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Outcome for Children With Autism Who Began Intensive Behavioral Treatment Between Ages 4 and 7

A Comparison Controlled Study

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This study extends findings on the effects of intensive applied behavior analytic treatment for children with autism who began treatment at a mean age of 5.5 years. The behavioral treatment group (*n* = 13, 8 boys) was compared to an eclectic treatment group (*n* = 12, 11 boys). Assignment to groups was made independently based on the availability of qualified supervisors. Both behavioral and eclectic treatment took place in public kindergartens and elementary schools for typically developing children. At a mean age of 8 years, 2 months, the behavioral treatment group showed larger increases in IQ and adaptive functioning than did the eclectic group. The behavioral treatment group also displayed fewer aberrant behaviors and social problems at follow-up. Results suggest that behavioral treatment was effective for children with autism in the study.

Keywords: *autism; early intervention; behavior modification; behavior analysis*

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Children with autism show severe impairment in reciprocal social inter-action and communication along with high rates of ritualistic and stereotyped behavior (American Psychiatric Association, 1994). Research indicates that treatment based on applied behavior analysis (ABA) may facilitate clinically significant gains in intellectual, social, emotional, and adaptive functioning (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris & Handleman, 2000; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Smith, Groen, & Wynn, 2000; Weiss, 1999). Behavioral (ABA) treatment uses principles derived from laboratory and applied research on learning psychology to establish devel-opmentally significant skills and to reduce challenging behaviors such as stereotyped or aggressive behaviors. Greatest effects may be achieved when (a) children are younger than 4 years at the onset of treatment, (b) treatment is intensive (up to 40 hours per week) and long term (2 years or more), (c) parents have an active role in carrying out and designing intervention programs, (d) children have one-to-one relationships with therapists or teachers, (e) treatment occurs in children's natural environment (e.g., home or school), and finally (f) children are included in regular classes for nondisabled children (Lovaas, 2003).

Although diagnosis of autism may now be occurring at younger ages than in the past, and although access to services may have improved (Jacobson, 2000), many children with autism still do not have an opportu-nity to begin treatment until they are 4 years old or older, and little is known about outcomes of these children. In a recent study, Eikeseth et al. (2002) examined progress after 1 year of treatment for children with autism who were between 4 and 7 years of age at the onset of treatment (age $M = 5.5$ years). Participants were 13 children receiving 28 hours per week of behav-ioral treatment and 12 children in a comparison group receiving 29 hours per week of eclectic special education treatment. At the time of the 1-year evaluation, standard scores for children in the behavioral treatment group rose an average of 17 points in IQ, 13 points in language comprehension, 27 points in expressive language, and 11 points in adaptive behavior. These gains were significantly larger than in the eclectic treatment group, which obtained an average change of 4 points in IQ, 1 point in language, and 0 points in adaptive behavior.

The present study reports on a follow-up of the same group of children when they averaged 8 years of age. All children in the behavioral group continued to receive ABA through the time of the second follow-up, and all

children in the eclectic group remained in education programs that combined a variety of interventions (ABA, TEACCH, sensory integration, and other approaches). The study was designed to evaluate change in functioning from intake and Year 1 assessments to the current follow-up. In addition, the behavioral and eclectic groups were compared on the level of behavior problems displayed at follow-up.

Method

Methods are described in detail by Eikeseth et al. (2002) and will only be summarized here. All referrals who met the following three criteria were admitted to the study: (a) a diagnosis of childhood autism (ICD-10) from both the Autism Diagnostic Interview-Revised (Lord, Rutter, & LeCouteur, 1994) and a licensed child clinical psychologist who was independent of the investigation, (b) chronological age between 4 and 7 years at the start of treatment, (c) a deviation IQ of 50 or above on the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R; Wechsler, 1989) or a ratio IQ of 50 or above from the Bayley Scales of Infant Development-Revised (Bayley, 1993), and (d) no medical conditions, such as uncontrollable epilepsy or major delays in motor development, that could interfere with treatment. A director of the habilitation team, who was independent of the study, assigned the children to one of two groups: (a) behavioral (ABA) treatment ($n = 13$, 8 boys), or (b) eclectic treatment ($n = 12$, 11 boys). Assignment was based on availability of ABA supervisors: If at intake for a particular child an ABA supervisor from the habilitation team was available to train parents and staff in ABA, the child entered the behavioral treatment group; otherwise, children entered the eclectic treatment group.

