This study was designed to evaluate 1 year of intensive treatment for 4- to 7-year-old children with autism. An independent clinician assigned children to either behavioral treatment (n = 13) or eclectic treatment (n = 12). Assignment was based on availability of personnel to supervise treatment and was not influenced by child characteristics or family preference. The two treatment groups received similar amounts of treatment (M = 28.52 hours per week at the child's school). Children in the behavioral treatment group made significantly larger gains on standardized tests than did children in the eclectic treatment group. Results suggest that some 4- to 7-year-olds may make large gains with intensive behavioral treatment, that such treatment can be successfully implemented in school settings, and that specific aspects of behavioral treatment (not just its intensity) may account for favorable outcomes.

Intensive Behavioral Treatment at School for 4- to 7-Year-Old Children With Autism

A 1-Year Comparison Controlled Study

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Studies have revealed that intensive, long-term, applied behavior analytic (ABA) treatment enables many children with autism to make significant gains on standardized tests of cognitive, language, adaptive, and academic skills (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Hoyson, Jamieson, & Strain, 1984; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Sheinkopf &

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Siegel, 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997). Moreover, some children have improved to the point that they have successfully passed typical classes in public schools; obtained scores in the average range on tests of intellectual, language, social, and emotional functioning; and maintained their gains several years after the treatment ended (Lovaas, 1987; McEachin et al., 1993).

Investigators have suggested that, to achieve the best possible outcomes, children with autism should begin intensive behavioral treatment as early as possible, preferably before the age of 4 years (Green, 1996). Younger children with autism may have more behavioral and neural plasticity than older children do (Borman & Fletcher, 1999), and they may not have fallen as far behind their peers. Hence, they may be able to catch up to their peers to a greater extent than older children with autism can. However, only a few studies have provided evidence to confirm (or refute) this suggestion. One such study compared outcomes of 9 children with autism who began behavioral treatment prior to 5 years of age and 9 children who entered the same program after 5 years of age (Fenske, Zalenski, Krantz, & McClannahan, 1985). The investigators found that the outcomes of the younger children were more favorable than those of the older children. Hence, they concluded that beginning treatment early may be important. Similarly, Harris and Handleman (2000) found that children who began treatment prior to the age of 4 years made larger gains than those who began treatment after this age. In contrast to these findings, Lovaas and Smith (1988) found no relation between age at treatment onset and outcome. However, these investigators studied a much narrower age range (16-46 months old at treatment onset) than did Fenske et al. (1985) and Harris and Handleman (2000). Therefore, they noted that older children might not have fared as well as children in their study. A limitation of all of these studies was that they lacked comparison groups that received intensive treatment based on a model other than ABA. Hence, questions have been raised as to whether intensive treatment needs to be behavioral or whether other intervention modalities would be equally efficacious.

Many children with autism do not have an opportunity to start intensive behavioral treatment prior to age 4. Some do not even receive a diagnosis of autism until they are past this age (Howlin & Moore, 1997). Moreover, parents have reported that, at the time of diagnosis,

professionals discouraged them from obtaining intensive behavioral treatment for their children (Maurice, 1993). Also, limited resources may result in long waiting lists for behavioral treatment. Thus, research is needed on the extent to which such treatment enhances the functioning of older children with autism and how this treatment compares to other interventions of equal intensity so that parents and professionals can determine whether the treatment is appropriate for this population.

This study was designed to evaluate the outcomes achieved after 1 year by 4- to 7-year-olds with autism who participated in intensive behavioral treatment based on the University of California, Los Angeles (UCLA), treatment model (Smith, Donahoe, & Davis, 2000; Smith & Lovaas, 1998). Because most children at this age attend school, treatment was school based rather than home based (as in previous studies of the UCLA treatment, e.g., McEachin et al., 1993). To test whether intensive behavioral treatment was more effective than an alternative intervention of equal intensity, we included a comparison group of children who received intensive, eclectic special education services.

