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The Relationship between Stereotyped Movements and Self-Injurious Behavior in Children with Developmental or Sensory Disabilities

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Abstract

We assessed whether the stereotyped movements (SM) that are a defining characteristic of autism are discriminable from those observed in other disorders, and whether stereotyped self-injurious movements, which are excluded as exemplars of SM in DSM-IV, differ from other SM in severity or in kind. We used the Stereotyped and Self-Injurious Movement Interview to assess self-injurious and other SM in children with autism (n=56), intellectual disability (n=29), vision impairment (n=50), or hearing impairment (n=51) and in typical children (n=30). Cross-tabulation of scores indicated that self-injurious behavior is rarely performed in the absence of other SM. Reliability analyses indicated that patterns of covariation among SM items differ across groups so that different item sets are necessary to reliably measure SM in each group. Analyses of variance indicated the autism group exceeded one or more other groups in the frequency of 15 SM, the vision impaired group exceeded others on 5 SM, and the hearing impaired group exceeded others on 1 SM. Discriminant function analysis of SM items indicated that although only 66% of participants were accurately classified, it was rare for a child with a different disorder to be misclassified as having autism or visual impairment. We concluded that self-injurious behavior is a more severe form of SM, and there is a distinctive pattern of SM, including self-injurious behavior, that characterises children with autism.

Apart from their capacity to cause harm, the self-injurious behavior of people with developmental or sensory disorders (Baumeister, 1978; Baumeister & Forehand, 1973; Berkson, 1983, Tate & Baroff, 1966; Turner, 1999a; Troster, Brambring & Beelmann, 1991) appears to have nothing in common with the self-harming behavior of other clinical groups (Alderman, 1997; Baroff, 1974; Briere & Gil, 1998; Favazza, 1996; Schroeder, Schroeder, Smith & Dalldorf, 1978). Rather, as Matson et al. (1997) noted, the self-injurious behavior of people with developmental disorders is frequently rhythmic and repetitive, that is, it closely resembles the repetitive and stereotyped movements (SM) that are a defining characteristic of autism (American Psychiatric Association, 2000; Schopler, 1995) and are also common among persons with an intellectual or sensory disability (Murdoch, 1996; Rojahn & Sisson, 1990; Troster et al.).

Until recently, self-injurious and other SM were both included in a class of behavior marked by repetition, rigidity, invariance, and inappropriate continuation (Baumeister & Rolling, 1976; deLissovoy, 1961; Turner, 1997; Wing, 1976), and self-injurious SM were classified as a "substrate of stereotyped behaviors" (Gorman-Smith & Matson, 1985). More recently, self-injurious and other SM have, with aggressive / destructive behavior and noncompliance, been construed as distinct sub-categories of "problem" (Rojahn, Matson, Lott, Esbensen & Smalls, 2001) or "challenging" behavior (Matson & Nebel-Schwalm, 2007), and self-injurious SM are being excluded from some definitions of repetitive behavior (Leekam et al., 2007). These changes may not be helpful in terms of understanding which characteristics differentiate persons with different developmental disorders, and what processes are responsible for those differences.

The first problem is that because “restricted repetive and stereotyped patterns of behavior, interests, and activities” is one of the criteria for diagnosing autism (American Psychiatric Association, 2000), whether or not self-injurious behavior is regarded as a form of SM affects how autism is diagnosed (self-injurious SM are currently listed among the associated features of autism, not as examples of stereotyped behavior), and how self-injurious behavior is construed among persons with autism. Because of how autism is defined, there would be a presumption that the processes responsible for self-injurious behavior are also responsible for the other ways in which this criterion can be met or in which the specific impairment is manifest, namely, stereotyped and restricted patterns of interest, inflexibility in adhering to schedules and routines, and a preoccupation with parts of objects. If self-injurious behavior is a form of SM, then it is not only behavior that is challenging, but behavior which, when accompanied by other defining symptoms of autism, is essentially autistic-like.

