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Response to Name in Infants Developing Autism Spectrum Disorder: A Prospective Study

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Abstract

Objective—To examine longitudinal patterns of response to name from 6–24 months of age in infants at high and low risk for autism spectrum disorder (ASD).

Study design—A response to name task was tested at 6, 9, 12, 15, 18, and 24 months of age in 156 infant siblings of children with ASD (high-risk) or typical development (low-risk). At 36 months of age, participants were classified into 1 of 3 outcome groups: group with ASD (n = 20), high-risk group without ASD (n = 76), or low-risk group without ASD (n = 60). Differences in longitudinal performance were assessed using generalized estimating equations, and sensitivity and specificity for identifying ASD were calculated. Differences in age 36-month functioning were examined between infants who developed ASD and repeatedly vs infrequently failed to respond to name.

Results—At 9 months of age, infants developing ASD were more likely to fail to orient to their names, persisting through 24 months. Sensitivity/specificity for identifying ASD based on at least 1 failure between 12 and 24 months were estimated at .70 in this sample. One-half of the infants who developed ASD had repeated failures in this timeframe, and demonstrated lower age 36-month receptive language, and earlier diagnosis of ASD than infants with ASD who had infrequent failures.

Conclusions—In addition to recommended routine broad-based and ASD-specific screening, response to name should be regularly monitored in infants at risk for ASD. Infants who consistently fail to respond to their names in the second year of life may be at risk not only for ASD but also for greater impairment by age 3 years.

Infants as young as 4–6 months of age listen significantly longer to their own names than to other names,[1,2] suggesting that sound patterns of infants' names are internalized early in life.

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The other authors declare no conflicts of interest.

Neural mechanisms underlying response to name likely involve a pre-attentive “detection” stage followed by an evaluation stage, during which attention is shifted only if the detected event is deemed meaningful.[3] Infants use their names as social cues to orient their attention to salient aspects of their environments.[2,4] Because of the centrality of this behavior in the development of social-communication skills, the assessment of response to name may be useful in the early identification of autism spectrum disorder (ASD). Indeed, retrospective studies of infants who developed ASD have demonstrated diminished response to name as early as 12 months of age,[5–8] and response to name is included in all diagnostic measures for ASD. However, many widely used screening tools rely solely on parent report, and little is known regarding developmental progressions of this behavior via direct observation.

Recent prospective studies, in which infants are recruited before diagnosis and followed longitudinally, have examined response to name in controlled environments using standardized procedures, finding reduced frequency of this behavior in toddlers diagnosed with ASD compared with those with developmental delays or typical development.[9] One such study found that infants with family histories of ASD were less likely to respond than infant siblings of typically developing children by 12 months of age.[10] Few studies have measured response to name behavior at multiple ages, however, making it difficult to determine when affected children first begin to fail the task, whether differences persist over the first years of life, and how early the behavior distinguishes children with ASD from unaffected children.

The present study examined differences in the longitudinal course of response to name among infants at high- and low-risk for ASD. We hypothesized that the group with ASD outcomes would exhibit reduced responding by 12 months of age relative to infants with non-ASD outcomes. We also evaluated, within the group with ASD, whether patterns of response to name between 12 and 24 months of age were related to age 36-month functioning.

Methods

This study uses data from a prospective longitudinal study of infants at risk for ASD and was conducted under the approval of the university’s Institutional Review Board. Informed consent was obtained from parents before assessments. Infants were evaluated by examiners unaware of group membership, with ongoing administration/scoring fidelity procedures in place to ensure minimal cross-examiner differences. The primary measure of interest, the “orients to name” task, was administered as part of a larger assessment battery with visits occurring at 6, 9, 12, 15, 18, and 24 months of age. At 36 months of age, participants were classified into 1 of 3 outcome groups: group with ASD, high-risk group without ASD, and low-risk group without ASD.

The sample was drawn from a larger longitudinal study of infant siblings of children with ASD (high-risk group) or typical development (low-risk group). The primary inclusion criterion for the high-risk group was status as a younger sibling of a child with ASD. Diagnosis of the older sibling (proband) was confirmed using the Autism Diagnostic Observation Schedule (ADOS[11]) and the Social Communication Questionnaire.[12] Exclusion

criteria for the high-risk group included birth before 32 weeks gestation and a known genetic disorder in the infant or proband. The primary inclusion criterion for the low-risk group was status as a younger sibling of a child with typical development, confirmed by an intake screening questionnaire and proband scores below the ASD range on the Social Communication Questionnaire. Exclusion criteria for the low-risk group were birth before 36 weeks gestation; developmental, learning, or medical conditions in any older sibling; and ASD in any first-, second-, or third-degree relative.