Both behavioral and eclectic treatment took place in public kindergartens and elementary schools for typically developing children. Each child was assigned a minimum of two therapists: a special education teacher and one or more aides. During individual treatment sessions (behavioral or eclectic), the child worked alone with his or her therapists in a separate room. When not in these sessions, the child was mainstreamed with his or her classmates while being shadowed by the therapists. No child was in the same class as other study participants.

The behavioral treatment was based on treatment manuals for the UCLA model of early intervention developed by Lovaas and colleagues, which was described in detail by Eikeseth et al. (2002). It was supervised by the first, third, and fourth authors who are professional behavior analysts with

extensive research and clinical experience with the UCLA Model. The eclectic treatment (also described by Eikeseth et al., 2002) was designed to reflect best practices for serving children with autism.

At the Year 1 assessment and the current follow-up, therapists were asked to report number of hours per week during which the child received one-to-one treatment in a separate room and the number of hours per week the child was integrated in his or her class together with a shadow teacher. Therapists also reported treatment goals for each child, intervention methods they had employed, and number of years of postsecondary schooling they had received in education, special education, or related fields.

A licensed clinical psychologist or an examiner with a master's degree in special education and a license to administer psychological tests carried out all assessments. Both examiners had extensive experience assessing children with autism, were independent of the study, and were not informed of children's group assignment.

Because the primary goal of behavioral treatment is to improve the level of functioning in children with autism (Lovaas, 2003), intellectual and adaptive functioning was measured at intake, Year 1, and the current follow-up. Intellectual functioning was evaluated with the WPPSI-R (Wechsler, 1989), Wechsler Intelligence Scale for Children-Revised (Wechsler, 1974), or Bayley Scales of Infant Development-Revised (Bayley, 1993). Eikeseth et al. (2002) described the procedures for selecting, administering, and scoring these tests. Children's adaptive behavior was assessed with the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984). At follow-up, children's primary school teacher completed a measure that was not administered in previous assessments, the Achenbach Child Behavior Checklist—Teacher Report Form (TRF; Achenbach, 1991). The TRF is an extensively studied measure of behavior problems in the areas of social withdrawal, somatization, anxiety/depression, social problems, thought problems, attention problems, delinquency, and aggression. The TRF has been used previously to assess children with autism (Smith et al., 2000), and the 1991 edition was the most recent version available in Norwegian.

Results

Therapy Measures

In the current follow-up, children in both groups had a mean age of 8 years, 2 months (*SD* = 6.5 and 7.9 in the behavioral and eclectic groups, respectively). The mean time between treatment onset and this follow-up

was 31.4 months (*SD* = 8.7) in the behavioral group and 33.3 (*SD* = 12.6) in the eclectic group. When the participants entered school (the year they turned 6 years old), their weekly treatment hours were reduced form a mean of 28 (*SD* = 5.76, range 20-35) and 29 hours (*SD* = 8.05, range 20-41) for the behavioral group and the eclectic group, respectively, to a mean of 18 hours (*SD* = 5.40, range 5-20) and 16 hours (*SD* = 7.00, range 4-20). Five of the 13 children in the behavioral treatment group (38%) no longer received one-to-one treatment, compared to 1 child (8%) in the eclectic treatment group. These 6 children participated full-time (i.e., 20 hours per week) in the mainstreamed class while supported full-time or part-time by an ABA shadow teacher (range 4-20 hours per week). The remaining children in both groups received one-to-one teaching in a separate room (range 3-18 hours per week) and support by a shadow teacher while being integrated in their class (range 2-17 hours per week). All children in both groups had therapy teams that included a teacher who had received 3 or more years of undergraduate or graduate training in special education or a related discipline (e.g., special education teachers). Also, 4 of 13 children in the ABA group (31%) and 2 of 12 children in the eclectic group (17%) had instructors with 1 to 3 years of undergraduate or graduate training; 7 of the ABA children (54%) and 7 of the eclectic children (58%) had paraprofessionals with less 1 year of training.

Other therapy measures are summarized in Table 1. As can be seen, a series of chi-square tests confirmed that services in the behavioral group were based exclusively on ABA, whereas services for the eclectic group were based on a variety of intervention models (ABA, TEACCH, sensory-motor therapies, and treatments derived from clinical experience or other sources). No significant differences emerged between the groups on the goals of treatment or therapist education (Table 1).

