

Effects of Low-Intensity Behavioral Treatment for Children with Autism and Mental Retardation

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We retrospectively compared 2 groups of children receiving either behavioral treatment ($n=13$) or eclectic treatment ($n=15$) for an average of 12 hours per week. Children were assessed on intelligence, language, adaptive functioning and maladaptive behavior at pretreatment and 2 years into treatment. The groups did not differ significantly at pretreatment. After 2 years of treatment, the behavioral group made larger gains than the eclectic group in most areas. However, gains were more modest than those reported in previous studies with children receiving more intensive behavioral treatment, and it is questionable whether they were clinically significant.

KEY WORDS: Behavioral intervention; eclectic treatment; autism; intensity.

A number of recent studies have shown that behavioral treatment may enhance the intellectual, language and adaptive functioning of children with autism (Anderson *et al.*, 1987; Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris & Handleman, 2000; Harris *et al.*, 1991; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Sheinkopf & Siegel, 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Weiss, 1999). Reviewers of the literature conclude that, to achieve best possible outcome, behavioral treatment needs to be intensive (Green, 1996; Smith & Lovaas, 1998). Indeed, as much as 40 hours per week of one-to-one behavioral treatment for a minimum of two years may be required to produce optimal results. Lovaas (1987) provided 40 hours per week of one-to-one

behavioral treatment for 2–3 years to a group of 19 children with autism who were less than 3 years and 10 months at intake. By the age of seven years 47% (9 children) achieved normal intellectual functioning and successful performance in school. These gains were maintained for eight of the nine children at follow-up when the children averaged 13 years of age and had been out of treatment for three to nine years (McEachin *et al.*, 1993). Another 42% (8 children) made clinically meaningful gains, and only 11% were classified as severely or profoundly mentally retarded and placed in classes for children with autism and mental retardation. The average IQ gain for the intensively treated group was 20 points. A control group of 19 children that received 10 hours or less per week of the same treatment lost an average of five IQ points, suggesting that treatment intensity was related to outcome.

In other studies where children have received somewhere between 20 and 30 hours per week of one-to-one behavioral treatment gains have been more modest showing average IQ gains between 4 and 17 points (Anderson *et al.*, 1987; Birnbrauer & Leach,

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1993; Eikeseth *et al.*, 2002; Smith, Groen, & Wynn, 2000). However, it is difficult to compare these studies directly because a number of other factors that may relate to outcome also varied. These include age and IQ at intake, duration of treatment, and level of supervision and staff training.

Less intensive ABA, in which children receive 10–20 hours per week of services, may be provided when circumstances such as costs, availability of professionals, and other logistical issues limit the amount of services that a child can obtain. Less intensive ABA may also be provided when parents or professionals express concerns that 40 hours per week of one-to-one treatment might put too much stress on the child and family while leaving too little time to play and socialize with peers. According to this view, a more effective treatment program may consist of fewer hours of one-to-one behavioral treatment and more time with peers in age-appropriate group settings (Autism National Committee, 1995).

However, to our knowledge, no outcome studies have focused on intervention programs for children with autism that combine a relatively small amount of one-to-one behavioral treatment (e.g., fewer than 20 hours per week) and placement with typical peers. The present study was done in an attempt to evaluate the effects of such programs. As a result of decisions made by local professionals and/or parents, children in the present study received low-intensity one-to-one behavioral treatment for two years. A comparison group of children who received one-to-one eclectic special education treatment of similar intensity was included to test whether the behavioral treatment was more effective than a commonly used alternative intervention.

METHOD

Participants and Group Assignment

Records were examined from children admitted to three regional Habilitation services in Norway between 1993 and 2001: Akershus (population of ca. 460,000), Buskerud (population of ca. 237,000), and Vestfold (population of ca. 213,000).

All children who met the following criteria were included in the study: (a) diagnosis of autism and mental retardation according to ICD-10 criteria (World Health Organization, 1993), from a licensed psychologist and/or a medical doctor, (b) chronological age below six years at the start of treatment, (c)

no medical conditions that could interfere with treatment such as sustained uncontrollable epilepsy or major delays in motor development, (d) treatment record indicating that the child had received between 10 and 20 hours per week of one-to-one treatment, and (e) assessments of intellectual functioning, adaptive behavior and language conducted pretreatment and after two years of treatment. These inclusion criteria resulted in a group of 28 children.

A thorough examination of each child's treatment record and a questionnaire completed by case supervisors were used to divide children into two groups. Before treatment started, an educational planning process involving local professionals, specialist services such as the regional Habilitation Services and regional Child- and Adolescent Psychiatric Services, and the parents had determined what type of treatment each child was to receive. Children who had received treatment based only on applied behavior analysis constituted the behavioral treatment group. The remaining children, who had all received a combination of two or more types of treatment, comprised an eclectic treatment comparison group. The local educational authorities are legally required to make a written individual treatment plan for any child receiving special education services. The individual plan must be evaluated and revised at least every six months. All programs, both the behavioral and the eclectic were subject to this routine. Typically, the same team that initially had determined what type of services the child was to receive along with kindergarten or school personnel would partake in this evaluation cycle.