METHOD

PARTICIPANTS

All referrals in the time span of November 1995 to November 1998 who met the following three criteria were included in this study: (a) diagnosis of childhood autism (ICD-10) (World Health Organization, 1993) from both the Autism Diagnostic Interview–Revised (ADI-R) (Lord, Rutter, & LeCouteur, 1994) and an independent child clinical psychologist, (b) chronological age (CA) between 4 and 7 years at the time of intake, (c) deviation IQ of 50 or above on the Wechsler Preschool and Primary Scale of Intelligence–Revised (WPPSI-R) (Wechsler, 1989) or ratio IQ of 50 or above on the Bayley Scales of Infant Development–Revised (Bayley, 1993), and (d) absence of major medical conditions other than autism. The ADI-R was administered by a child clinical psychologist who was independent of the study and who had received training from one of the developers of

the instrument (Lord). In all cases, the diagnosis was established fewer than 6 months before entering the study. The catchment area was the counties of Akershus and Vestfold in Norway, and all participants were clients of the Akershus or Vestfold Regional Habilitation Team. The Habilitation teams were state-founded agencies to provide specialist services to children with autism. The participants were standard referrals to the Habilitation teams that would have been made whether the study took place or not. All referrals agreed to participate in the study. Children with IQs under 50 were excluded because previous studies had indicated that they may be less likely to benefit from intensive behavioral treatment (e.g., Fenske et al., 1985; Harris & Handleman, 2000).

ASSIGNMENT TO GROUPS

A director of the Habilitation team, who was independent of this study, assigned the children to one of two groups: (a) behavioral treatment (n = 13; 8 boys) or (b) eclectic treatment (n = 12; 11 boys). Children in both groups received a minimum of 20 hours per week of treatment for 1 year from trained therapists at their local schools. Assignment was based on the Habilitation teams' availability of supervisors for behavioral treatment: If qualified supervisors were available to train the therapists and to oversee the behavioral treatment (as described in the next section), children entered the behavioral treatment group; otherwise, children entered the eclectic treatment group. There were no instances where group assignment was based on factors other than staff availability. In addition to the 25 participants, there were 2 dropouts: One child who was assigned to the behavioral group (intake CA = 55 months, IQ = 52) received only 9.5 hours per week of treatment, although a minimum of 20 hours per week was planned. The family of one child assigned to eclectic treatment (intake CA = 73 months, IQ = 76) declined follow-up testing.

SETTING

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 edu-

cation teacher, who provided a minimum of 4 to 6 hours per week of treatment, and one or more aides, who provided the remaining treatment hours. During individual treatment sessions (behavioral or eclectic), the child worked alone with his or her therapist in a separate room. When not in these sessions, the child was mainstreamed with his or her classmates while being shadowed by the therapist. Having the therapist serve as a shadow was designed to promote generalization of skills from individual treatment sessions to the classroom and to ensure that the shadow was familiar with the child and his or her treatment.

As is usual in Norway, kindergarten classes were located in buildings separate from elementary schools and were composed of 18 typically developing children (ages 3-6 years), a teacher, and two teacher's aides, in addition to the child with autism and his or her therapist. The kindergartens were open from 8:00 a.m. to 4:30 p.m., Monday through Friday. Children were required to attend from 10:00 a.m. to 2:00 p.m. Elementary school classes were composed of a maximum of 28 typically developing children (all in the same grade and hence having the same age), as well as two to three teachers. These classes commenced at 8:30 a.m. and ended at 12:30 p.m., Monday through Friday. From 12:30 until 4:30 p.m., children could participate in a child care program at the school. If a child with autism participated in this child care program, efforts were made to schedule one-to-one treatment during this time. No two participants were enrolled in the same class.

TREATMENT

Behavioral treatment. Behavioral treatment was based on a manual (Lovaas et al., 1981) and associated videotapes (Lovaas & Leaf, 1981), with the modification that contingent aversives such as those used by Lovaas (1987) were not employed. In brief, the treatment began with relatively simple tasks, such as responding to basic requests made by an adult. It then progressed to more complex tasks, such as imitating verbal and nonverbal behaviors, labeling objects, identifying actions, and understanding abstract concepts such as colors, size, and prepositions. The treatment subsequently focused on advanced skills such as answering questions, conversing, and making

friends with peers. The program also emphasized play and social skills, progressing from functional toy play and parallel play to symbolic and cooperative play. The program emphasized the implementation of experimentally validated teaching approaches (cf. Newsom & Rincover, 1989; Schreibman, 1988; Smith, 1993) based on operant conditioning principles such as shaping, chaining, discrimination training, and contingency management. In the early stages of treatment, instruction took place in a one-to-one discrete-trial format, which enabled therapists to devote highly individualized attention to each child. Later, the focus shifted gradually to help children generalize skills to natural settings with regular peers, adjust to classroom routines and settings, and acquire new skills in such settings.