Participants were enrolled by 9 months of age, with 76% having their first visit at 6 months of age. The sample consisted of 156 participants: 20 with ASD (n = 19 high-risk, 1 low-risk), 76 high-risk without ASD, and 60 low-risk without ASD, as determined at the age 36-month outcome assessment. Consistent with prior reports,[13] ASD outcomes at the 36-month visit required that ADOS scores be at or above the ASD cut-off and that the child meet Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision criteria for Autistic Disorder or Pervasive Developmental Disorder-Not Otherwise Specified. Diagnoses were determined by a licensed psychologist or pediatrician. Outcomes were finalized at 36 months of age, but if a child met criteria for ASD at an earlier visit, the diagnosis was made and referrals for intervention provided. Of the children with ASD outcomes, 87% had received services for autism or other developmental delays before age 3 years (average hours per week = 17.80, SD = 9.57; data missing for 5 children). Table I displays sample characteristics by outcome group.

Measures

All measures in the present study met applicable psychometric standards for standardization, reliability, and validity.

Orients to Name—This task, adapted from the Autism Observation Scale for Infants,[14] was administered at 6, 9, 12, 15, 18, and 24 months of age. It involves calling the infant's name in a clear voice at a normal volume up to 2 times (constituting a "press") while the infant is engaged with toys and seated in the parent's lap, at least 2 feet from (and not facing) the examiner. A total of 2 presses are administered, with each press consisting of 2 trials. Participant behavior was scored as follows, consistent with the Autism Observation Scale for Infants scoring guidelines[14]: 0 = orients to name with eye contact on both presses, at least one of which is on the first trial; 1 = orients with eye contact at least once; or 2 = does not orient on any trial. For this study, we consider a score of 0 or 1 to be "passing," and a 2 to constitute a "failure," resulting in a dichotomous measure of the orienting response.

ADOS—The ADOS is a semistructured interaction and observation that measures symptoms of autism. It has 2 empirically derived cut-offs for ASD and autistic disorder. The ADOS[11] was used for diagnostic classification purposes in both the proband (to verify inclusion criteria) and the participant (to determine outcome at 36 months of age).

Mullen Scales of Early Learning—The Mullen Scales of Early Learning[15] standardized developmental test for children from birth to 68 months of age was used to evaluate cognitive functioning. Four subscales were administered: visual reception, fine motor,

receptive language, and expressive language, each resulting in separate T-scores (mean = 50, SD = 10). An overall composite score, the early learning composite, is calculated using published normative data (mean = 100, SD = 15).

Age at First Concerns and Diagnosis—If, at any visit, an examiner had ASD-related concerns about a child, this was noted in a tracking system, as was the age at which a formal diagnosis was made.

Vineland Adaptive Behavior Scales: Second Edition—The Vineland Adaptive Behavior Scales: Second Edition[16] is a parent-report assessment of social, communication, motor, and daily living skills is normed for use with infants to adults. It provides standard scores and age equivalents for subscales and an overall score, the adaptive behavior composite (mean = 100, SD = 15).

Missing Data—Missing orients to name data were due to variability in enrollment ages, missed visits, and skipped administrations. All 156 infants had data for at least 3 time points: 42% had data for all 6 visits, 38% had data for 5, 17% had data for 4, and 3% had data for 3.

Data Analytic Plan

Longitudinal Differences between Groups—Generalized estimating equations[17] with binomial variance function and logit link were used to examine longitudinal changes in orienting to name and to evaluate differences between outcome groups over time. This approach makes use of all available data for a child, allows for adjustment for potential confounders, and does not depend on the correct specification of the within-person correlation over time. We modeled the within-child correlation with exchangeable log ORs, and used empirical (robust) variance estimators. The model included terms for group (low-risk group without ASD, high-risk group without ASD, and ASD), the linear effect of visit age in months (ie, 6, 9, 12, 15, 18, 24; centered at 6 months), the interaction between group and visit age, and child sex. Analyses were implemented using PROC GENMOD in SAS v 9.4 (SAS Institute, Cary, North Carolina). Hypothesis tests were 2-sided; *P* values of <.05 were considered statistically significant.

