

# **The Relation Between General Cognitive Level and Adaptive Behavior Domains in Individuals With Autism With and Without Co-Morbid Mental Retardation**

**Sven Bölte, PhD**

**Fritz Poustka, MD**

*J. W. Goethe University, Frankfurt/M., Germany*

**ABSTRACT:** This study examined the association between adaptive behavior and general cognitive level in individuals with autism or PDD-NOS with and without comorbid mental retardation. Data from the screening version of the Vineland Adaptive Scales and the Wechsler Intelligence Scales were analysed in a sample of 67 subjects. While in the higher functioning individuals (IQ > 70, n = 34) IQ and adaptive behavior level differed significantly, performances were fairly comparable in subjects showing lower cognitive functioning (IQ < 70, n = 33). Regression models revealed a higher correlation between IQ and single adaptive behavior domains in the non-mentally retarded participants, with the domain Communication reaching the highest predictive power of the single adaptive behavior areas. Findings indicate, the relationship between adaptive and cognitive function in autistic disorders is mediated by the presence of a qualitative reduction of intelligence. Methodological limitations of the study are discussed.

**KEY WORDS:** adaptive behaviour; mental retardation; intelligence; autism; PDD.

## **Introduction**

Autism is a severe, chronic neurodevelopmental disorder beginning within the first three years of life. It is characterised by striking social and communicative deficits as well as ritualised, stereotyped, bizarre behaviour patterns and interests. Mental retardation, probably present in 25–75% of affected subjects,<sup>1,2</sup> is not a defining but a highly frequent comorbid feature in autism. The assessment of cognitive abil-

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Address correspondence to Sven Bölte, PhD, Klinik für Psychiatrie und Psychotherapie des Kindes- und Jugendalters, Deutschordenstr. 50, 60528 Frankfurt/M., Germany; e-mail: Boelte@em.uni-frankfurt.de.

ities is viewed an integral part of diagnosing individuals with autistic disorders.<sup>3</sup> Apart from a psychometrically tested IQ of 70 or less, for making a diagnosis of mental retardation, ICD-10 and DSM-IV also require childhood or adolescent onset of qualitative deficits in adaptive functioning. Estimating the level of adaptive behaviour skills is therefore another important aspect when comprehensively diagnosing the autistic condition and other pervasive developmental disorders, especially for the planning of adequate therapy, education and care. Both the level of cognitive and adaptive function are considered important predictors of outcome of patients with autism. An assessment of both cognitive and adaptive skills is of particular significance in the case of autism, since intellectual capacities and daily function only weakly predict each other. In subjects with autism IQ-testing can sometimes be tricky. Hence, a better understanding of the relationship between IQ and adaptive behavior could also aid a provisional estimation of cognitive function on the basis of observable adaptive function in persons with autism, if testing is constrained.

Even though there is a growing body of literature on the issue<sup>4</sup> it is unclear how the two constructs are connected within autism. Platt et al.<sup>5</sup> reported low correlations between intelligence and adaptive behaviour measures in 99 children with mental retardation, and suggested that these constructs do embody distinct psychological entities. This is perhaps especially the case in autism. Severe maladaptive social behaviour despite an IQ within the normal range has been described.<sup>6</sup> On the other hand, Freeman et al.<sup>7</sup> found an association between WISC-R full scale IQ and the composite score of the Vineland Adaptive Behaviour Scales (VABS)<sup>8</sup> in 27 individuals with autism indicating an interdependency of the constructs. The correlation in this study reached  $r = .72$ . Schatz and Hamdan-Allen<sup>9</sup> reported increasing IQ being associated with a minor increase of adaptive skills in autism, compared to subjects with mental retardation without autism. In addition, their results indicate a stability of differences between the groups regarding the structure of adaptive behavior from childhood to adolescence. Finally, a more recent investigation by Freeman et al.<sup>10</sup> on a large sample of 210 subjects with autism using data of the VABS even showed that an improvement in all adaptive skills is possibly the "natural course" of the disorder. Furthermore, the study states that the non-verbal IQ is valuable for predicting the outcome of Communication and Daily Living skills, but not for Social Interaction.