Child Measures

Main findings. Independent *t* tests were conducted to compare changes in scores between intake and follow-up measures across groups and to compare TRF and Vineland Maladaptive scores at the current follow-up. Independent *t* tests were also performed to compare changes between Year 1 and the current follow-up. Then, clinical significance was evaluated by examining the number of children who achieved scores in the average range on outcome measures. Finally, Pearson correlations were performed to explore whether pretreatment variables were associated with outcomes.

Table 1
Characteristics of Treatment in the Behavioral and Eclectic
Treatment Groups (Percentage of Children)

	Behavioral Group (%)	Eclectic Group (%)	$\chi^2(1, 1)$
Treatment based on the following:			
Alternative communication	0	25	3.7
Applied behavior analysis	100	42	10.5**
Total communication	0	17	2.4
Sensory-motor	0	25	3.7
TEACCH	0	50	8.6**
Clinical experience	0	50	8.6**
Other	0	67	12.7***
Treatment goals:			
Vocal language	46	50	0.3
Augmentative communication	0	8	1.1
Behavior management	31	67	3.2
Imitation	54	33	1.1
Play	62	58	0.0
Daily living skills	31	25	0.1
Academics	62	75	0.5
Motor skills	31	42	0.3
Social skills	69	75	0.1
Other	0	17	2.4

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2 exhibits means and standard deviations for all outcome measures at the current follow-up. Descriptive statistics from the previous assessments were reported by Eikeseth et al. (2002) and are summarized in Figure 1. As Figure 1 reveals, gains for IQ and adaptive behavior were greater for the behavioral treatment group than for the eclectic treatment group. Table 2 shows that these differences were statistically significant ($p < .05$). The largest gain was in IQ; the behavioral treatment group showed an increase of 25 points (from 62 to 87) compared to 7 points (from 65 to 72) in the eclectic treatment group. Gains on the Vineland Adaptive Behavior Scales ranged from 9 points for Daily Living Skills to 20 points for Communication; in contrast, mean scores in the eclectic treatment group declined 6 to 12 points.

Group differences in social emotional functioning at follow-up, as measured by the TRF, are presented in Table 2. Though the groups did not differ significantly on most scales, the behavioral treatment group displayed

Table 2
Means and Standard Deviations of Scores in the Behavioral
and Eclectic Groups for Outcome Measures Collected
at the 8-year-old Follow-Up Assessment

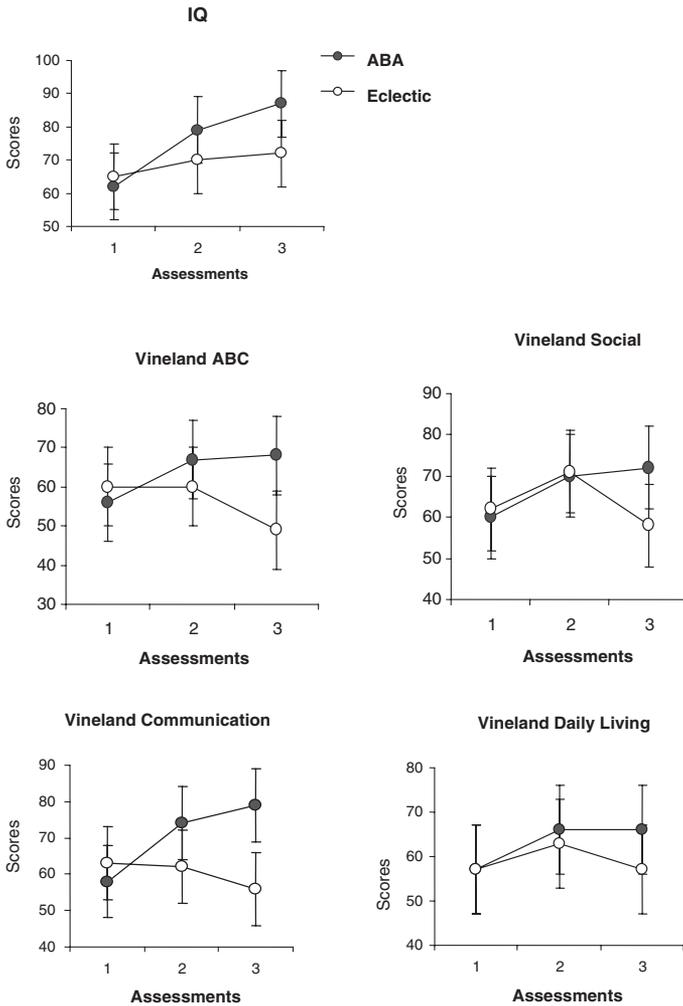| Measure	Behavioral Group		Eclectic Group	
	M	*SD*	*M*	*SD*
IQ*	86.9	25.0	71.9	28.4
Vineland Adaptive Behavior Scales				
Communication**	78.5	22.3	56.0	16.3
Daily Living*	66.1	18.1	50.4	20.2
Socialization**	72.2	14.4	58.1	9.6
Composite**	67.9	17.1	49.5	13.0
Maladaptive Behavior*	6.3	4.1	11.0	5.8
Achenbach Child Behavior Checklist				
Withdrawn	59.4	6.3	61.4	5.3
Somatic	55.0	7.0	58.0	9.6
Anxious/depressed	57.8	6.1	57.1	7.1
Social*	62.3	6.3	67.2	4.9
Thought	68.1	9.6	68.5	7.0
Attention	59.0	5.4	62.1	6.1
Delinquent	56.0	5.2	59.0	3.8
Aggressive**	57.3	4.5	63.7	4.6

