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Social and Communication Abilities and Disabilities in Higher Functioning Individuals with Autism Spectrum Disorders: The Vineland and the ADOS

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Abstract The relationship between adaptive functioning (*ability*) and autism symptomatology (*disability*) remains unclear, especially for higher functioning individuals with autism spectrum disorder (ASD). This study investigates *ability* and *disability* using the *Vineland* and *Autism Diagnostic Observation Schedule* (*ADOS*), respectively, in two clinical samples of children with ASD. Participants included 187 males with VIQ > 70. Vineland scores were substantially below VIQ, highlighting the magnitude of adaptive impairments despite cognitive potential. A weak relationship was found between ability and disability. Negative relationships were found between age and Vineland scores and no relationships were found between age and ADOS scores. Positive relationships were found between IQ and Vineland Communication. Results stress the need for longitudinal studies on ability and disability in ASD and emphasize the importance of adaptive skills intervention.

Keywords Autism · Vineland · ADOS · Adaptive functioning · Social disability · Autism spectrum disorders

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Introduction

Autism is an early onset and lifelong condition characterized by impairments in socialization and communication that have a severe impact on a person's ability to meet the demands of everyday life (American Psychiatric Association, 2000). Although early studies of outcome predicted a rather bleak future for those affected with the condition, a number of factors (ranging from effective early intervention and more appropriate and intensive educational programming, to the broadening of defining criteria) have led to a marked increase in the number of individuals who achieve higher levels of independence in adulthood (National Research Council, 2001). It is still the case that there is great variability in outcome, with maybe 12% or so reaching a "very good outcome" and maybe 60% or so being described as having a "poor" or "very poor outcome" (Howlin, Goode, Hutton, & Rutter, 2004). Reviewers of this still limited literature have catalogued a number of measures and indicators used to study outcome in individuals with autism (e.g., Howlin & Goode, 1998). Quite often, standardized instruments testing cognitive and language functioning and attainment are used to measure outcome, and yet, outcome studies of individuals in the higher end of the cognitive spectrum of autism (e.g., Howlin, 2003) seem to indicate that higher intellectual potential and academic achievement cannot be seen as assurance of better outcome in adulthood.

From a practical standpoint, one critical indicator of an individual's progress is his or her ability to translate cognitive potential into real-life skills, here defined as adaptive behaviors (Sparrow & Cicchetti, 1985). These include a person's capacity for conversing with and

understanding others, for taking care of one's health, grooming and domestic chores, participating in group and community activities, as well as interacting with others and developing relationships among many other skills necessary to successfully navigate the social world. Among these various skills, communicative and social adaptive skills are of particular interest since disabilities in these areas are both central and defining features of autism. Knowledge of the developmental course (i.e., age-related changes) and individual factors (e.g., intellectual endowment) impacting on the acquisition of communicative and social adaptive skills can be of great importance in planning more effective interventions. For example, information on spurts or lags in the acquisition of adaptive skills can inform interventionists of the need to intensify adaptive skill instruction at specific age transitions. Information on the relationship between IQ level and adaptive skill acquisition can help interventionists to further individualize intensity level of adaptive skill instruction on the basis of the person's developmental level. Similarly, one of the factors addressed in most educational and treatment programs is reduction of autistic symptomatology (National Research Council, 2001). In order to ascertain that this is a justified priority in such programs, there is a need to systematically document a positive relationship between symptom reduction and adaptive skill improvement.

This paper examines communicative and social adaptive skills in a group of individuals with pervasive developmental disorders (PDDs) or autism spectrum disorders (ASDs), whose verbal IQs are above the cut-off point for mental retardation. The expectation for these individuals, typically referred to as persons with ''higher functioning'' ASDs, is that they have the cognitive and language endowment to achieve positive outcomes. Indeed, in some parts of the U.S. they have no entitlements once they reach adulthood, a fact that can pose tremendous hardships to the individuals themselves and their families. Thus, it is particularly important to examine levels of adaptive functioning in this population. Our samples of individuals with ASD included persons with the diagnoses of Autistic Disorder, Asperger Disorder, and PDD, Not Otherwise Specified. This study explores the relationship between communicative and social adaptive skills and age, IQ level and profile, and level of autistic symptomatology. We chose to adopt the more continuous term ASD rather than the more specific categorical labels because there is a consensus that regardless of the more specific PDD label applied to an individual, similar services (in terms of intensity, comprehensiveness, and hierarchy of objectives) should be secured for and provided to

individuals with any diagnosis among the subtypes of PDD (National Research Council, 2001). Also, because of the controversial status of Asperger Disorder (e.g., Klin, Pauls, Schultz, & Volkmar, 2005), and since different definitions of this condition affect diagnostic assignment within this population of individuals with ASDs, we chose to avoid this nosologic issue altogether in order not to confound our results and in order to maximize replicability of our findings.

