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Changes in Cognitive and Language Functioning of Preschool Children with Autism[1]

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Preschool children with autism and their normally developing peers were compared on the Stanford-Binet IV and Preschool Language Scale before and after 1 school year. Both measures showed that although the children with autism functioned at a lower level than their normally developing peers, the children with autism had narrowed this gap after treatment, making a nearly 19-point increase in IQ and an 8-point gain in language quotient. The IQ measure remained stable for the normally developing peers while their language showed a 7.73-point increase. The data support the notion that young children with autism can make very significant developmental gains.

Increasingly, there are good reasons to expect that preschool aged children with autism who receive an intensive early education will benefit from the effects of such treatment. In the most dramatic of these demonstrations, Lovaas (1987) found that nearly half of his sample of very young children with autism who were provided with an intensive behavior modification program, achieved normal intellectual and educational functioning at follow-up. Strain, Odom, and their colleagues have similarly shown that young children with autism can benefit socially and educationally from placement in

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an integrated preschool with normally developing youngsters (e.g., Odom, Hoyson, Jamieson, & Strain, 1985; Odom & Strain, 1986; Strain, Hoyson, & Jamieson, 1985).

In 1987, we opened two new preschool classes for young children with autism at the Douglass Developmental Disabilities Center. One of these, the "segregated class' serves only children with autism, while the other is an "integrated" class that includes normally developing children. Typically, children with autism enter the developmentally segregated class and remain there for 1 or possibly 2 years before moving into the integrated class from which they are promoted to a variety of classes in public and private settings. Our preliminary findings, with a very small sample, suggested that children with autism do benefit from their placement at the Center (Handleman, Kristoff, Fuentes, & Alessandri, 1991; Harris, Handleman, Kristoff, Bass, & Gordon, 1990). After 3 years we have accumulated a more substantial data pool from which to draw and can now report our findings with increasing confidence.

The present study explored changes in intellectual and language functioning for children with autism and normally developing peers over the course of 1 school year. We predicted that the children with autism, as compared to their normal peers would have significantly lower IQs and language quotients (LQ) before and after treatment. We further predicted that the children with autism would show an increase in both IQ and LQ after 1 year at the Center, while the normal peers would not change on these measures. Because we did not have enough peers from the integrated class to provide a comparison group, we used an additional four children from a university day care facility.

METHOD

Setting

The Douglas Developmental Disabilities Center is a Rutgers University based program for the intensive behavioral treatment of children with autism. The Center includes two classes structured according to a preschool model with a focus on small and large group work supplemented by individual instruction as needed. These classes are a segregated preschool class for six children with autism, their teacher, and three teaching assistants, and an integrated preschool class for six children with autism, seven normally developing peers, a teacher, and three teaching assistants. Instruction is frequently done through incidental teaching. New material is typically introduced with discrete trial teaching. Support is provided to parents for home programming.

The normally developing peers from the university day care center who participated in the Stanford-Binet IV sample came from a program for children ages 30 months to 72 months. The adult-to-child ratio is 1:6. The center emphasizes daily outdoor activities, weekly classroom themes, monthly field trips, and computer terminal instruction.

Subjects

The participants in this study were preschool aged children with autism and their normally developing peers. Although there was considerable overlap in participants, the number of children who took the two tests differed because the *Preschool Language Scale* (PLS; Zimmerman, Steiner, & Pond, 1979) had been in use for more years than the *Stanford-Binet IV* (Thorndike, Hagen, & Sattler, 1986). For all children the data presented are from their first year at the Center.

The children with autism were referred to the Center with this diagnosis from an outside agency and the diagnosis was confirmed at our Center by an experienced clinical psychologist. Children admitted in 1987 (who formed part of the PLS sample) were diagnosed according to criteria of DSM-III (American Psychiatric Association [APA], 1980) and those in 1988 and 1989 by the criteria in DSM-III-R (APA, 1987). The Childhood Autism Rating Scale (CARS; Schopler, Reichler, DeVellis, & Daly, 1988) was an additional measure of autistic behavior. The children with autism were selected as being able to function in a small group with at least one other child, and not requiring continuous one-to-one attention in order to respond in the classroom. Although more impaired children with autism were admitted to other classes in the Center, they were not included in the present sample.

The normally developing children from our integrated preschool class and the day care center were chosen as exhibiting no known developmental difficulties. Parental consent was obtained for all children.