Note: For IQ and Vineland Adaptive Behavior Scales, the change in scores between intake and follow-up in each group (shown in Figure 1) was calculated, and independent *t* tests were performed to compare change cores in each group. For the Achenbach Child Behavior Checklist and the Maladaptive Behavior, independent *t* tests were conducted to compare scores in each group at follow-up.
*$p < .05$. **$p < .01$.

fewer social problems, $t(22) = 2.36$, $p < .05$, and aggressive behavior, $t(22) = 3.56$, $p < .01$, than the eclectic group. The behavioral group also obtained lower scores on the Maladaptive Behavior subscale of the Vineland Adaptive Behavior Scales ($M = 6.33$, $SD = 4.1$) than the eclectic group ($M = 11.0$, $SD = 5.8$), $t(20) = -2.20$, $p < .05$.

Progress between 1 year of treatment and follow-up. Figure 1 indicates that the difference in scores between groups widened from the Year 1 follow-up to the CA-8 follow-up. Differences in progress between the behavioral treatment group and the eclectic treatment group between 1 year of treatment and follow-up differed significantly on Vineland Adaptive

Figure 1
Mean and 95% Confidence Interval Scores at Intake,
Year 1, and Follow-Up

Note: Scores are for IQ, Vineland Adaptive Behavior Composite, Vineland Socialization, Vineland Communication, and Vineland Daily Living for the behavioral and eclectic groups.

Behavior Composite, $t(22) = 2.99$, $p < .01$, and Vineland Socialization, $t(22) = 2.52$, $p < .05$. However, no other significant differences in gains between Year 1 and follow-up were found.

Achievement of scores within the average range. Of children in the behavioral group 54% (7 of 13) scored within one standard deviation of the mean on IQ at follow-up. These children increased their IQ scores from a mean of 70 at intake to 104 at follow-up. Both verbal and nonverbal IQ at follow-up fell in the average range for these children (verbal $M = 105$, $SD = 13$; performance $M = 103$, $SD = 9$). On the TRF, all these children scored below the clinically significant level on all subscales except Thought Problems; on this subscale, 3 of the 7 children had elevated scores. On adaptive behavior (as measured by the Vineland Adaptive Behavior Scales), all these children scored within two standard deviations of the mean, though many scored within the low end of this range. Because there is some evidence that Vineland scores are lower in Norwegian samples than in the United States (Smith, Eikeseth, & Lande, in press), the scores in the present study may underestimate these children's adaptive functioning. On the Maladaptive subscale of the Vineland Adaptive Behavior Scales, 6 of 7 children scored within the typical range, one child scored within the borderline significant range, and none obtained clinically significant scores. In sum, 54% (7 of 13) of children in the ABA group performed in the average range on most or all measures. Of the 6 children in the behavioral group who did not achieve scores within the typical range, 3 gained between 25 and 30 IQ points, but 3 others lost 2-5 IQ points.