Prior to the study, none of the therapists (teachers and aides) had had any supervised experience in the implementation of behavioral treatment for children with autism. During the study, the therapists received 10 hours per week of supervision in an apprenticeship format: Supervisors set up and implemented treatment programs, and then the therapists implemented these programs and received feedback based on supervisors' in vivo observations of their work. Supervisors were staff at the Vestfold and Akershus Habilitation Services who had a minimum of 1,500 hours of experience implementing the UCLA treatment and possessed the qualifications specified by Smith et al. (2000). They met weekly with the project directors (the first, third, and fourth authors), each of whom were psychologists with approximately 10 years of experience implementing the UCLA treatment prior to the study.

Parental participation was considered central to the treatment. As part of their training, parents worked alongside therapists at school for the first 3 months of treatment for a minimum of 4 hours per week. The therapists and parents took turns implementing the child's one-to-one, discrete-trial treatment programs, and they gave each other feedback on their work. This training was intended to enable the parents to become effective therapists for their children so that the behavioral treatment could be extended to the home and community and to help parents to make informed decisions about their children's treatment. After the first 3 months, parents' focus shifted to the home and com-

munity, where they implemented primarily generalization and maintenance programs.

Weekly, 2-hour meetings were held for each child. The child, primary caregiver, therapists, supervisor, and director attended. At the meetings, the child's treatment program was modified based on data collected during the preceding week. Also, therapists and parents received training on their work with the child.

Eclectic treatment. All children in the comparison group received eclectic treatment that was designed to reflect best practices for serving children with autism (Dawson & Osterling, 1997). The treatment incorporated elements from a variety of different interventions, such as Project TEACCH (Schopler, Lansing, & Waters, 1983), sensory-motor therapies (Ayres, 1972), and applied behavior analysis (Lovaas et al., 1981), as well as methods derived from personal experience. Each child received a combination of interventions that were individually selected for the child based on recommendations from a multidisciplinary team of school personnel. These interventions were implemented in a one-to-one format in a separate room by therapists who were assigned to children in the same way as in the behavioral treatment group. The therapists received weekly, 2-hour consultations from the supervisors and directors who oversaw behavioral treatment in this study.

ASSESSMENT AND DATA COLLECTION

Therapy measures. At follow-up for each child in both groups, therapists were asked to report the number of hours per week of one-to-one treatment (not including time with an aide in the classroom) that the child had received during the preceding year. To compare treatment goals for children in the two groups, therapists were asked to report the goals in each child's individualized education plan in each of the following areas: vocal language, alternative/augmentative communication, academics, play, social skills, imitation, motor skills, daily living skills, and behavior management. Finally, to compare the level of therapist training in the two groups,

therapists reported the number of years of postsecondary schooling they had received in special education or related fields.

Child measures. All children were assessed at intake and 1 year after treatment began. In all cases, intake assessment was conducted within 1 month of the onset of treatment. A licensed clinical psychologist carried out all intake assessments. Follow-up assessments were conducted either by this psychologist or by an examiner who had a master's degree in special education and a license to administer psychological tests. Both examiners had extensive experience with children with autism. They were independent of the study and were not informed of children's group assignment. Intake assessments were carried out in order of referral, and follow-up assessments were carried out in the order that children completed 1 year of treatment. Assessments were composed of standardized tests of intelligence, visual-spatial skills, language, and adaptive functioning.

Intellectual functioning. Depending on their CAs, children were given the WPPSI-R (Wechsler, 1989) or the Wechsler Intelligence Scale for Children–Revised (WISC-R) (Wechsler, 1974). The WPPSI-R measures cognitive functioning in children ages 3 years to 7 years, 3 months; the WISC-R is a similar instrument for older children (6 years, 6 months through 16 years). Children who were in the age range covered by both tests (6 years, 6 months to 7 years, 3 months) were given the WPPSI-R. The WISC-R has been revised (Wechsler, 1996), but the revision was not used because it has not been standardized in the children's native language (Norwegian). If a child failed to achieve basal on the WPPSI-R or WISC-R (defined for this study as two 2-point responses on the vocabulary subtest), the Bayley Scales of Infant Development–Revised (Bayley, 1993) were given. This occurred for 6 children at intake (2 in the behavioral group and 4 in the eclectic group); 2 of these 6 children (both in the eclectic group) were administered the Bayley again at follow-up. The Bayley is a test of cognitive functioning in children ages 2 to 42 months. For the WPPSI-R and the WISC-R, a deviation score was obtained. For the Bayley, a ratio score was used because the children's CAs were higher than 42 months (i.e., higher than that of the norm group for the test).