The behavioral group consisted of 13 children (10 boys) and the comparison group 15 children (14 boys). Seventeen children were recruited from Akershus (10 behavioral), 10 children from Vestfold (3 behavioral) and 1 child from Buskerud (0 behavioral). In the process of getting a diagnosis 11 of the 13 children in the behavioral group had been assessed using the Autism Diagnostic Interview - Revised (Lord, Rutter, & Le Couteur, 1994), 5 of these assessments were conducted by an independent professional. In the comparison group 13 of the 15 children had been given the ADI-R; 8 of the 13 were done by an independent professional. The remaining ADI-R's were administered by one of the authors.

Setting

All participants attended regular kindergartens or elementary school classes for typical children.

Classes were located in the children's local community. As required by Norwegian regulations all mainstream kindergartens were divided into units with up to 18 children between 3 and 6 years of age, with 3 adult staff (6 to 1, staff to child ratio). Kindergartens were typically open weekdays from 7:00 a.m. to 5:00 p.m.; children in the present study stayed in the kindergarten for at least 20 hours every week. Elementary school classes were composed of up to 28 children with 1 to 3 teachers. Classes typically started at 8:30 a.m. and ended at 12:30 p.m. on all weekdays. From 12:30 p.m. until 4:30 p.m., children could participate in a childcare program at the school.

In all kindergartens and schools a separate treatment room was made available for the participant. Most teaching sessions involved one-to-one instruction in the treatment room. However, during some teaching sessions, particularly those targeting social skills, typical children worked together with the participant in the treatment room. During other sessions, treatment took place in other parts of the school. For example, instructional programs for enhancing group interaction took place in the classroom, and instructional programs focusing on self-help skills such as dressing were sometimes implemented in the coat room or bathroom.

Outside of one-to-one instruction, each participant was mainstreamed with the rest of the unit or class and had assistance from an individual aide who guided the participant to complete classroom activities but provided no systematic training towards educational goals. There were no instances where two participants from this study were enrolled in the same kindergarten unit or school class.

Treatment

Behavioral Treatment

The regional Habilitation services offered training and supervision to all staff involved in the behavioral treatment. The model used for staff training and supervision was similar to that described as clinic-supervised treatment in Smith, Donahoe, and Davis (2001). Staff training started with a three-day training workshop and continued throughout the duration of the study with weekly consultations lasting 1–4 hours. In addition, weekly two-hour staff meetings were held for each child. The child, primary caregiver(s), and therapists attended both the workshops and the staff meeting, and all were trained in an

apprenticeship manner. The supervisor first explained and demonstrated how to do a program, and then the therapists took turns practicing the program with the child, while being coached by the supervisors and the other team member. At staff meetings, the child's program or treatment procedures were modified based on the child's progress during the preceding week. A team of two-to-four therapists was recruited from the kindergarten or school personnel to provide the treatment for the child. One of these teachers was also responsible for scheduling and monitoring treatment hours, updating program sheets, and finding materials needed for the treatment. Parental participation was a central part of the program. Typically, the main responsibility for the parents was to ensure generalization and maintenance of skills to the home and other community settings.

The same therapists who provided 1:1 teaching also served as 1:1 aides in the unit or classroom. They devoted a portion of their time in the classroom to implementing specific behavioral interventions (e.g., conducting incidental teaching, providing instruction on self-help skills, teaching peer interaction skills, or implementing behavior management plans). However, because the educational teams and families of children in the behavioral treatment group had determined that children would receive a low intensity of behavioral treatment, most of the 1:1 hours in the classroom focused on practical help for getting dressed or undressed, eating, toileting, and going outside to play, without the use of systematic behavioral teaching methods. For the purposes of this study, the hours spent implementing behavioral teaching methods, whether inside or outside of the treatment room, were considered part of the behavioral treatment, while the hours of practical assistance were considered separate from the behavioral treatment.

The supervisors had a minimum of one-year experience with implementation and supervision of behavioral intervention programs for children with autism, and possessed qualifications similar to those specified by (Smith *et al.*, 2001). They met weekly with one of the project directors (the first three authors of this study) who were all licensed psychologists with at least four years of experience implementing the UCLA treatment prior to the study.

The behavioral treatment was based on treatment manuals (Lovaas, 1981; Maurice, Green, & Luce, 1996). In short, the treatment began with establishing basic tasks, such as responding to simple requests made by an adult, imitation of gross motor

behaviors, identity matching of objects, and teaching of simple toy play such as completion of puzzles or putting shapes in a shape sorter. When these tasks were mastered, the treatment moved on to more complex skills such as imitation of fine motor and oral motor behaviors, imitation of sounds and words, and recognizing objects and actions upon request. After the child had acquired vocal imitation of words and basic receptive language, the child was taught to use the words functionally, for example by making wants known and naming objects and actions. Next, more abstract concepts such as color, size, adjectives and prepositions were targeted. Subsequent treatment goals included discriminating Wh-questions, conversing and making friends with peers. From the start, the treatment also targeted play and social skills, progressing from functional toy play and parallel play to symbolic play and cooperative play. All procedures were based on operant conditioning techniques such as differential reinforcement, shaping, chaining, and prompt and prompt fading. In the early stages of treatment all instruction took place in a one-to-one discrete trial format, enabling the therapists to devote highly individualized attention to each child. Later, the focus shifted gradually to include small group settings with typical children to help generalize skills and adjust to classroom routines. The ultimate goal of treatment was to make the children capable of learning in natural settings the same way that typical children learn.