Sensitivity/Specificity—We calculated sensitivity, specificity, positive predictive value (PPV), and negative predictive value of failure to orient to name in identifying ASD. We first calculated estimates for having at least 1 failing score across all visits between the group without ASD (collapsing low-risk and high-risk) and the group with ASD. We chose to collapse across the 2 outcome groups without ASD because combining these 2 groups is more representative of a general pediatrics sample, and, thus, sensitivity/specificity estimates are more translatable. Next, we narrowed the age window to correspond with when ASD symptoms are known to emerge,[18,19] calculating estimates for having at least 1 failing score between 12 and 24 months of age. Finally, we examined failure to orient at each individual age to determine whether 1 particular time point was most critical in predicting ASD. We imputed missing data via multilevel imputations[20] and constructed 10 separate complete datasets, so that estimates were based on the same sample at each age and, thus, comparable

across ages. Analyses were performed on each of the imputed datasets and combined according to Rubin's rules.[21]

Patterns within the Group with ASD—Finally, we examined performance within the group with ASD to look for potential predictors of later functioning and impairment levels. We divided the infants with ASD outcomes into 2 subgroups (infrequent vs repeated failures to orient to name) based on patterns of performance between 12 and 24 months of age. We then compared these subgroups on multiple age 36-month developmental measures, age at first concerns, and age at diagnosis, using Wilcoxon 2-sample exact tests.

Results

Table II summarizes results for the orients to name task. The interaction between outcome group and visit age was significant, $\chi^2(2) = 8.86$, $P = .01$, indicating differences between the 3 groups in orienting to name patterns over time. The 3 outcome groups had similar performance at baseline, $\chi^2(2) = 1.80$, $P = .41$. The likelihood of receiving a failing score decreased over time in the low-risk group without ASD (OR 0.91, 95% CI 0.84–0.99 for each 1-month increase in visit age) and high-risk group without ASD (OR 0.92, 95% CI 0.87–0.96). By contrast, the group with ASD had a flat trajectory (OR 1.03, 95% CI 0.98–1.09), showing no decrease in failure rates with age. Significant differences between the group with ASD and both groups without ASD emerged at 9 months, increasing in magnitude over time (Table II). The difference in slopes between the high-risk group without ASD and low-risk group without ASD was not significant (OR 1.01, 95% CI 0.92–1.11), with comparable odds of a failing score at all visit ages. The effect of sex was nonsignificant, $\chi^2(1) = 0.07$, $P = .79$.

Parameter estimates for the generalized estimating equation model are presented in Table III (available at www.jpeds.com).

Sensitivity/Specificity

Most sensitivity and PPV estimates were below acceptable standards for developmental screening measures (Table IV),[22] and although the broadest test of at least 1 failure between 6 and 24 months of age resulted in sensitivity of .80. However, specificity was low, at .52. The values obtained for the comparison of at least 1 failure between 12, 15, 18, and 24 months of age provided the best balance of sensitivity and specificity in our sample, which were at the lower bound of acceptable standards for developmental screening measures,[22] with both estimated at .70. Across comparisons, confidence intervals for sensitivity and PPV were wide.

Patterns within the Group with ASD

To identify patterns of performance within the group with ASD that may indicate later functioning/impairment levels, we first reasoned that because approximately 30% of infants who did not develop ASD failed the orients to name task at least once between 12 and 24 months of age, 1 failure would represent a lower limit of "acceptable" performance. Thus, infants with ASD outcomes were grouped based on repeated (ie, ≥2) vs infrequent (ie, 0–1)

failures between 12–24 months of age. One-half of the infants with ASD outcomes (n = 10) repeatedly failed the task, and the remaining 10 failed 0–1 times (n = 6 never failed). The groups differed on age 36-month Mullen Scales of Early Learning Receptive Language (P = .02), with the group with repeated failures performing worse by an average of >10 points (Table V).

The repeated failures group was also diagnosed earlier by an average of 10 months (P < .01). There was a trend toward lower Vineland Adaptive Behavior Scales communication scores (P = .08; Cohen d = 1.08) and higher ADOS total scores (P = .05; Cohen d = .77) in the group with repeated failures. The group with repeated failures were first identified with examiner concerns at an average age of 11 months vs 17 months in the group with infrequent failures, which was not statistically significant (P = .21) but may be clinically significant (Cohen d = .77). The groups differed by sex, with all of the 5 girls with ASD belonging to the repeated failures group.