In summary, the existing data on the relationship between intellectual and adaptive behavior patterns in autistic disorders remains con-

troversial. The objective of the current study was to investigate, whether the association between adaptive and intellectual abilities in autism varies depending on the presence and absence of comorbid mental retardation.

## Method

All  $n = 67$  participants were recruited through an ongoing international project on the molecular-genetic of autism ([www.well.ox.ac.uk/maestrin/iat.html](http://www.well.ox.ac.uk/maestrin/iat.html)). The sample consisted of  $n = 33$  subjects with mental retardation ( $IQ < 70$ ) and  $n = 34$  individuals outside the mentally retarded spectrum ( $IQ \geq 70$ ), 53 of whom received a diagnosis of autistic disorder (AD) (DSM-IV/ICD-10) and 14 of pervasive developmental disorder not otherwise specified (PDD-NOS). Clinical diagnosis were corroborated by conducting the German versions of the Autism Diagnostic Interview-Revised (ADI-R)<sup>11,12</sup> and the Autism Diagnostic Observation Schedule.<sup>13</sup> In the subgroup of subjects with an  $IQ < 70$ , 27 probands displayed AD and 6 PDD-NOS. This sample consisted of 10 female and 23 male subjects with a mean  $IQ$  of 53.4 (35–66;  $SD = 8.5$ ) and a mean age of 16.2 years (8.4–49.4;  $SD = 8.9$ ). The group of probands outside the mentally retarded range included 26 subjects with AD and 8 with PDD-NOS. 6 were of female and 28 of male gender. The mean  $IQ$  was 93.2 (71–130;  $SD = 15.6$ ) and the mean age was 14.4 years (8.4–49.4;  $SD = 8.9$ ). The sample characteristics are summarised in Table 1.

**Table 1**  
Sample Characteristics

	<i>Higher Functioning Sample (<math>IQ \geq 70</math>) (<math>n = 34</math>)</i>	<i>Low Functioning Sample (<math>IQ &lt; 70</math>) (<math>n = 33</math>)</i>
AD <sup>1</sup> /PDD-NOS <sup>2</sup>	26/8	27/6
Sex (f/m)	6/28	10/23
Age (mean/SD)	14.4 (8.9)	16.2 (8.9)
IQ <sup>3</sup>	93.2 (15.6)	53.4 (8.5)
Vineland ABS <sup>4</sup> (mean, SD)		
ABC <sup>5</sup>	63.5 (20.6)	50.6 (10.5)
Social Interaction	61.8 (16.6)	53.1 (18.6)
Communication	65.8 (25.2)	55.4 (26.7)
Daily Living	72.1 (27.1)	59.8 (25.7)

<sup>1</sup>Autistic Disorder.

<sup>2</sup>Pervasive Developmental Disorder Not Otherwise Specified.

<sup>3</sup>Full-Scale  $IQ$  of the Wechsler Intelligence Scales for Children or Adults.

<sup>4</sup>Vineland Adaptive Behavior Scales Screening Version.

<sup>5</sup>Adaptive Behavior Composite-Score.