The most studied measure of adaptive behavior is the *Vineland Adaptive Behavior Scales* (Vineland; Sparrow, Balla, & Cicchetti, 1984a), particularly in the area of autism research (e.g., Klin, Volkmar, & Sparrow, 1992; Volkmar et al., 1987; Volkmar, Carter, Sparrow, & Cicchetti, 1993), where the Vineland provides supplementary norms for individuals with autism (Carter et al., 1998). It is a measure of personal and social self-sufficiency obtained through a semi-structured interview with the person's parents or caregivers. It examines the domains of communication, daily living skills, and socialization skills from birth to adulthood, and motor skills for preschool children only (the focus of this paper is on the communication and socialization domains only). The typical pattern of adaptive behavior in autism is marked by significant deficits in socialization, intermediate deficits in communication, and relative strengths in daily living skills (e.g., Bolte & Poustka, 2002; Carter et al., 1998), whereas in Down syndrome, for example, socialization skills are a relative strength (Dykens, Hodapp, & Evans, 1994). There is typically a significant discrepancy between overall cognitive ability and adaptive functioning favoring IQ over real-life skills (Bolte & Poustka, 2002; Carter et al., 1998; Freeman, Del'Homme, Guthrie, & Zhang, 1999; Liss et al., 2001; Volkmar et al., 1987).

Since impairments in adaptive functioning are part of the required criteria for the designation of mental retardation (American Psychiatric Association, 1994), several studies have investigated the nature of adaptive impairments in the mentally retarded population with and without autism. For example, in a sample of children with Angelman syndrome with severe to profound mental retardation, significant deficits in adaptive behavior were also found, yet there was strong positive correlation between adaptive behavior and IQ (Peters et al., 2004). Adaptive impairments in individuals with autism, however, exist above and beyond what might be expected from their cognitive delays (Carpentieri & Morgan, 1996; Rodrigue, Morgan, & Geffken, 1991; Volkmar et al., 1987). We were not able to find a peer-reviewed report on Vineland profiles focusing on higher functioning individuals with PDD (one study that provided such data used only a screening version of the

Vineland; Bolte & Poustka, 2002). However, there are published Vineland data on this population provided as part of sample characterization in papers focusing on other topics. For example, in one study involving only 15 adolescents and adults with higher functioning autism (Age = 15.4 years; SD = 7.2; Mean verbal IQ = 101; SD = 25), the Vineland score for the Socialization domain was 46.7 (SD = 12.7), corresponding to an age equivalent score of 4.8 years (SD = 2.6), thus indicating severe deficits in social adaptive skills, particularly considering how cognitively high functioning this sample was (Klin, Jones, Schultz, Volkmar, & Cohen, 2002).

Given the paucity of studies in this area, it is not surprising that the relationship between specific domains of adaptive behavior in higher functioning ASDs and cognitive ability and profile/degree of autistic symptomatology is not clear. In samples including variable cognitive levels (with a substantial majority of individuals with mental retardation), results have been somewhat inconsistent. Some studies show a positive relationship between adaptive behavior and IQ whereas others show the opposite (Freeman et al., 1999; Liss et al., 2001; Schatz & Hamden-Allen, 1995; Szatmari, Bryson, Boyle, Streiner, & Duku, 2003). The Vineland Communication domain has been shown to have the highest positive correlation with IQ, although several studies also showed a positive correlation between nonverbal IQ and Vineland Communication, Socialization, and Daily Living scores (Freeman et al., 1999; Schatz & Hamden-Allen, 1995). Both early language and nonverbal skills were found to be important predictors of outcome in Vineland Communication and Socialization domains in the ASDs (Szatmari et al., 2003).

The relationship between adaptive behavior and age is equally unclear. Schatz and Hamden-Allen (1995) found a stable relationship between age and adaptive functioning in a cross-sectional sample of mentally retarded children ranging from preschool age through adolescence. Yet, in the study by Freeman and colleagues (1999), Vineland Communication, Socialization, and Daily Living skills actually improved with age. In a longitudinal study involving children with ASD ages 4–6 through 12–14, Vineland Socialization scores decreased over time for individuals with both autism and Asperger syndrome, while Communication scores remained more stable for both groups (Szatmari et al., 2003).

Only a few studies investigated the relationship between autistic symptomatology and adaptive functioning, and the measures used to assess disability have varied across these studies. In a two- and six-year outcome study looking at autism symptomatology using the *Autism Behavior Checklist* (Volkmar et al., 1988), Vineland Communication scores were the strongest predictors of outcome compared to severity of autism-related symptoms, which were the weakest predictors of outcome (Szatmari et al., 2003). In a study using the *Wing Autism Diagnostic Interview Checklist* (Leekam, Libby, Wing, Gould, & Taylor, 2002), a negative correlation was found between severity of autistic symptoms and adaptive behavior as measured with the Vineland (Liss et al., 2001).

A little more is known about the relationship between level of autistic symptomatology (as measured through a standardized instrument) and intellectual level, but not age. One study (Joseph, Tager-Flusberg, & Lord, 2002) investigated the relationship between cognitive profiles and autistic symptomatology as measured with the *Autism Diagnostic Observation Schedule* (ADOS; Lord, Rutter, DiLavore, & Risi, 1999) in a group of children with ASD. The ADOS is a state-of-the-art, standardized diagnostic instrument for direct observation and measurement of autistic symptomatology. It is a comprehensive, investigator-based procedure that places the child in naturalistic social situations demanding specific social and communicative reactions. In this way, a sample of naturalistic social and communicative behaviors is obtained. Behaviors are coded in the areas of social communication, social relatedness, play and imagination, and restricted and/or repetitive behaviors. The ADOS provides a DSM-IV (APA, 2000) based algorithm for the diagnosis of autism, non-autistic PDD, and non-PDD. In this study, the sample included 73 children assessed using the Preschool level of the *Differential Ability Scales* (DAS, Elliott, 1990), Mean Age = 5;5) and 47 children assessed with the School-Age level of the DAS (Mean Age = 8;11). Children in both samples had General Conceptual Ability scores > 55 and they were administered the various modules of the ADOS (Module 1 for preverbal children, Module 2 for children with phrase speech, and Module 3 for more verbally fluent and older children). Results for the Preschool sample indicated that social disability, as measured by the ADOS, was inversely correlated with both Nonverbal and Verbal abilities. For the School-Age sample, however, social disability was inversely correlated with Verbal, but not with Nonverbal ability, and was even more strongly correlated with the discrepancy between Verbal and Nonverbal abilities (i.e. the greater the Nonverbal–Verbal split with a higher Nonverbal score, the more socially disabled). Communication disability was inversely correlated with level of verbal abilities in both groups. To summarize,

