J Autism Dev Disord (2016) 46:42–52
DOI 10.1007/s10803-015-2533-3

ORIGINAL PAPER

The Vineland-II in Preschool Children with Autism Spectrum Disorders: An Item Content Category Analysis

Giulia Balboni[1] · Alessandra Tasso[2] · Filippo Muratori[3,5] · Roberto Cubelli[4]

Published online: 26 July 2015

Abstract We investigated which item subsets of the Vineland-II can discriminate low-functioning preschoolers with ASD from matched peers with other neurodevelopmental disorders, using a regression analysis derived from a normative sample to account for cognitive and linguistic competencies. At variance with the typical profile, a pattern with Communication more impaired than Socialization was observed. The source of the frequently reported Socialization delay in ASD appears to be in Playing and Imitating skills only, not in other social adaptive behavior skills. The combination of item subsets Playing, Following instructions, Beginning to talk, and Speech skills provided the best discrimination between the two clinical groups. Evaluation of the Vineland-II score on item content categories is a useful procedure for a more efficient clinical description.

Keywords Vineland · Autism spectrum disorder · Adaptive behavior profile · Matching equivalence

✉ Giulia Balboni
giulia.balboni@med.unipi.it

[1] Department of Surgery, Medical, Molecular and Critical Area Pathology, University of Pisa, Via Roma, 67, 56126 Pisa, Italy

[2] Department of Humanities, University of Ferrara, Via Paradiso, 12, 44121 Ferrara, Italy

[3] IRCCS Stella Maris Foundation, University of Pisa, Via dei Giacinti, 2, 56128 Calambrone, Pisa, Italy

[4] Department of Psychology and Cognitive Sciences, University of Trento, Corso Bettini 31, 38068 Rovereto, Italy

[5] Department of Clinical and Experimental Medicine, University of Pisa, Via dei Giacinti, 2, 56128 Calambrone, Pisa, Italy

Introduction

Autistic spectrum disorder (ASD) is defined as a pervasive neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts and by repetitive or restrictive behaviors, activities, and interests (American Psychiatric Association 2013). Frequently, individuals with ASD also have an intellectual disability (e.g., Centers for Disease Control and Prevention 2009, 2012, 2014) which compromises their adaptive behavior skills. In agreement with the DSM-5, in case of diagnosis of ASD, it is also necessary to ascertain whether the individual presents an intellectual impairment or not.

Because early and targeted intervention has positive benefits (see, e.g., Dawson et al. 2010; Fein et al. 2013; Green et al. 2010; Muratori and Narzisi 2014), children with ASD should be enrolled in intervention programs as soon as possible (e.g., Makrygianni and Reed 2010; Rogers et al. 2014). To this aim, several valid and reliable instruments are available for evaluating the core behavioral features of ASD [e.g., the Autism Diagnostic Observation Schedule-2 (ADOS-2) and the Autism Diagnostic Interview-Revised (ADI-R); Lord et al. 1994, 2012] and can be used for clinical purposes (Matson et al. 2011, 2012). However, the evaluation of adaptive behavior is also useful for diagnostic classification and treatment planning (Carter et al. 1998; Farley et al. 2009; Klin et al. 2007).

The assessment of adaptive behavior is intended to determine individual abilities in everyday life in terms of functional communication, socialization, and daily living skills (Schalock et al. 2010; Tassé et al. 2012). The Vineland Adaptive Behavior Scale (VABS; Sparrow et al. 1984) and the revised edition (Vineland-II; Sparrow et al. 2005) have been documented as two of the most valid and

reliable tools for the evaluation of adaptive behavior skills (Balboni et al. 2001; Schalock et al. 2010; Sparrow et al. 2005). The four scales of Communication, Daily Living Skills, Socialization, and Motor Skills are quickly and easily administered via a semi-structured interview with the individual's caregiver, and have often been used for individuals with ASD (e.g., Carter et al. 1998; Klin et al. 2007).

Several investigations have attempted to identify a typical adaptive behavior profile of autism (e.g., Carpentieri and Morgan 1996; Volkmar et al. 1987). Yet, results do not seem to be conclusive. The observed behavioral patterns differ for critical factors such as the participant's age and cognitive level, as well as for research methodology employed (experimental design, normative scores, and Vineland version) (see, e.g., Paul et al. 2011; Perry et al. 2009).

Using within-participants research designs and standard scores, a profile including very substantial delays in Socialization, moderate delays in Communication, and relative strengths in Daily Living and Motor Skills has generally been found in individuals with high or average cognitive level, i.e., the so-called "typical autism profile" (Carter et al. 1998; Klin et al. 2007; Kraijer 2000; Volkmar et al. 1993). A different profile with Socialization higher than Communication (Communication < Socialization < Daily Living Skills < Motor Skills) has generally been observed in individuals with below-average cognitive levels (see, e.g., Fenton et al. 2003). However, in young children with different cognitive levels, the studies that have used the VABS have found contrasting results: either Socialization higher than Communication and Daily Living skills (Carter et al. 1998; Perry et al. 2009) or Communication higher than Socialization and Daily Living skills (Matthews et al. 2015). Only with the Vineland-II the standard patterns have been reported: the typical autism profile in 4- to 17-year-old high-functioning individuals (Kanne et al. 2011) and the Socialization higher than Communication pattern in toddlers with below-average cognitive levels (Ray-Subramanian et al. 2011).

A different pattern emerges from studies with a matched group design involving individuals with and without ASD. Using the standard scores of the VABS, the typical ASD profile has been found in individuals with low to high cognitive level (e.g., Loveland and Kelley 1991; Volkmar et al. 1987; Mouga et al. 2014). However, using the Vineland-II with low-functioning toddlers, Paul et al. (2011) recently found that those with ASD, compared with peers without ASD, had lower scores in the Communication and Daily Living Skill domains but not in the Socialization domain.