Discussion

In this study, we examined longitudinal differences in performance on a standardized task measuring response to name between infants who did and did not develop ASD. Participants were followed prospectively and tested directly, addressing many of the methodologic limitations of previous retrospective studies. We also evaluated whether patterns of this behavior over time within the group of infants who developed ASD predicted later functioning.

Our findings indicate that, at a group level, the infants who developed ASD were more likely to fail to orient to their names than infants who did not develop ASD. In the current sample, this group difference was evident by 9 months of age, even earlier than previous studies have reported.[6–8,10] Consistent with prior research,[10] specificity of failing to respond to name at individual ages was high, but sensitivity was low, indicating that failure to respond to one's name may be 1 indicator of emergent ASD, but that not all infants who develop ASD will neglect to respond. This is also consistent with a recent study in which experts rated behavior, including response to name, from short video clips of young children with ASD, typical development, or language delays.[23] Although the group with ASD responded significantly less often than the other groups, all children with ASD responded at least once.[23] Thus, there is not an absence of ability to respond to name in children with ASD, but a reduced likelihood. Notably, 54% of the infants with ASD in our sample who passed the task at 12 months of age failed during at least 1 subsequent assessment, suggesting that this behavior should be monitored over time.

We chose to collapse across the 2 groups without ASD in our sensitivity/specificity analyses given that combining them may provide a more representative picture with regard to a general pediatrician's patient population. Rates of false positives are a persistent concern in the field of autism screening. In this sample, rates of false positives at individual ages ranged from 4% to 21% in the low-risk group without ASD and from 3% to 26% in the high-risk group without ASD (Table II). For our estimates of ≥1 failure between 6 and 24 months of age, false positive rates were 38% for the low-risk group without ASD and 47% for the high-

risk group without ASD, and for ≥1 failure between 12 and 24 months of age, rates were 22% vs 34%, respectively. These rates are consistent with prior work documenting subclinical features of ASD (ie, the broader autism phenotype) in siblings without ASD of children with ASD.[13] However, given the nature of our sample, we cannot extrapolate to the general pediatrics population and cannot address how well orienting to name distinguishes ASD from other developmental delays.

The pattern of failing responses over time between the group with ASD and groups without ASD is reminiscent of patterns previously shown across other measures,[18,19,24] with differences generally emerging between 12 and 18 months of age and increasing over time. Early failures to respond to name may be a manifestation of the decreased social orienting characteristic of children with ASD.[25,26] Consistent failure to orient to one's name early in life may be part of a larger developmental cascade resulting in the social-communication symptoms of ASD because infants who do not respond to their names likely engage in a decreasing number of social opportunities over time.

The heterogeneity in the group with ASD highlights the importance of approaches that focus on examining individual differences in patterns of behavior. In our sample, one-half of the infants who developed ASD exhibited repeated failures over time, and demonstrated significantly lower receptive language at 36-months of age and earlier age of diagnosis. Although these subsamples are small and no other comparisons were statistically significant, some may be clinically significant, as is suggested by moderate-to-large effect sizes (Table V). Combined, these data suggest that a pattern of repeated failure to respond to one's name in the second year of life may be associated with earlier emerging ASD and predictive of greater impairment by 36 months of age. Thus, it may be especially important to refer infants who consistently fail to respond to their names in the second year of life because they may be at risk not only for ASD but also for greater impairment by age 3 years. Future research with larger samples should investigate whether intervention history impacts rates of response to name.

There are several limitations to this study worth noting. First, the sample of children with ASD was small, limiting our ability to estimate sensitivity and specificity reliably, to robustly evaluate subgroup differences within the ASD sample, and to extrapolate to the general pediatric population. Second, our definition of a failure on the response to name task differed from some previous studies, in that we used a stringent definition of "failure," based on the task from which our measure was adapted,[14] potentially resulting in inflated passing rates. Despite this, our overall findings are consistent with those of prior studies, but differences in methods make it difficult to compare exact rates of failure across samples.