The difference between the low-intensity behavioral program in this study and more intensive programs provided in other studies was that the amount and comprehensiveness of weekly treatment goals had to be adjusted to fit with the fewer hours available for 1:1 treatment. Quality of treatment was facilitated by the second author, who was a director of a site in the Multi-Site Young Autism Project (MYAP) and had completed a nine-month internship at the UCLA Clinic for the Behavioral Treatment of Children. The first and third authors were collaborating researchers at the Norway replication site of the MYAP.

Eclectic Treatment

For children in this group elements from various types of treatment were combined in an attempt to best meet each child's educational needs. As reported by the case supervisors the treatment included at least two of the following intervention types: alternative communication, applied behavior analysis, total

communication sensorymotor therapies, programs based on the principles from Division TEACCH, as well as other methods that were incorporated based on the personal experience of the particular teacher.

As in the behavioral treatment group, the same therapists who provided 1:1 teaching also served as aides in the mainstream unit or classroom. Also similar to the arrangements in the behavioral treatment group, the majority of the time in the mainstream classroom was not used to implement standardized instructional programs or systematic work towards educational goals. The 1:1 hours in the eclectic group were analyzed in the same way as in the behavioral group; that is as either 1:1 hours spent on working towards educational goals or as 1:1 hours of practical assistance. The organization of supervision and staff training for the eclectic programs were in some ways similar to that of the behavioral group. A special education teacher (2 children) or a supervisor from the regional Habilitation Services (8 children) or a combination of the two (5 children) would do one or two weekly consultations of about 2 hours. The agency to be responsible for supervision was determined in the interdisciplinary educational planning process for each child, within each agency a particular person was assigned on the basis of capacity or geographical location. These consultations were used to train and supervise the treatment personnel. As in the behavioral group, a team of 2–4 therapists were recruited from the kindergarten or school to do the daily work with the child. Also, a psychologist from the Local Educational Authority or the regional Habilitations Services would oversee the program making 2–4 visits per semester.

The treatments components typically found in the eclectic group present study can be summarized as follows: ABA would typically include working on selected programs from ABA treatment manuals such as matching, imitation or toilet training. Alternative communication would typically include working towards a symbol or sign based communication system. Symbols were typically line drawings, Bliss symbols or photographs taken of objects, persons or activities from the child daily life. Signs would typically be hand signs for expressing needs such as "Hungry", "Thirsty" or "Toilet". Both symbolic communication and sign language are skills commonly taught in ABA programs and are included in the first and second edition of the ABA manual used in the present study (Bondy & Frost, 2003; Carr, 1981). However, in the eclectic group, teaching procedures differed from those used in ABA. For

example, in ABA, teaching symbolic communication usually involves one or two instructors working with a child, using spatial fading to prompt correct responding, and following an instructional sequence beginning with teaching the child first to exchange a symbol for a preferred object, then to an approach an adult before exchanging the symbol, then to discriminate between symbols for preferred and non-preferred objects, and so on (Bondy & Frost, 2003). In ABA, teaching sign language involves one instructor working with a child, using systematic shaping or prompt/fading procedures to increase the accuracy of signs, following a progression from basic requests or objects labels to more advanced communication, and reinforcing correct responding (Carr, 1981). In eclectic programs, alternate teaching procedures were used such as providing instruction in a group of children, following a different sequence of instruction, or using varied prompting and reinforcement procedures.

Sensory integration would typically involve daily activity sessions of 15–20 minutes of going on a swing, rocking and stretching while listening to music, or getting a massage.

Total communication elements would include strategies for the complementary use of signs, symbols and speech to enhance verbal comprehension, improve expressive language and develop a form of literacy. It would focus on broadening the medium of communication to include signs, symbols, pictures, photographs and objects, as well as speech. It might also involve the use of drama, mime or other forms of visual communication.

Elements taken from division TEACCH would typically involve making length of sessions predictable by using baskets to separate the tasks and assigning areas for specific activities. The content and procedures of specific programs would most often be suggested based on assessments made by the PEP-R (Schopler, Reichler, Bashford, Lansing, & Marcus, 1990) and TEACCH treatment manuals (Schopler, Lansing, & Waters, 1983). The manuals for the PEP-R and TEACCH treatment are translated into Swedish and thus readily understandable to Norwegian readers.

The treatment elements that were reported to be based on the teacher's clinical experience would typically involve the use of worksheets, learning through educational software on a computer and training social skills through listening to stories and looking at picture sequences.

Unfortunately, although we were able to obtain reports from supervisors on whether or not particular treatment types were implemented for a child, we

were unsuccessful in reliably measuring the portion of time spent on each treatment type. Often, a teaching session was comprised of a mix of different treatment types. For instance, when applying principles derived from division TEACCH such as structuring daily activities with baskets, instructors simultaneously used techniques derived from ABA such as reinforcement and prompting, and principles from total communication such as combining visual and verbal modalities to promote spoken language.

Assessment and Data Collection

Therapy Measures

A questionnaire was used to get more detailed information about each child's treatment program. Supervisors or special education teachers were asked to report both the total weekly hours of systematic one-to-one treatment the child received working towards educational goals, whether the treatment took place in the treatment room, in the classroom, or elsewhere in the school. Moreover, they were asked to report the one-to-one hours that the child received from therapists for tasks such as getting dressed to go outside, washing hands after going to the toilet or help to get on the swing. This time was delineated from treatment time because it did not reflect systematic teaching of new skills. The questionnaire also asked supervisors to report whether the following goals were included in the child's education plan: vocal language, augmentative communication, behavior management, imitation, academics, play, motor skills, social skills or other. Moreover, the number of years of training in special education or related fields was registered for all therapists involved, along with the education and background of case supervisors and clinical professionals responsible for each case.

