Outcome for children with autism receiving early and intensive behavioral intervention in mainstream preschool and kindergarten settings[☆]

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A B S T R A C T

The evidence for Early and Intensive Behavioral Intervention (EIBI) for children with autism is well founded in several efficacy studies. However, only a few studies have investigated the effectiveness of EIBI in community settings. This study examined whether children receiving one year of EIBI ($N = 35$) would make larger gains in adaptive behaviors than a group of children receiving treatment as usual (TAU; $N = 24$). At intake, the groups did not differ significantly on chronological age or level of adaptive behavior. After one year of treatment, children in the EIBI group scored significantly higher on all scales of adaptive behavior as compared to the children receiving TAU. Moreover, children in the EIBI group showed significant improvements in adaptive behaviors, maladaptive behaviors, and autism symptoms after one year of treatment, and this change continued into the second year of treatment, albeit to a lesser degree. Limitations of the study include lack of independent assessments of children receiving EIBI, and lack of random assignment of participants to treatment groups.

1. Introduction

In outcome research, the term *efficacy study* is used to describe research conducted under rigorous experimental control, and in laboratory-type settings. The term *effectiveness study* is used to describe outcome research carried out in community-clinical-settings, typically serving a broader range of clients, with treatment carried out by staff working in such settings (Howard, Moras, Brill, Martinovich, & Lutz, 1996). Often, poorer outcome is reported when a particular treatment is tested in effectiveness research as compared to efficacy research. Hence, after a particular treatment has been demonstrated effective in efficacy research, a next important step to scientifically validate the treatment is to test it in community effectiveness research (Smith et al., 2007; Weisz, Jensen, & McLeod, 2005).

For children with autism spectrum disorders (ASD), efficacy research has shown that Early and Intensive Behavioral Intervention (EIBI; Lovaas, 2003), based on Applied Behavior Analysis (ABA), may be effective in increasing intellectual and adaptive functioning in preschool-aged children (Eikeseth, Smith, Jahr, & Eldevik, 2002, 2007; Hayward, Eikeseth, Gale, & Morgan, 2009; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). For

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reviews see Eikeseth (2009), Howlin, Magiati, and Charman (2009) and Rogers and Vismara (2008). Eldevik et al. (2009) reported in a meta analysis an Adaptive-Behavior-effect-size of 0.66, and an IQ-effect size of 1.09. Recently, Virués-Ortega (2010) reported a slightly higher effect size; 0.81 for Adaptive Behavior and 1.31 for IQ. See Reichow (2011) for a comprehensive review of these and other meta analyses.

To date only a few effectiveness studies of EIBI for children with ASD have been conducted. The results are somewhat mixed, though most show positive effects. One effectiveness study, Cohen, Amerine-Dickens, and Smith (2006) compared three years of 35–40 h of one-to-one teaching per week of EIBI to an age- and IQ matched control group of children in special education classes at local public schools. All assessments were made independently, but assignment to groups was based on parent preferences. Results showed that at follow-up, children in the EIBI group scored significantly higher on IQ, language comprehension and adaptive functioning as compared to the control group.

Sheinkopf and Siegel (1998) conducted a retrospective study examining effects of ABA treatment for children with autism and children with PDD-NOS. Mean intake age was 34 months. The diagnosis was made by consensus from two or more independent clinic staff and was based on the DSM-III criteria. Eleven children (10 with autism) received ABA treatment and 11 children (10 with autism) received services available in the child's local community. Participants were matched on pre-treatment chronological age, mental age, interval between pre- and post-assessments, diagnosis and sex. Participants in the ABA group received a mean of 19.5 h per week of one-to-one ABA treatment for an average of 15.7 months. Measures included IQ and autism symptoms. At follow-up the ABA treatment group scored significantly higher as compared to the control group on both measures. The ABA treatment group gained an average of 26.9 IQ points. By comparison the control group gained two IQ points.