lower levels of verbally mediated intelligence were strong predictors of both greater communicative and social disability. Lower levels of nonverbally mediated intelligence were predictors of greater social disability in the younger but not in the older children, although in the latter group the size of the discrepancy between nonverbal and verbal intelligence was an even stronger predictor of social impairment. There was no attempt in this study to measure the correlation between ADOS scores and age, as data for each one of the groups were analyzed separately.

The present study attempts to clarify the relationship between levels of communicative and social ability, as measured with the Vineland, and levels of communicative and social disability, as measured with the ADOS, in higher functioning school-age and adolescent individuals with ASDs. The relationship between ability and disability and age and IQ is explored in two samples of individuals across the autism spectrum; one from the Yale Child Study Center and one from the Autism and Communication Disorders Center at the University of Michigan, also including some individuals from the University of Chicago.

Method: General Overview

Participants

Since the focus of this study was on individuals with "higher functioning" ASDs, only individuals with verbal IQs greater than 70 were included. Furthermore, because there were fewer females in the pool of eligible participants, this study reports data on males only. Finally, in order to eliminate age outliers (i.e., very young children or adults), only data on individuals aged 7–18 years are reported here. Age, IQ, and standardized measures of social and communication ability (levels of adaptive skills) and disability (levels of autistic symptomatology) were collected on consecutive participants in a large, federally funded project on the neurobiology of higher functioning individuals with ASDs (at the Yale Child Study Center; Yale Site) or consecutive referrals to the developmental disabilities clinics at the Department of Psychiatry at the University of Chicago Hospitals or the Autism and Communication Disorders Center at the University of Michigan (Michigan Site). Since both sites are self-referred clinics, the participant demographics involved primarily, although not entirely, middle-class families. The parents or legal guardians of all participants were able to provide informed consent, and the participants themselves were able to provide informed assent following a protocol approved by the Yale University School of Medicine Institutional Review Board, or the equivalent institutions at the University of Chicago and University of Michigan.

Instruments and Administration

Social and communication ability was defined as scores on the socialization and communication domains, respectively, of the *Vineland Adaptive Behavior Scales, Expanded Form* for the Yale sample and *Survey Form* for the Michigan sample (Vineland; Sparrow et al., 1984a, Sparrow, Balla, & Cicchetti, 1984b). Social and communication disability was defined as sum of scores on the algorithm items of the social and communication domains, respectively, of the ADOS (Lord et al., 1999). Algorithm items are a subset of the ADOS items that are used for the purpose of defining whether or not a person meets criteria for autism or for an ASD in this instrument. These items were defined as such because of their higher discriminative power (relative to other items; Lord et al., 1999). The "algorithm sum" for the specific domains of the ADOS has been commonly used for characterization of the level of autistic symptomatology of a given sample within a relatively narrow range of verbal skills (e.g., Klin et al., 2002).

The Vineland was administered to parents (typically the mother) of participants by trained personnel prior to, and therefore independent of, ascertainment of diagnosis. For both sites, clinicians' assigned diagnosis was based on the entirety of historical information and current data accumulated in the course of the individual's participation in the research study. Inter-rater reliability among experienced clinicians for diagnostic assignments of an ASD vs. a non-ASD condition has been demonstrated to be high (Klin, Lang, Cicchetti, & Volkmar, 2000). Furthermore, reliability between pairs of raters at Yale and Michigan exceeded 85% exact agreement on items in 11 videotapes that were coded for both Module 3 and 4 ADOS assessments (kappas exceeded 0.65) and complete agreement was found for ASD/non-spectrum distinctions.

The Yale and Michigan samples were analyzed separately in order to examine the various relationships involving abilities and disabilities in this population in two different clinical sites, which may involve different referral biases. Also, although inter-rater reliability for the diagnostic instruments carried out in the two sites has been demonstrated in the past, clinical procedures involved slightly different procedures (e.g., for the assessment of intellectual functioning). We felt that the validity of our findings would be strengthened

if results were consistent across the two sites. An important by-product of this study is the straightforward documentation of the levels and profiles of communicative and social adaptive skills for this population, which is meant to clarify assumptions made about the levels of real-life skills exhibited by higher functioning individuals with ASDs.

Method for Yale Site

Participants

Participants were included in the study to the extent that their diagnosis of an ASD (autistic disorder, Asperger's disorder, or PDD-NOS) could be ascertained by two experienced clinicians from each site on the basis of a comprehensive evaluation that included the *Autism Diagnostic Interview, Revised* (Rutter, LeCouteur, & Lord, 2003) and the ADOS (Lord et al., 1999).

Eighty-four participants were included from the Yale sample. Characterization data for each general ASD sample are provided in Table 1.