Finally, supervisors were asked to report what type of treatment or special education each child's program was based on, from one or more of the following: Alternative communication, applied behavior analysis, total communication, sensory motor therapies, TEACCH, clinical experience or other. Due to the retrospective nature of this study the questionnaires were completed between 6 months and 3 years after the rest of the post treatment assessments.

Child Measures

All children in both the behavioral and eclectic group had been assessed at intake and after two years of treatment on the following measures.

Intellectual Functioning

At intake and post-treatment the child completed the Bayley Scales of Infant Development (BSID-II), (Bayley, 1993) the Stanford-Binet Intelligence Scale (SB: FE), (Thorndike, Hagen, & Sattler, 1986) the Wechsler Preschool and Primary Scale Intelligence-Revised (WPPSI-R), (Wechsler, 1989) or the Wechsler Intelligence Scale for Children-Revised (WISC-R), (Wechsler, 1974). At intake 19 children (8 in the behavioral group) were given the BSID-II, 5 the SB: FE (all in the behavioral group), and 4 the WPPSI-R (all in the eclectic group). Post-treatment 12 children were given the BSID-II (3 in the behavioral group), 7 the SB: FE (all in the behavioral group), 5 the WISC-R (all in the eclectic group) and 4 the WPPSI-R (3 in the behavioral group).

The BSID-II is a measure of mental developmental level for children up to 42 months. It will yield a mental developmental index (MDI) that, for the purposes of this study, was considered equivalent of an IQ. For all tests except the BSID-II, a deviation IQ was obtained (except for one child in the behavioral group for whom a ratio score was computed on the SB: FE pretreatment, because he scored below the norms provided for his age group). For the BSID-II a ratio score was used either because the children scored below the norms provided for their age group or were too old for the norms to be used (i.e. older than 42 months). All these tests have been extensively validated and used for children with developmental delays and autism (Newsom & Hovanitz, 1997). The WPPSI-R and WISC-R were used because more recent editions of these tests had not been adapted for Norwegian children at the time of this study.

Language Functioning

The Reynell Developmental Language Scales (RDLS), (Reynell, 1990) was used to measure language in 22 of the participants at intake and post-treatment. This test yields developmental ages and standard scores for receptive and expressive language. A ratio score was computed using the developmental age equivalents from the norms in the manual, dividing it by the child's chronological age, and multiplying by 100. For the child from Buskerud, the Psycho Educational Profile-Revised (PEP-R), (Schopler *et al.*, 1990) was used instead of the RDLS because of different assessment practices across agencies. The age equivalents scores from the PEP-R on receptive and expressive language were used to

compute a ratio score in the same way as with the RDLS scores described above. Because neither the PEP-R nor the RDLS were designed to yield a ratio score, the use of ratio scores in the present study raises some psychometrical questions; however, we still elected to do this to make it easier to compare pre and post scores.

Adaptive Behavior

The Vineland Adaptive Behavior Scales (VABS), (Sparrow, Balla, & Cicchetti, 1984) was used to measure adaptive skills before and after treatment. The VABS gives standard scores for communication, daily living skills, socialization, and (for children under six years old) motor skills. It also yields a total adaptive behavior composite (ABC). The motor domain was given to children under 6 years and included in the ABC score; however, it was not used in the statistical analyses because most children were above the age range for the scale at post-treatment. The VABS is widely regarded as the best interview for assessing adaptive levels for children with autism (Newsom & Hovanitz, 1997).

Non-Verbal Intelligence

The records showed that 8 children from the behavioral group and 13 from the comparison group had also been given the Merrill-Palmer Scale of Mental Tests (Stutsman, 1948) both pretreatment and post-treatment. These data are included although the MPSMT is said to give inflated intelligence scores and reliability, and validity is not well documented (Sattler, 1992). Children who did not meet the basal on the MPSMT were assigned a mental age score of 18 months, which is the lowest possible score on the test. Because only a limited number of children were given this test, and because the psychometrical properties are not well documented, particular caution should be used in interpreting the data from this test.

Pathology Data

Pathology data were taken pre- and post-treatment either from archival data, parental reports or a direct observation of the child. A measure for estimating pathology was adopted from Lovaas (1987). A score of 1 was given if the symptom was present and a score of 0 if it was absent. The maximum pathology score was 7 and the minimum pathology was 0. Reliability was checked for 30% of

the sample (9 children) by letting two supervisors follow the procedure described above and assign scores independently of each other. The Pearson correlation between raters for the pathology scores was .84. These results indicate acceptable reliability but should nonetheless be viewed with caution because cases were not selected randomly for this analysis.