Most of these inconsistencies could be related to the level of measurement of adaptive behavior. Usually, scores on the Vineland domains (or on the subdomains) are compared with each other. However, domains (but also subdomains) allow measurement of several adaptive behavior skills at different levels of development. On narrow domains such as Socialization and Communication, weaknesses and strengths may coexist in the same individual and cause high variability. To understand the adaptive behavior profile, researchers should consider not only the total scores of the domains and subdomains but also the scores of item subsets that measure specific adaptive behavior skills. For example, to investigate differences between school-aged children with ASD and other neurodevelopmental disorders (NDDs), the Receptive Vineland-II subdomain can be used by treating separately the sets of items labeled "Understanding," "Listening and attending," and "Following instructions" (see Paul et al. 2004).

Moreover, instead of a within-group design, a comparison between matched groups of individuals with ASD or with other NDDs (e.g., intellectual disability, language disorder) should be undertaken. To this aim, a group with ASD and one without should be matched for relevant variables that may influence individuals' adaptive behavior: age, gender, cognitive and socio-cultural level (e.g., Tassé et al. 2012), and linguistic abilities (e.g., Kanne et al. 2011). To match groups of participants on a great number of critical variables, the methodological procedure proposed by Volkmar et al. (1993) is preferable. This procedure involves a representative normative sample to derive multiple regression equations that predict expected scores in Vineland-II on the basis of the relevant variables. The application of these equations to the clinical samples allows the computation of Vineland-II *Z* scores that express, for each participant with and without ASD, the difference between the individual's adaptive behavior and that of the normative sample that has the same value on the relevant variables (i.e., adaptive behavior level expected, given the clinical participant's values on relevant variables). In this way, groups with and without ASD can be compared regardless of their values on relevant variables.

The present study aimed to examine whether Vineland-II performance at the item subset level can account for the inconsistencies in the description of the typical ASD profile reported in the literature. The main goal was to identify the subsets of items that could discriminate between two matched groups of Italian preschoolers, one with ASD and one with non-autistic NDD. Moreover, we aimed to identify the combination of item subsets that renders the best classification of participants. At the clinical level, this study is particularly useful because the Vineland-II has not yet been employed to investigate the profiles of preschoolers with ASD.

Method

Participants

Fifty-two Italian children (M_{age} = 4.44 years, SD = 0.90, range 3–6; 83 % male) participated. They were recruited at the IRCCS Stella Maris Foundation, an Italian center specialized in the assessment of children with autism and other NDDs. The participants were selected from the 3- to 6-year-old children who had been evaluated for suspected ASD during 2006 and 2007 and had received a diagnosis in agreement with the DSM-IV-TR criteria (American Psychiatric Association 2000) on the basis of the ADOS scale (Lord et al. 1999), direct observation, and parent interview. The selected participants were assigned to one of two groups upon the diagnosis received: those with the diagnosis of pervasive developmental disorder (ASD group; n = 32) and those with the diagnosis of a non-autistic NDD (NDD group; n = 20). Following the criteria proposed by Kover and Atwood (2013) for establishing equivalence in group-matching design with participants with developmental disabilities, the two groups did not differ statistically on a number of relevant variables: age ($t(50) = 0.47$, $p = .640$, Cohen's $d = 0.13$, $SD^2_{ASD}/SD^2_{NDD} = 1.19$), gender ($\chi^2(1) = 0.61$, $p = .434$, Cohen's $w = 0.11$), or mother's and father's educational level ($\chi^2(2) = 0.61$, $p = .738$, Cohen's $w = 0.11$; $\chi^2(2) = 0.18$, $p = .915$, Cohen's $w = 0.06$, respectively) (Table 1).

Table 1 Characteristics of participants with ASD and with non-autistic NDD

	ASD (n = 32)	NDD (n = 20)
Gender (%)		
F–M	13–87	25–75
Age (years_months)		
M (*SD*)	4_5 (0_11)	4_6 (0_10)
Mother's–father's educational level (%)		
Middle school	22–25	30–30
High school	66–50	55–45
University degree	12–25	15–25
Autism severity: ADOS[a]		
Social affect: *M* (*SD*) calibrated severity score	5.37 (2.09)	2.53 (1.07)
Restricted and repetitive behavior: *M* (*SD*) calibrated severity score	5.09 (1.94)	3.00 (2.18)
Cognitive level: Leiter-R		
M (*SD*) standard score	70.13 (25.13)	89.70 (24.59)
Linguistic level: Peabody-R		
M (*SD*) raw score	15.03 (19.64)	26.95 (21.87)

[a] ADOS was not administered to one participant of the NDD group

Children with ASD had a statistically significant higher ADOS calibrated severity score (Gotham et al. 2007, 2009; Hus et al. 2014) in both ADOS Social Affect and Restricted and Repetitive Behaviors domains ($t(48,255) = 6.41$, $p < .001$, Cohen's $d = 1.61$; $t(34,411) = 3.45$, $p = .002$, Cohen's $d = 1.03$, respectively). All children lived with their families and 96 % (n = 50) attended kindergarten.

The ASD group comprised 16 (50 %) children who also had an intellectual disability (5 mild, 11 moderate). The NDD group included 13 children (65 %) with language disorders (8 of them had also a regulation or behavioral disorder), 5 children (25 %) with intellectual disability (3 mild and 2 moderate), and 2 (10 %) with a global developmental delay.

The two groups of children differed in their cognitive ($t(50) = 2.75$, $p = .008$, Cohen's $d = 0.78$) and linguistic ($t(50) = 2.04$, $p = .047$, Cohen's $d = 0.58$) abilities, as measured by the Leiter-R (Roid and Miller 1997) and the Peabody Picture Vocabulary Test-R [PPVT-R; Dunn and Dunn 1981 (Italian adaptation, Stella et al. 2000)], respectively (see Table 1). To compare the two groups and rule out the influence of the different levels of cognitive and linguistic competence, following Volkmar et al.'s procedure (1993), a group comprising children with typical development was recruited and underwent the same tests to produce normative individual scores. The normative group included 122 children (M_{age} = 4.52 years, SD = 0.77, range 3–6) selected from an urban area in northern Italy. One thousand and fifty parents of potential participants were asked to participate in the study; of these, 12 % agreed. All children of the normative group were born in Italy and were Italian native speakers; 97 % of them attended kindergarten. The characteristics of the normative sample are shown in Table 2. For all participants, parental informed consent was obtained and no monetary incentive was given.