Individuals were tested using the German versions of the Wechsler Intelligence Scale for Children (WISC-R)<sup>14</sup> or Adults (WAIS-R)<sup>15</sup> for general intelligence and the German adaptations of the VABS-screening.<sup>16</sup> The WISC-R or WAIS-R are the most regularly used IQ-scales in contemporary child and adolescent psychiatry in Germany<sup>17</sup> and probably worldwide in clinical settings. The VABS is a widespread, semi-structured interview to register current behaviour in psychiatric or otherwise impaired patients regarding four domains: motor skills (in children below 6 years of age), socialisation, communication and daily-living skills. A selection of 60 items (15 for each domain) of the entire Vineland survey form of 261 items is included. It is conducted with parents or caregivers familiar with the behavior of the individual subject. The interview provides an insight into the impact of a mental disorder on everyday life. Good psychometric properties have been reported for the instrument by the authors of the VABS and others.<sup>18</sup> A overall cross-cultural validity<sup>19</sup> has been reported. Together with a useful discussion on the usage and interpretation in autistic patients, Carter et al.<sup>20</sup> calculated autism-specific norms for the VABS. At all cognitive levels, subjects with autism tend to score low in the domain of socialisation, whereas relative strengths are found in Daily Living and in-between-values for Communication.<sup>21</sup> Besides this typical domain profile primarily taping social deficits it seems likely that people with autism exhibited a higher intradomain variation than children with mental handicap without autism and unaffected children.<sup>22</sup> There are four age-related VABS-screeners derived from the complete instrument: 0 to 2; 11 years, 3 to 5; 11 years, 6 to 12; 11 years and 13 to 18; 11 years of age. Technical data supplied by the authors of the VABS indicate a high convergence of the screeners and the full Vineland with correlations between  $r = .87$  and  $r = .98$  when the total raw score is used as criteria. Interrater-reliability including two raters judging 12 individuals was  $r = .98$ . Items are coded on a 0 (absence of activity) to 2 (definite presence of the activity) scale. Values are summed to domain scores. Raw scores collected with the screeners can be converted to equated raw scores that serve for the determination of normative values. Standard scores are available for each behaviour domain. Moreover, a normative adaptive behaviour composite score (adaptive behaviour composite, ABC) expressing the global adaptive functioning derived from the results of the subscales can be generated.

For the purpose of finding out how general intelligence and adaptive behavior are related in autism, we compared the performances on the WISC-R/WAIS-R (full scale IQ) and the VABS-screening (ABC). Both parameters (IQ-norms and standard scores) share the same distributional characteristics (mean = 100, SD = 15) and are adjusted for effects age and gender. Because we compared within-subject data inference statistics for dependent measures were applied. T-tests for paired samples were computed separately for the groups of subjects with (IQ < 70) and without (IQ ≥ 70) mental retardation. In addition to these comparisons we carried out linear multiple regression analysis models to explore the predictive power of the three VABS adaptive behavior domains (Socialisation, Communication, Daily living) regarding the Wechsler IQ in each of the samples. All statistics were calculated with SPSS/Windows 10.0.7.

## Results

The VABS composite standard score in the low functioning AD/PDD-NOS subsample ranged between 36 and 72 with a mean of 50.6 (SD = 10.5). Mean domain scores were 53.1 (SD = 18.6) for Socialisation, 55.4 (SD = 26.7) for Communication and 59.8 (SD = 25.7) for Daily Living. In the higher functioning AD/PDD-NOS subsample the VABS composite score had a minimum of 29 and a maximum of 103 with a mean of 63.5 (SD = 20.6). Average scores within the adaptive behavior areas were 61.8 (SD = 16.6) for Socialisation, 65.8 (SD = 25.2) for Communication and 72.1 (SD = 27.1) for Daily Living (see Table 1).

The overall adaptive behavior and IQ-level differed highly significant only in the subgroup of non-mentally retarded individuals with AD/PDD-NOS ( $t = 9.1, p < .0001$ ). The difference was not significant in the subjects with AD/PDD-NOS and mental retardation ( $t = 1.2, p = .22$ ). The regression model for the subsample of the non-mentally retarded subjects ( $F = 4.3, p = .01, R^2 = .33$ ) gained significant explanation regarding IQ. Herein, the subscale Communication showed a significant positive correlation with the criterion (Beta = .65,  $t = 2.1, p = .04$ ). Even though, the regression model for the subsample of subjects with intellectual retardation and AD/PDD-NOS was not significant as a whole ( $F = .49, p = .68, R^2 = .09$ ) the Daily Living scale of the VABS displayed a positive association with general IQ worth mentioning (Beta = .50,  $t = 1.7, p = .09$ ).