Pathology scores were given on the following symptoms:

- (a) *No Words*. The child had no meaningful expressive speech. The child did not express wants or needs, label toys or everyday objects, or otherwise use at least single words.
- (b) *Not Affectionate*. The child was arching the back, running away or was otherwise showing resistance when the caregiver(s) tried to show physical affection.
- (c) *No Toy Play*. The child did not play appropriately with toys. For instance, the child would repeatedly shut and open the doors of a car instead of pushing it on the floor.
- (d) *No Peer Play*. The child did not show interactive play with peers such as parallel play or cooperative play.
- (e) *Stereotypical Behaviors*. The child showed stereotypical behaviors including (1) repetitive behaviors, such as flicking the fingers in front of eyes or spinning objects, (2) unusual motor mannerisms such as toe-walking or gazing out of corner of eye, or (3) rituals and as insisting on sameness, such as requiring furniture to be arranged in a special way or doors to be in a certain position.
- (f) *Severe Tantrums*. The child showed aggression towards other, self or property at least once per day.
- (g) *Not Toilet Trained*. The child was not toilet trained. Toilet trained was defined as being out of diapers and having maximum two accidents per week.

Degree of Mental Retardation

Based on IQ and ABC scores, the degree of mental retardation according to the ICD-10 criteria (World Health, 1993), were determined before and after treatment for each child. The ICD-10 uses the following categories of mental retardation: Mild (IQ range 50–69), Moderate (IQ range 35–49), Severe (IQ range 20–34) and Profound (Below 20). Also the

ICD-10 recommends that the ABC score should be within the mental retardation range for the diagnoses to be given.

Data Collection

Professionals who were independent of the present study carried out 55% of the total test administrations. The independent professionals were either licensed clinical psychologists or examiners with a master's degree in special education and a license to administer psychological tests. The first or third author (both licensed clinical psychologists) did 37% of the administrations. The remaining 8% were performed both by an independent professional and by one of the authors within 6 months of each other. When two test results were available, a conservative measure of improvement was obtained for statistical analyses by using the higher score in pretreatment tests and the lower score in post-treatment tests.

The overall Pearson reliability between the test scores obtained by the authors of this study and the independent examiners was .92 for adaptive functioning and .99 for intellectual functioning. The means were also similar for intellectual functioning (authors' mean = 48.7, independent examiners' mean = 48.8) and for adaptive functioning (authors' mean = 50.1, independent examiners' mean = 50.7).

RESULTS

Therapy Measures

Table I summarizes the therapy measures. The behavioral group received 12.5 hours per week of one-to-one treatment for a period of 20 months, and the eclectic group 12 hours of one-to-one treatment for 21 months. The average number of hours per week of 1:1 assistance without systematic 1:1 instruction in the mainstream kindergarten unit or school class was 8 for the behavioral group and 12 for the eclectic group. The number of therapists was on average 2.5 for the behavioral group and 2.8 for the eclectic group. None of these differences were statistically significant.

Not surprisingly, the groups differed significantly with regard to the types of treatments offered. As can be seen in Table II, a series of chi-square tests revealed differences between the two groups in the treatment models that the children received. While the programs in the behavioral group were based almost exclusively on applied behavior analysis, the

Table I. Age at Intake, Treatment Hours per Week, Duration of Treatment and Number of Therapists per Child in Each Group

Therapy measure	Behavioral group		Eclectic group		<i>t</i> (28)
	<i>M</i>	<i>SD</i> (range)	<i>M</i>	<i>SD</i> (range)	
Age at intake	53.0	9.5 (36–68)	49	16.9 (21–69)	0.76
1:1 Hours in treatment room/spent on weekly goals	12.5	1.9 (10–15)	12.0	3.0 (10–20)	0.55
1:1 Hours assisted in mainstream environment	8.3	5.4 (2–20)	12.0	8.1 (0–28)	–1.41
Duration of treatment in months	20.3	5.3 (13–28)	21.4	6.4 (14–30)	–0.49
Number of therapists per child	2.5	0.7 (2–4)	2.8	0.6 (2–4)	–1.13

programs for the eclectic group were on average based on three different treatments (*SD* 0.6, range 2–5). One child in the behavioral group was eventually taught augmentative communication using the Picture Exchange Communication System (PECS) (Frost & Bondy, 1994), which is based on principles of applied behavior analysis. Another child in the behavioral group received services based on clinical experience. Here, a special education teacher supplemented the behavioral program by working with the child for 1 hour a week for 6 months using instructional methods reportedly based on clinical experience rather than on a particular intervention model. Because this work constituted a small proportion of the total intervention hours, we chose to include the child in the behavioral group.

Significant differences also emerged between the groups on the goals of treatment (Table II). Play,

academics and social skills were more often reported as goals in the behavioral group, while augmentative communication was more often a goal in the eclectic treatment group. Goals in vocal language, behavior management, imitation and motor skills were not significantly different across groups. Therapist education was also similar in the two groups with about the same percentage of therapists having less than a year, between 1 and 3 years, and more than 3 years of special education, respectively.