The second problem is that self-injurious and other SM are not specific to autism but are common among young typically developing children (Leekam et al.) and children with other disabilities. Even if self-injurious and other SM are a symptom of the impairment responsible for autism, they also reflect normal developmental processes and other impairments. This means that unless there is some measurable difference between the self-injurious and other SM of persons with and without autism, there is little point in including SM of any kind in the criteria set for the diagnosis of autism. To date, there is little evidence of such a measurable distinction between autism and related conditions like Asperger’s Disorder (South, Ozonoff & McMahon, 2005) or intellectual disabilities (Bodfish, Symons, Parker & Lewis, 2000; Matson et al., 1996; Reese, Richman, Belmont

& Morse, 2005), only with unrelated conditions like Obsessive Compulsive Disorder where the focus was on non-stereotyped forms of behavior (Zandt, Prior & Kyrios, 2007).

In raising this specificity issue, we are not suggesting that there is no distinction between the self-injurious and other SM characteristic of autism versus other conditions, only that there is little evidence of such a distinction. Research on sensory disorders suggests that different forms of impairment may result in some distinctive SM. For example, eye-poking and pressuring the eyeball appear to be relatively specific to children with a vision impairment, and especially to those with an intact optical nerve but a damaged cornea (Troster et al.). Other SM, although not specific to vision impairment, do appear to be related to a specific cause of vision impairment when a child is vision-impaired. Rocking, for example, appears to be strongly associated with retinopathy of prematurity (Jan, Freeman & Scott, 1977; McHugh & Pyfer, 1999; McHugh & Lieberman, 2003).

The third problem is that if there are differences in self-injurious and other SM as a function of which disorder or impairment a person has, then assessment tools designed for use and validated with one population may not be valid, or may be less valid, when used with another population. For example, if behaviors like staring and eye poking are quite specific to people who are visually impaired, then inclusion of items related to these behaviors may be essential for assessing the severity of self-injurious and other SM in this population while being largely irrelevant to such assessments in other populations. With other groups, these items would be essentially unrelated to the other behavior being sampled (low inter-item and item-total correlations) and would serve to introduce error (unreliability) to the assessment tool.

Our aims in this study were to assess whether there are distinctive patterns of self-injurious and other SM among persons with autism and other disorders and, within each sample, to assess whether relationships between self-injurious SM and other SM are consistent with self-injurious behavior being regarded as part of the same class of behavior as other SM. If repetitive and stereotyped patterns of behavior are essentially autistic-like, then we could expect that the SM of persons with autism would differ from persons with other disorders not only by being more frequent or severe (which could be expected to result from applying diagnostic criteria), but by covarying in ways that are distinctive and would lead to different sets of SM being sampled to assess the severity of SM in an autism than a non-autism group. If SM constitute a distinct construct in the context of autism, then it will have different components and / or different relations between components among persons with autism than among persons with other disorders. Across samples, if self-injurious SM differ from other SM only in degree, we expect that self-injurious behavior items will be internally consistent with other SM items and that they will be evident only in children who perform other SM. We also expect that between-group differences in the prevalence of self-injurious behavior will parallel group differences in the prevalence of other SM.

Method

Participants and Procedure

Participants were recruited after this project had been approved by the Human Research Ethics Committee of Curtin University of Technology. Participants were 221 children (129 boys, 92 girls) aged 6 to 13 years (mean= 9.40, SD=1.81) comprising five groups: typical children (n=30, boys=14, mean age=8.75, SD=1.64), children with

intellectual disabilities (n=29, boys=17, mean age=10.35, SD= 2.02), children with visual impairments (n=50, boys=25, mean age=9.02, SD=1.59), children with hearing impairments (n=51, boys=31, mean age=9.29, SD=1.73), and children with autism (n=56, boys=42, mean age=9.71, SD=1.86). All participants were living with their families and were attending school, either a state school, segregated school or a semi-inclusive school in the Haifa metropolitan region of northern Israel. Children with a developmental or sensory disorder had been diagnosed by a physician or a psychologist from medical developmental services.