Materials

Vineland-II

Vineland-II Survey Interview Form scales assess adaptive behavior in terms of abilities for personal and social functioning in different domains of everyday life. Specifically, four different domains assess each developmental step from 0 to 90 years old in communication, socialization, and daily living adaptive skills, and from 0 to 7 years old in motor adaptive skills. Each domain is formed by subdomains (Receptive, Expressive, and Written Communication; Personal, Domestic, and Community Daily Living Skills; Interpersonal Relationship, Play and Leisure Time, and Coping Skills Socialization; Gross and Fine Motor Skills) with item sets assessing specific content areas

Table 2 Characteristics of the normative group, classified into three 1-year age groups

	Age		
	3_0–3_11 (n = 34, 28 %)	4_0–4_11 (n = 50, 41 %)	5_0–5_11 (n = 38, 31 %)
Gender (%)			
F–M	50–50	64–36	50–50
Age (years_months)			
M (*SD*)	3_6 (0_3)	4_6 (0_3)	5_5 (0_3)
Mothers'–fathers' educational level (%)			
Elementary school	0–3	0–0	0–0
Middle school	35–35	20–36	18–32
Vocational school	9–9	12–6	11–5
High school	32–38	36–32	45–34
University degree	23–15	32–26	26–29
Cognitive level: Leiter-R			
M (*SD*) standard score	113.47 (10.60)	112.92 (10.33)	106.63 (9.56)
Linguistic level: Peabody-R			
M (*SD*) raw score	38.41 (11.93)	58.62 (14.35)	75.47 (14.45)

(i.e., adaptive skills). In the present study, the scores obtained for all the 47 item sets of Communication, Daily Living Skills, and Socialization domains identified by Sparrow et al. (2005) were used. All sets contain 1–14 individual items (median = 6 items); possible item scores are 2, 1, or 0, and the score for each set is calculated as the mean of the individual item scores (for more detail see Sparrow et al. 2005).

An Italian adaptation of the Vineland-II, approved by Pearson Editor, was used (Balboni et al., in press). The adaptation was realized by a group made up of three professors of psychology and one professional psychologist, with expertise in the following areas: adaptive behavior, typical and atypical development, intellectual disabilities and ASD, psychometrics, and theory of tests. The International Test Commission Guidelines for Translating and Adapting Tests were followed (International Test Commission 2005). When suitable, the same items used in the Italian version of the VABS were maintained (Balboni and Pedrabissi 2003). Items newly introduced on the Vineland-II were translated in Italian in accordance with Tassé and Craig's (1999) principles. Items were modified only if necessary to allow the measurement of adaptive behavior in the Italian context. A pilot administration was conducted to investigate the comprehensibility of items. Finally, a back translation was performed by two native English-speaking translators to ensure that the meaning of the items was preserved. In regards the psychometric properties of the Italian adaptation of the Vineland-II, internal consistency reliability was investigated in 27 age groups of 64–120 persons each (mean = 99), covering the age range from birth to 90. The mean of reliability coefficients for Communication, Daily Living Skills, and Socialization domains were very good: 0.90, 0.90, and 0.91, respectively. Test–retest reliability was investigated in 87 children aged 3–6 years old by means of a second administration of the Vineland-II after a mean interval of 33 days (range 21–49 days) with the same respondent and interviewer pairs. The Pearson's correlation coefficients for Communication, Daily Living Skills, and Socialization domains were high: 0.94, 0.94, and 0.91, respectively. Finally, criterion validity was studied in 32 children aged 3–5 years old, comparing the Vineland-II score with the score on the Raven's Coloured Progressive Matrices (Raven et al. 1998). In agreement with the literature (Tassé et al. 2012), the correlation between the Communication domain and intelligence was 0.63, higher than the 0.38 correlation obtained for the Daily Living Skills domain and the 0.16 correlation for the Socialization domain (for more detail, see Balboni et al., in press).

Leiter-R

To prevent the influence of linguistic competence, the Leiter-R was used, which provides a nonverbal measurement of global intelligence for individuals up to a developmental age of 24 months. The tasks from the Visualization and Reasoning Battery were used: Figure Ground, Form Completion, Matching, Sequential Order, Repeated Pattern, and Classification.

Peabody Picture Vocabulary Test-R

The PPVT-R allows the measurement of receptive vocabulary in individuals up to a developmental age of 30 months. The examiner says a word, and the examinee

must choose from four presented pictures the one that best corresponds to the word. An Italian adaptation of the test was used (Stella et al. 2000).

ADOS

The ADOS is a standardized semi-structured observational instrument that assesses symptoms of autism in the areas of communication, socialization, toy play, stereotyped behaviors, and restricted interests, through a standard series of activities designed to elicit certain behaviors. Four different modules can be administered, depending on the individual's age and level of language development. The number and the nature of items differ across modules, as does the diagnostic algorithm used to identify the presence of ASD. The two separated calibrated severity scores developed by Gotham et al. (2007, 2009; Hus et al. 2014) for the ADOS Social Affect and Restricted and Repetitive Behaviors domains were used.

Procedure

Trained psychologists administered all tests and those who evaluated the participants with ASD or with NDD did not know the clinical group each child was assigned to. The Vineland-II Survey Form was administered to the mother (97 %) or father (3 %) of each participant in the clinical and normative groups. All children underwent the Leiter-R and the PPVT-R. The ADOS was administered during the clinical evaluation by psychologists with the requested training. For organizational reasons, one child in the NDD group did not undergo the ADOS. At the end of the evaluation process, this child received a diagnosis of language disorder based on the standard protocol for suspected ASD and confirmed by the speech pathologist consultants. The participants completed either module 1 (77 %) or module 2 (23 %). The Vineland-II was administered first and the ADOS immediately afterward. The PPVT and the Leiter-R were administered as the third or fourth task in a counterbalanced order.