Main Findings

Table III presents intake and post-treatment scores. The table also displays the results of a series of independent *t*-tests that were performed to compare groups on all intake measures and to assess changes in scores on all measures between intake and

Table II. Treatment Specifics for Behavioral and Eclectic Group

	Behavioral group (<i>n</i> = 13)	Electric group (<i>n</i> = 13)	χ^2 (1)	<i>p</i>
<i>Treatment based on the following; percent of children in each group</i>				
Alternative communication	8	47	5.2	.05
Applied Behavior Analysis	100	53	8.1	.05
Total communication	0	27	4.0	.05
Sensorymotor	0	27	4.0	.05
TEACCH	0	27	4.0	.05
Clinical experience	8	47	5.2	.05
Other	0	40	6.6	.05
<i>Treatment goals; percent of children in each group</i>				
Vocal language	92	80	.86	ns
Augmentative Communication	8	67	10.2	.05
Behavior Management	46	60	.54	ns
Imitation	85	67	1.2	ns
Play	100	67	5.3	.05
Daily Living Skills	100	73	4.0	.05
Academics	77	33	5.3	.05
Motor Skills	38	67	2.2	ns
Social Skills	100	73	4.0	.05
Other	0	20	2.9	ns
<i>Therapist Education; percent of therapists</i>				
< 1 year	45	38	.17	ns
1–3 years	9	10	.11	ns
> 3 years	45	52	.73	ns

Table III. Mean Scores at Intake and after 2 Years of Treatment, Changes in Scores, and *t*-Values for Change Scores, for Both Groups

Measures	Behavioral group						Eclectic group						<i>df</i>	<i>t</i>
	Intake		After 2 years		Change		Intake		After 2 years		Change			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Intellectual functioning	41.0	15.2	49.2	16.6	8.2	7.4	47.2	14.7	44.3	18.9	-2.9	8.1	26	3.79***
Non-verbal intelligence	68.2	28.3	76.9	27.2	8.6	24.7	72.0	22.1	61.5	24.5	-10.5	20.6	19	1.92
Language Comprehension	37.3	11.7	44.3	17.8	6.8	10.8	44.0	17.7	33.2	24.7	-7.7	15.9	20	2.56*
Language Expressive	33.8	10.6	44.8	19.2	11.0	16.3	41.6	15.4	34.1	26.2	-6.4	22.2	20	2.13*
<i>Vineland Adaptive Behavior Scales</i>														
Adaptive Behavior Composite	52.5	3.9	52.4	9.2	-0.2	9.0	52.5	9.6	47.7	10.2	-4.8	7.8	26	1.46
Communication	54.1	7.0	58.8	12.8	4.4	10.4	54.7	10.0	50.2	9.4	-4.5	5.8	26	2.85**
Daily Living	56.7	6.0	53.7	9.9	-2.9	10.6	54.5	15.2	47.2	14.6	-7.2	12.2	26	.98
Socialization	53.7	3.7	56.2	5.2	2.5	3.7	59.3	7.8	57.9	12.1	-1.4	9.6	26	1.36

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

post-treatment. As shown, at intake, the eclectic group obtained higher scores than the behavioral group on all measures except VABS Composite and Daily Living. However, a significant difference in favor of the eclectic group was found for only 1 of the 16 measures, VABS Socialization.

Although the two groups did not differ significantly at intake on most measures, the behavioral group showed significantly more change than the eclectic group on intellectual functioning, language comprehension, expressive language, and VABS Communication. Changes in scores on the other measures did not differ significantly between groups, though the behavioral group showed more progress or not as much decrease (Daily Living Skills domain

on the VABS and Adaptive Behavior Composite also on the VABS) on all variables assessed.

The changes in IQ score post-treatment were also reflected in changes in the degree of mental retardation. According to ICD-10 criteria the degree of mental retardation was reduced for 38% of the children (5 of 13, 1 moving from profound to severe, 3 moving from moderate to mild, and 1 moving from mild and into the non retarded range) in the behavioral group, as compared to only 7% (1 of 15 children moving from the moderate to mild range) in the eclectic group, $\chi^2(1, 1) = 4.18 p < .05$. None of the children in the behavioral group received a more severe classification of mental retardation at post-treatment, whereas 40% of the children (6 of 15, 1

Table IV. Mean Scores at Intake and after 2 Years of Treatment on Pathology Measures for Both Groups

Pathology variable	Behavioral group						Eclectic group						<i>t</i> (28)
	Intake		After 2 years		Change		Intake		After 2 years		Change		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>D</i>	
No words	0.4	0.5	0.1	0.3	-0.3	0.5	0.5	0.5	0.4	0.5	-0.1	0.3	-1.69
Affectionate	0.9	0.3	0.2	0.4	-0.7	0.4	0.7	0.5	0.5	0.5	-0.2	0.4	-4.26***
Toy play	0.8	0.4	0.2	0.4	-0.6	0.5	0.9	0.4	0.6	0.5	-0.3	0.4	-2.91**
Peer play	1.0	0.0	0.6	0.5	-0.4	0.5	0.9	0.4	0.9	0.4	0.0	0.0	-2.95**
Stereotypies	1.0	0.0	0.9	0.3	-0.1	0.3	0.9	0.3	0.9	0.3	0.0	0.0	-1.08
Temper tantrums	0.4	0.5	0.1	0.3	-0.3	0.5	0.5	0.5	0.5	0.5	0.0	0.5	-1.59
Toilet trained.	0.8	0.4	0.2	0.4	-0.6	0.5	0.6	0.5	0.4	0.5	-0.2	0.4	-2.39*
Sum pathology	5.3	1.1	2.2	1.4	-3.1	1.2	4.9	1.6	4.2	2.1	-0.7	1.3	-5.35***

A score of 1 indicates symptom is present, and a score of 0 indicates symptom is absent. Maximum sum pathology is 7 points indicating high degree of pathology, and minimum is 0 indicating no pathology. Thus, lower scores are better.

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

moving from severe to profound, 3 moving from moderate to severe, 2 moving from mild to moderate) in the eclectic group did so, $\chi^2(1, 1) = 6.62$ $p < .01$.