Instruments and Administration

For the Yale site, the ADOS was administered to participants by an experienced clinician certified in the procedure who was blind to the person's history or previous diagnostic status. Seventy-five percent of subjects received an ADOS Module 3 and 25% received Module 4. Intellectual testing for participants in the Yale sample was also conducted blind to diagnostic status by an experienced clinician otherwise uninvolved in the study, and involved completion of the Wechsler Intelligence Scale for Children – Third Edition (WISC-III; Wechsler, 1991) or the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III; Wechsler, 1997).

Table 1 Sample characterization: Age, IQ, Vineland Standard Scores**, Vineland age equivalents, and ADOS domains*** for the Yale ($n = 84$) and Michigan ($n = 103$) samples

	Yale		Michigan		$T_{(1, 185)}$	Sig.	%*
	Mean (SD)	Range	Mean (SD)	Range			
Age	12.4 (2.9)	7.0–18.9	10.0 (2.4)	7.0–17.8	6.26	$p < .01$	51.6
IQ							
FS IQ	99.8 (20.6)	62–141	99.0 (17.1)	57–144	0.28	$p = .77$	0
VIQ	104.7 (21.3)	70–150	101.2 (18.3)	70–148	1.22	$p = .22$	14.7
PIQ	94.5 (19.7)	52–139	98.5 (18.9)	55–142	–1.48	$p = .14$	14.7
Vineland SS**							
Comm.	72.2 (17.1)	28–113	83.5 (20.0)	39–131	–4.06	$p < .01$	38.2
Social.	52.0 (11.5)	20–79	67.0 (15.4)	36–110	–7.38	$p < .01$	58.9
Daily living	55.3 (13.7)	20–80	69.6 (20.8)	17–118	–5.3	$p < .01$	47.4
Composite	55.1 (10.7)	25–79	68.2 (16.8)	28–113	–6.19	$p < .01$	51.6
Vineland age equivalents							
Comm.	8.7 (2.1)	4.0–16.0	8.3 (3.0)	2.7–18.9	1.04	$p = .28$	7.7
Receptive	4.1 (1.1)	2.4–7.8	6.2 (1.8)	2.5–7.8	–9.32	$p < .01$	68.1
Expressive	7.2 (1.9)	2.6–15.5	7.3 (2.7)	2.4–15.4	–.24	$p = .79$	0
Written	10.5 (3.1)	6.9–19.0	8.4 (2.5)	1.5–17.8	5.02	$p < .01$	43
Socialization	4.5 (1.4)	1.8–9.1	5.2 (2.1)	1.5–10.5	–2.56	$p < .05$	27.4
Interpersonal	3.2 (1.6)	1.2–7.7	4.7 (2.6)	1.0–18.0	–4.65	$p < .01$	43
Play/Leisure	5.1 (1.9)	1.5–11.2	5.8 (2.9)	.8–14.3	–1.8	$p = .06$	21.3
Coping	5.8 (2.2)	2.0–13.8	5.6 (2.2)	.9–12.8	0.74	$p = .46$	7.7
Daily living	6.9 (1.9)	3.1–11.8	6.7 (2.4)	1.5–17.8	0.63	$p = .52$	7.7
Personal	6.2 (2.7)	2.3–17.5	6.5 (2.8)	2.1–17.5	–0.6	$p = .55$	7.7
Domestic	6.1 (2.8)	1.8–16.0	6.6 (2.4)	1.3–11.8	–1.33	$p = .19$	14.7
Community	8.5 (1.6)	4.9–13.3	7.3 (2.6)	2.2–15.3	3.56	$p < .01$	38.2
ADOS***							
Comm.	4.0 (1.5)	2–7	3.2 (1.7)	0–8	3.55	$p < .01$	33
Social	9.5 (2.6)	4–14	6.5 (3.0)	0–14	7.17	$p < .01$	58.9
Combined	13.5 (3.7)	6–21	9.7 (4.4)	1–20	6.41	$p < .01$	51.6

* Percent of nonoverlap based on effect sizes of differences between Yale and Michigan samples

** Vineland standard scores (Mean = 100; SD = 15)

*** ADOS algorithm items. The range of possible scores for ADOS communication is 0–8, for ADOS social is 0–14, and for ADOS communication + social (combined) is 0–22

Method for Michigan Site

Participants

One hundred and three participants were included from the Michigan sample, which was primarily a clinical sample of consecutive referrals to a private university autism clinic and a similar clinic at a state university. Characterization data for the Michigan sample are provided in Table 1.

Instruments and Administration

For the Michigan/Chicago sites, the same examiner administered the ADOS and the intellectual assessment and she/he was not blind to previous history or diagnoses. Eighty-five percent of subjects received an ADOS Module 3, and 15% received Module 4. Intellectual functioning was assessed using a hierarchy of tests chosen by the clinician based on age and level of functioning (i.e., the Differential Ability Scales, School Level (Elliott, 1990); The WISC-III; and the WAIS-III).

Results

Sample Characterization for the Yale Site

The data in Table 1 indicate that the Yale sample is comprised of higher-functioning school age and adolescent individuals with ASD who exhibit significant levels of communication and social disabilities. Despite having average IQ scores, this sample of individuals presents with significant adaptive impairments across areas of development, as well as significant levels of autism symptomatology.