Typical children were a convenience sample of second to fourth graders recruited from a state school. Children with an intellectual disability had been diagnosed by psychological services according to DSM-IV criteria and all had a measured IQ less than 70. The educational system had also declared them as having a mild or moderate intellectual disability and as being in need of special education. These participants were recruited from 3 special education segregated schools, i.e., schools that only educated children with an intellectual disability.

Children with visual impairments included included two subgroups: those who had typical intelligence (IQ>69; n=25) and those who were also intellectually disabled (IQ<70; n=25). All of these children had been defined by medical services as legally blind / suffering from vision loss and, as a result, were eligible for special educational support. They were recruited from special school classes designed for them. Children with hearing impairments included the same subgroups: those who had typical intelligence (IQ>69; n=34) and those who were intellectually disabled (IQ<70; n=22). All of these children had been defined by medical services as requiring hearing aids and as

eligible for special educational support. They were recruited from special school classes designed for them.

Children with autism were diagnosed based on DSM-IV criteria and / or by the Childhood Autism Rating Scale (CARS; Schopler, Reichler & Rochen Renner, 1998). Half (n=28) of these child had typical intelligence, and half were intellectually disabled. All of these children were defined by psychological services as eligible for special education in a school for children with autism spectrum disorders and were recruited from two such special education schools.

For all samples, children were excluded if they had been diagnosed with other syndromes strongly associated with specific repetitive movements, including Lech Nyhan Syndrome, Cornelia de Lange Syndrome, Rilez Day Familial Dysautonomia, Fragile X Syndrome and Rett Syndrome. These syndromes are associated with an abnormal metabolism and / or a specific x-linked gene, and have known sensory abnormalities which differentiate them from other populations with intellectual disabilities. Children with tardive dyskinesia were excluded as well. In addition, the intellectual disability group did not include children with a diagnosed sensory loss or impairment.

Statistical tests indicate that groups differed in age [$F(4, 216)=4.14$, $p=.003$] and sex [χ^2 $(4)=9.71$, $p=.045$]. Post hoc tests indicated that children in the typical group were younger than those in the intellectually disabled and autism groups, children in the intellectually disabled and autism groups were older than those in the visual and hearing impairment groups. Girls were overrepresented in the intellectual disability group and boys were overrepresented in the autism group; the latter result is consistent with sex differences in the prevalence of autism.

We used the Stereotyped and Self-Injurious Movement Interview (Gal, Dyck & Passmore, 2002) to assess stereotyped body movements, stereotyped manipulation of objects, and stereotyped self-injurious behavior. This interview is an adaptation of Turner's Repetitive Behavior Interview (Turner, 1999b) and includes 15 SM items from the original interview and 10 additional items assessing self-injurious SM. For each item, at least 4 scores are generated. The first measures how many different SM a child performs, the second measures the frequency with which each form of SM is performed (once or twice per week to 30 or more times per week), the third measures the duration of each performance (less than 60 seconds to more than 30 minutes) and the fourth measures the intensity with which SM are performed (2 or 3 movements per 10 seconds to 10 or more movements per 10 seconds). For self-injurious SM, 2 additional scores are generated: how much effort is involved in the activity (minimal to maximal) and how damaging is the behavior (no damage to life-threatening). The interview (among other measures) was administered face-to-face to the participants' teachers by the first author in their home schools. Interviews lasted approximately 60 minutes per child, of which 30 minutes was devoted to assessing SM.