As evidenced in Table IV, there were no significant group differences on the pathology measures at intake. At post-treatment, however, there were statistically significant changes in favor of the behavioral group on 4 of the 7 symptoms (affection, toy play, peer play and toilet training). The change in the sum pathology score was also significant in favor of the behavioral group.

On average, the behavioral group gained 8.2 IQ points, 6.8 points in language comprehension, 11.0 points in expressive language, and 4.4 points on the communication domain of the VABS. By comparison, the eclectic group lost 2.9 IQ points, 7.7 points in language comprehension, 6.4 points in expressive language, and 4.5 points on the communication domain on the VABS. The 11-point advantage of the behavioral group in IQ translates to an Effect Size estimate of 1.43 (mean difference/pooled standard deviation), which is considered large for a study within the behavioral sciences (Cohen, 1988). Similarly, some writers have viewed gains of this size as clinically significant (Guralnick, 1998). However, these gains were much more modest than those reported in previous studies employing intensive behavioral treatment (e.g., Lovaas, 1987) and have a large margin of error because of the small sample size. For this reason, the clinical significance of our results is doubtful. There was however considerable individual variation in outcome within each group. In the behavioral group 23% (3 children) made gains of at least one standard deviation on IQ, whereas 7% (1 child) made such progress in the eclectic group. The VABS and RDLs scores showed a similar pattern as the intelligence scores, but none of the group differences were statistically significant. See Table V.

Only one child in each group made progress into the normal range on intelligence tests.

Prediction of Outcome

Pearson correlations were computed to assess whether intake measures were associated with outcome measures. These data are exhibited in Table VI. As indicated in the first column, age at intake was not associated with any of the outcome variables except intellectual functioning at post-treatment in the eclectic group. However, as shown in the next column, intellectual functioning at pretreatment was significantly correlated with all measures at post-treatment. Non-verbal intelligence was not associated with any outcome variable in the behavioral group but predicted both intellectual functioning and non-verbal intelligence in the comparison group. The VABS scores were not associated with outcome for any variables except VABS in the eclectic group. Language comprehension was a strong predictor for all variables in the behavioral treatment group and all variables in the comparison group except for non-verbal intelligence. Finally, expressive language was associated only with intellectual functioning and language comprehension post-treatment in the behavioral group. In sum, intake intellectual functioning, language comprehension, and expressive language were reliably associated with post-treatment scores; however, intake non-verbal intelligence and VABS had less consistent associations.

DISCUSSION

In this study we analyzed outcome data for 28 children with autism and mental retardation by comparing one group of children that had received low-intensive behavioral treatment ($n = 13$) with

Table V. Percentage of Children within Each Group with a Gain of At Least One Standard Deviation

	Behavioral Group	Eclectic Group	$\chi^2(1)$	p
Intellectual functioning	23	7	.48	ns
Non-verbal intelligence	38	8	1.25	ns
Language Comprehension	15	0	.84	ns
Language Expressive	8	0	2.56	ns
<i>Vineland Adaptive Behavior Scales</i>				
Adaptive behavior composite	0	13	.01	ns
Communication	8	0	.71	ns
Daily living	23	0	.01	ns
Socialization	38	0	.4	ns

Table VI. Correlations between Scores at Intake and Scores Post-Treatment for the Behavioral Group and the Eclectic Group

Post-treatment	Intake					
	Age	Intellectual functioning	Non-verbal intelligence	Adaptive Behavior Composite	Language Comprehension	Language Expressive
<i>Behavioral group</i>						
Intellectual functioning	-.05	.89**	.56	.25	.87**	.60*
Non-verbal intelligence	.47	.84**	.60	.09	.74*	.54
Adaptive behavior composite	-.17	.78**	.70	.27	.71**	.48
Language comprehension	-.04	.89**	.67	.27	.81**	.60*
Language expressive	-.16	.73**	.56	.24	.73**	.52
<i>Eclectic group</i>						
Intellectual functioning	.52**	.92**	.69**	.48	.63**	.47
Non-verbal intelligence	.28	.86**	.61*	.35	.57	.44
Adaptive behavior composite	-.04	.55*	.55	.69**	.56*	.36
Language comprehension	.27	.82**	.42	.60	.77*	.56
Language expressive	.30	.78**	.40	.58	.76*	.53

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

another group that had received eclectic treatment ($n = 15$). After 2 years of treatment the behavioral group made significantly larger gains on measures of intellectual functioning, receptive and expressive language, communication skills and behavior pathology. Furthermore, the degree of mental retardation according to the ICD-10 classification criteria improved significantly more often in the behavioral group than in the eclectic group. However, the gains were small and of questionable clinical significance.

Other studies have reported that almost half of the children receiving intensive behavioral treatment achieved normal intellectual functioning (Lovaas, 1987). One reason for this difference in outcome may be that the children in the present study had an average pretreatment IQ score of 41. In contrast most other studies have reported average pretreatment IQ's between 50 and 65 (Eikeseth *et al.*, 2002; Harris & Handleman, 2000; Lovaas, 1987). Another reason may be the relatively low number of treatment hours in the present study. When comparing individual data from two recent studies on intensive behavioral intervention (Harris & Handleman, 2000; Smith *et al.*, 2000) 21 of the children in these two studies had a pretreatment IQ below 50. The mean IQ gain for these were 15.4 points ($SD = 21.4$, range from -15 to $+61$). Thus, the behavioral group in the present study may have made more modest gains than children of a similar IQ at intake but with more intensive treatment.

