

Adaptive Behavior in Autism and Pervasive Developmental Disorder-Not Otherwise Specified: Microanalysis of Scores on the Vineland Adaptive Behavior Scales

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The purpose of this study is to provide a microanalysis of differences in adaptive functioning seen between well-matched groups of school-aged children with autism and those diagnosed as having Pervasive Developmental Disorder-Not Otherwise Specified, all of whom functioned in the mild to moderate range of intellectual impairment. Findings indicate that the major area of difference between children with autism and those with Pervasive Developmental Disorder-Not Otherwise Specified, was expressive communication; specifically, the use of elaborations in syntax and morphology and in pragmatic use of language to convey and to seek information in discourse. Linear discriminant function analysis revealed that scores on just three of these expressive communication item sets correctly identified subjects in the two diagnostic categories with 80% overall accuracy. Implications of these findings for both diagnosis and intervention with children with Autism Spectrum Disorders will be discussed.

KEY WORDS: Autism; Pervasive Developmental Disorders; adaptive behavior; communication; expressive language; socialization.

Ever since the initial delineation of the autistic syndrome (Kanner, 1943), children have been recognized who demonstrate social and communicative disabilities but who—because of late onset, atypical presentation, or subthreshold symptoms—do not fully meet diagnostic criteria for autism. *Diagnostic and Statistical Manual of Mental Diseases Fourth Edition* (DSM-IV; American Psychiatric Association [APA], 1994) specifies a condition referred to as Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) to cover such conditions. Specific diagnostic criteria, which have been validated by a large-scale field trial (Volkmar *et al.*, 1994), are provided in the DSM-IV of

the American Psychiatric Association (1994) for the diagnosis of autism. The diagnosis of PDD-NOS, however, is much less specified; DSM-IV criteria merely state that, “a severe and pervasive impairment in the development of social interaction associated with impairment in either verbal or nonverbal communication skills or . . . stereotyped behaviors, interests and activities” (APA, 1994, p. 84) are present, and that the diagnostic criteria for autism, schizophrenia, schizotypal personality, or avoidant personality are not met. Although the diagnosis of autism is made with a good deal of guidance from the literature, with a wide range of carefully studied instruments (Volkmar & Lord, 1998), conferring a diagnosis of PDD-NOS forces clinicians to rely primarily on subjective judgment as to whether the social and communicative deficits observed rise to the explicitly defined level of the diagnostic category. In addition, it is as yet unclear whether the distinction between autism and PDD-NOS has any implications for treatment of children with these disorders. This

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study will examine specific aspects of adaptive behavior in these two subject groups to find out whether any of these behaviors help to differentiate these diagnoses.

Although cognitive level is a significant predictor of outcome in autism, as it is in other conditions (DeMyer, Hingtgen, & Jackson, 1981; Prior & Ozonoff, 1998), adaptive skills are another aspect of development that contributes strongly to prognosis (Gillham, Carter, Volkmar, & Sparrow, 2000). Adaptive skills are those involved with using whatever capacities the individual possesses to function within the everyday environment. These skills are particularly important in individuals with autism and related conditions because it is these, rather than cognitive level, that contribute most to the individual's ability to function successfully and independently in the world (Liss *et al.*, 2001). Literature attesting to the adaptive deficits in autism dates back at least to Volkmar *et al.* (1987). Several later studies confirmed that the *Vineland Adaptive Behavior Scales* (Sparrow, Balla, & Cicchetti, 1984), a well-standardized, semistructured caregiver report instrument for assessing adaptive behavior, could be used to document delays in adaptive development in individuals with autism (Carter *et al.*, 1998; Liss *et al.*, 2001; Loveland & Kelley, 1991; Rodrigue, Morgan, & Gefken, 1991; Schatz & Hamdan-Allen, 1995). Gillham, Carter, Volkmar, and Sparrow (2000) reported that autism could be differentiated from both PDD-NOS and nonautistic developmental disorder (DD) by means of scores on the Socialization and Daily Living scales of the *Vineland Adaptive Behavior Scales* (Sparrow *et al.*, 1984). These authors suggested that the broad domains of the *Vineland* employed in their study might miss subtle differences between performance in autism and PDD-NOS. Looking more closely at the specific items that make up the scales on the *Vineland* might yield a better ability to discriminate PDD-NOS from autism in several areas of adaptive skills. The purpose of this study is to provide a microanalysis of differences in adaptive functioning seen between well-matched groups of school-aged children with autism and those diagnosed as having PDD-NOS.

