use of language to communicate[a]	.87	.69	.92	.81
11. Social interactions with others his/her age[a]	.87	.71	.92	.82
12. Reactions to normal, everyday sounds (e.g., vacuum, coffee grinder)	.83	.47	.90	.73
13. Response to others' social cues[a]	.85	.65	.87	.71
14. Reaction to normal, everyday lights (e.g., streetlights, etc.)	.87	.26	.93	.72
15. Peer relationships[a]	.84	.63	.92	.83
16. Rhythm of speaking (e.g., sing-song; If nonverbal, rate "0")	.86	.54	.82	.45
17. Use of language in conversations with others[a]	.87	.71	.91	.80
18. Shares enjoyment, interests, or achievement with others (e.g., parents, friends, caregivers)[a]	.85	.61	.89	.73
19. Ability to make and keep friends[a]	.86	.68	.93	.85
20. Interest in participating in social games, sports, and activities[a]	.85	.67	.89	.77
21. Interest in another person's side of the conversation (e.g., talks to people with intention of hearing what others have to say)[a]	.89	.76	.92	.83
22. Able to understand the subtle cues or gestures of others (e.g., sarcasm, crossing arms to show anger)[a]	.87	.69	.90	.79
23. Use of too few or too many social gestures[a]	.86	.67	.92	.81
24. Body posture and/or gestures[a]	.87	.63	.90	.70
25. Communicates effectively (e.g., using words, gestures or sign language)[a]	.90	.75	.88	.70
26. Likes affection (e.g., praise, hugs)	.86	.38	.88	.57
27. Displays a range of socially appropriate facial expressions[a]	.87	.62	.92	.75
28. Restricted interests and activities[a]	.87	.70	.90	.79
29. Motivated to please others (e.g., peers, caregivers, parents)	.84	.59	.86	.63
30. Eye-to-eye gaze[a]	.86	.65	.88	.71
31. Reaction to sounds and sights	.86	.59	.87	.63
32. Walks or runs on toes/balls of feet (If unable to walk/run, rate "0")	.89	.59	.92	.72
33. Awareness of the unwritten or unspoken rules of social play (e.g., turn taking, sharing)	.80	.52	.88	.72
34. Facial expression corresponds to environmental events	.82	.53	.88	.66
35. Sticking to odd routines or rituals that don't have a purpose or make a difference[a]	.84	.60	.88	.72
36. Abnormal preoccupation with the parts of an object or objects	.78	.39	.83	.59
37. Plays appropriately with others[a]	.85	.62	.90	.77
38. Reads nonverbal cues (body language) of other people (if blind, rate "0")[a]	.86	.68	.88	.73

(*Continued*)

ASD-DC item number and description	Inter-rater (n = 65)		Test–retest (n = 56)	
	%	κ_ω	%	κ_ω
39. Speaks in monotone (e.g., voice is flat, does not change in sound; If nonverbal, rate "0")	.84	.41	.92	.66
40. Expects others to know their thoughts, experiences, and opinions without communicating them (e.g., expects others to "read his/her mind")[a]	.85	.61	.88	.71
41. Interest in a highly restricted set of activities	.84	.57	.79	.51
42. Talking to others in a social context (If nonverbal, rate "0")	.83	.58	.92	.81
43. Use of facial expressions[a]	.88	.65	.91	.72
44. Abnormal fascination with the movement of spinning objects (e.g., closing doors, electric fan blades)	.79	.36	.92	.78
45. Curiosity with surroundings	.81	.35	.88	.65
46. Saying words and phrases repetitively (If nonverbal, rate "0")[a]	.85	.63	.89	.74
47. Make-believe or pretend play	.83	.57	.85	.64
48. Understanding of age appropriate jokes, figures of speech, or sayings[a]	.87	.73	.91	.81
49. Gives subtle cues or gestures when communicating with others (e.g., hinting)[a]	.83	.63	.88	.74
50. Becomes upset if there is a change in routine[a]	.85	.67	.86	.70
51. Needs reassurance, especially if events don't go as planned	.81	.59	.83	.64
52. Language development[a]	.87	.71	.93	.84
53. Responds to others' distress[a]	.86	.64	.87	.70
54. Socializes with other children[a]	.90	.75	.94	.86
55. Use of nonverbal communication[a]	.90	.74	.87	.64
56. Clumsiness	.86	.54	.88	.68
57. Limited number of interests	.82	.59	.89	.77
58. Imitation of an adult or child model (e.g., caregiver waves "bye" then the child waves "bye")	.84	.48	.85	.51
59. Abnormal, repetitive hand or arm movements	.85	.53	.89	.70
60. Body posture	.86	.39	.89	.63
61. Abnormal, repetitive motor movements involving entire body	.87	.57	.87	.62
62. Development of social relationships[a]	.87	.73	.95	.88
63. Respect for others' personal space (e.g., stands too close to others)	.83	.58	.92	.83
64. Isolates self (i.e., wants to be by him/her self)[a]	.84	.61	.89	.76
65. Participation in games or other social activities[a]	.86	.66	.91	.80
66. Speaks overly precise or scholarly (e.g., high vocabulary, speaks very properly)	.76	.37	.91	.73
67. Academic skills	.69	.21	.87	.62
68. Reading above age/grade level	.76	.42	.87	.68
69. "Over the top" vocabulary (sounds like a "little professor")	.74	.31	.94	.83
70. Has an exceptional memory (e.g., can memorize full passages, monologues, speeches, etc.)	.80	.51	.82	.60
71. Musical or artistic ability	.79	.43	.83	.51