The WPPSI-R, WISC-R, and Bayley have all been widely used and validated with children with autism.

Visual-spatial skills. The Merrill-Palmer Scale of Mental Tests (Stutsman, 1948) was given to all participants at intake and all children with CAs under 6 years, 6 months at follow-up. This instrument assesses primarily visual-spatial skills in children ages 1 year, 6 months to 6 years, 6 months, and it has been shown to predict later functioning in children with autism (e.g., Lord & Schopler, 1989). A ratio IQ was derived from it. For children older than 6 years, 6 months at follow-up (8 children in the behavioral group, 5 in the eclectic group), visual-spatial skills were assessed using the performance subscale of the WPPSI-R or WISC-R.

Language functioning. The Reynell Developmental Language Scales (Reynell, 1990) were used to assess language functioning in all participants at intake and in all participants who were younger than 7 years at follow-up. This instrument yields developmental ages and standard scores for language comprehension and for expressive language. It is commonly administered to children with autism (Sparrow et al., 1997), although its psychometric properties have not been studied with this population. Children who were older than 7 years at follow-up (4 children in behavioral treatment and 4 in the eclectic group) received the verbal subscale of the WPPSI-R or the WISC-R instead of the Reynell. A standard score was derived from the manual. If the child performed below the range covered by the manual, a ratio quotient was substituted for the standard score.

Adaptive behaviors. Children's adaptive skills were assessed with the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984). The Vineland yields standard scores for communication, daily living skills, and socialization, as well as a composite standard score. It also provides a measure of maladaptive behavior (normed for children ages 5 years and older, and hence given only at follow-up). The Vineland is widely regarded as the instrument of choice for assessing adaptive functioning in children with autism (Newsom & Hovanitz, 1997).

TABLE 1
Characteristics of Behavioral Treatment (*n* = 13) and Eclectic Treatment (*n* = 12)

	Behavioral Treatment		*Eclectic Treatment*	
Treatment hours (*M* [*SD*, range])	28.00	(5.76, 20-35)	29.08	(8.05, 20-41)
Goals (*n*)				
Vocal language	13		12	
Alternative/augmentative communication	0		4[a]	
Academics	10		8	
Play	12		11	
Social skills	13		12	
Imitation	8		5	
Motor skills	5		5	
Daily living skills	11		7	
Behavior management	9		12[a]	
Therapist education (*n*)				
Less than 1 year	12		14	
1-3 years	1		1	
3-year degree	13		19	

a. Unprotected $\chi^2(1, 1)$ significant at $p < .05$.

RESULTS

THERAPY

Table 1 summarizes the data on therapy. As shown, the amount of treatment that children received in each group was similar. The average for all children in the study was 28.52 hours (*SD* = 6.83) per week. Children in each group were approximately equally likely to have treatment goals in the areas of vocal language, academics, play, social skills, imitation, motor skills, and daily living skills. However, children in behavioral treatment were significantly less likely to have goals for alternative/augmentative communication and behavior management than those in eclectic treatment. Educational levels of therapists did not significantly differ between groups.

MAIN FINDINGS

A series of independent *t* tests were conducted on intake measures to assess between-group differences. This procedure was repeated on follow-up measures, with the modification that analyses were one-tailed. A sign test was also performed on intake measures and again on follow-up measures to assess whether one group consistently scored higher than the other across measures (cf. Lovaas, 1987). Because the sign test yielded significant results for both intake and follow-up measures, *t* tests were also conducted to compare changes in scores between intake and follow-up in each group. Each series of *t* tests was Dunn-Bonnferroni corrected for a family-wise error of .10. To examine the clinical significance of follow-up data, one-tailed chi-square tests were performed on the proportion of children in each group who achieved scores in the average range (within 1 standard deviation of the population mean) (Jacobson & Truax, 1991).