Results

Relationships Between Scoring Methods

We began our analyses by assessing the extent to which the different scoring procedures produce non-redundant information by calculating Pearson correlations between the different scores. The results indicated that the correlations are so strong that the different scoring systems are essentially interchangeable. For stereotyped body movement items, correlations between scoring procedures ranged from $r = .88$ (between

prevalance and duration scores) to r = .95 (between prevalence and repetitiveness scores). For stereotyped manipulation of objects, the range of correlations was from .90 to .95, and for stereotyped self-injurious movements, was from .76 to .95. Children who perform a larger variety of SM also perform more repetitions of the SM, over a longer time period, and on more occasions. Children who perform a larger number of self-injurious SM show the same pattern, and also perform their SM with greater effort which causes more damage. Because the different scoring systems are redundant, except where noted, we report results only for the frequency/repetitiveness with which different SM are performed.

Are self-injurious SM more severe SM?

To assess whether self-injurious behavior represents the more severe end of the SM construct, we assessed the likelihood of observing any self-injurious behavior in the absence of other SM (and vice versa) on the assumption that more severe stereotyped movements will not be evident in the absence of less severe movements. Cross-tabulation of responses indicated that among the 90 persons who performed at least 1 self-injurious behavior, in only 3 cases (1 in the typical sample, 2 in the hearing impaired sample) was it performed in the absence of other SM. Conversely, of the 170 persons who performed at least 1 other SM, it was performed in the absence of self-injurious behavior in 83 cases. With few exceptions, the performance of self-injurious behavior is contingent on the performance of other SM.

Consistency of Relationships Across Samples

Self-injurious and other SM are evident in all samples, but the prevalence of these movements varies markedly across samples. This variation is to be expected because the

samples also differ markedly in the known and hypothesized impairments that distinguish children with a disorder from typical children. However, if self-injurious and other SM are of the same form, it would be expected that how one form of SM varied across samples would be paralleled by how the other forms of SM varied across samples. We tested this hypothesis by ranking samples in terms of the prevalence of self-injurious and other SM. From most to least common, the proportion of children in each sample showing other SM was 98.2% (autism), 86.0% (vision impaired), 79.3% (intellectually disabled), 67.9% (hearing impaired), and 36.7% (typical). For self-injurious SM, the order was identical: 64.3% (autism), 52.0% (vision impaired), 31.0% (intellectually disabled), 30.0% (hearing impaired), and 6.7% (typical).

Internal consistency of items across samples

We next assessed whether the internal consistency of items was itself consistent across samples, that is, whether all of the items were sampling the same construct in each group (excluding typical children, where there was 0 variance for 19 items). The results, reported in Table 1, indicate that this set of items is not consistent in any sample and that as many as 17 of the 25 items (in the case of the intellectually disabled group) have near 0 or negative correlations with the total score. The results also show that there is no consistency across samples in terms of which items are positively correlated with the total score; there are only 2 items, those assessing manipulation of objects and rhythmic rocking, where there are non-trivial positive correlations with the total score in all groups. However, in each sample, those items that have positive correlations with the total score include both self-injurious and other SM.

Although the internal consistency of a scale typically increases as the number of items increases, in each of our samples, the reliability of measurement of SM would be enhanced by removing items that have trivial (<.20) or negative correlations with the total score in that sample. Table 2 shows that sample-specific item sets result in a higher alpha coefficient for that sample than is obtained using the complete item set, but that when this sample-specific item set is used with any other sample, there is usually a large reduction in the reliability of measurement.

Group differences in SM performance patterns

We used analyses of variance to assess between group differences in SM. The results, shown in Table 3, indicate that groups differed significantly on 19 of 25 SM, and differences were least likely to be observed on items assessing self-injurious SM (5 of 10). Post hoc comparisons using the Bonferroni method to control for inflation of error rates indicated that the autism group showed more of 15 SM than at least 1 other group and more of 8 SM (including 3 self-injurious SM) than all other groups. The visually impaired group showed more of 5 SM than at least 1 other group, and 2 SM (including 1 self-injurious SM) more than all other groups. The hearing impaired group showed more of 1 SM than 2 other groups. No other between-group differences were observed.