Using a pre-post design, Perry et al. (2008) reported the largest effectiveness study to date. 332 children with autism or PDD-NOS participated. Their mean chronological age was 18 months (range 4–47 months). The mode of delivery varied with some children receiving treatment at home, some at treatment centers and some in mainstream pre-schools. Children were tested for adaptive functioning, autism severity, and IQ (although not all children were tested with all measures). After treatment, the children had improved significantly on all measures.

Also using a pre–post design, Ben-Itzchak and Zachor (2007) assessed outcome in 25 children with autism with a chronological age between 20 and 32 months at the time of intake. Six developmental–behavioral domains were assessed (imitation, receptive language, expressive language, nonverbal communication, play and stereotyped behaviors). Significant progress was found in all the six developmental–behavioral domains after one year of intervention. Children with higher initial cognitive levels and children with fewer social deficits showed better progress.

More recently, Eldevik, Hastings, Jahr, and Hughes (2011) published an effectiveness study for 31 children receiving 13.6 h of one-to-one EIBI for two years, compared to a control group of 12 children receiving treatment as usual. All children had been independently diagnosed with autism or PDD-NOS and their mean age at treatment onset was 3.5 years. The children in the EIBI-group attended mainstream pre-schools and kindergartens and treatment was carried out by staff who received weekly supervision from trained behavior analysts. Although the two groups did not differ at intake, children in the EIBI group scored significantly higher on both IQ and adaptive functioning at follow-up.

Three studies from the UK have reported little or no effectiveness of EIBI when carried out in community settings (Bibby, Eikeseth, Martin, Mudford, & Reeves, 2002; Kovshoff, Hastings, & Remington, 2011; Magiati, Charman, & Howlin, 2007; Remington et al., 2007). Bibby et al. (2002) analyzed data for 66 children with autism, and using a pre-post design found that mental age and Vineland adaptive behavior increased significantly for only a subgroup of the participants, but failed to find significant changes in IQ.

Magiati et al. (2007) compared outcome for pre-school aged children with autism receiving autism-specific nursery provision or home-based EIBI in a community setting. Forty-four 23- to 53-month-old children participated (28 in EIBI home-based programs; 16 in autism-specific nurseries). Cognitive, language, play, adaptive behavior skills and severity of autism were assessed at intake and 2 years later. Although children from both groups increased their mental age scores, IQ standard scores were unaffected after treatment.

Remington et al. (2007) reported favorable results of EIBI compared to a control group receiving special education at a follow-up one and three years into treatment, but these differences were not maintained on a follow-up assessment carried out two years after EIBI had been terminated (Kovshoff et al., 2011).

There are several reasons why EIBI may be difficult to replicate in community settings. The intervention is highly intensive and comprehensive, it requires highly skilled tutors and supervisors, and it requires a strong parental involvement (Eikeseth, 2011; Lovaas, 2003). Research has identified large turnover amongst EIBI therapists in community settings (Johnson & Hastings, 2002), potentially low allegiance amongst the therapists to the ABA techniques (Klintwall, Gillberg, Bölte, & Fernell, 2011), less experienced and educated therapists and supervisors, and less intensive supervision of the staff and parents (Eikeseth, Hayward, Gale, Gitlesen, & Eldevik, 2009). Such factors may indeed contribute to the poor treatment effect reported in some studies, though more research is needed to confirm this explanation.

The current study was a comparison controlled trial designed to assess the effectiveness of community school-based EIBI carried out in mainstream preschool and kindergarten settings using the school's staff as therapists. The staff typically had no training or experience of EIBI prior to the onset of treatment. Each child's team received supervision from a center specializing in EIBI. Assessment included measures of adaptive behavior, maladaptive behavior, and autistic behaviors. A comparison group of children receiving treatment as usual was included to compare outcome of community based EIBI to the outcome of services typically provided to children with ASD.