Results

Computation of the Vineland-II Z Scores Following Volkmar's Procedure

First, multiple regression equations were derived from the normative sample to predict raw scores on Vineland-II domains, subdomains, and subsets of items on the basis of raw scores on Leiter-R and PVTR-R predictors. Raw scores rather than normative scores were used for both predictors as well as for Vineland-II domains and subdomains to increase the variability of the score distribution of the variables (for more details, see Volkmar et al. 1993 and an application in Gillham et al. 2000). Regression equations were derived using forward stepwise regression. Cognitive and linguistic levels were always entered as the first and second predictors. The cognitive level predictor was conserved if its unique contribution was statistically significant; the linguistic level predictor was conserved if it added at least 1 % of variance to R^2 (see, Volkmar et al. 1993). In Table 3, equations obtained for Communication, Daily Living Skills, and Socialization domains are reported. Regression equations were obtained also for the Vineland-II subdomains and for all the subsets of items with a non-zero standard deviation of normative sample scores (i.e., equations were not derived for item subsets on which all the normative participants obtained a score equal to zero or two). For all the equations derived, the associated analysis of variance was statistically significant. For the normative participants, the ratio of observed raw scores to predicted scores was computed for domains, subdomains, and subsets of items. The means of the ratios for domains, subdomains, and item subsets were close to the expected value of 1.00.

Table 3 Regression equations derived from the normative sample that predict Vineland-II domain raw scores, using cognitive (Leiter-R) and linguistic (PPVT-R) levels as predictors

Domain	Equation
Communication	0.369 × Leiter-R + 0.182 × PPVT-R + 69.321
Daily living skills	0.539 × Leiter-R + 21.042
Socialization	0.445 × Leiter-R + 48.515

Regression equations were then used with the two clinical groups with ASD and with non-autistic NDD to derive their expected scores given their intellectual and linguistic competence. Expected scores were computed for Vineland-II domains, subdomains, and subsets of items. Ratios between observed and expected scores were computed and, as anticipated, they were below 1 in the communication and socialization domains. Ratios were then transformed into Z scores using the mean and the standard deviation of the ratios of the normative sample.

This procedure allows conversion of raw scores of the participants with ASD and with non-autistic NDD into Z scores that express the level of adaptive behavior compared with individuals of the normative sample with the same intellectual and linguistic competencies. For example, a negative Z score indicates that the participant has adaptive behavior skills that are lower than those of normative children with the same cognitive and linguistic competencies. In this way, the groups with ASD and with non-autistic NDD could be compared although they had different levels of cognitive and linguistic competencies.

In accord with previous studies (Gillham et al. 2000; Volkmar et al. 1993), this procedure was not applied to the Vineland-II Motor Skills domain. Even if cognitive and linguistic competencies proved to be statistically significant predictors of scores on the Motor Skills domain, this could be due mostly to fine motor abilities required by the tests used (i.e., Leiter-R and PVTR-R). Furthermore, from our clinic participants we selected two subgroups with ASD and non-autistic NDD and matched them not only on age, gender and parents' educational level but also on cognitive and linguistic abilities. The raw scores on the Vineland-II Motor Skills domain, subdomains, and item subsets obtained by these two subgroups were compared and no statistically significant differences were found.

Identification of Sets of Items that Discriminate the Groups with ASD and with Non-autistic NDD

First, we compared the two groups on the *Z* scores obtained in the Vineland-II Communication, Socialization, and Daily Living Skills domains and subdomains (Table 4). The ASD group had a significantly lower *Z* score only in the Communication domain ($t(50) = 2.47$, $p = .017$, Cohen's $d = 0.70$,) while the other domains as well as the Composite score were comparable. Comparisons across subdomains revealed that the ASD group obtained significantly lower scores in Receptive ($t(50) = 3.18$, $p = .002$, Cohen's $d = 0.91$), Expressive ($t(50) = 2.95$, $p = .005$, Cohen's $d = 0.84$), and Play and Leisure Time ($t(25.635) = 2.47$, $p = .020$, Cohen's $d = 0.81$) subdomains. All differences were large (Cohen's $d \geq 0.80$) except for Communication, which was a medium-sized effect ($0.50 \leq$ Cohen's $d < 0.80$), according to Cohen (1988). No differences were found on the other subdomains.

Table 4 M (SD) of Z scores obtained on the Vineland-II domains and subdomains by the two groups with DSA and with non-autistic NDD

	ASD *M* (*SD*)	NDD *M* (*SD*)
Communication	**−4.53 (3.37)**	**−2.33 (2.69)**
Receptive	**−3.28 (2.45)**	**−1.38 (1.52)**
Expressive	**−7.59 (4.53)**	**−3.93 (4.03)**
Written	−0.09 (1.81)	−0.10 (1.53)
Daily living skills	0.46 (2.62)	−0.57 (2.39)
Personal	0.32 (2.26)	−0.82 (1.72)
Domestic	1.67 (3.92)	0.36 (3.16)
Community	−0.41 (2.78)	0.29 (3.20)
Socialization	−3.44 (1.14)	−2.38 (2.45)
Interpersonal relationship	−2.82 (1.37)	−2.01 (2.41)
Play and leisure time	**−4.17 (1.41)**	**−2.56 (2.69)**
Coping skills	−1.80 (1.38)	−1.36 (1.64)
Adaptive behavior composite	−2.09 (1.63)	−1.75 (2.20)

Bold values indicate statistically significant differences between mean group scores ($p \leq .05$)

We then analyzed the scores on the item subsets. To identify those that discriminated the ASD and non-autistic NDD groups, we used *t* tests.

For the Communication domain (Table 5), significant differences in the *Z* scores were found for the following item subsets: Understanding, Listening and attending, and Following instructions (Receptive subdomain); and Beginning to talk, Interactive speech, and Speech skills (Expressive subdomain). In the Daily Living Skills domain, differences were found in Telephone skills, which implies the use of language, and in Rules, rights, and safety (Community subdomain). In the Socialization domain, significant differences were found in Imitating (Interpersonal Relationship subdomain) and in Playing (Play and Leisure time subdomain). In all comparisons, the ASD group obtained lower scores. The effect size was medium (Understanding, Listening and attending, Speech skills, Telephone skills, Rules, rights, and safety, and Imitating) or large (Following instructions, Beginning to talk, Interactive speech, and Playing). In summary, whereas at the domain level the only differences between the two groups were in Communication, when item subsets were considered, differences in Daily Living Skills and in Socialization were also observed.