METHOD

Subjects

The sample comprised 40 subjects between the ages of 4 and 11 years who were assessed at a university-based clinic that specializes in diagnosis and

assessment of children with PDD. Children received a comprehensive evaluation, which included administration of the survey form of the *Vineland*, tests of communicative ability, a psychiatric examination, and a test of intellectual functioning.

Subjects for this study had been assigned to diagnostic groups on the basis the clinical diagnoses they received following their assessment. Diagnostic characterization included the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & LeCouteur, 1994) and the Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord *et al.*, 2000). To be included in the autistic or PDD-NOS group, each subject had to meet either DSM-III-R (APA, 1987) or DSM-IV (APA, 1994) criteria for the disorders. Clinical diagnoses were confirmed independently by two experienced clinicians (A. Klin and F. Volkmar) who were blind to *Vineland* interview data and results. Interrater reliability between these clinicians for diagnostic assignment was high, with kappa values ranging from .80 to .95 in related research projects (Klin, Lang, Cicchetti, & Volkmar, 2000).

Twenty subjects were selected who had received a diagnosis of autism and whose ages and full-scale IQs (FSIQs) fell within the ranges specified at the outset of the study (ages 4–12 years; FSIQ 50–100). These subjects represented all the eligible candidates with autism in the clinical database whose *Vineland* data were available for item-level analysis. A group of 20 children who were diagnosed as having PDD-NOS was selected to match the group with autism in terms of age, IQ range, and *Vineland* data availability. Mean age in the group with autism was 6.5 years (SD: 1.8); in the group with PDD-NOS, it was 6.6 years (SD: 1.2). Mean FSIQ in the group with autism was 71.2 (SD: 13.4; range: 50–99; mean mental age based on this average IQ was 4.6). In the group with PDD-NOS, mean IQ was 76.3 (SD: 13.0; range: 56–98; mean mental age based on this average IQ was 5.0). Average age and IQ scores between the two groups were not significantly different. Eighteen of the 20 subjects in the group with PDD-NOS were male; 19 of the 20 in the group with autism were male.

Measures

The *Vineland Adaptive Behavior Scales Survey* form (Sparrow *et al.*, 1984), a nationally standardized semistructured caretaker interview instrument that assesses day-to-day adaptive functioning, was administered to primary caregivers by research assistants extensively trained in *Vineland* interview and scoring procedures. The *Vineland* consists of four domains: Communication,

Table I. Vineland Adaptive Behavior Scales Domains and Subdomains

Domains	Subdomains
Communication	Expressive: What an individual says Receptive: What an individual understands Written: What an individual reads and writes
Daily Living	Personal: How an individual eats, dresses, and practices personal hygiene Domestic: What household tasks an individual performs Community: How an individual uses time, money, the telephone, and job skills
Socialization	Interpersonal: How an individual interacts with others Play and Leisure: How an individuals plays and uses leisure time Coping: How an individual shows responsibility and sensitivity to others

Daily Living, Socialization, and Motor. For the purpose of this study, only data on the first three domains were used because the Motor domain is only administered to children below 6 years, so that data were not available for all subjects in the cohort. Each domain contains several subdomains, which are listed and described in Table I.

Within each subdomain, the Vineland is divided into sets of items that probe a particular area of development. These sets each contain two to seven individual items. Each item within the set is scored as a 0 (never), 1 (sometimes; partially), or 2 (usually), according to criteria detailed in the Vineland manual. For the comparisons used in this study, each subject's score for each set of items was derived by summing the number of points assigned for each item within the set. In addition to these set total scores, the percentage of possible points earned within each set by each individual was also computed to compare performance across sets.