Discrimination of Groups

Groups differ from each other in both the frequency with which they perform SM and in the patterns of covariation among different SM. Both of these characteristics suggest that it may be possible to discriminate group membership on the basis of SM. We conducted a discriminant function analysis (excluding typical children) to test this possibility. The results indicated that the first 3 functions were significant [χ^2 (75) =

248.79, $p < .001$] and correctly classified 66% of participants in the 4 groups (see Table 4). Children in the intellectually disabled group were most likely to be misclassified (75%), in all but one case as hearing impaired, but misclassifications were also common in the vision impaired (38%) and autism (28%) groups. However, it was most uncommon for children with non-autism disorders to be misclassified as having autism: only 1 intellectually disabled and 1 hearing impaired child were so misclassified. It was also uncommon for children with other disorders to be misclassified as vision impaired; only 2 children with autism and 3 hearing impaired children were so misclassified.

Discussion

Our aims were to assess whether there are distinctive patterns of self-injurious and other SM among persons with autism and other disorders in which SM are common and, within each sample, to assess whether relationships between self-injurious SM and other SM are consistent with self-injurious behavior being regarded as part of the same class of behavior as other SM. The answer to both questions appears to be yes.

Self-Injurious and Other Stereotyped Movements

Our results suggest that self-injurious behavior, when it is marked by repetition, rigidity, invariance, and inappropriate continuation, should be regarded as more severe SM, not as a form of behavior that differs in kind from other SM. Self-injurious behavior is rarely observed in the absence of other SM. Like other SM, self-injurious SM are observed in a greater proportion of children with autism than in other groups, and when observed in children with autism, are engaged in more frequently than in other groups. In all groups, self-injurious behavior is as strongly related to other SM as other SM are related to each other. In discriminating between groups, self-injurious behavior

contributes to other SM in distinguishing autism from other groups and visual impairment from other groups. Our results provide no basis for distinguishing self-injurious from other SM except by their capacity for harm to the child who engages in the behavior.

There are 2 main implications of this conclusion. The first is that we may need to regard self-injurious behavior not only as challenging behavior that sometimes accompanies autism and other disorders, but as a form of behavior that is a defining characteristic of autism. In diagnostic practice, including self-injurious behaviors among those that would lead to a diagnosis would make little difference; because they are not observed in the absence of other SM, diagnostic criteria would be satisfied without recourse to self-injurious behavior. The second implication, to be discussed further below, arises from the first. If self-injurious SM are a specific defining characteristic of autism, then we need to understand how the specific impairments responsible for autism cause these challenging forms of behavior.

Distinctive Patterns of Stereotyped Movements

Because SM are a defining characteristic of autism, it is not surprising that the autism group performed more SM than any other group. But because the “restricted repetitive and stereotyped behavior and interests” criterion can be met by characteristics other than SM (SM need not be present), it is interesting to note than only 1 child in our autism group was not reported to perform any self-injurious or other SM. Stereotyped movements per se, not stereotyped interests or preoccupations or inflexibility, are characteristic of children with autism in a way that they characterize no other groups. Not only did the autism group perform more SM than other groups, they engaged in forms of SM that were rarely present in other groups. Arranging objects or biting one’s hands may

not be typical of persons with autism (15 and 14 of 56 cases, respectively), but they are very unlikely among other persons (1 and 3 of 155 cases). These behaviors, along with arm/hand/finger movements, mouth/tongue movements, and pacing, appear to be specific enough to autism to ensure that children in other groups are seldom misclassified as having autism on the basis of their SM.

What also distinguished autism from the other groups was the pattern of covariation across the set of SM items. Simply, more items had stronger relationships with other items and the total score of our interview than was the case in any other group: SM constitute a broader and more coherent construct when applied to individuals with autism than when applied to other groups. In part, this result can be construed as an artifact of the greater frequency of most forms of SM in the autism group: more observations results in more reliable estimates of correlations and other statistics. But it also reflects the fact that in persons with autism, SM are not isolated behaviors but exist as part of a syndrome, an interrelated set of behaviors.