To identify the item subsets that discriminated the two clinical groups, we also used ROC analysis and logistic regression. In particular, ROC analysis allowed estimation of the probability of correct classification, while logistic regression allowed computation of the percentage of participants correctly classified into each group. In Table 5, sets of items for which both ROC analysis and logistic regression revealed a discriminant ability at above-chance level (i.e., statistically significantly higher than 0.50) are reported. As can be seen, these item subsets were, for the Communication domain, Understanding, Listening and attending, and Following instructions (Receptive subdomain); Beginning to talk, Interactive speech, and Speech skills (Expressive subdomain); for the Daily Living Skills domain, Rules, rights, and safety (Community subdomain); and for the Socialization domain, Imitating (Interpersonal Relationship subdomain) and Playing (Play and Leisure time subdomain).

Identification of the Item Subset Combination that Best Classifies Participants in the Two Groups

To identify the best combination of item subsets, linear discriminant functions analyses were run. Linear discriminant analysis requires at least five participants in each group per predictor variable (Fletcher et al. 1987). Because the smaller of the two matched groups included 20 participants, four predictors could be entered.

Table 5 Sets of Vineland-II items with a statistically significant capacity to discriminate the two groups (ASD and NDD): differences (Student's *t* test), probability of correct classification (ROC analysis), percentage correctly classified (logistic regression), with the corresponding effect size, and total capacity of classification

	ASD *M* (*SD*)	NDD *M* (*SD*)	Student's *t* test (Cohen's *d*)	Correct classification probability (*SE*)	Correct classification percentage (Nagelkerke's R^2)	Total capacity classification in percentage
Communication						
Receptive						
Understanding	−2.89 (3.55)	−0.67 (1.04)	3.33 (0.78)	0.697 (0.07)	65.40 (0.23)	67.54
Listening and attending	−2.20 (1.33)	−1.22 (1.37)	2.54 (0.72)	0.698 (0.07)	65.40 (0.15)	67.58
Following instructions	−2.66 (2.01)	−1.02 (1.82)	2.95 (0.84)	0.728 (0.07)	69.20 (0.20)	71.01
Expressive						
Beginning to talk	−46.85 (36.19)	−19.28 (27.62)	3.10 (0.83)	0.752 (0.07)	67.30 (0.20)	71.27
Interactive speech	−7.50 (4.40)	−4.10 (3.97)	2.81 (0.80)	0.722 (0.07)	67.30 (0.19)	69.74
Speech skills	−4.84 (2.59)	−3.19 (3.14)	2.06 (0.59)	0.678 (0.08)	65.40 (0.10)	66.61
Daily living skills						
Community						
Telephone skills	−2.04 (1.72)	−0.89 (1.70)	2.34 (0.67)	–	–	–
Rules, rights, and safety	−0.95 (1.25)	−0.18 (1.35)	2.11 (0.60)	0.681 (0.08)	63.50 (0.11)	65.81
Socialization						
Interpersonal Relationship						
Imitating	−5.30 (2.98)	−3.08 (3.61)	2.31 (0.69)	0.661 (0.08)	71.20 (0.14)	68.65
Play and Leisure time						
Playing	−8.96 (3.53)	−4.99 (4.69)	3.25 (0.99)	0.736 (0.08)	73.10 (0.25)	73.35

The four item subsets for which the differences between the two groups had the highest magnitude were (in order of magnitude) Playing, Following instructions, Beginning to talk, and Interactive speech (Table 5). The total capacity for classification, i.e., the mean of probability of correct classification and participants correctly classified, was computed. The same four item subsets produced the best results for classification capacity, but with a slightly different order of magnitude: Playing, Beginning to talk, Following instructions, and Interactive speech. Therefore, we ran a discriminant analyses with these four item subsets as predictors. This combination correctly classified 67 % of participants, and, specifically, 72 % of children with ASD and 60 % of children with non-autistic NDD (Wilks' $\lambda = 0.75$; $\chi^2[4] = 13.94$; $p = .007$). In children classified with ASD, sensitivity was 74 % and specificity was 57 %.

Other discriminant analyses were run with the three sets showing the best discriminant capacity as fixed predictors (Playing, Following instructions, Beginning to talk). As a fourth predictor, each of the five other item subsets with discriminant capacity was entered, one at a time: Imitating, Listening and attending, Understanding, Speech skills, and Rules, rights, and safety. The following combination produced the best classification results: Playing, Following instructions, Beginning to talk, and Speech skills (Wilks' $\lambda = 0.73$; $\chi^2[4] = 15.11$; $p = .004$). This combination correctly classified 73 % of participants, and, specifically, 75 % of children with ASD and 70 % of children with non-autistic NDD. In children classified with ASD, sensitivity was 80 % and specificity was 64 %.

To confirm the validity of this combination in classifying children with ASD, the correlations between these four subsets and the calibrated severity scores on the ADOS Social Affect and Restricted and Repetitive Behaviors domains were investigated (Table 6). The correlation coefficients were statistically significant for the Social

Table 6 Correlation between scores on sets of Vineland-II items that best discriminate the two groups (ASD and NDD) and ADOS social affect and restricted and repetitive behaviors domain calibrated severity scores for all the clinical participants

Sets of Vineland-II items	ADOS	
	Social affect	Restricted and repetitive behaviors
Following instructions	**−0.32**	−0.03
Beginning to talk	**−0.37**	0.03
Interactive speech	**−0.27**	−0.05
Playing	**−0.37**	−0.24

ADOS was not administered to one participant of the NDD group. Bold values indicate statistically significant correlation coefficients ($p \leq .05$)

Affect but not for the Restricted and Repetitive Behaviors domain. Using Cicchetti et al.'s (2011) effect size index for correlation, all the coefficients for Social Affect reflected medium effects (0.30–0.49) except for the Vineland-II Speech skills, where the effect was small (0.10–0.29).

Discussion

Our main goal was to identify the item subsets of the Vineland-II that could best discriminate two matched groups of preschoolers, one with ASD and one with non-autistic NDD. To this end, the two groups were matched for age, gender, and both parents' educational levels, in accord with the criteria proposed by Kover and Atwood (2013) for establishing equivalence in group-matching design with participants with developmental disabilities. Moreover, following Volkmar et al.'s procedure, the two groups also were made comparable for cognitive and linguistic levels, variables on which they initially were significantly different. To this end, the level of adaptive behavior of each participant was expressed as the *Z* score obtained after comparing the individual's performance with that of a normative group with typical development and similar intellectual and linguistic competences (i.e., the *Z* score expresses the individual's adaptive behavior level independent of his or her cognitive and linguistic competencies).