The average percentage score for each subject for each set was then calculated. Age equivalents for each set were derived from the Vineland standardization data, to determine which sets could be expected to fall within the range of expected performance for these subjects.

Data Analysis

Analysis of variance was used to test for differences in raw scores between groups on each domain score (Communication, Daily Living, Socialization) and on each subdomain score (Communication-Expressive, Communication-Receptive, Communication-Written; Daily Living-Personal, Daily Living-Domestic, Daily Living-Community; Socialization-Interpersonal, Socialization-Play/Leisure, Socialization-Coping). These results appear in Tables II and III. Multivariate analysis of variance, using FSIQ as a covariate, was used to test for differences in raw scores between the autism and PDD-NOS groups on each item set. Although all statistics were performed on raw scores, data in Table III are presented as percentage scores to enable comparison across items. Linear discriminant function analysis was also performed, to examine the ability of item set scores to correctly classify individuals within the two diagnostic groups.

RESULTS

Differences between Groups

Vineland Domain and Subdomain Scores

As in previous studies (e.g., Klin, Volkmar, & Sparrow, 1992; Gillham *et al.*, 2000), univariate analysis of variance (using the SPSS computer program) in this study revealed significant differences in raw scores between the group with autism and the group with

Table II. Mean (SD) *Vineland Adaptive Behavior Scales* (Sparrow, Balla, & Cicchetti, 1984) Domain Raw Scores and Standard Scores (in italics) for Two Groups

	Age (years)	IQ	Vineland Adaptive Behavior Scales domain scores		
			Communication ^a	Socialization ^a	Daily living
Autism (n = 20)	6.5 (1.8)	71.8 (13.4)	136.9 (34.9) <i>57.8 (14.0)</i>	93.7 (22.5) <i>56.8 (9.3)</i>	131.7 (32.2) <i>50.3 (17.0)</i>
PDD-NOS (n = 20)	6.6 (1.2)	76.3 (13.0)	171.4 (33.4) <i>65.3 (13.6)</i>	113.7 (24.2) <i>60.8 (8.3)</i>	149.0 (40.5) <i>53.4 (16.8)</i>

Note: PDD-NOS, Pervasive Developmental Disorder-Not Otherwise Specified.

^aSignificant difference between groups at $p < .01$.

Table III. Percentage Scores of Subjects in Two Groups for Item Sets in Which Significant Differences Were Found

Vineland item set	Percentage score autism	Percentage score PDD-NOS	Item set age equivalent (months) ^a	Multivariate F	Difference between autism and PDD-NOS groups
Communication Domain					
Expressive Subdomain^b					
Talking in sentences	60.6	88.1	25.5	36.2	<i>p</i> < .007
Asking questions	31.2	69.6	26.0	15.6	<i>p</i> < .0001
Abstract concepts	53.8	82.5	29.3	8.4	<i>p</i> < .006
Relating experiences	15.5	49.5	31.6	10.1	<i>p</i> < .003
Using prepositions	29.0	65.0	39.2	14.1	<i>p</i> < .001
Using function words	37.0	70.5	33.6	12.6	<i>p</i> < .001
Plurals/Tenses	28.8	63.8	36.8	10.7	<i>p</i> < .002
Gives information about self	37.8	68.2	50.4	8.7	<i>p</i> < .005
Socialization Domain					
Interpersonal Subdomain^b					
Identifying others	46.3	73.8	24.5	14.4	<i>p</i> < .001
Play/Leisure Subdomain^b					
Coping Subdomain					
Manners in conversation	7.5	29.2	65.6	8.0	<i>p</i> < .008
Daily Living Domain					
Community Subdomain					
Phone use	22.5	45.0	36.3	14.9	<i>p</i> < .001

Note: PDD-NOS, Pervasive Developmental Disorder-Not Otherwise Specified.