The sample for the Stanford-Binet IV consisted of 9 children with autism and 9 normally developing children. The peer group included 5 children from the integrated preschool and 4 from the day care center. The mean age at time of pretesting for the children with autism was 50.11 months (range 40–62 months) and for the normally developing children, 45.00 months (range 39–57), $t(16) = 1.634$, $p =$ ns. At posttesting the children with autism had a mean age of 61.33 months (range 51–74) and the normally developing children, 55.56 months (range 48–67), $t(16) = 1.897$, $p =$ ns. There was one girl in each group. The children with autism had a mean score of 32.1 (range 30–37.5) on the CARS, placing them for the most part in the mild to moderate range. None of these children were part of our previously reported research (Harris et al., 1990).

The sample for the PLS included 16 children with autism and 12 normal peers. All of the peers were from the integrated preschool. The mean age at time of pretesting for the children with autism was 46.63 months (range 33–52 months) and for the peers, 41.00 months (range 28–53), $t(26) = 1.918$, $p =$ ns. At posttesting the children with autism had a mean age of 56.38 months (range 40–67) and the peers, 50.92 months (range 38–61), $t(26) = 1.844$, $p =$ ns. There were three girls in each group. The children with autism had a mean score on the CARS of 31.27 (range 30–34), placing them in the mild to moderate range. Two of these children were part of our previously reported research (Harris et al., 1990).

Instruments

The Stanford-Binet IV is a widely used, standarized test of individual intelligence suitable from the preschool years through adulthood. Scoring of responses was done following the procedures described in the *Guide for Administering and Scoring the Fourth Edition* (Thorndike et al., 1986). The eight subtests administered to each child were Absurdities, Bead Memory, Comprehension, Copying, Memory for Sentences, Pattern Analysis, Quantitative, and Vocabulary. We have previously discussed the merits of this test for young children with autism (Harris, Handleman, & Burton, 1990).

The PLS (Zimmerman et al., 1979) is a measure of language development in the early years. It includes auditory comprehension and verbal ability subscales with developmentally sequenced items. Scores are reported in developmental months and age quotients. Unlike the Stanford-Binet, age levels reflect the age at which most children have passed an item. According to the authors, the PLS has a split-half reliability of .88; it correlates .97 with the Illinois Test of Psycholinguistic Ability, .59 with the Peabody Picture Vocabulary Test, and .66 with the 1960 Stanford Binet (Zimmerman et al., 1979). Zimmerman et al. (1979) also provided data on predictive validity of the PLS, indicating it was a better predictor of later language functioning for children from a Head Start program than was the Peabody Picture Vocabulary Test. The normative sample on which the PLS is based includes Head Start children, youngsters in early childhood education programs, and from middle-class nursery schools. We previously reported in a preliminary study that the PLS was useful in measuring language progress of a small group of children with autism (Harris et al., 1990).

Procedures

The Stanford-Binet IV was administered to each child by an experienced clinical psychologist, a certified school psychologist, or one of four advanced doctoral level students in clinical or school psychology. The PLS was administered by one of two certified speech therapists. All of these examiners had at least 1 year of intensive experience working with children with autism. Testing for the children at the Center was done during the summer prior to admission or during the early fall. For some of the children several weeks of adaptation to the Center were required before they became "testable." Testing for the children from the day care center was done during the fall of the school year. Posttesting was done in the late spring and early summer. The mean time from pre- to posttesting on the Stanford-Binet IV was 10.89 months and for the PLS, 9.82 months.

The tests were administered individually with care taken to ensure that every child's attention was optimal. The tests were often given over several short sessions rather than a single prolonged one, and effort and cooperation were liberally praised. For some of the younger children a parent or familiar staff member was presented to facilitate the assessment. In spite of these efforts, at pretesting, among the children with autism, 7 did not respond to the Absurdities subtest, 2 the Quantitative, 2 Bead Memory, and 1 Memory for Sentences. At posttesting 1 did not respond to Absurdities and 1 to Bead Memory. There were no unscorable subtests for the normally developing children during either the pre- or posttesting.

RESULTS

Independent t tests were used to assess the differences between and within the two groups of children before and after the school year.