Using two different types of data analyses, we were able to identify the item subsets for which the differences between the two matched groups were statistically significant and that allowed classification of the participants of both groups at a level above chance. These item subsets were Understanding, Listening and attending, Following instructions (these constitute all the items in the Receptive Communication subdomain), and Beginning to talk, Interactive speech, and Speech skills (for the Expressive Communication domain), Playing and Imitating (for the Socialization domain), and Rules, rights, and safety (for the Daily living skills domain). The effect sizes of the differences (Cicchetti et al. 2011) were medium or large. The percentage of individuals correctly classified ranged from 66 to 73 %.

These results are in agreement with the adaptive behavior profile found with the Vineland-II in low-functioning toddlers with ASD, characterized by Communication lower than Socialization (Paul et al. 2011; Ray-Subramanian et al. 2011). For the first time, we have been able to observe the same pattern in low-functioning preschoolers. We also found a difference in the Daily Living Skills item subset Rules, rights, and safety, which is in agreement with the unpredictable and volatile behavior that children with autism sometimes display (e.g., Abbeduto et al. 2004; Bryson and Smith 1998). In our investigation, as well as that of Paul and colleagues (2011), no statistically significant difference was found between children with ASD and those with non-autistic NDD in the Vineland-II Socialization domain. This is an unexpected result, because this difference is the one most frequently reported (e.g., Carpentieri and Morgan 1996; Volkmar et al. 1987). Therefore, we decided to examine the Vineland-II performance at the item subset level to account for the ASD profile inconsistencies in the literature. We found that differences not observed at the domain level (i.e., Socialization domain) were found at the item subset level (i.e., Playing and Imitating) and also at the subdomain level (i.e., Play and Leisure time). In low-functioning preschoolers compared with peers who have non-autistic NDD, the typical Socialization delay of ASD seems to be expressed mainly in playing and imitating skills and not in other social adaptive behavior skills. The same interpretation could account for the results reported by Paul et al. (2011), but to verify this hypothesis, a more direct investigation with toddlers, using the same methodology employed here, is needed.

We also found that the four Vineland-II sets of items Playing, Following instructions, Beginning to talk, and Speech skills constitute the combination that best discriminates between the two clinical groups. This combination allowed identification of preschoolers with ASD and discrimination between these children and non-autistic NDD peers with a sensitivity of 80 % and a specificity of 64 %. These results are consistent with previous investigations that used all the items of the VABS and reported good sensitivity (Carpentieri and Morgan 1996; Gillham et al. 2000; Volkmar et al. 1993) and ability to reduce diagnostic errors in the case of contrasting results between ADOS and ADI-R (Tomanik et al. 2007). These results may be useful for research on early diagnosis and for clinicians for planning tailored treatment for individual with ASD.

This combination has a moderate negative relationship with the ADOS Social Affect domain but it is not associated with the ADOS Restricted and Repetitive Behaviors domain. The present investigation is the first to use the Vineland-II and the new ADOS calibrated severity scores (Hus et al. 2014). These new ADOS scores allow a distinction between the symptoms from the social communication and the repetitive behavior domains, unlike the previous calibrated score that combined all symptoms from both areas (Gotham et al. 2007, 2009). The same method was employed by Paul et al. (2011), who found differences in the Daily Living Skills domain and Receptive subdomain, thus confirming that the Vineland-II domains and subdomains that discriminate between toddlers with and without ASD are related to ADOS symptoms. Those

studies that used the scores in all the Vineland-II domains and subdomains found a low or null relationship with ADOS symptom severity (Kanne et al. 2011; Ray-Subramanian et al. 2011). Finally, our results are in agreement with studies using the Vineland-II, which reported that the individual's ability to function independently in the world is not related to the level of severity of symptoms in the repetitive behavior domain, measured with the ADIR-R (Kanne et al. 2011).

The updated Vineland-II, like the previous version, appears to be a very efficient tool to measure, even in preschoolers, the adaptive behavior profile of children with ASD. A close look at the adaptive behavior profile reveals that preschoolers with ASD have deficits in playing with objects or peers, in using language to interact with others, and in receptive adaptive behavior skills of showing interest and paying attention to what caregivers say and following verbal instructions. Comparisons of children with ASD and peers who have the same linguistic and cognitive competence but different neurodevelopmental disorders suggest that children with ASD experience a specific deficit, not in verbal knowledge or linguistic competencies, but in the functional use of language in everyday activities (see the same results in Paul et al. 2008, 2011). These results emphasize the importance of the evaluation of adaptive behavior in measuring the effects of ASD in daily living activities.

The unique contribution of this study can be summarized as follows: (1) For the first time the adaptive behavior profile of preschoolers with ASD has been investigated using the updated Vineland-II; (2) Strong strategies have been used to establish equivalence (i.e., matching) of children with and without ASD and to rule out the effect of the more relevant variables that could influence adaptive behavior; (3) The analyses went beyond the Vineland-II total domain and subdomain scores and considered specific item subsets to account for the inconsistent ASD profile in the literature and to help in diagnosis and intervention. However, relevant limitations of the study must be mentioned. First, participants in the NDD group presented different types of neurodevelopmental disorders (i.e., intellectual disability and language disorder) and some of them also presented an associated regulation or behavioral disorder. A more traditional NDD group with only one type of NDD disorder (e.g., intellectual disability) could better enhance understanding of the unique characteristics of ASD. Moreover, the sample size was a bit small compared with sample sizes in previous studies on this topic that used a within-participants research design (e.g., Ray-Subrmanian et al. 2011). Yet, our sample size was similar to those of studies that have used the updated Vineland-II and the matched group research design (e.g., Paul et al. 2011). However, further investigations with a bigger sample size could find other differences we didn't found in Vineland-II domains, subdomains, and sets of items.

In conclusion, the present investigation has important practical implications. Our results clearly demonstrate that performance on the Vineland-II item content categories can be very useful for deriving a valid picture of abilities and disabilities of children with ASD, which is necessary for personalized diagnosis and treatment.