There was also some evidence of a distinct pattern of SM for the visually impaired group. This group had the second greatest prevalence of SM and, consistent with previous research, was distinguished from other groups by the greater frequency of eye movements and eye gouging (Troster et al., 1991) and, to a lesser extent, by rocking (Jan et al., 1977; McHugh & Pyfer, 1999; McHugh & Lieberman, 2003), which were sufficiently distinctive to ensure that children in other groups were seldom misclassified as visually impaired on the basis of their SM. Otherwise, the tendency of hearing impaired children to make repetitive noises, words, or sounds was not sufficiently distinctive to prevent other children being misclassified as hearing impaired, and there

were no SM that were particular to the intellectually disabled, a group that did not differ from typical or hearing impaired children in the frequency of any form of SM.

These results provide clear support for continuing to construe SM as a defining characteristic of autism, but raise questions about how they are used in the criteria set. The first issue is whether SM ought to be a separate criterion or continue to be one of several ways in which the current criterion can be satisfied. Recent research on repetitive behavior in young typical children has shown that the alternatives are largely independent of each other; when an oblique rotation of factors in an analysis of the Repetitive Behavior Questionnaire-2 was performed, the rotated factors were found to be minimally correlated with each other and, between them, accounted for barely half of the scale's variance (Leekam et al., 2007). Given our finding that SM are observed in virtually all cases of autism, the other criteria may be unnecessary. The second issue concerns which SM ought to be observed for the diagnosis to be made: if only a small subset of SM facilitate a distinction from other disorders, perhaps only these should be regarded as symptomatic of autism. In our data, if we take the six SM with the highest positive loadings on the first discriminant function (manipulate objects, arrange objects, pace, arm/hand/finger, mouth/tongue, biting self), we find that at least one of these SM was performed by 52 of 56 members of our autism sample. The third issue, introduced earlier, is whether self-injurious behavior should be included among the the set of SM used to diagnose autism. It is worth noting that biting oneself was the behavior that best facilitated a discrimination between the autism and other groups.

To the extent that autism, visual impairment, and possibly hearing impairment each have disorder-specific SM, it becomes important to understand how the underlying

impairments responsible for the disorder have resulted in those specific SM. Arguably, the eye gouging (Fazzi et al., 1999), eye movements and even the rocking (Gosch, Brambring, Gennat, & Rohlmann, 1997; O'Donnell & Livingston, 1991; Troster & Brambring, 1993) of the visually impaired are an attempt to increase sensory stimulation where it is lacking, just as the repetitive noise/words/sounds of the hearing impaired may be. In these cases, the *choice* of SM is at least superficially congruent with the impairment. Why children with autism are more likely to choose the particular forms of SM that they choose and to eschew others is something that needs to receive greater attention in future research.

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Table 1

Item – total score correlations by sample

	ID (α=.68)	AD (α=.68)	VI (α=.54)	HI (α=.70)
1. Manipulate Objects	**.70**	**.28**	**.27**	**.56**
2. Operate Switches, etc.	**.55**	.16	**.30**	.07
3. Arrange Objects	-.13	.14	.00	.00
4. Mouth or Suck Objects	**.24**	**.49**	.03	.09
5. Stare Closely	**.87**	**.37**	-.08	**.44**
6. Pace, Move Repetitively	-.13	**.27**	**.32**	.19
7. Spin Self	**.53**	.12	**.37**	**.33**
8. Rock Rhythmically	**.62**	.15	.19	**.51**
9. Touch Body / Clothing	-.01	**.33**	**.23**	**.27**
10. Arm / Hand / Finger	**.39**	**.34**	.02	**.48**
11. Feet / Legs	.06	.14	**.43**	**.47**
12. Noises / Words / Sounds	-.02	**.36**	.19	**.38**
13. Head / Neck	-.06	**.40**	.15	**.37**
14. Eye	-.12	.19	.16	**.21**
15. Mouth / Tongue	-.06	-.01	.17	**.59**
20. Bang Head	.00	**.22**	.16	-.07
21. Bite Hands, etc.	-.07	.05	.11	.02
22. Hit Head, etc.	**.55**	**.21**	.18	-.10
23. Pull Hair	.00	**.42**	**.32**	-.02