Stanford-Binet IV

There was a significant difference in mean IQ between the children with autism and their normal peers before treatment (autistic $M = 67.56$, $SD = 16.16$; normal $M = 114.11$, $SD = 9.06$), $t(16) = 7.540, p = .0001$ (see Table I). This difference although smaller, remained significant after treatment (autistic $M = 86.33$, $SD = 16.54$; normal $M = 113.67$, $SD = 8.96$, $p = .0001$). A comparison of pre- ($M = 67.56$) and posttest ($M = 86.33$) IQ measures for the children with autism indicates that their 18.78-point increase in IQ was a significant change, $t(8) = 4.522, p = .002$. The normally developing children showed no significant change in IQ from pre- ($M = 114.11$) to posttesting ($M = 113.67$), $t(8) = .129, p =$ ns.

Table II summarizes the individual Stanford-Binet data for the 7 children with autism who earned a 10-point or greater increase in IQ from pretest to posttest. A correlation between their age at pretest and posttest IQ was

Table I. Pre- to Posttest Changes in Stanford-Binet IV and PLS Scores of Children with Autism and Normally Developing Peers

	Pre IQ	Post IQ	Pre PLS	Post PLS
Autistic				
M	67.56	86.33[a]	66.94	74.97[a]
SD	16.16	16.54	16.56	15.21
Peers				
M	114.11	113.67	121.42	129.18[a]
SD	9.06	8.96	15.50	16.36

[a]Significant improvement pre- to posttest.

not significant, $r(7) = .20$, $p =$ ns; nor was a correlation between pretest age and posttest IQ significant, $r(7) = -.36$, $p =$ ns.

The right-hand portion of Table II identifies for each child the subtests on which that child earned a 10-point or greater increase in prorated IQ during posttesting. IQs were prorated for subtests by converting the subtest standard age score to an area standard age score which was in turn converted to a composite standard age score (Thorndike et al., 1986). Inspection of the changes in subtests reveals that 5 of the 8 subtests showed a mean increase of 10 points or more in prorated IQ (Absurdities, Pattern Analysis, Quantitative, Bead Memory, and Sentence Memory). By contrast, the normally developing children showed a mean 10-point or greater increase on none of the subtests and a 12.89-point decrease on Memory for Sentences.

Preschool Language Scale

The children with autism earned a significantly lower LQ on the PLS ($M = 66.94$, $SD = 15.56$) before treatment than did the normally develop-

Table II. Stanford-Binet IV Subtest Changes for Children with 10-Point or Greater IQ Increase

	Pretest		Post	Subtests[a]							
Child	Age	IQ	IQ	Voc	Comp	Abs	Pat Anal	Copy	Quant	Bead Mem	Mem Sent
1	51	51	91			X	X	X	X	X	
2	40	68	105	X	X	X	X			X	
3	52	57	79	X	X	X		X	X		X
4	45	68	90		X	X	X				X
5	45	78	90		X	X	X				
6	49	78	89			X	X				X
7	62	84	94				X	X			

[a]X = Subtest with a 10-point or greater increase in prorated IQ.

ing children (M = 121.42, SD = 15.50), $T(26) = 8.850, p = .0001$ (see Table I). After treatment, this difference remained significant (autistic M = 74.97, SD = 15.21; normal M = 129.18, SD = 16.36), $t(26) = 9.03, p = .0001$. The children with autism made a significant 8.03-point gain in LQ from pre- (M = 66.94) to posttesting (M = 74.97), $t(15) = 2.848, p = .012$. A significant 7.73-point change in LQ was also noted from pre- (M = 121.42) to posttesting (129.18) for the normal peers, $t(11) = 2.421, p = .034$.

DISCUSSION

The results of the present study indicate that relative to their normally developing peers, children with autism showed a greater increase in intellectual progress over their first year in a preschool program. Thus, while the peers, who were initially somewhat above average in intelligence, maintained this functioning across the school year, the children with autism showed a significant increase in IQ. The nearly 19-point increase in IQ shown by the children with autism is especially striking, and if maintained over time, provides encouraging support for the notion that children with autism can make major developmental increases during their early years.

The approximately 8-point increase in PLS scores for both groups of children may reflect the language-intensive nature of the preschool curriculum to which all of the peers, as well as the children with autism were exposed. Although it is possible that these changes reflect an error in measurement, a hypothesis that cannot be ruled out, it seems more plausible that all of the children responded to the intensity of language stimulation by showing measurable growth in this area. The present results, using only two children who had participated in our previous research (Harris et al., 1990) replicate and extended our observation that young children with autism and their peers can both benefit from a language-enriched setting.