Of the children in the eclectic treatment group, 17% (2 of 12) scored within one standard deviation of the mean on IQ and verbal IQ at follow-up (an additional child did so both at intake and at follow-up). One of the 3 children scored within two standard deviation of the mean on the Vineland Adaptive scale. The other 2 children scored more than two standard deviations below the mean.

On the TRF, all 3 children had clinically significant elevations on Thought Problems; one also had a clinically significant elevation on Aggression. However, they scored in the typical range on the remaining TRF subscales. On the Maladaptive subscale of the Vineland, 2 children scored within the borderline significant range, and the third scored within the significant rage. In sum, the 3 children scoring within one standard deviation on IQ and verbal IQ at follow-up exhibited clinically significant behavior problems on the TRF and Vineland Maladaptive, and 2 scored below the average range on adaptive behavior. Of the 9 children in the eclectic group who did not achieve scores within the typical range, 3 gained 1 to 23 IQ points, 1 was unchanged, and 5 others lost 3 to 13 IQ points.

Association between pretreatment and outcome measures. Unprotected Pearson correlations were conducted to assess whether intake measures were associated with outcome measures and with changes in scores. Tables 3 and 4 present the results for the behavioral treatment group and eclectic treatment group, respectively.

Table 3 shows that, in the behavioral treatment group, all correlations among intake age and outcome measures and changes were nonsignificant, with $r(12)$ ranging from –.40 to .46. Thus, age was not reliably associated with outcome or amount of change for this group. Intake IQ was strongly associated with follow-up IQ, language, and Vineland Scores except Socialization. Correlations between intake IQ and gains on these measures, however, were nonsignificant. Thus, children with higher intake IQ tended to score higher on follow-up measures but did not tend to make larger gains in IQ, language, and adaptive scores. The remaining intake measures had no or limited predictive value, indicating that these measures were not reliably associated with outcome or amount of change for this group.

In the eclectic treatment group, the intake Vineland Adaptive Behavior Composite score may have been the strongest correlate with outcome scores (see Table 4). This measure was reliably associated with higher follow-up scores on all measures except Vineland Maladaptive (the latter was not predicted by any intake variables). Intake IQ and intake language scores were reliably associated with higher scores on follow-up IQ and language. Generally, intake measures were more often associated with outcome scores and changes in scores for the eclectic group than for the behavioral group.

Discussion

This study extends findings by Eikeseth et al. (2002) on the effects of intensive applied behavior analytic (behavioral) treatment for children who began intervention at a mean age of 5.5 years. In a follow-up of the same group of children at a mean age of 8 years, 2 months, the behaviorally treated children showed larger increases in scores with intervention than did the eclectic treatment group and less severe aberrant behavior and fewer social problems at follow-up. The behavioral treatment group gained an average of 25 IQ points, 12 points in adaptive functioning (as measured by the Vineland Adaptive Behavior Scales), 20 points in Vineland Communication, 9 points in Vineland Daily Living Skills, and 12 points in Vineland Socialization Skills. By comparison, the eclectic treatment group

Table 3

Unprotected Pearson Correlations of Intake Scores With Follow-up Scores and With Changes in Scores: Behavioral Treatment Group

Follow-Up	Intake					
	Age	IQ	Vineland Communication	Vineland Daily Living	Vineland Social	Vineland Composite
IQ	.01 −.06	.60* .18	.17 −.12	−.21 −.40	−.19 −.32	.03 −.17
Vineland Communication	−.06 .19	.56* .40	.64* .29	.32 .06	.42 .14	.49 .19
Vineland Daily Living	.36 .36	.60* .45	.31 −.05	−.20 −.33	−.19 −.24	.26 −.21
Vineland Social	.40 .46	.40 .34	.43 .06	−.17 −.25	.36 −.14	.31 −.14
Vineland Composite	.23 .37	.58* .43	.52 .10	.28 −.20	.37 −.11	.43 −.11
Vineland Maladaptive	−.40 —	−.64* —	−.09 —	.13 —	.06 —	.06 —

Note: $n = 13$. For each column, the first value is the correlation between intake and follow-up scores; the second value is the correlation between intake scores and change in scores.

$*p < .05$. $**p < .01$.