Acknowledgments The investigation was partially supported with funding from the Italian Department of Education, University and Research, Grant PRIN 2005. The authors thank Federica Bianchi, Paolo Guzzon, Roberta Igliozzi, and Maria Rosa Valsecchi for their help with the data collection, and Antonio Narzisi for his helpful comments. Portions of this research were presented at the annual meeting of the American Psychological Association, Boston, in August 2008.

Author Contributions All authors contributed equally to the work presented in this paper.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Standards This study was approved by the local ethics committee and was performed in accordance with the ethical standards laid down in the 2013 Declaration of Helsinki and its later versions. Parental informed consent was obtained.

References

Abbeduto, L., Seltzer, M. M., Shattuck, P., Krauss, M. W., Orsmond, G., & Murphy, M. M. (2004). Psychological wellbeing and coping in mothers of youths with autism, Down syndrome, or fragile X syndrome. *American Journal of Mental Retardation, 109*, 237–254.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Association.

Balboni, G., Belacchi, C., Bonichini, S., & Coscarelli, A. (in press). *Vineland-II, Survey Interview Form. Standardizzazione Italiana* [Vineland-II, Survey Interview Form. Italian standardization]. Firenze, Italy: Giunti OS.

Balboni, G., & Pedrabissi, L. (2003). *Adattamento italiano delle Vineland Expanded Form* [Italian adaptation of Vineland Adaptive Behavior Expanded Form]. Firenze, Italy: Giunti OS.

Balboni, G., Pedrabissi, L., Molteni, M., & Villa, S. (2001). Discriminant validity of the Vineland Scales: Score profiles of individuals with mental retardation and a specific disorder. *American Journal on Mental Retardation, 106*, 162–172.

Bryson, S. E., & Smith, I. M. (1998). Epidemiology of autism: Prevalence, associated characteristics, and implications for research and service delivery. *Mental Retardation and Developmental Disabilities Research Reviews, 4*, 97–103.

Carpentieri, S., & Morgan, S. B. (1996). Adaptive and intellectual functioning in autistic and nonautistic retarded children. *Journal of Autism and Developmental Disorders, 26*, 611–620.

Carter, A. S., Volkmar, F. R., Sparrow, S. S., Wang, J.-J., Lord, C., Dawson, G., et al. (1998). The Vineland adaptive behavior scales: Supplementary norms for individuals with autism. *Journal of Autism and Developmental Disorders, 28*, 287–302.

Centers for Disease Control and Prevention. (2009). Prevalence of autism spectrum disorders—Autism and developmental disabilities monitoring network, United States, 2006. *MMWR Surveill Summary, 58*, 1–20.

Centers for Disease Control and Prevention. (2012). Prevalence of autism spectrum disorders—Autism and developmental disabilities monitoring network, 14 sites, United States, 2008. *MMWR Surveill Summary, 61*, 1–19.

Centers for Disease Control and Prevention. (2014). Prevalence of autism spectrum disorder among children aged 8 years—Autism and developmental disabilities monitoring network, 11 sites, United States, 2010. *MMWR Surveill Summary, 63*, 1–21.

Cicchetti, D. V., Koenig, K., Klin, A., Volkmar, F. B., Paul, R., & Sparrow, S. (2011). From Bayes through marginal utility to effect sizes: A guide to understanding the clinical and statistical significance of the results of autism research findings. *Journal of Autism and Developmental Disorders, 41*, 168–174.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., et al. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics, 125*, 17–23.

Dunn, L. M., & Dunn, D. M. (1981). *Peabody picture vocabulary test—Revised*. Circle Pines, MN: American Guidance Service.

Farley, M. A., McMahon, W. M., Fombonne, E., Jenson, W. R., Miller, J., Gardner, M., et al. (2009). Twenty-year outcome for individuals with autism and average or near-average cognitive abilities. *Autism Research, 2*, 109–118.

Fein, D., Barton, M., Eigsti, I.-M., Kelley, E., Naigles, L., Schultz, R. T., & Tyson, K. (2013). Optimal outcome in individuals with a history of autism. *Journal of Child Psychology and Psychiatry, 54*, 195–205.

Fenton, G., D'Ardia, C., Valente, D., Vecchio, I. D. V., Fabrizi, A., & Bernabei, P. (2003). Vineland adaptive behavior profiles in children with autism and moderate to severe developmental delay. *Autism, 7*, 269–287.

Fletcher, J. M., Rice, W. J., & Ray, R. M. (1987). Linear discriminant function analysis in neuropsychological research: Some uses and abuses. *Cortex, 14*, 564–577.

Gillham, J. E., Carter, A. S., Volkmar, F. R., & Sparrow, S. S. (2000). Toward a developmental operational definition of autism. *Journal of Autism and Developmental Disorders, 30*, 269–278.

Gotham, K., Pickles, A., & Lord, C. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39*, 693–705.

Gotham, K., Risi, S., Pickles, A., & Lord, C. (2007). The Autism Diagnostic Observation Schedule: Revised algorithms for improved diagnostic validity. *Journal of Autism and Developmental Disorders, 37*, 613–627.

Green, J., Charman, T., McConachie, H., Aldred, C., Slonims, V., Howlin, P., et al. (2010). Parent-mediated communication-focused treatment in children with autism (PACT): A randomized controlled trial. *Lancet, 375*, 2152–2160.

Hus, V., Gotham, K., & Lord, C. (2014). Standardizing ADOS domain scores: Separating severity of social affect and restricted and repetitive behaviors. *Journal of Autism and Developmental Disorders, 44*, 2400–2412.

International Test Commission (2005). *International guidelines on test adaptation*. www.intestcom.org

Kanne, S. M., Gerber, A. J., Quirmbach, L. M., Sparrow, S. S., Cicchetti, D. V., & Saulnier, C. A. (2011). The role of adaptive behavior in autism spectrum disorders: Implications for functional outcome. *Journal of Autism and Developmental Disorders, 41*, 1007–1018.

Klin, A., Saulnier, C., Sparrow, S., Cicchetti, D., Volkmar, F., & Lord, C. (2007). Social and communication abilities and disabilities in higher functioning individuals with autism spectrum disorders: The Vineland and the ADOS. *Journal of Autism and Developmental Disorders, 37*, 748–759.