2. Method

2.1. Participants

All children diagnosed with autism enrolled at Banyan Center between March 2008 and May 2010 were included in the study, provided that they had not received EIBI prior to their enrollment (such children lacked pretreatment assessment). 38 children received treatment at the center, but three were excluded from data analysis; two participants because they received less than 10-hours-per-week of one-to-one teaching, and one was excluded because she was re-diagnosed with Rett's syndrome. This left a total of 35 participants (6 girls). The diagnosis was set by an independent agency prior to referral to the center, based on the ICD-10 criteria (WHO, 1993). Mean intake age was 3-years-and-11-months (range 2-years-and-1-month to 6-years-and-4 months).

A comparison group of 24 children (4 girls) was included. The comparison group comprised the total population of children diagnosed with autism at Akershus University Hospital between 2005 and 2010, and who received treatment as usual (TAU) between the intake diagnostic evaluation and the follow-up diagnostic evaluation conducted one year later. The diagnosis was based on the ICD-10 criteria (WHO, 1993). Mean intake age was 4-years-and-5-months (range 2-years to 7-years-and-4-months).

2.2. Setting

Treatment for all children in both groups was carried out in the children's local preschools or kindergartens which were publicly funded mainstream schools. Typically the participant was the only child with a developmental disorder in his/her class. All children had a specially designated room for treatment at the kindergarten, but training was not limited to that room. For children in the experimental group, additional treatment was carried out in the children's homes.

2.3. Treatment personnel

Experimental group. Typically, when a child with a diagnosis of autism enrolls in a particular pre-school or kindergarten, the school receives state funding to hire a person working one-to-one with the child. This person functioned as the child's therapist in the current study, sometimes with additional help from other school staff members. Only a minority of the therapists had any academic degree. In almost all cases, the staff members had no training or experience of EIBI or ABA prior to treatment onset. In addition to the therapist, the child's education team consisted of the parents, other significant adults, the supervisor from Banyan Center, and sometimes other school staff members. The parents had agreed to allocate 10-hours-per-week to the child's program, including meetings, preparing teaching materials, natural environment teaching and discrete-trial-teaching.

Roughly half of the supervisors had a master's degree in psychology or speech pathology, or else a minimum of a bachelors' degree in psychology or pedagogy. One supervisor was a Board Certified Behavior Analyst. All treatment was supervised by the first author, who met all children at least once and who conducted training of all supervisors.

Comparison group. Similar to the experimental group, the school received funding to hire a special education teacher with a minimum of a bachelor degree in special education to work three-to-five hours per week with the child, conducting one-to-one teaching and staff training. In addition, a teacher assistant was hired 50–100% to work one-to-one with the child. The teacher assistant, who typically had no academic degree, was supervised by the special education teacher. The teacher assistant worked on specific educational targets in one-to-one settings, worked on self-help skills such dressing, undressing, eating, and toileting, and otherwise shadowed the child while he/she was on the playground or together with the other children in the class.

2.4. Treatment

Experimental group. Treatment for the children in the experimental group was based on the UCLA model (Lovaas, 1993), and has been described elsewhere (Cohen et al., 2006; Eikeseth, 2011). In brief, it consisted of using several ABA procedures to teach new skills and to reduce interfering behavior. Much of the curriculum has been detailed in teaching manuals (Leaf & McEachin, 1999; Lovaas, 1977, 2003; Lovaas et al., 1981; Maurice, Green, & Luce, 1996; Maurice, Green, & Foxx, 2001). In general, intervention goals are tailored to fit each child's individual needs and are guided by typical developmental sequences.

During the first year of treatment, weekly two-hour supervision meetings were held for each child. The child, primary caregiver, therapists, and supervisor attended. At the meetings, the child's treatment program was modified and updated based on the child's development during the preceding week. Also, therapists and parents received hands-on training.

Treatment intensity during the first year of intervention ranged from 15 to 37 hours-per-week, with an estimated mean of 23 h ($SD = 5.3$) (data on training hours was reported for 28 children and was not analyzed further due to low reliability). Teaching was not limited to discrete-trials-teaching and included teaching in group settings and natural environment teaching.