Table 2 presents intake and follow-up data. As shown, the behavioral and eclectic treatment groups did not significantly differ on any of the 11 intake variables. However, the eclectic group attained higher average scores than the behavioral group on 10 of these 11 variables (sign test, $p < .01$). Hence, the eclectic group may have functioned at a more advanced level than the behavioral group at intake. At follow-up, the behavioral group obtained average scores above those of the eclectic group on all measures except Vineland Socialization (sign test, $p < .01$), although none of the differences on individual measures reached statistical significance. Differences in mean overall scores on each test ranged from 5 points for the performance IQ to 15 points for Total Language. The one measure given only at follow-up, the Vineland Maladaptive Behavior scale, indicated that children in the behavioral group displayed significantly fewer disruptive behaviors than the eclectic group, with raw score M (SD) = 4.29 (2.89) for the behavioral group and M (SD) = 7.25 (2.99) for the eclectic group, $t(23) = -2.56$, $p < .05$.

Consistent with the results of the sign tests, the behavioral group showed more gains than the eclectic group on all measures. These differences were statistically significant for IQ, language (as assessed by

TABLE 2
Intake and Follow-up Chronological Age and Standardized Test Scores for the Behavioral Treatment Group (n = 13) and Eclectic Treatment Group (n = 12)

	Behavioral Treatment						*Eclectic Treatment*					
	Intake		*Follow-up*		*Change*		*Intake*		*Follow-up*		*Change*	
Measure	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Chronological age (months)	66.31	(11.31)	78.50	(10.73)	12.19	(10.21)	65.00	(10.95)	78.58	(10.94)	13.58	(9.93)
IQ	61.92	(11.31)	79.08	(18.09)	17.15	(10.97)	65.17	(14.97)	69.50	(18.38)	4.33	(7.55)**
Performance IQ[a]	77.54	(30.21)	95.00	(16.91)	17.46	(30.70)	81.83	(21.05)	90.17	(19.97)	8.33	(16.12)
Language												
Comprehension[b]	49.03	(16.42)	58.47	(17.11)	12.70	(14.58)	50.38	(15.46)	47.55	(17.25)	–0.70	(8.65)*
Expressive[b]	45.12	(13.44)	67.39	(17.81)	22.57	(22.99)	51.24	(19.24)	49.00	(18.69)	–2.23	(24.46)*
Total[c]	51.83	(17.42)	76.85	(26.67)	27.00	(20.41)	60.00	(24.22)	61.58	(24.34)	1.08	(17.07)*
Vineland Adaptive Behavior Scales												
Communication	58.23	(9.21)	73.93	(16.55)	15.69	(16.89)	63.17	(16.11)	61.58	(13.37)	–1.58	(7.81)**
Daily living	56.92	(9.80)	66.15	(16.55)	9.23	(15.12)	57.00	(15.92)	62.50	(10.97)	5.50	(11.37)
Socialization	59.92	(7.19)	69.92	(17.26)	10.00	(16.13)	62.17	(10.32)	70.67	(13.66)	8.50	(12.28)
Composite	55.77	(8.96)	67.00	(16.30)	11.23	(14.79)	60.00	(13.20)	60.17	(11.69)	0.17	(7.76)*

a. Merrill-Palmer or Performance scale of the Wechsler Preschool and Primary Scale of Intelligence–Revised (WPPSI-R) or the Wechsler Intelligence Scale for Children–Revised (WISC-R) (Merrill-Palmer n = 13 in the behavioral group and 12 in the eclectic group at intake; 8 in the experimental group and 5 in the eclectic group at follow-up).
b. At intake, n = 12 in the behavioral group and 9 in the eclectic group; n = 10 in the behavioral group and 8 in the eclectic group at follow-up (scores available only for children who completed the Reynell rather than the WISC-R or WPPSI-R).
c. Total language for Reynell = (Comprehension + Expressive Language)/2; Total language for WPPSI-R/WISC-R = Verbal IQ.
*p < .05. **p < .01.

TABLE 3
Unprotected Pearson Correlations of Intake Scores With Follow-up Scores and With Changes in Scores: Behavioral Treatment Group (n = 13)

	Intake				
Follow-up	*Age*	*IQ*	*Performance IQ*	*Language*	*Vineland Adaptive Behavior Scales*
IQ	.08/–.15	.82**/.24	.14/.24	.45/.01	.22/.01
Performance IQ	.13/.07	.46/.10	.25/–.84**	.09/–.61	.04/–.60*
Language	.03/–.07	.89***/.59*	–.01/–.50	.65**/.00	.43/.06
Vineland Adaptive Behavior Scales	–.21/–.29	.40/.14	.41/.16	.45/.09	.44/–.12