Vineland subdomain scores in Communication indicated a great deal of scatter, with written skills (reading and writing) at a higher level than receptive and expressive communication, though this result is in part the effect of the relatively low ceilings in receptive and expressive language. The lowest age equivalents were on the Interpersonal domain of Socialization, which also contained remarkable scatter. In a sample with a mean age of 12.4 years and a mean full scale IQ of 99.8, the age equivalent score of 3.2 years (with a standard deviation of 1.6 years) on the interpersonal domain of the Vineland highlights the magnitude of the social disability in this group of cognitively able individuals. Figure 1 illustrates the gap between

general cognitive ability (or Full Scale IQ) and real-life skills (as measured with the Vineland).

In regards to autistic symptomatology, 100% of the Yale subjects met ADOS criterion scores for at least an ASD in both the Communication and Social domains. For autism criteria, 83.3% were at or above the cut-off in the Communication domain, and 91.6% were for the Social domain. Thus, despite relatively intact cognitive ability, the individuals have significant communicative and social autistic disabilities.

Sample Characterization for Michigan Site

The data in Table 1 indicate that, like the Yale participants, the Michigan sample is comprised of higher functioning, school-age and adolescent individuals with ASD who exhibit significant levels of communication and social disabilities. The Michigan sample differed significantly from the Yale sample in (a) age (the Michigan sample was slightly younger), (b) Vineland scores (the Michigan sample was less impaired in regards to communication and social adaptive skills, as well daily living skills), and (c) ADOS scores (the Yale sample exhibited more autistic symptoms in the communication and social domains). The two samples were not different in terms of IQ. Of notable importance, while Vineland Communication standard scores were significantly different across the two samples, the Vineland Communication Age Equivalents only differed between the samples for Receptive Language and Written domains. For Receptive Language, the difference in Age Equivalent scores represents a difference of only *one item* on the Expanded form and *two items* on the Survey form. This reflects the "sticky
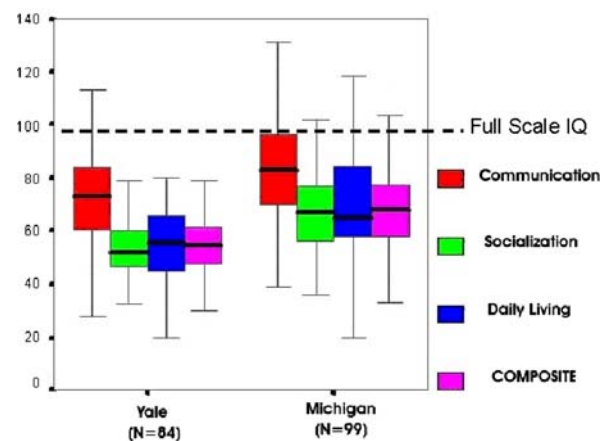

Fig. 1 Boxplot of Vineland communication, socialization, daily living, and composite standard scores relative to the mean Full Scale IQ for the Yale and Michigan sites

ceilings'' for scores between the ages of 35 and 54 months within this domain of the Vineland. For older children, the difference of just one item (i.e., one ability) can result in perceived discrepancies in age equivalents (Taylor, Pickering, Lord, & Pickles, 1998). Therefore, the difference in Communication standard scores is more a reflection of Written abilities rather than comprehension or use of language, per se. The percents of nonoverlap of mean scores derived from effect sizes between groups are also provided in Table 1 (Borenstein, Rothstein, & Cohen, 2001).

In regards to the Vineland adaptive skills, the mean standard score on the Communication domain was over 1-1/2 standard deviations below these individuals' verbal IQ in the Michigan samples, compared to over 2 standard deviations in the Yale sample. As with the Yale sample, the mean standard score on the Socialization domain was over 2 standard deviations below full scale IQ for the same participants; see Table 1. There was a 3-year discrepancy between the mean age equivalent scores on the Communication and the Socialization domains, respectively, favoring the former. Therefore, similar to Yale and shown in Fig. 1, these individuals exhibit extreme discrepancies between their cognitive ability as measured by their IQ scores and their real life adaptive communication and, particularly, social skills.

The Michigan sample was significantly less impaired in standard scores on adaptive Daily Living skills than the Yale group, despite being younger. The age equivalent scores signify comparable levels of functioning for Personal and Domestic skills despite the age differences, but greater Community skills for the Yale sample. Although the discrepancy for the Michigan sample was slightly smaller (i.e., a mean age of 10.0 years, mean Verbal IQ of 101.2, and mean interpersonal age equivalent of 4.7 years), the disparity between interpersonal skills is similarly striking.

In regards to autistic symptomatology, 80.6% of the Michigan subjects met ADOS criterion scores for at least an ASD in the Communication domain, and 97.1% met criterion in the Social domain. For autism criteria, 43.7% were at or above the cut-off in the Communication domain, and 76.9% were for the Social domain. The fact that the two samples differed in ADOS scores is likely a reflection of the variation in diagnostic breakdown of each sample. That is, the Yale group appears to be comprised of individuals with more prototypical autistic symptomatology, whereas the Michigan sample has greater representation of individuals with PDD-NOS (i.e., less disabled; for a similar comparison see Charkrabarti & Fombonne, 2005 and Bertrand et al., 2001).