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Table 4
Unprotected Pearson Correlations of Intake Scores With Follow-up Scores and With Changes in Scores: Eclectic Treatment Group

Follow-Up	Intake					
	Age	IQ	Vineland Communication	Vineland Daily Living	Vineland Social	Vineland Composite
IQ	.10 / -.14	.84** / .49	-.12 / .46	.58* / .60*	.58* / .53	.67* / .63*
Vineland Communication	.13 / -.64*	.46 / -.43	.29 / .90**	-.12 / .73*	.03 / .72*	.82** / -.14
Vineland Daily Living	.23 / .00	.12 / -.24	-.05 / .73*	-.29 / .50	.03 / .58	.67* / -.02
Vineland Social	.14 / -.17	.27 / -.05	.06 / .67*	.07 / .70*	-.14 / .85*	.76** / .04
Vineland Composite	.00 / -.58	.33 / -.31	.10 / .77**	-.34 / .70*	-.09 / .77*	.80** / -.35
Vineland Maladaptive	-.54 / -.29	.11 / -.40	.44 / -.40	-.30 / -.45	-.26 / -.56	-.60 / -.33

Note: $n = 12$. For each column, the first value is the correlation between intake and follow-up scores; the second value is the correlation between intake scores and change in scores.

*$p < .05$. **$p < .01$.

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obtained average change of +7 points in IQ, –10 points in Vineland Adaptive Functioning, –7 points in Vineland Communication, –6 points in Vineland Daily Living Skills, and –12 points on Vineland Socialization. Seven of 13 children in the ABA group who scored within the range of mental retardation at intake scores within the average range (≥ 85) on both IQ and verbal IQ at follow-up, compared with 2 of 12 children in the eclectic treatment group.

The present study had several limitations, including quasirandom rather than random group assignment, small sample size, and no direct quality control measures of treatment. Thus, replications are needed. However, the study does yield findings that are of interest. First, gains in IQ are comparable to those obtained with younger children with autism, and gains in adaptive skills (measured by the Vineland) and management of problem behavior (measured by the TRF) actually appear larger than in some studies of younger children with autism (e.g., Smith et al., 2000). The present study included only children with an intake IQ of 50 or above (perhaps explaining the more favorable results than in reports such as Smith et al., 2000) but suggests that some 4- to 7-year-olds with autism may benefit considerably from intensive ABA.

The pattern of results from intake to Year 1 to the second follow-up is noteworthy. The behavioral group showed statistically significant gains from pretreatment to Year 1 on most measures and from pretreatment to follow-up on all measures. Nevertheless, gains from Year 1 to follow-up were not statistically significant except on Vineland Adaptive Behavior Composite and Vineland Socialization. Thus, most gains in IQ and communication appeared between intake and Year 1. It is unclear whether this finding indicates that children derived maximal benefit on IQ and communication in the first year of intervention or whether the present study had insufficient statistical power to detect gains on these measures after Year 1. Studies with larger samples would be required to resolve this issue.

In contrast, Vineland Composite scores increased throughout ABA treatment, and significant changes in Vineland Socialization and Daily Living scores occurred only after 1 year of ABA treatment. This finding suggests that it may be important to extend ABA treatment beyond 1 year to achieve reliable gains in social behavior and daily living skills.

As in previous studies (e.g., Lovaas, 1987), there were large individual differences in gains made by children in the ABA group. However, none of the demographic variables (e.g., age at treatment onset) or pretreatment test scores (e.g., IQ) predicted these individual differences in the ABA group. To identify children most likely to succeed in intensive ABA and to develop

appropriate interventions for other children, a priority for future research is to identify intake variables that are associated with individual differences in response to this treatment.

Interestingly, age at intake predicted neither treatment outcome nor gains in treatment for children in the behavioral group, suggesting that this variable may not be as important for outcome as previously thought. Similar findings have been reported for younger children (Lovaas & Smith, 1988; see also Lovaas, 1987). However, other investigators have reported a relation between age at intake and treatment outcome, perhaps because of their inclusion of children with a wider age range than in the present study (e.g., Harris & Handleman, 2000). Because identification of the age range during which intensive ABA is most effective has important ramifications for public policy, further research to resolve the conflicting findings is warranted. While raising new questions, the present study adds to the literature indicating that some children with autism who began treatment between age 4 and 7 may make substantial gains with intensive behavioral treatment.

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