[a] The item was retained in the final scale, item inter-rater and test–retest reliability $\geq$.60.

The average item mean for the 37 remaining items was .69 (range = .48 to .89) and the average item standard deviation was .82 (range = .66 to .91). Inter-item correlations averaged .70 with a range of .35 to .91. Item-scale correlations ranged from .57 to .91, with an average of .82. Further, the internal consistency of the scale was α = .99. The exclusion of any item did not result in a substantial increase in alpha. Finally, inter-rater and test–retest reliabilities were recalculated with the 37 items retained in the scale. The final scale mean inter-rater item reliability was κ_ω = .67 (range = .60 to .79), and the mean test–retest item reliability was κ_ω = .77 (range = .72 to

.86). Table 4 provides means, standard deviations, and corrected item-total correlations for each retained item of the ASD-DC.

The ASD group had a total sum mean of 48 (*SD* = 16; range = 1–72) on the retained items of the ASD-DC, while the control group had a total sum mean of 4 (*SD* = 7; range = 0–47). There was a significant difference in the total sum endorsements between groups, t (205) = 25.79,

Table 4
Means, standard deviations, and corrected item-total correlations for the 37 retained items

ASD-DC item number and description	Mean	*SD*	Corrected item-total correlation
1. Communication skills	.80	.84	.86
2. Age appropriate self-help and adaptive skills (i.e., able to take care of self)	.66	.78	.80
3. Engages in repetitive motor movements for no reason (e.g., hand waving, body rocking, head banging, hand flapping)	.61	.76	.79
4. Verbal communication	.72	.83	.83
5. Prefers foods of a certain texture or smell	.60	.76	.57
6. Use of language to communicate	.68	.82	.82
7. Social interactions with others his/her age	.85	.86	.88
8. Response to others' social cues	.75	.83	.88
9. Peer relationships	.86	.88	.91
10. Use of language in conversations with others	.72	.87	.84
11. Shares enjoyment, interests, or achievement with others (e.g., parents, friends, caregivers)	.58	.75	.80
12. Ability to make and keep friends	.83	.88	.88
13. Interest in participating in social games, sports, and activities	.78	.88	.82
14. Interest in another person's side of the conversation (e.g., talks to people with intention of hearing what others have to say)	.89	.91	.90
15. Able to understand the subtle cues or gestures of others (e.g., sarcasm, crossing arms to show anger)	.78	.87	.89
16. Use of too few or too many social gestures	.70	.86	.91
17. Body posture and/or gestures	.51	.70	.80
18. Communicates effectively (e.g., using words, gestures or sign language)	.62	.80	.84
19. Displays a range of socially appropriate facial expressions	.48	.69	.77
20. Restricted interests and activities	.70	.85	.87
21. Eye-to-eye gaze	.62	.74	.83
22. Sticking to odd routines or rituals that do not have a purpose or make a difference	.60	.81	.79
23. Plays appropriately with others	.67	.80	.90
24. Reads nonverbal cues (body language) of other people (if blind, rate "0")	.75	.86	.88
25. Expects others to know their thoughts, experiences, and opinions without communicating them (e.g., expects others to "read his/her mind")	.61	.81	.74
26. Use of facial expressions	.49	.66	.84
27. Saying words and phrases repetitively (if nonverbal, rate "0")	.53	.77	.57
28. Understanding of age appropriate jokes, figures of speech, or sayings	.81	.90	.90
29. Gives subtle cues or gestures when communicating with others (e.g., hinting)	.72	.87	.88
30. Becomes upset if there is a change in routine	.80	.86	.80
31. Language development	.76	.88	.87
32. Responds to others' distress	.67	.81	.85
33. Socializes with other children	.72	.82	.86
34. Use of nonverbal communication	.56	.77	.83
35. Development of social relationships	.83	.88	.91
36. Isolates self (i.e., wants to be by him/her self)	.63	.83	.81
37. Participation in games or other social activities	.72	.82	.86