^a Age-Equivalents derived from Vineland normative data.

^b Significant difference between groups was found on total subdomain score. **Boldface** indicates items achieved at <4.5 years (average MA of subjects in sample) in typical development, based on *Vineland* standardization sample (Sparrow, Balla, & Cicchetti, 1984).

PDD-NOS on the Vineland domains of Communication and Socialization. Significant differences ($p < .01$) were also found on the Expressive subdomain within the Communication Domain and on both the Interpersonal and Play/Leisure subdomains within the Socialization domain. No significant differences were found on the Daily Living domain, nor on any of its subdomains. These results appear in Tables II and III.

Vineland Item Set Scores

Table III presents the percentage scores for the item sets on which significant differences were found between raw scores of the two groups, using multivariate analysis of variance with FSIQ as a covariate (using the SPSS computer program multivariate analysis package). It should be noted that in all cases, scores for subjects with PDD-NOS were higher than for those with autism. Significant differences between the autism and PDD-NOS groups were seen on 64% of the item sets in Communication-Expressive, 7% of the sets in Socialization-Interpersonal, 9% of the sets in Socialization-Coping, and 20% of the sets in Daily Living-Community. No significant differences were found between any sets in the following remaining

subdomains: Communication; Receptive, Written; Socialization; Play/Leisure (although a significant difference was found on this set as a whole); and Daily Living; Personal, Domestic.

Seventy percent of the differences found were on item sets with age-equivalents below the mental age of the subjects; that is, on sets that were clearly within the expected range of achievement for these individuals.

Discriminant Function Analysis

Work by Fletcher, Rice, & Ray (1978) indicates that a minimum of five subjects per group per predictor variable is required for valid application of linear discriminant function analysis. Thus, our sample size would allow only four predictors to be entered into this analysis. Examining the significant differences between groups indicated that the Expressive Communication subdomain was the area in which the largest number of differences was found; seven item sets with age-equivalents below 4.5 showed significant differences between groups. Of these, one appeared to be a general index of multiword communication ("Talking In Sentences"), three appeared to assess grammatical ability ("Function Words," "Plurals/Tense Use," and

“Preposition Use”), two indexed pragmatic use of communication (“Asking Questions” and “Relating Experiences”), and one measured conceptual ability (“Abstract Concepts”). For the discriminant function analysis, then, the one variable from each of these four categories with the highest p value in the multiple analysis of variance was chosen to enter into the analysis. This resulted in the use of Asking Questions, Using Prepositions, Talking in Sentences, and Abstract Concepts as predictors. Using these four variables, the discriminant analysis correctly predicted group membership for 80% of children with autism and 75% of children with PDD-NOS, for an overall classification accuracy of 77.5%. Further analysis indicated that removing Abstract Concepts from the analysis resulted in improving sensitivity for the diagnosis of autism to 85%, with no change in specificity for the diagnosis of PDD-NOS. Thus, including only the Asking Questions, Using Prepositions, and Talking in Sentences item sets in the analysis was sufficient to yield 80% accuracy of classification overall. Applying criteria proposed by Cicchetti, Volkmar, Klin, and Schowalter (1995), this level of classification would be considered “good.” Additional analyses indicated that no other combination of item sets exceeded this level of classification accuracy.

DISCUSSION

This study finds a relatively small number of differences in adaptive function between children with autism and PDD-NOS, and all of these seem to reflect a deficit on the part of the children with autism in verbal expression. In the Expressive Communication subdomain, children with PDD-NOS scored higher than those with autism in areas that involve more elaborated language usage and more socially oriented criteria for success, including: using grammatical combinations of words; using function words (e.g., a, the, in, on) and grammatical markers (e.g., plurals, -ed endings); using language to communicate personal experiences and commonly known information (e.g., age, birthday); using language to impart new information, such as to communicate simple messages; using language to gain new information by asking questions; talking about objects and events removed from the “here and now”; and talking about less concrete, more conceptual topics.