Comparison group. Treatment for children in the comparison group can best be described at eclectic-special education-teaching, where the special education teacher and the teacher assistant employed a number of special education procedures and methods to teach communication, play, social and self-help skills, and to reduce aberrant behaviors The treatment incorporated elements from a variety of different interventions, such as alternative communication, total communication,

TEACCH, sensory-motor therapies, Applied Behavior Analysis (ABA), as well as procedures derived from their own clinical experience

Alternative communication typically involved establishing communication based on symbols or signs. Total communication involved the use of gestures, signs, and other visual communication systems to build and strengthen receptive and expressive communication. Sensory integration therapy typically involved swinging, rocking, massaging, and/or listening to music. Interventions based on ABA involved working on a small number of intervention goals (e.g., matching, imitation, or toilet training) described in behavioral treatment manuals, and/or to use behavioral procures to address aberrant behaviors. TEACCH procedures typically involved strategies to enhance visual processing, including the physical (ecological) set-up of the therapy room, the use of visual schedules to help children anticipate future events, and a visual organization of the work materials to teach the learning tasks and their sequences. Interventions based on own clinical experience typically included the use of worksheets and/or other teaching materials designed by the teacher, and/or adaption of teaching procedures based on experience with other children.

The intervention goals and teaching procedures were individually selected for each particular child based on recommendations from a multidisciplinary team of parents and school personnel. Based on those recommendations, the special education teacher wrote the child's Individual Education Plan. The special education teacher also provided supervision of the teaching assistant and performed other types of staff training when necessary. See Eikeseth et al. (2002) and Eldevik et al. (2011) for a more detailed description of this intervention.

2.5. Measures

Independent variables were the adaptive behavior subscales and the maladaptive behavior subscale from the Vineland Adaptive Behavior Scales (VABS: Sparrow, Cicchetti, & Balla, 2005), and the Childhood Autism Rating Scale (CARS: Schopler, Reichler, & Renner, 1986). Assessments were carried out at intake and then after one and two years of treatment. The assessment was carried out by the child's supervisor, based on interviews of the parents and on the supervisors' detailed knowledge of the child's adaptive and autistic behaviors.

From the Vineland Adaptive Behavior Scales, both standard scores (four sub domains and a total score) and adaptive age equivalents were computed. To obtain a total age equivalent score, a mean was computed from all sub domains except for the "Written" sub domain (which gives a minimum age equivalent of 1-year-and-10-months). As a conservative measure, sub domain age equivalent was set at a maximum of 10 years. A learning rate figure was computed, defined as the change in VABS total age equivalent, divided by months in treatment. This is similar to Howard et al. (2005).

VABS data at intake and after one year was available for all participants. For the two-year follow-up, data for 15 children was available (the other participants had not yet completed two years of treatment). VABS maladaptive scores were not available for all children, partly because the minimum age to score this subscale is three years, partly because of missing data. For the first year data on 24 children was available, and then 14 for the second year in treatment.

The Childhood Autism Rating Scale (CARS) was used to assess autism severity. The measure consists of a list of 15 behaviors that can be exhibited by the child, and which are rated on a four-point Likert scale. The total score varies between 15 and 60, with a high score indicating higher frequencies of autism typical behaviors. The CARS was available for 27 children at intake and after one year, and then for 13 children at the second follow-up.

Children in the comparison group were assessed on the Vineland Adaptive Behavior Scales at intake and one year later. The Vineland was conducted by the staff at Akershus University Hospital as a part of an assessment battery conducted during the participants' diagnostic evaluation at referral and one year later.

2.6. Design and statistical methods

A quasi-experimental group design was employed. Independent t-tests were used to assess between-group differences (EIBI vs. TAU) on all scales on the VABS at intake and again at the one year follow-up. Also, a t-test was used to evaluate between-group-differences in learning rates during the first year of intervention.

For the EIBI group, paired t-tests were used to investigate differences on the VABS and CARS between intake and after one year of treatment. Another set of paired t-tests was used to assess the EIBI group's progress between the first and the second year of treatment. For all measures, pooled standard deviation effect sizes were computed.

A number of putative outcome predictors for change in VABS standard scores and CARS scores were investigated: age at intake, intake VABS score, intake maladaptive score, and intake CARS score. Predictors were Pearson correlated to each child's change in standard VABS score and change in CARS scores after one year in treatment.