## Discussion

On average, and in line with previous findings, our entire sample of individuals with AD or PDD-NOS showed higher intellectual functioning than adaptive behaviour skills. Regarding performance on the VABS, we could also replicate the finding, that subjects with AD or PDD-NOS typically score highest on Daily Living, lowest on Socialisation and intermediate on Communication.<sup>23</sup> However, more detailed analyses subdividing individuals with and without mental retardation reveals that the magnitude of the adaptive behaviour level and the general cognitive function differs primarily in higher functioning and a lot less in subjects with low functioning. So stating that IQ typically exceeds adaptive behaviour competencies in individuals with autism spectrum disorders may be of limited validity in low-IQ AD/PDD-NOS

persons. Some further conclusions can also be drawn from the results of the regression analysis that were computed in this study. First, even though the levels of adaptive and cognitive function are more comparable in subjects with AD/PDD-NOS and mental retardation their relationship seems to be less correlated than in subjects without mental handicap. Second, while in the non-mentally retarded group Communication was the best single adaptive behavior predictor for general cognitive level, it was Daily Living skills in the subjects being retarded.

From a methodological standpoint it should be considered however, that the power of the WISC-R/WAIS-R to differentiate low-level performances is restricted. Thus, floor effects cannot be ruled out. Furthermore, causing a selective sample, the Wechsler scales are verbal, so subjects with AD/PDD-NOS who have not developed speech were excluded from the start. Moreover, the screening version of the VABS may provide less accurate data than the original. Finally, the variance of the overall cognitive and adaptive capacities is clearly higher in the group of individuals with an  $IQ \geq 70$ . Thus, some statistical results are possibly confounded by lack in homogeneity of data distribution between groups. In summary, our findings need replication. Future research should also investigate, if our results are sufficiently specific to autistic disorders. On balance, our study of a group of carefully diagnosed individuals with autism is a step towards understanding the interplay and meaning of various psychological assessments in pervasive developmental disorders.

### Summary

The determination of intellectual and adaptive functioning is an important element in diagnosing autism. Both qualities are often severely impaired. The objective of the present study was to examine how adaptive behaviour and general cognitive level are related in subjects with autism and how they depend on the presence of co-morbid mental retardation. Data collected with the screening form of the Vineland Adaptive Scales (VABS) was compared to performance on the Wechsler Intelligence Scale for Children (WISC-R) or adults (WAIS-R) in a sample of 67 subjects with core autism or PDD-NOS. The full scale IQ was significantly higher than the overall adaptive behaviour level only in the subgroup of 34 subjects with an  $IQ > 70$ . The measures did not differ in the 33 individuals with mental retarda-

tion ( $IQ < 70$ ) indicating unison of the capacities in individuals with low-functioning and divergence in higher-functioning individuals. However, regression analysis demonstrated that the association between adaptive behavior and global intellectual ability is higher in the group with an  $IQ > 70$ . The adaptive behavior domain Communication correlated substantially with the general IQ. In the lower functioning sample the area of Daily Living was weakly related to IQ. The results stress the importance of co-morbid mental retardation in the evaluation of the relationship between intelligence and adaptive behavior competencies. Findings are discussed in the light of methodological limitations.