NOTE: The first number in each cell is the correlation between intake and follow-up scores; the second number is the correlation between intake scores and change in scores.
*p < .05. **p < .01. ***p < .001.

each scale of the Reynell or WPPSI-R), and adaptive behavior (as assessed by the Vineland Communication and Composite scores). Analyses of clinical significance revealed that children in the behavioral group were more likely to have IQs in the average range. Seven of 13 in the behavioral group achieved WPPSI-R IQ scores above 85 (with 1 other scoring 84), compared to 2 in the eclectic treatment group, χ^2 (1, 1) = 3.64, p < .05. The behavioral group was also more likely than the eclectic group to score in the average range on other measures, although this difference was not statistically significant. Eleven in the behavioral group had visual-spatial IQs above 85 (with 1 other scoring 84), compared to 7 in the eclectic group. Four in the behavioral group and 3 in the eclectic group had overall language scores above 85. Also, 2 in the behavioral group and 1 in the eclectic group had adaptive behavior composite scores above 85.

PREDICTION OF OUTCOME

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 and eclectic groups, respectively.

TABLE 4
Unprotected Pearson Correlations of Intake Scores With Follow-up Scores and With Changes in Scores: Eclectic Treatment Group (n = 12)

	Intake				
Follow-up	*Age*	*IQ*	*Performance IQ*	*Language*	*Vineland Adaptive Behavior Scales*
IQ	.36/.08	.92***/.25	.86**/.67*	.87***/.29	.49/.16
Performance IQ	.43/.20	.76**/.01	.69*/–.44	.82**/.13	.58/–.15
Language	.39/–.41	.78**/–.24	.69*/–.03	.76**/–.39	.56/–.04
Vineland Adaptive Behavior Scales	.12/–.65*	.63*/.04	.65*/–.22	.58/–.15	.85**/–.54

NOTE: The first number in each cell is the correlation between intake and follow-up scores; the second number is the correlation between intake scores and change in scores.
*p < .05. **p < .01. ***p < .001.

In the behavioral group, all correlations of intake age with outcome measures and changes in score were nonsignificant, with r(12) ranging from –.29 to .17. Thus, age was not reliably associated with outcome or amount of change in this group. However, in the eclectic group, a significant correlation was found between intake age and change in Vineland scores, indicating that younger children in this group tended to make larger gains on the Vineland.

Table 3 shows that, in the behavioral group, intake IQ was strongly associated with follow-up IQ and language. It was also positively but nonsignificantly correlated with follow-up Performance IQ and the Vineland. Furthermore, intake IQ correlated strongly with change in language. Thus, intake IQ predicted outcome on many variables for the behavioral treatment group. Other intake variables were less reliably associated with outcome measures and changes in score.

Intake IQ emerged again as a strong predictor of outcome measures in the eclectic group (see Table 4). Intake Performance IQ and language were also strong predictors. Similarly, intake Vineland predicted outcome Vineland and was positively correlated with other outcome measures, although these associations were nonsignificant.

However, intake measures were not significant predictors of changes in scores in this group.

DISCUSSION

At a 1-year evaluation, 13 children who had received intensive behavioral treatment made significantly larger improvements than a comparison group of 12 children who had received intensive, eclectic intervention. On average, the intensive behavioral group gained 17 points in IQ, 13 points in language comprehension, 23 points in expressive language, and 11 points in adaptive behavior. By comparison, the eclectic group obtained average changes of +4 points in IQ, –1 points in language comprehension, –2 points in expressive language, and 0 points for adaptive behavior. At follow-up, behaviorally treated children also achieved standardized test scores in the average range more often than did eclectically treated children. In addition, they averaged 5 to 15 points higher on standardized tests (with the exception of Vineland Socialization) than did eclectically treated children, but this advantage was not statistically significant. Such between-group differences emerged even though the groups appeared similar to each other in the amount of treatment that children received and the level of education that therapists possessed. Treatment goals also appeared similar for both groups, except that augmentative/alternative communication and behavior management were more often targeted in eclectic treatment than in behavioral treatment. Intake IQ and other standardized scores predicted outcome for children in the behavioral treatment group, but intake CA did not.