In conclusion, this prospective study implicates diminished response to name as an early indicator of ASD by 9 months of age and has clinical implications for early detection of ASD risk in combination with other validated screening tools. We suggest that response to name should be monitored at multiple time points in infants because single failures may indicate heightened risk for developing ASD but, among the children who do develop ASD, repeated failures may be an indicator of later functioning, serving as a means by which to identify infants and toddlers developing ASD who demonstrate the greatest need for

intensive early intervention. Overall, these findings are consistent with the American Academy of Pediatrics guidelines to conduct both broadband and ASD-specific screening via parent report multiple times in the first years of life. A fast, easy to administer probe like the one used in this study may be a useful additional instrument in the pediatric toolbox for identifying risk for ASD in the clinical setting. ■

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Glossary

ADOS	Autism Diagnostic Observation Schedule
ASD	Autism spectrum disorder
PPV	Positive predictive value

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Table I

Participant characteristics

	Low-risk group without ASD (n = 60)	High-risk group without ASD (n = 76)	ASD (*n* = 20)	*P* value*
Male sex (n, %)	36 (60%)	45 (59%)	15 (75%)	ns
Age at first visit (n, % first visit at 6 mo)	48 (80%)	55 (72%)	16 (80%)	ns
Ethnicity (n, % non-white)†,‡,§	20 (34%)	28 (38%)	6 (32%)	ns
Household income (n, %)				ns
≤$80 000	19 (32%)	17 (22%)	6 (30%)	
>$80 000	35 (58%)	51 (67%)	9 (45%)	
Decline to state/missing	6 (10%)	8 (11%)	5 (25%)	
Mullen Scales of Early Learning, 36 mo of age (mean, SD)				
Visual reception†	62.15 (11.21)[a]	58.76 (14.61)[a]	43.95 (16.42)[b]	<.001
Fine motor	48.50 (9.81)[a]	48.37 (13.53)[a]	37.50 (12.73)[b]	<.01
Receptive language§,¶	52.83 (9.15)[a]	47.78 (9.32)[b]	38.38 (9.09)[c]	<.001
Expressive language**	54.71 (7.32)[a]	49.88 (9.74)[a]	37.56 (11.40)[b]	<.001
Early learning composite§,¶	109.36 (13.83)[a]	102.75 (18.84)[b]	84.13 (16.81)[c]	<.001
ADOS social affect + repetitive behavior Total, 36 mo of age (mean, SD)	2.62 (1.66)[a]	3.58 (2.22)[a]	14.85 (5.03)[b]	<.001

ns, not significant.

*Overall group differences assessed using logistic regression for sex, ethnicity, and household income (excluding decline to state/missing values), and 1-way ANOVA for remaining variables. *P* values of <.05 were followed by post-hoc comparisons between groups; groups with different superscript letters differ significantly after Tukey-Kramer adjustment for multiple comparisons. Frequency missing

†n = 1 in group with ASD,

‡n = 3 in high-risk group without ASD,

§n = 2 in low-risk group without ASD,

¶n = 4 in group with ASD, and

**n = 2 in group with ASD.

Table II

Frequency/proportion of failing scores by group and ORs (95% CI) for GEE models based on age 36-month outcome

	Frequency/proportion failing			OR (95% CI)*		
	Low-risk group without ASD n (%)	High-risk group without ASD n (%)	ASD n (%)	ASD vs low-risk group without ASD	ASD vs high-risk group without ASD	High-risk group without ASD vs low-risk group without ASD
6 mo	9/44 (20.5%)	13/51 (25.5%)	4/15 (26.7%)	1.88 (0.78–4.56)	1.47 (0.63–3.43)	1.28 (0.61–2.70)
9 mo	5/57 (8.8%)	7/68 (10.3%)	6/20 (30.0%)	2.74 (1.30–5.80)†	2.11 (1.02–4.35)‡	1.30 (0.72–2.34)
12 mo	8/56 (14.3%)	12/74 (16.2%)	7/20 (35.0%)	3.99 (1.96–8.11)§	3.01 (1.56–5.81)§	1.33 (0.77–2.28)
15 mo	6/53 (11.3%)	8/67 (11.9%)	8/18 (44.4%)	5.81 (2.66–12.67)§	4.30 (2.23–8.29)§	1.35 (0.72–2.54)
18 mo	2/51 (3.9%)	8/68 (11.8%)	4/14 (28.6%)	8.46 (3.32–21.56)§	6.15 (2.99–12.65)§	1.38 (0.61–3.12)
24 mo	2/53 (3.8%)	2/63 (3.2%)	7/18 (38.9%)	17.92 (4.52–71.06)§	12.57 (4.67–33.81)§	1.43 (0.39–5.23)

GEE, generalized estimating equations.

*Estimated from GEE models for binary data that included terms for group (low-risk group without ASD, high-risk group without ASD, ASD), visit age, sex, and the interaction between group and visit age, and accounted for the within-child clustering because of repeated observations.

†$P < .01$.

‡$P < .05$.

§$P < .001$.