These items can be construed to reside in two basic areas of language function: a) syntax/morphology and b) pragmatics. Pragmatics is an aspect of communication well known to be impaired in all ASDs, but the

present data indicate that, relative to PDD-NOS, pragmatics in autism is more severely affected. These data also indicate that syntax is an area of significant difficulty for children with autism.

Only three other significant differences were found outside the Expressive Communication subdomain; one in each of the Daily Living-Community, Socialization-Interpersonal, and Socialization-Coping subdomains. The first was the “Phone Use,” set in Daily Living-Community. This set is clearly related to skill in expressive language. The second difference, in the “Identifying Others” set on the Socialization-Interpersonal subdomain, indicates that children with autism are less likely than those with PDD-NOS to engage others through the use of their names or to name others without prompting. This, again, appears to be strongly related to their pragmatic use of expressive communication. The third difference, “Manners In Conversation,” on the Socialization-Coping subdomain, is the only difference with an age equivalent above 4.5. It is noteworthy that even this relatively sophisticated set of behaviors, which relies primarily on verbal expression, reveals significant differences between the two groups. This finding again emphasizes the primacy of the role of expressive communication in differentiating between autism and PDD-NOS in this mildly to moderately impaired sample of school-aged children.

In summary, the major differences in adaptive function found in this study are in the area of expressive communication; specifically, use of elaborations in syntax and morphology, beyond the most basic expression of sounds and words, and use of language to initiate interaction and to seek and convey information in discourse. Other areas in which differences are found seem to be the direct result of this deficit in verbal expression. Moreover, a small number of item sets that index the major deficits in expressive language correctly classify 80% of the subjects into their diagnostic groups.

IMPLICATIONS

This study indicates that children with PDD-NOS, when compared with those with autism, appear not to be more mildly impaired in all areas of adaptive function. Instead, these groups differ only in very specific areas, primarily the use of expressive language for communication—namely, the areas of syntax and pragmatics—and the areas of adaptive function on which these skills have a direct effect, such as phone use, manners in conversation, and using language to

identify and initiate interaction with others. The discriminant function analysis indicates that focus on assessing the syntactic and pragmatic expression of mildly to moderately impaired school-aged children with autistic spectrum disorders will be useful in helping to establish categorical diagnoses for individuals with these disabilities. Moreover, these findings highlight the importance of intensive intervention in the area of expressive language, particularly for children with autism, as this is an area of weakness over and above other social and adaptive deficits seen in this group. Finally, the findings indicate that although social-pragmatic skills are greatly in need of intervention in the group with autism, grammatical production should not be ignored in intervention programs for these children. Although it has been thought for some time that grammar is relatively “spared” in autistic communication (Tager-Flusberg, 1995), these results indicate that syntactic deficits do contribute to the severity of the disability in expressive communication and should be addressed as part of a comprehensive program for improving social communication in autism.