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### References

1. Fombonne E: The epidemiology of autism: a review. *Psychol Med* 29:769–786, 1999.
2. Chakrabarti S, Fombonne E: Pervasive developmental disorders in preschool children. *JAMA* 285:3093–3099, 2001.
3. Klin A, Carter AS, Sparrow SS: Psychological assessment of children with autism. In: *Handbook of Autism and Pervasive Developmental Disorders*, ed. Cohen DJ, Volkmar FR (pp. 418–427). New York: Wiley, 1997.
4. Kraijer D: Review of adaptive behavior studies in mentally retarded persons with autism/pervasive developmental disorder. *J Autism Dev Disord* 30:39–47, 2000.
5. Platt LO, Kamphaus RW, Cole RW, Smith CL: Relationship between adaptive behavior and intelligence: additional evidence. *Psychol Rep* 68: 139–145, 1991.
6. Volkmar FR, Sparrow SS, Goudreau D, Cicchetti DV, Cohen DJ: Social deficits in autism: an operational approach using the Vineland Adaptive Behavior Scales. *J Am Acad Child Psy* 26:151–161, 1987.
7. Freeman BJ, Del'Homme M, Guthrie D, Zhang F: Vineland Adaptive Behavior Scale Scores as a function of age and initial IQ in 210 autistic children. *J Autism Dev Disord* 29:379–384, 1999.
8. Sparrow SS, Balla DA, Cicchetti DV: *Vineland Adaptives Behavior Scales: Survey Form*. Circle Pines, MN: American Guidance Service, 1985.
9. Schatz J, Hamdan-Allen G: Effects of age and IQ on adaptive behaviour domains for children with autism. *J Autism Dev Disord* 25:51–60, 1995.
10. Freeman BJ, Ritvo ER, Yokota A., Childs J, Pollard J: WISC-R and the Vineland Adaptive Behavior Scale Scores in autistic children. *J Am Acad Child Psy* 27:428–429, 1988.
11. Lord C, Rutter M, Le Couteur A: Autism Diagnostic Interview-Revised: A revised

- version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *J Autism Dev Disord* 24:659–685, 1994.
12. Poustka F, Lisch S, Rühl D, Sacher A, Schmötzer G, Werner K: The standardized diagnosis of autism: Autism Diagnostic Interview-Revised: inter-rater reliability of the German form of the ADI-R. *Psychopathology* 29:145–153, 1996.
  13. Lord C, Risi S, Lambrecht L, Cook EH, Leventhal B, DiLavore PC, Pickles A, Rutter M: The ADOS-G (Autism Diagnostic Observation Schedule-Generic): A standard measure of social-communication deficits associated with autism spectrum disorders. *J Autism Dev Disord* 30:205–223, 2000.
  14. Tewes U: Hamburg-Wechsler-Intelligenztest für Kinder–Revision. Göttingen: Hogrefe, 1983.
  15. Tewes U: Hamburg-Wechsler-Intelligenztest für Erwachsene–Revision. Göttingen: Hogrefe, 1991.
  16. Rühl D: *Vineland-Beurteilungsskalen (A1–A4)*. Unpublished manuscript. Department of Child and Adolescent Psychiatry, University of Frankfurt, 1995.
  17. Bölte S, Adam-Schwebe S, Englert E, Schmeck K, & Poustka F: Test-usage in German child and adolescent psychiatry: report on a survey. *Z Kinder Jug-Psych* 28: 151–161, 2000.
  18. Kamphaus R: Conceptual and psychometric issues in the assessment of adaptive behaviour. *J Spec Edu* 21:27–35, 1987.
  19. Fombonne E, Achard S: The Vineland Adaptive Behavior Scale in a sample of normal French children: a research note. *J Child Psychol Psyc* 34:1051–1058, 1993.
  20. Carter AS, Volkmar FR, Sparrow SS, Wang JJ, Lord C, Dawson G, Fombonne E, Loveland K, Mesibov G, Schopler E: The Vineland Adaptive Behaviour Scales: supplementary norms for individuals with autism. *J Autism Dev Disord* 28:287–302, 1998.
  21. Loveland KA, Kelley ML: Development of adaptive behaviour in preschoolers with autism or Down Syndrome. *Am J Ment Retard* 96:13–20, 1991.
  22. VanMeter L, Fein D, Morris R, Waterhouse L, Allen D: Delay versus deviance in autistic social behavior. *J Autism Dev Disord* 27:557–569, 1997.
  23. Ando H, Yoshimura I, Wakabayashi S: Effects of age on adaptive behavior levels and academic skills in autistic and mentally retarded children. *J Autism Dev Disord* 10:173–184, 1980.