Table III

Results (parameter estimates and SE) of the longitudinal analyses predicting failing response on the orients to name task

Model terms	Estimate (SE)*
Intercept	−1.56 (0.30)†
Sex (female)	0.07 (0.26)
ASD	0.63 (0.45)
High-risk group without ASD	0.25 (0.38)
Visit age (mo)	−0.09 (0.04)‡
Visit age × group with ASD	0.13 (0.05)§
Visit age × high-risk group without ASD	0.01 (0.05)

*Estimated from GEE models for binary data that included terms for group (low-risk group without ASD, high-risk group without ASD, ASD), visit age (centered at 6 months), their interaction, and child sex, and accounted for the within-child clustering because of repeated observations.

†$P < .001$.

‡$P < .05$.

§$P < .01$.

Table IV

Psychometric properties of failing to orient to name for identifying ASD at age 36 months

	ASD		Group without ASD		Estimate (95% CI)*			
	True positives	False negatives	False negatives	True positives	Sensitivity	Specificity	PPV	NPV
≥1 failure 6–24 mo	16	4	59	77	.80 (.62–.98)	.52 (.43–.60)	.20 (.11–.28)	.95 (.89–1.00)
≥1 failure 12–24 mo	14	6	39	97	.70 (.50–.90)	.70 (.62–.78)	.25 (.14–.37)	.94 (.89–.99)
6 mo	4	11	22	73	.30 (.09–.51)	.78 (.71–.85)	.17 (.04–.30)	.88 (.83–.94)
9 mo	6	14	12	113	.30 (.10–.50)	.91 (.86–.96)	.33 (.11–.54)	.90 (.85–.95)
12 mo	7	13	20	110	.35 (.14–.56)	.85 (.79–.91)	.26 (.09–.42)	.90 (.85–.95)
15 mo	8	10	14	106	.40 (.19–.61)	.88 (.83–.94)	.33 (.14–.52)	.91 (.86–.96)
18 mo	4	10	10	109	.29 (.07–.50)	.91 (.86–.96)	.31 (.09–.52)	.90 (.84–.95)
24 mo	7	11	4	112	.36 (.14–.57)	.96 (.93–.99)	.57 (.29–.85)	.91 (.86–.96)

NPV, negative predictive value.

*Based on combining analyses from 10 complete datasets constructed using multiple imputation for missing values. Sensitivity = true positives/(true positives + false negatives); specificity = true negatives/(true negatives + false positives); PPV = true positives/(true positives + false positives); NPV = true negatives/(true negatives + false negatives).

Table V

Comparisons between infants with ASD who exhibited infrequent vs repeated failures on the response to name task between 12 and 24 months of age

	Infrequent failures (n = 10)	Repeated failures (n = 10)	Cohen *d*	*P* value*
Male sex (n, %)	10 (100%)	5 (50%)	–	.03
Age at first concerns, mo (mean, SD)	17.10 (10.10)	11.10 (4.48)	0.77	.21
Age at diagnosis, mo (mean, SD)	28.50 (8.15)	18.50 (3.72)	1.58	<.01
Mullen Scales of Early Learning (mean, SD)				
Visual reception†	46.30 (16.14)	41.33 (17.28)	0.30	.59
Fine motor	39.10 (16.21)	35.90 (8.57)	0.25	.87
Receptive language‡	43.22 (7.79)	32.14 (6.72)	1.52	.02
Expressive language§	40.40 (11.42)	34.00 (11.05)	0.57	.19
Early Learning composite‡	88.4 (17.95)	78.57 (14.59)	0.60	.31
Vineland Adaptive Behavior Scales (mean, SD)¶				
Communication	89.89 (9.80)	77.44 (13.06)	1.08	.08
Daily living	87.89 (10.91)	81.67 (16.82)	0.44	.45
Socialization	87.22 (11.95)	76.22 (16.09)	0.78	.14
Motor	91.44 (11.02)	93.56 (11.64)	0.19	.95
Adaptive behavior composite	86.89 (10.23)	79.56 (13.26)	0.62	.25
ADOS social affect + repetitive behavior total	13.00 (4.22)	16.70 (5.29)	0.77	.05

*Group differences assessed using Fisher exact test for sex and Wilcoxon 2-sample exact test for remaining variables.

Frequency missing

†n = 1 in repeated failures group;

‡n = 1 in infrequent failures group and 3 in repeated failures group;

§n = 2 in repeated failures group;

¶n = 1 per group for all subscales.