The Effects of Age on Communicative and Social Abilities and Disabilities

Pearson Product Moment correlation analyses were conducted to investigate the relationship between Vineland Communication and Socialization scores and ADOS Communication and Social scores on the one hand, and age and IQ on the other hand. It is important to note that higher Vineland scores signify greater ability (standard scores follow the usual psychometric convention of mean = 100, and $SD = 15$), whereas higher ADOS scores signify greater disability (i.e., the greater the score, the more disabled is the individual). Also, since this study used a cross-sectional design, any significant correlations with age could be an artifact of IQ differences between the younger and the older participants that may have been due to differences in referral or recruitment patterns as well as possible changes in IQ with time. In order to rule out this possibility, both samples were divided into two age groups at the median age point (12.9 years for Yale and 9.3 years for Michigan) and ANOVAs were performed to test for significant differences in IQ. There were no significant differences in IQ between the two age groups for either site [Yale: FSIQ: $F(1, 82) = 1.60$, $p = .21$; VIQ: $F(1, 82) = 2.32$, $p = .13$; and PIQ $F(1, 82) = .48$, $p = .49$. Michigan: VIQ: $F(1, 100) = .08$, $p = .77$; and PIQ $F(1, 98) = .01$, $p = .92$]. Furthermore, controlling for IQ in the correlation analyses did not alter the findings.

As shown in Table 2, there were strong negative correlations at $p < .01$ levels between Vineland scores and age for the Yale sample, suggesting that the gap in communicative and social abilities between individuals with higher functioning ASDs and their typical peers increases with age (i.e., that individuals with ASD become increasingly less able relative to same-age typical peers as they move into later adolescence). It is important to note that this result does not reflect a loss of skills over time, as both Vineland Communication and Socialization age equivalent scores were positively correlated with age ($r = .44$ and $r = .29$, respectively; $p < .01$); rather, this result indicates that individuals with ASD fail to make gains in adaptive skills at a level commensurate with their gains in chronological age. Thus their standard scores decrease with time. There was no association between ADOS scores and age for either group, suggesting stable levels of disability across chronological age.

For the Michigan sample, there was also a strong negative correlation between Vineland Social standard scores and age, but a weaker correlation between Vineland Communication standard scores and age.

Table 2 Effects of age and IQ on Vineland (communication, social, daily living, and composite) and ADOS (communication, social, and combined) scores for the Yale and Michigan samples

| | Age | | IQ | | | |
| | | | Verbal | | Performance | |
	Yale	Mich.	Yale	Mich.	Yale	Mich.
Vineland						
Communication	–.45**	–.29**	.51**	.49**	.25*	.46**
Socialization	–.63**	–.43**	.12	.08	.1	.22*
Daily living	–.03	–.12	.14	.20*	.23*	.44**
Composite	–.45**	–.30**	.35**	.33**	.25*	.45**
ADOS						
Communication	.07	–.02	–.2	–.11	–.05	–.19
Social	.14	.12	–.27*	–.22*	–.18	–.18
Comm + Social	.13	.08	–.27*	–.20*	–.15	–.20*

* Correlation is significant at $p < .05$ level (2-tailed)

** Correlation is significant at $p < .01$ level (2-tailed)

The smaller correlation could be the result of the sample being slightly younger and having stronger adaptive communication skills (as a whole, the Michigan sample was somewhat less affected than the Yale sample). If so, this emphasizes the notion that Vineland standard scores are lower for the older relative to younger individuals with ASD. Again, this result does not reflect a loss of skills over time, but rather indicates that gains are not commensurate with chronological development. Similar to the Yale sample, Vineland Communication and Socialization age equivalent scores were also positively correlated with age for the Michigan sample ($r = .21$, $p < .05$, and $r = .38$, $p < .01$).

The Effects of IQ on Communicative and Social Abilities and Disabilities

Examining the relationship between Vineland scores and verbal and performance IQs (VIQ and PIQ) for the Yale sample, there was a significant correlation between Vineland Communication scores (but not Socialization scores) and both VIQs and PIQs, with higher IQs predicting higher levels of communication abilities. VIQ was a much stronger predictor of better communication skills than PIQ. Neither VIQ nor PIQ predicted levels of social abilities. In regards to associations between ADOS scores and VIQ and PIQ, the only significant correlations were between VIQ and level of social disability, with higher VIQ predicting lower social impairment. These correlations were quite small, however, relative to the other significant results. There was no significant association between ADOS scores and performance IQ. In summary, higher verbal intelligence predicted lower social disability and higher communication ability, whereas higher nonverbal intelligence predicted higher communication ability only.

Examining the relationship between Vineland scores and VIQs and PIQs for the Michigan sample, there was a significant correlation between Vineland Communication scores (but not Socialization scores) and both VIQs and PIQs, with higher IQs predicting higher levels of communication abilities (see Table 2). However, for the Yale sample, VIQ was a much stronger predictor of better communication skills than PIQ, whereas for the Michigan sample both VIQ and PIQ were strong predictors of adaptive communication. Neither VIQ nor PIQ predicted levels of social abilities in the Yale sample, and the small correlation between PIQ and Vineland Socialization scores in the Michigan sample is likely due to the larger sample size for that group. It should also be noted that IQ scores were derived using different measures at each site.

In regards to associations between ADOS scores and VIQ and PIQ, the only significant correlations for both samples were between VIQ and level of social disability, with higher VIQ predicting lower social impairment. These correlations were quite small, however, relative to the other significant results. There was no significant association between ADOS scores and performance IQ. In summary, higher verbal intelligence predicted lower social disability and higher communication ability, whereas higher nonverbal intelligence predicted higher communication ability.