24. Gouge Eyes	.00	.01	**.31**	.00
25. Pinch	-.03	**.28**	**.26**	.00
26. Fall / Throw Self	**.49**	**.30**	.03	**.31**
27. Pick / Scratch Body Cavities	-.02	**.31**	.16	**.21**
28. Scratch Self	**.49**	**.22**	.02	.18
29. Pick Wounds	**.78**	.17	-.00	**.21**

Abbreviations: ID = Intellectual Disability; AD = Autistic Disorder; VI = Vision Impaired; HI = Hearing Impaired

Table 2

The reliability (coefficient alpha) of sample specific scales, by sample

Group Scale	Items	ID	AD	VI	HI
ID	1 2 4 5 7 8 10 22 26 28 29	**.84**	.60	.30	.59
AD	1 4 5 6 9 10 12 13 20 22 23 25 26 27 28	.58	**.70**	.33	.51
VI	1 2 6 7 9 11 23 24 25	.31	.40	**.58**	.39
HI	1 5 7 8 9 10 11 12 13 14 15 26 27 29	.64	.60	.41	**.74**

Abbreviations: ID = Intellectual Disability; AD = Autistic Disorder; VI = Vision Impaired; HI = Hearing Impaired

Table 3

Descriptive statistics (mean and standard deviation) for each form of SM, by sample

	TC		ID		AD		VI		HI		*F*, *p*	Post hoc tests (Bonferroni
	M	SD	M	SD	M	SD	M	SD	M	SD		
1. Manipulate Objects	.00		.52	1.18	2.20	1.95	1.48	1.66	.54	1.17	16.17, <.001	AD>TC, ID, HI; VI>TC, H
2. Operate Switches, etc.	.00		.07	.37	.63	1.13	.34	.84	.07	.32	5.98, <.001	AD>TC, ID, HI
3. Arrange Objects	.00		.03	.18	**.36**	.86	.00		.00		6.69, <.001	AD>TC, VI, VI, HI
4. Mouth or Suck Objects	.67	1.39	.55	1.35	1.36	1.86	.60	1.24	.46	1.02	3.45, =.009	AD>HI
5. Stare Closely	.00		.24	.91	1.21	1.74	.66	1.34	.13	.57	8.52, <.001	AD>TC, ID, HI
6. Pace, Move Repetitively	.00		.07	.37	**1.52**	1.77	.24	.98	.20	.77	16.64, <.001	AD>TC, ID, VI, HI
7. Spin Self	.03	.18	.10	.55	.25	.64	.12	.59	.27	.79	1.08, *ns*	
8. Rock Rhythmically	.00		.28	.70	.98	1.50	1.06	1.59	.34	.97	6.21, <.001	AD>TC; VI>TC, HI
9. Touch Body / Clothing	.17	.64	.38	1.08	1.25	1.88	.42	1.09	.16	.70	6.95, <.001	AD>TC, VI, VI, HI
10. Arm / Hand / Finger	.00		.31	1.07	**2.09**	2.01	.16	.79	.11	.59	28.42, <.001	AD>TC, ID, VI, HI
11. Feet / Legs	.30	.83	.17	.75	1.29	1.68	1.32	1.80	.91	1.45	4.99, =.001	AD>TC, ID; VI>TC, ID