Kover, S. T., & Atwood, A. K. (2013). Establishing equivalence: Methodological progress in group-matching design and analysis. *American Journal on Intellectual and Developmental Disabilities, 118*, 3–15.

Kraijer, D. (2000). Review of adaptive behavior studies in mentally retarded persons with autism/pervasive developmental disorder. *Journal of Autism and Developmental Disorders, 30*, 39–47.

Lord, C., Rutter, M., DiLavore, P. C., & Risi, S. (1999). *Autism Diagnostic Observation Schedule*. Los Angeles: Western Psychological Services.

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., Bishop, L. S., et al. (2012). *Autism Diagnostic Observation Schedule* (2nd ed.). San Antonio, TX: Pearson.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview-Revised: A revised version of diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*, 659–685.

Loveland, K. A., & Kelley, M. L. (1991). Development of adaptive behavior in preschoolers with autism or Down syndrome. *American Journal of Mental Retardation, 96*, 13–20.

Makrygianni, M. K., & Reed, P. (2010). A meta-analytic review of the effectiveness of behavioural early intervention programs for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 4*, 577–593.

Matson, J. L., Beighley, J., & Turygin, N. (2012). Autism diagnosis and screening: Factors to consider in differential diagnosis. *Research in Autism Spectrum Disorders, 6*, 19–24.

Matson, J. L., Rieske, R. D., & Tureck, K. (2011). Additional considerations for the early detection and diagnosis of autism: Review of available instruments. *Research in Autism Spectrum Disorders, 5*, 1319–1326.

Matthews, N. L., Pollard, E., Ober-Reynolds, S., Kirwan, J., Malligo, A., & Smith, C. J. (2015). Revisiting cognitive and adaptive functioning in children and adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*, 138–156.

Mouga, S., Almeida, J., Café, C., Duque, F., & Oliveira, G. (2014). Adaptive profiles in autism and other neurodevelopmental disorders. *Journal of Autism and Developmental Disorders,*. doi:10.1007/s10803-014-2256-x.

Muratori, F., & Narzisi, A. (2014). Exploratory study describing 6 month outcomes for young children with autism who receive treatment as usual in Italy. *Neuropsychiatric Disease and Treatment, 10*, 577–586.

Paul, R., Chawarska, K., Cicchetti, D., & Volkmar, F. (2008). Language outcomes in toddlers with ASD: A 2 year follow-up. *Autism Research, 1*, 97–107.

Paul, R., Loomis, R., & Chawarska, K. (2011). Adaptive behavior in toddlers under two with Autism spectrum disorder. *Journal of Autism and Developmental Disorders,*. doi:10.1007/s10803-011-1279-9.

Paul, R., Miles, S., Cicchetti, D., Sparrow, S., Klin, A., Volkmar, F., et al. (2004). Adaptive behavior in autism and pervasive developmental disorder-not otherwise specified: Microanalysis of scores on the Vineland Adaptive Behavior Scales. *Journal of Autism and Developmental Disorders, 34*, 223–228.

Perry, A., Flanagan, H. E., Geier, J. D., & Freeman, N. L. (2009). Brief report: The Vineland Adaptive Behavior Scales in young children with autism spectrum disorders at different cognitive

levels. *Journal of Autism and Developmental Disorders, 39*, 1066–1078.

Raven, J., Raven, J. C., Court, J. H. (1998). *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 2: The coloured progressive matrices*. San Antonio, TX: Harcourt Assessment.

Ray-Subramanian, C. E., Huai, N., & Weismer, S. E. (2011). Brief report: Adaptive behavior and cognitive skills for toddlers on the Autism spectrum. *Journal of Autism and Developmental Disorders, 41*, 679–684.

Rogers, S. J., Vismara, L., Wagner, A. L., McCormick, C., Young, G., & Ozonoff, S. (2014). Autism treatment in the first year of life: A pilot study of infant start, a parent-implemented intervention for symptomatic infants. *Journal of Autism and Developmental Disorders, 44*, 2981–2995.

Roid, G. H., & Miller, L. J. (1997). *Leiter International Performance Scale-Revised*. Wood Dale, IL: Stoelting.

Schalock, R. L., Bothwick-Duffy, S. A., Bradley, V. J., Buntinx, W. H. E., Coulter, D. L., Craig, E., et al. (2010). *Intellectual disability: Definition, classification, and systems of supports* (11th ed.). Washington, DC: American Association on Intellectual and Developmental Disabilities.

Sparrow, S. S., Balla, D. A., & Cicchetti, D. V. (1984). *Vineland Adaptive Behavior Scales* (2nd ed.). Circle Pines, MN: American Guidance Service.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland Adaptive Behavior Scales* (2nd ed.). Circle Pines, MN: American Guidance Service.

Stella, G., Pizzoli, C., & Tressoldi, P. E. (2000). *Peabody. Test di vocabolario ricettivo* [Receptive vocabulary test]. Torino: Omega.

Tassé, M. J., & Craig, E. (1999). Critical Issues in the cross-cultural assessment of adaptive behavior. In R. Schalock & D. Braddock (Eds.), *Adaptive behavior and its measurement* (pp. 161–183). Washington, DC: American Association on Mental Retardation.

Tassé, M. J., Schalock, R. L., Balboni, G., Bersani, H, Jr, Borthwick-Duffy, S. A., Spreat, S., et al. (2012). The construct of adaptive behavior: Its conceptualization, measurement, and use in the field of intellectual disability. *American Journal on Intellectual and Developmental Disabilities, 117*, 291–303.

Tomanik, S. S., Pearson, A. D., Loveland, A. K., Lane, M. D., & Shaw, J. B. (2007). Improving the reliability of autism diagnoses: Examining the utility of adaptive behavior. *Journal of Autism and Developmental Disorders, 37*, 921–928.

Volkmar, F. R., Carter, A., Sparrow, S. S., & Cicchetti, D. V. (1993). Quantifying social development in autism. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 627–632.

Volkmar, F. R., Sparrow, S. S., Goudreau, D., Cicchetti, D. V., Paul, R., & Cohen, D. J. (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.