Relationship Between Level of Communication and Social abilities (Vineland) and Communication and Social Disabilities (ADOS)

Table 3 lists the correlations between Vineland and ADOS scores. Results from the Yale sample indicated that level of communication ability was significantly correlated with levels of both communication and social disability, with higher levels of communication skills predicting lower levels of communication and social disability. These significant results, however, reflected a low level of association. There was no significant correlation between levels of social ability and levels of communication or social disability for this sample. In other words, lower symptomatology relates to better communication (but not social) skills in real-life situations for the Yale group. Overall, the size of the correlations between Vineland and ADOS scores were quite low, suggesting weak associations between levels of autistic symptomatology and levels of adaptive functioning in real life.

Table 3 Relationship between Level of Communicative and Social Ability (Vineland) and Disability (ADOS) for the Yale and Michigan Samples

	Ability (Vineland)			
	Communication		Socialization	
	Yale	Mich.	Yale	Mich.
Disability (ADOS)				
Comm	−.24*	−.09	−.20	−.20*
Social	−.22*	−.28**	−.15	−.28**

* Correlation is significant at *p* < .05 level (2-tailed)

** Correlation is significant at *p* < .01 level (2-tailed)

As shown in Table 3, the correlations between the Vineland and the ADOS domains were slightly different between the two samples. Similar to Yale, in the Michigan sample there was a significant correlation between Vineland Communication and ADOS Socialization scores, but not with ADOS Communication scores, suggesting that less social disability (but not less communicative disability) relates to better adaptive communication skills. In contrast to the Yale sample, however, there were also significant correlations between Vineland Socialization scores and ADOS Communication and Socialization scores, suggesting that lower symptomatology relates to better socialization skills in real-life situations. Despite these minor differences, some of which related to sample size (e.g., the correlation between Vineland Socialization and ADOS Communication domains was the same for the two samples but significant only in the larger Michigan sample), the correlations between Vineland and ADOS scores were quite low in both samples, suggesting weak associations between levels of autistic symptomatology and levels of adaptive functioning in real life.

Despite the small correlations between the Vineland and ADOS measures, very strong correlations were found between the subdomains *within* each measure. For the Vineland, the correlations between the communication and socialization domains were .54 for Yale and .51 for Michigan (*p* < .001). For the ADOS, the correlations between communication and social domains were .63 for Yale and .66 for Michigan (*p* < .001).

Discussion

This study examined the relationship between communication and social abilities and disabilities as measured with the Vineland and ADOS in two samples of cognitively higher functioning school-age and adolescent males with ASDs. Through a cross-sectional design, the relationship between Vineland and ADOS scores and age and IQ levels and profiles was also explored.

Sample Characterization

One of the most important aspects of the data presented here is the straightforward documentation of adaptive skill levels in this sample. For a group consisting of individuals aged 7–18 years with verbal IQs within the normative range, there were deficits of 1 and 2 standard deviations for communicative adaptive skills in the Michigan and Yale samples, respectively; and there were deficits of 2 and 3 standard deviations for social adaptive skills in the two samples, respectively. Most importantly, the mean age equivalent scores on the Vineland Interpersonal Relationships subdomain were 3.2 years (*SD* = 1.6) and 4.7 years (*SD* = 2.6) in the Yale and Michigan samples, respectively. These data highlight the magnitude of deficits in real-life skills in the communication and social domains, which can be colloquially described as ''street smarts'', and which play a central role in real-life prospects for these individuals including having relationships, enrolling in institutions of advanced learning, securing employment, and achieving independence. The similarity of these data for slightly different samples coming from two unrelated sites strengthens its validity. If replicated in other sites, these findings should inform discussions on priorities of treatment and intervention programs as well as of entitlements, particularly as these individuals graduate from school-related mandated services and are expected to fend for themselves as adults in the real world.

The Effects of Age on Communicative and Social Abilities and Disabilities

One issue studied in this paper was the relationship between Vineland and ADOS scores and age. While levels of communication and social disability (ADOS) were stable across age groups, levels of communication and, particularly social ability (Vineland) showed a marked decrease with age. In regards to the latter, the strong negative correlations of *r* = −.63 (*p* < .01) in the Yale sample and *r* = −.43 (*p* < .01) in the Michigan sample highlight the magnitude of these individuals' failure to make gains in adaptive skills at a level commensurate with their chronological growth. Collectively, the data on Vineland scores as a function

of age suggest that individuals with higher functioning ASD become increasingly more impaired relative to their age-peers through later childhood and into adolescence. Certainly, intensity and type of intervention could account for these differences in that younger children might have received more intervention than older individuals. Since data collection on intervention was not a part of the present study, this will be critical investigation for future research. Furthermore, given the important implications of this finding for discussions of priorities of intervention programs as well as of timing and intensity of adaptive skills instruction, it will be important to explore this worrisome age trend in a longitudinal design.