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REFERENCES

- American Psychiatric Association (1987). *Diagnostic and Statistical Manual of Mental Diseases-III-R*. Washington, DC: Author.
- American Psychiatric Association (1994). *Diagnostic and Statistical Manual of Mental Diseases*. (4th ed.). Washington, DC: Author.
- Carter, A., Volkmar, F., Sparrow, S., Wang, J., Lord, C., Dawson, G., Fombonne, E., Loveland, K., Mesibov, G., & Schopler, E. (1998). The Vineland Adaptive Behavior Scales: Supplementary norms for individuals with autism. *Journal of Autism and Developmental Disorders*, 28, 287–302.
- Cicchetti, D., Volkmar, F., Klin, A., & Schowalter, D. (1995). Diagnosing autism using ICD-10 criteria: A comparison of neural networks and standard multivariate procedures. *Child Neuropsychology*, 1, 26–37.
- DeMyer, M., Hingtgen, J., & Jackson, R. (1981). Infantile autism reviewed: A decade of research. *Schizophrenia Bulletin*, 7, 388–451.
- Fletcher, J., Rice, W., & Ray, R. (1978). Linear discriminant function analysis in neurophysiological research: Some uses and abuses. *Cortex*, 14, 564–577.
- Gillham, J., Carter, A., Volkmar, F., & Sparrow, S. (2000). Toward a developmental operational definition of autism. *Journal of Autism and Developmental Disorders*, 30, 269–278.
- Kanner, L. (1943). Autistic disorders of affective contact. *Nervous Child*, 2, 217–250.
- Klin, A., Lang, J., Cicchetti, D. V., & Volkmar, F. R. (2000). Brief Report: Interrater reliability of clinical diagnosis and DSM-IV criteria for autistic disorder: Results of the DSM-IV autism field trial. *Journal of Autism and Developmental Disorders*, 30, 163–167.
- Klin, A., Volkmar, F., & Sparrow, S. (1992). Autistic social dysfunction: Some limitations of the theory of mind hypothesis. *Journal of Child Psychology and Psychiatry*, 33, 861–876.
- Liss, M., Harel, B., Fein, D., Allen, D., Dunn, M., Feinstein, C., Morris, R., Waterhouse, L., & Rapin, I. (2001). Predictors and correlates of adaptive functioning in children with developmental disorders. *Journal of Autism and Developmental Disorders*, 31, 219–230.
- Lord, C., Risi, S., Lambrecht, L., Cook, E. H., Jr., Leventhal, B. L., DiLavore, P. C., Pickles, A., & Rutter, M. (2000). The Autism Diagnostic Observation Schedule—Generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, 30, 205–223.
- Lord, C., Rutter, M., & LeCouteur, A. (1994). Autism Diagnostic Interview—Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, 24, 659–685.
- Loveland, K., & Kelley, M. (1991). Development of adaptive behavior in preschoolers with autism or Down syndrome. *American Journal of Mental Retardation*, 96, 13–20.
- Prior, M., & Ozonoff, S. (1998). Psychological factors in autism. In F. Volkmar (Ed.), *Autism and Pervasive Developmental Disorders* (pp. 64–108). Cambridge: Cambridge University Press.
- Rodrigue, J., Morgan, S., & Gefken, G. (1991). A comparative evaluation of adaptive behavior in children and adolescents with autism Down syndrome and normal development. *Journal of Autism and Developmental Disorders*, 21, 187–198.
- Schatz, J., & Hamdan-Allen, G. (1995). Effects of age and IQ on adaptive behavior domains for children with autism. *Journal of Autism and Developmental Disorders*, 25, 51–60.
- Sparrow, S., Balla, D., & Cicchetti, D. V. (1984). *The Vineland Adaptive Behavior Scales (Survey Form)*. Circle Pines, MN: American Guidance Service.
- Tager-Flusberg, H. (1995). Dissociations in form and function in the acquisition of language in autistic children. In H. Tager-Flusberg (Ed.), *Constraints on language acquisition: Studies of atypical children* (pp. 175–194). Hillsdale, NJ: Erlbaum.
- Volkmar, F., & Lord, C. (1998). Diagnosis and definition of autism and other pervasive developmental disorders. In F. Volkmar (Ed.), *Autism and Pervasive Developmental Disorders* (pp. 1–31). Cambridge: Cambridge University Press.
- Volkmar, F., Klin, A., Siegel, B., Szatmari, P., Lord, C., Campbell, M., Freeman, B., Cicchetti, D. V., Rutter, M., Kline, W., Buitelar, J., Hattab, Y., Fombonne, E., Fuentes, J., Werry, J., Stone, W., Kerbeshian, J., Hoshino, Y., Bregman, J., Loveland, K., Szymanski, L., & Towbin, K. (1994). Field trial for autistic disorder in DSM-IV. *American Journal of Psychiatry*, 151, 1361–1367.
- Volkmar, F., Sparrow, S., Goudreau, D., Cicchetti, D., Paul, R., & Cohen, D. (1987). Social deficits in autism: An operational approach using the *Vineland Adaptive Behavior Scales*. *Journal of the American Academy of Child and Adolescent Psychiatry*, 26, 156–161.