At the same time the results from the behavioral group in the present study appear to be more favorable than those reported from the group of

children who received less than 10 hours per week of behavioral treatment in the Lovaas (1987) study. This group on average lost 5 IQ points (going from 57 to 52) after two-three years of treatment. Lovaas (1987) did not report the precise number of hours that these children received. Hence, it is possible that the children received substantially fewer hours than children in the present study and had less favorable results for this reason. Another possible explanation is that recent advances in treatment methodology and programming may explain the differences observed. Alternatively, the observed differences may have reflected methodological limitations involved in making comparisons across studies. For example, children in different studies may differ on variables other than pretreatment IQ and hours of treatment, such as age at intake, duration of treatment, and amount of supervision and staff training. Research methods such as the selection of assessment instruments and procedures for monitoring treatment intensity may also differ.

In most other studies on the effects of early intervention the results from the comparison groups tend to be stable or decline somewhat (Lovaas, 1987; Smith *et al.*, 1997). This is similar to the outcome reported in epidemiological studies on children with autism (Sigman & Kim, 1999). In the present study, a decline in IQ, language, and adaptive scores occurred even though the children in the comparison group received treatment that was tailored to fit each child educational needs and composed of elements from commonly used and well established treatments for children with autism delivered with similar intensity

as the behavioral treatment. This finding is comparable to that of Eikeseth *et al.* (2002). It should be noted, however, that, although we obtained information on what treatment types that were implemented in the eclectic group, we did not monitor the quality of implementation. Hence, quality of implementation rather than the eclectic model itself may be the reason that gains in the eclectic group were smaller than in the behavioral treatment group.

There is also a possible confound in that we were not able to get reliable and valid data on the portion of time spent on the various treatment types in the eclectic group. For instance, one might argue that it is possible that a child in the eclectic group received behavioral treatment 90% of the time and other types of treatment only 10% of the time. This would imply that this child received essentially the same treatment as a child in the behavioral group. However, our general impression is that these programs were truly eclectic, in the sense that rather than devoting a certain amount of time to treatment X, Y and Z, the aim was to approach each child individually and combine elements from various types of treatment.

A clear need for future research is to develop objective, reliable measures of the portion of time devoted to different interventions in a treatment program. Lovaas and Smith (1989) distinguished between ABA approaches and others by saying that ABA uses both stimulus control and systematic reinforcement, while other approaches tend to rely more on stimulus control. Another distinction may be that ABA uses systematic prompting and prompt-fading procedures, whereas other approaches may not. Thus, systematic reinforcement and systematic prompting/prompt-fading may be ways to distinguish ABA from other interventions. "Systematic" means that there would be a specific schedule of reinforcement (e.g., continuous reinforcement), or specified kinds of prompts for particular behaviors and how to fade these (e.g., a specified prompt hierarchy determined by level of intrusiveness) written in the program book or agreed in the team meeting.

Children in the present study did not make significant progress in adaptive behavior, as measured by VABS, except in the communication domain. Thus, mainstreaming participants in ordinary kindergartens with typical peers did not seem to have any major impact on either socialization or daily living skills. In contrast, most studies with intensive behavioral treatment have reported significant changes on all domains of the VABS including the

ABC score (Eikeseth *et al.*, 2002; Lovaas, 1987; McEachin *et al.*, 1993; Weiss, 1999). Thus, intensive treatment may afford more opportunities to work specifically on enhancing self-help and social skills than does inclusion in a classroom.

As in previous studies (Bibby, Eikeseth, Martin, Mudford, & Reeves, 2002; Eikeseth *et al.*, 2002; Harris & Handleman, 2000; Lovaas & Smith, 1988) intake standardized test scores, particularly IQ, predicted outcome in both groups. Thus, the children with the highest IQ scores at the start of treatment generally also tended to have the highest scores after treatment.

The present study had several limitations, including a retrospective analysis rather than a planned investigation, no random assignment to groups, small sample size, no direct quality control measures of treatment, and assessments in part conducted by the authors of the study. The fact that parents were involved in deciding what type of treatment their child should receive may have resulted in the more motivated families seeking behavioral treatment because parental involvement is perhaps more central in this approach. Also we cannot rule out the possibility that the parents in the behavioral group had higher education and higher socioeconomic status in general and thus wanted behavioral treatment. Another confound may be that the curriculum for the behavioral programs is perhaps more systematic and manualized. Unfortunately we have not collected data on these variables. Nevertheless, the study also had several strengths: high test-retest reliability on assessment conducted by the authors and the independent and blind assessors, similar staffing and amounts of intervention across groups, similar amount of staff training and supervision, a manualized research-based treatment for the behavioral group, and apparently similar groups at pretreatment, as measured by a comprehensive and uniform assessment battery. In sum, results from the present study suggest that low-intensive behavioral treatment may be more effective than low-intensive eclectic special education treatment. But, gains in IQ and language skills made in the behavioral treatment group were more modest than those reported in previous studies employing intensive behavioral treatment. Finally, replacing the 1:1 behavioral treatment time in a separate room with time in mainstream kindergarten was not successful in improving participant's adaptive and social skills.

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