Could all of these changes simply reflect a regression toward the mean? An inspection of obtained ($Z = -.85$) and predicted ($Z = -1.97$) mean Z scores argues strongly against this explanation for the Stanford-Binet data. Similar calculations for the PLS data, although less strong (obtained $z = -1.23$) are similarly consistent with the notion that these scores reflect real changes in functioning for the children with autism.

It is important to note that as a group, these children with autism are best classified as "higher functioning" because they had a mean IQ of nearly 70 at the time of admission and mean CARS scores that placed them in the mild to moderate range of autistic functioning. However, at least within the range of children whom we treated, progress was not confined to those children who were highest functioning, with positive changes noted across the range of ability in the present sample. None of the children we studied were severely or profoundly mentally retarded.

Lord and Schopler (1988, 1989) examined IQ changes across time for a large sample of children with autism seen for evaluation at the TEACCH clinic. In general, they found early IQs to be stable and to predict later IQ scores, although, as is the case with this literature in general (e.g., Freeman, Ritvo, Needleman, & Yokota, 1985), the older the child's age at first testing, the more stable were the results across time. In Lord and Schopler's (1989) sample the group of children who showed large increases in IQ on follow-up were tested initially with the Bayley Scale of Mental Development, at an age of 3 years or younger, and earned scores of 50 or lower. These children were quite different from the present sample who were, on average, approximately 4 years of age at first testing, an age when Lord and Schopler's (1989) data suggest there should be considerable stability of scores. Among the 7 children in the present study who showed a 10-point or greater overall IQ increase, the mean age at pretesting was 49 months (range 40–62).

It is interesting to speculate on what altered the test performance of the youngsters who participated in the present study. It is likely that test-taking skills, such as the ability to sit quietly, look at the stimuli, and follow an adult's instructions contributed to the change in measured performance. It is also likely that these same attending skills made the children more receptive in the classroom, enabling them to focus on learning activities for sustained periods. However, it is doubtful that attending skills alone account for these changes. First, it is noteworthy that tests of short-term memory where attending might be the single most important component (Bead Memory and Memory for Sentences) were among the subtests showing the least change. Second, two tests of abstract ability, one verbal and visual (Absurdities) and one visual (Pattern Analysis), showed the greatest change. Improvement on these subtests suggests the children had started to learn how to process information they previously had been unable to organize. The normally developing youngsters showed no systematic change on these two subtests, 2 had a 10-point or greater gain on Absurdities, 1 a 10-point or greater loss, and 1 had a 10-point or more gain on Pattern Analysis and 2 a 10-point or greater loss on this subtest.

The present study addressed systematically only cognitive and language changes in the young participants. Additional data measuring behavioral changes would have been useful, but unfortunately, were not collected. On a less rigorous basis, it is worth noting that among the 4 children from the Stanford-Binet sample who have graduated from the Center, all moved to a less restrictive setting for children with communication handicaps or learning disabilities, 4 children are still at the Center, but slated to move to similarly less restrictive setting in Fall 1991, and the outcome for 1, the lowest functioning child at time of admission, is not yet determined. None of the children is fully mainstreamed and all remain socially and affectively impaired.

In the absence of a comparison group of children with autism who were not enrolled in a treatment program it is not possible to conclude that changes in the children with autism were the product of their education at the Douglass Developmental Disabilities Center. We can however state that over the course of a school year during which normally developing children maintained their relative pace of cognitive development, the children with autism demonstrated an accelerated rate of progress. Given the literature which indicates that children with autism tend to have stable IQs over time (DeMyer et al., 1973; Freeman et al., 1985; Lord & Schopler, 1988, 1989) and Lovaas's (1987) finding that it was his treated subjects who showed a significant increase in IQ, it seems plausible that the changes we observed may be linked to the children's intensive educational experiences. Unfortunately for research purposes (but happily for parents and children) the state of New Jersey has a relatively strong network of services for children with autism and we have been unable to obtain an untreated control group in spite of several efforts to do so. It is also important to follow-up these children in several years to assess the stability of gains.

The results of the present study provide additional support for the notion that early intervention can have an important impact on relatively high-functioning children with autism. We cannot address ourselves to the outcome for children who are initially more impaired or more profoundly involved autistically, because we did not have such children in our sample. Continuing work with a wider variety of children including those who are more impaired will be important in knowing to what extent these early efforts pay off for later developmental gains.

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