The Effects of IQ on Communicative and Social Abilities and Disabilities

Another issue addressed in this study involved the relationship between communication and social abilities and disabilities on the one hand and IQ levels on the other hand. In both samples, VIQ, and to a lesser degree PIQ, predicted higher levels of Vineland Communication scores, but were unrelated to Vineland Socialization scores. There was some difference between the Yale and the Michigan samples in regards to these relationships insofar as PIQ and Vineland scores were concerned, with stronger associations obtained in the Michigan sample relative to the Yale sample. This is curious since both the mean and range of PIQ scores were comparable in both samples. One could speculate that since the Michigan sample was less impaired than the Yale sample (i.e., had less symptoms and stronger adaptive skills), perhaps in individuals with less prototypical autism, there is some suggestion that PIQ (or more generally, nonverbal cognitive skills) may mediate communicative and social adaptive skills differently for parts of the autistic spectrum (Joseph et al., 2002). If substantiated in future studies, this possibility may have important practical implications. While verbal intelligence has been possibly one of the most consistently emphasized predictors of outcome and is, therefore, emphasized in intervention programs, much less attention has been directed to the role of nonverbal skills in facilitating communication and socialization in individuals with ASD. And yet, nonverbal processing is known to play a very critical role in socialization (e.g., Howlin et al., 2004; Rourke, 1989). In the context of the hypotheses raised by these data, there is a need to better conceptualize and systematically test the contributions that visual processing skills might play in facilitating real-life

adaptive functioning in individuals with ASD (e.g., Hodgdon, 1995, 1999).

The fact that very small correlations were found between IQ and ADOS scores highlights the counter-intuitive notion that more abled individuals should present with fewer symptoms. Based on the small correlations, those individuals with higher verbal abilities may have less social impairments, but surprisingly do not have less communication impairments. Therefore, even the ''higher functioning'' individuals with cognitive prowess can still present with debilitating symptoms that impact their ability to function in the real world.

Relationship Between Level of Communication and Social Abilities (Vineland) and Communication and Social Disabilities (ADOS)

An important and unexplored issue to date concerns the relationship between abilities (Vineland) and disabilities (ADOS) in the communication and social domains. Again, the intuitive notion that lower levels of symptomatology should imply higher levels of adaptive skills was not corroborated by our data. In the Yale sample, correlations between communicative adaptive functioning and both autistic communication and social disability were only marginally significant ($r = -.24$ and $r = -.22$, respectively), whereas correlations between social adaptive functioning and both measures of autistic disability were not significant. In the Michigan sample, results were very similar and fluctuations appeared to reflect primarily sample size. Communicative adaptive functioning was not significantly associated with autistic communication disability, and was only marginally significantly correlated with autistic social disability ($r = -.28$).

This finding calls to question an important tenet in intervention programs for individuals with higher functioning ASD, according to which a major effort is made to reduce symptoms with the implied goal to maximize positive outcomes such as independent living skills. Our data suggest that adaptive skills and symptomatology, or abilities and disabilities, might have to be conceived, at least partially, as independent domains of intervention. In other words, factors mediating the acquisition of adaptive skills may be different from factors mediating the expression of autistic symptomatology.

First suggested by Szatmari and colleagues (2003), this is an important insight from both a theoretical and a practical standpoint. The former points to better understanding of learning in naturalistic environments,

or why there is so much difficulty in higher functioning individuals with autism to translate cognitive potential into real life skills (e.g., Klin, Jones, Schultz, & Volkmar, 2003). Klin et al. (2003) theorized that individuals with autism learn about the world differently from their typical peers. They may develop compensatory strategies that help them score well on standardized tests. Yet, they are not naturally drawing upon their repertoire of skills in naturalistic contexts. This information needs to be used as a platform for research to clarify what factors truly can predict real-life success. This issue has received much less attention than it should, both scientifically and clinically.

A more methodologically oriented reason to examine adaptive behavior in individuals with ASD comes from the need for dimensional quantifiers of the core social disability. This is of critical importance for (a) psychological research: to test the predictive value of neuropsychological constructs hypothesized to underlie autistic symptomatology (i.e., more impairment in the construct measured under lab conditions should predict less social and communicative adaptive competence in real life); (b) neurofunctional research: to increase the power of neuroimaging experiments (e.g., less activation of a given structure involved in social processing should predict less social and communicative adaptive competence); and (c) genetics research: to increase the power of genetic analyses by relying on dimensional measures of affectedness (Volkmar, Lord, Bailey, Schultz, & Klin, 2004). Autism-specific measures do not, by their nature, generate normal distributions of affectedness that include the non-autistic population. Thus, levels of ability (such as adaptive behavior), rather than disability (such as autism-specific measures), which are designed to cover the entire spectrum of adaptive outcomes (of disabled as well as of typical populations), could potentially serve this quantifying role.

From a practical standpoint and relevant to current intervention practices (National Research Council, 2001), this finding suggests the need to prioritize adaptive skill instruction as its own goal in intervention. And given the worrisome levels of adaptive skill deficit documented here and their negative correlation with age, this instruction should be intensified as the child grows older.

Finally, it is paradoxical that the literature on adaptive skills in individuals with higher functioning ASD is so limited given their importance for treatment and programmatic considerations and for studies of outcome. Very likely, there are many ongoing, large research projects focused on different aspects of autism and related disorders in which Vineland and ADOS data are routinely collected. And yet, there have been no peer-reviewed reports of the relationships between these data. The rather worrisome findings of the present study should serve to motivate replication attempts of our results.

Future studies should also address two important limitations of the present one. First, generalizability of these findings could be compromised by the fact that both samples may be more disabled relative to samples obtained in a population-based study. For instance, families are self-referred and they often make a great effort to participate in research projects or to have their children complete clinical evaluations, which could be a consequence of these families having children who encounter a greater degree of hardship in their daily lives. If so, there should be caution in generalizing from these rather dramatic results to individuals with higher functioning ASD in the general population. Second, it is worth reiterating that this study utilized a cross-sectional design, and that all conclusions drawn regarding age trends will need to be further studied using a longitudinal design (Szatmari et al., 2003), along with investigating the effects of intervention on adaptive outcome.

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