p = .000. The ASD group had significantly higher endorsements on the ASD-DC than the control group. Chi-square analyses indicated significant (p = .000) group differences on all 37 retained items of the ASD-DC, with higher endorsements for the ASD group over the control group. The correlation between the total number of endorsements on the DSM-IV-TR/ICD-10 Checklist and the sum of the ASD-DC endorsements was .93, p = .000.

3. Discussion

While a substantial number of ASD scales have been developed for children, they rarely have included more than one ASD (typically including autism only), and scaling methods that take into account PDD-NOS have been largely absent (Matson, 2007a; Matson & Boisjoli, 2007b). Thus, scaling methods that incorporate the most frequent of the ASD (Autistic Disorder, PDD-NOS, and Asperger's Disorder) have important implications for screening and diagnosis. Additionally, rarely are ASD measures used in early intervention outcome studies (Matson, 2007b). Given that children with PDD-NOS and autism are often both included in such research, one scale to measure both conditions would appear to be advantageous. The fact that this scale can be completed in a few minutes, and is part of a battery of scales that measure comorbid psychopathology and challenging behaviors, adds considerably to the potential utility of the scale.

These initial data on the ASD-DC are quite promising. The internal consistency of the scale was excellent at .99 (Cicchetti, 1994). Inter-rater reliability was good at .67, and test–retest reliability was excellent at .77 (Cicchetti & Sparrow, 1981). Total ASD-DC endorsements, as well as individual item endorsements, were significantly higher for the ASD group compared to the control group. Thus, tentatively suggesting that it can be used to differentiate ASD from non-ASD children and adolescents across a wide age range. Total ASD-DC endorsements were also highly correlated with endorsements based on DSM-IV-TR/ICD-10 criteria, suggesting that the scale may prove to be a valuable diagnostic tool for differential diagnosis and classification. Furthermore, because considerably more items are included relative to the DSM-IV-TR/ICD-10 criteria, it allows for the provision of useful individualized treatment planning. Finally, future research will focus on empirically derived cutoffs between various ASD, which should prove to be an improvement of DSM and ICD systems where cutoffs and symptom cluster definitions are largely determined on clinical judgment.

Of note are some limitations of the present study which should prove instructive for further study. The test–retest interval was rather large in some instances (i.e., months). Future studies should evaluate test–retest reliability with an interval approximating 2 weeks. Although high internal consistency reliability is necessary and desired, future studies should examine if the scale contains unnecessary item redundancy due to the high alpha of the scale. Next, future studies should examine the ASD-DC scale results in conjunction with observation methods, as the scales are based on parent report. Finally, the factor structure and validity of the ASD-DC will be examined in future research.

To date most scaling attempts have been largely relegated to one specific ASD. However, the growing consensus that these disorders are on a continuum would appear to suggest that the time has come to develop scales that can address multiple ASD, and evaluate symptoms in conjunction with the assessment of comorbid psychopathology and challenging behaviors (Matson & Minshawi, 2007; Matson & Nebel-Schwalm, 2007; Plant & Sanders, 2007).

We believe that future research with a psychometrically sound measure of multiple ASD may prove useful in eliminating false categorical distinctions and clarify the empirical basis of

diagnostic practices (Towbin, Volkmar, Paul, Klin, & Cohen, 2005). The attempt to better establish empirical methods of diagnosing PDD-NOS may be particularly salient given the current difficulty in the reliable diagnosis of this ASD relative to other childhood disorders (Mahoney et al., 1998).

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