The gains made by behaviorally treated children in this were generally consistent with those reported for younger children with autism who have received intensive behavioral intervention (Smith, 1999). Thus, some 4- to 7-year-old children with autism may benefit as much as younger children from this intervention, contrary to the view presented in the introduction that children younger than 4 years would respond most favorably. However, because one requirement for enrollment in this study was an intake IQ of 50 or above, participants may have been higher functioning at intake than is usual for children

with autism. The evidence on this point is mixed. Children's average intake IQs (64) and adaptive behavior scores (58) resembled those in other studies, but their average scores were relatively high on intake tests of visual-spatial skills (Performance IQ = 83; language ratio score of 49 for language comprehension and 48 for expressive language, equivalent to developmental ages of 32 and 30 months, respectively) (Smith, 1999). Hence, a question for future research is whether other groups of 4- to 7-year-olds would show gains of the same magnitude as did children in this study.

In contrast to other studies on the behavioral treatment model we implemented (reviewed by Smith et al., 2000), intervention in this study took place primarily at school rather than at home. Thus, our results suggest that the intervention can be successfully adapted to school settings for some children with autism. However, this adaptation may not be effective for younger children, such as those who have participated in previous investigations (e.g., Lovaas, 1987). Most of these younger children have had language and social skills comparable to that of a typically developing 1-year-old. For such children, home or a homelike setting such as day care may be more developmentally appropriate than school. Thus, further research is needed to determine whether younger children would benefit if the intervention were delivered at school rather than at home.

A persistent question about intensive behavioral treatment has been whether children's gains are due to specific techniques used in this treatment (e.g., discrete-trial training, systematic use of reinforcement, shaping, and chaining) or to nonspecific or placebo factors such as providing many hours of service and setting treatment goals that address diverse areas of functioning (Dawson & Osterling, 1997). Given that the behavioral group in this study apparently did not differ from the eclectic group on these nonspecific factors yet made larger gains, our results indicate that specific behavioral techniques are important. However, an alternative explanation is that the behavioral group received higher quality treatment than the eclectic group. For example, the behavioral group received more supervision than the eclectic group, as described in the Treatment section. Also, the treatment goals differed in some respects between groups. At minimum,

though, the results suggest that an effective intervention involves more than providing an intensive, comprehensive treatment program.

Despite differing in how much change they made, the behavioral and eclectic groups did not have significantly different follow-up test scores on any measure except the Vineland Maladaptive Behavior (with the behavioral group displaying fewer maladaptive behaviors than the eclectic group). Of course, one possible interpretation of the small between-group differences in follow-up test scores is that intensive behavioral treatment is not really as effective as previous studies have suggested. However, another interpretation is that the eclectic treatment may have been more efficacious than other interventions to which behavioral treatment has been compared in the past. Consistent with this view, the eclectic treatment was much more intensive and may have included more behavioral techniques than comparison treatments in previous studies (Smith, 1999). Still another interpretation is that the behavioral treatment in the present investigation may have been less efficacious than in previous studies. For example, children received an average of 28 hours per week of treatment, rather than 40, as in the study by Lovaas (1987). Treatment lasted a year, instead of 2 years or longer, as in previous studies (Lovaas, 1987). Such reductions in intensity and duration may have weakened the treatment. An additional interpretation is that the small number of children in each of the two groups may have yielded too little statistical power to detect differences between groups. Unfortunately, the available data do not make it possible to determine which of these interpretations is most plausible.

Intake standardized test scores, particularly IQ, predicted the outcome of behavioral treatment more strongly than in previous studies (e.g., Smith, Groen, & Wynn, in press). This finding may reflect the fact that children were older and hence more likely to have stable test scores. Alternatively, it may stem from the use of intake tests that have greater predictive power (e.g., the WPPSI-R rather than the Bayley). Still, additional investigations are necessary to determine whether the strong predictions we found can be cross-validated with other samples.

This study had several limitations, including a small sample size, quasi-random rather than fully random procedures for group assignment, measures that focused more on cognitive than social development, and lower treatment intensity than has been recommended by the developers of the behavioral treatment model used in the study. Nevertheless, the study also had several strengths, notably (a) comprehensive, uniform assessment protocols administered by blind examiners; (b) manualized, research-based interventions for the behavioral treatment group (Lovaas et al., 1981); (c) treatment supervision by experienced personnel; (d) measures of the amount of treatment that children received, skills addressed in treatment, and education of therapists; and (e) group assignment performed by a professional who was independent of the study. Thus, the results provide evidence that some 4- to 7-year-old children with autism may make substantial gains with intensive behavioral intervention.

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