12. Noises / Words / Sounds	.00		.31	.85	2.43	1.81	.74	1.33	1.54	1.85	18.86, <.001	AD>TC, ID, VI, HI; HI>T
13. Head / Neck	.00		.07	.37	.57	1.21	.54	1.28	.11	.41	4.10, =.003	
14. Eye Movements	.00		.10	.40	.55	1.22	1.92	2.38	.14	.61	16.29, <.001	VI>TC, AD, ID, HI
15. Mouth / Tongue	.00		.07	.37	.84	1.60	.04	.28	.13	.57	8.16, <.001	AD>TC, ID, VI, HI
20. Bang Head	.03	.18	.00		.13	.33	.08	.34	.05	.29	1.13, *ns*	
21. Bite Hands, etc.	.00		.03	.18	**.63**	1.25	.04	.28	.02	.13	8.78, <.001	AD>TC, ID, VI, HI
22. Hit Head, etc.	.00		.07	.37	.66	1.11	.14	.45	.11	.49	7.87, <.001	AD>TC, ID, VI, HI
23. Pull Hair	.10	.54	.00		.13	.50	.06	.31	.04	.18	0.74, *ns*	
24. Gouge Eyes	.00		.00		.05	.40	.38	1.04	.00		4.47, =.002	VI>TC, AD, ID, HI
25. Pinch	.00		.03	.18	.18	.81	.06	.31	.00		1.43, *ns*	
26. Fall / Throw Self	.00		.24	.83	.30	.76	.12	.32	.20	.48	1.65, *ns*	
27. Pick / Scratch Body Cavities	.00		.24	.91	.32	1.04	.24	.71	.11	.49	1.16, *ns*	
28. Scratch Self	.00		.07	.25	.25	.72	.02	.14	.05	.29	2.99, =.02	
29. Pick Wounds	.00		.17	.46	.41	.93	.06	.24	.07	.26	4.69, =.001	AD>TC, VI, HI

Abbreviations: TC = Typical Children; ID = Intellectual Disability; AD = Autistic Disorder; VI = Vision Impaired; HI = Hearing Impaired

Table 4

Standardized Discriminant Function Coefficients

	Function 1	Function 2	Function 3
1. Manipulate Objects	**.240**	**.335**	-.145
2. Operate Switches, etc.	.089	-.006	-.025
3. Arrange Objects	**.334**	.061	.166
4. Mouth or Suck Objects	-.072	-.006	-.113
5. Stare Closely	-.113	**.248**	.187
6. Pace, Move Repetitively	**.408**	.140	-.071
7. Spin Self	-.170	**-.257**	**.268**
8. Rock Rhythmically	-.044	**.213**	-.056
9. Touch Body / Clothing	.175	.118	**-.442**
10. Arm / Hand / Finger	**.414**	-.149	**-.215**
11. Feet / Legs	-.029	-.012	**.502**
12. Noises / Words / Sounds	**.224**	-.181	**.742**
13. Head / Neck	.075	-.038	.110
14. Eye Movements	**-.200**	**.740**	.115
15. Mouth / Tongue	**.390**	-.086	.145
20. Bang Head	-.059	.024	**.215**
21. Bite Hands, etc.	**.466**	-.075	.015
22. Hit Head, etc.	.198	.103	-.135
23. Pull Hair	-.025	**-.207**	**.235**

24. Gouge Eyes	-.162	**.399**	-.112
25. Pinch	-.138	.083	.011
26. Fall / Throw Self	-.003	-.092	**-.259**
27. Pick / Scratch Body Cavities	-.024	.023	**-.220**
28. Scratch Self	-.033	.146	-.087
29. Pick Wounds	-.014	-.049	**-.330**

Function at Group Centroid

Group	Function 1	Function 2	Function 3
ID	-.724	-.535	-.776
AD	1.840	.093	-.008
VI	-.919	1.027	.055
HI	-.644	-.733	.361

Classification Results

	Predicted			
Observed	ID	AD	VI	HI
ID	**7**	1	0	21
AD	2	**40**	2	12
VI	4	0	**31**	15
HI	4	1	3	**48**

Abbreviations: ID = Intellectual Disability; AD = Autistic Disorder; VI = Vision Impaired; HI = Hearing Impaired