3. Results

3.1. Between group comparisons

Intake data for the two groups are presented in Table 1. As can be seen, the groups did not differ on any measure at intake. Table 2 exhibits data for the two groups at the one-year follow-up. As can be seen, children in the EIBI group scored significantly higher on all VABS scales as compared to the children receiving TAU.

Table 1
Intake data for treatment and comparison group (df = 57).

	Treatment group Mean (SD)	Comparison group Mean (SD)	t-test t-value
Age	3.9 (0.9)	4.4 (1.2)	−1.867
VABS total	67.0 (10.3)	63.6 (8.1)	1.351
- Communication	67.1 (14.0)	65.5 (14.2)	0.432
- ADL	71.8 (12.8)	67.5 (10.9)	1.343
- Socialization	65.4 (9.8)	63.3 (7.0)	0.894
- Motor	75.9 (12.8)	72.5 (10.6)	1.058
- Age equivalent	1.9 (0.9)	2.1 (0.8)	−1.162

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

Table 2
One year data for treatment and comparison group (df = 57).

	Treatment group Mean (SD)	Comparison group Mean (SD)	t-test t-value
VABS total	75.3 (12.0)	64.0 (12.5)	3.506[**]
- Communication	81.3 (16.9)	63.6 (16.0)	4.046[***]
- ADL	78.3 (14.4)	68.0 (14.8)	2.678[**]
- Socialization	72.5 (12.3)	64.3 (9.4)	2.769[**]
- Motor	80.6 (10.6)	71.8 (14.4)	2.560[*]
- Learning rate	1.13 (0.66)	0.59 (0.43)	3.566[***]

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

Effect sizes for VABS were as follows; Total (composite) = 0.92, Communication = 1.08, ADL = 0.71, Socialization = 0.75, Motor = 0.70, and Learning rate = 0.97.

3.2. Within-group comparison (EIBI-group)

During the first year of treatment, the VABS total score increased significantly from 67.0 to 75.3 points (t (34) = −5.695, $p < .001$, mean increase = 8.3 points, SD = 8.7, range −13 to 25). Between the first and the second year of treatment, no significant changes were observed in the VABS total score (t (14) = −.819, $p > .05$, mean increase = 1.2 points; SD = 5.7; range = −8 to 13). Similar pattern was observed for all VABS subscales.

VABS maladaptive scores decreased significantly between intake and one year (from 19.5 (SD = 2.4) to 16.9 (SD = 2.5), t (23) = −5.747, $p < .001$), yielding an effect size of 1.0. For the children with two-year treatment data VABS maladaptive scores continued to decrease during a second year of treatment, but this improvement was not significant (t (13) = 1.947, $p > .05$, mean decrease 1.0; SD = 2.65).

The CARS scores decreased significantly between intake and one year (from 37.2 (SD = 7.7) to 30.6 (SD = 7.1), t (26) = 11.559, $p < .001$), yielding an effect size of 0.92. In contrast to the other measures, CARS scores continued to decrease significantly during the second year of treatment (from 31.8 (SD = 8.5) to 27.2 (SD = 6.2), t (12) = 2.469, $p < .05$), yielding an effect size of 0.59.

The mean Learning Rate during the first year was 1.13 (SD = 0.65), that is, slightly more than one developmental year per chronological year in treatment. The range for Learning Rates was from −0.05 to 2.73, showing that any individual decrease in standard scores falls well within error of measurement and probably does not reflect any worsening in functioning.

During the second year of treatment, the mean Learning Rate was 0.81 (SD = 0.72; range −0.20 to 2.44). Individual Learning Rates for all children with two year data are presented in Fig. 1.

None of the putative predictors of individual outcome was significantly correlated to neither change in VABS standard score (age at intake: $r = .06$; $p = .75$; VABS at intake: $r = −.20$; $p = .25$; maladaptive behaviors: $r = .14$; $p = .51$ and CARS at intake: $r = −.14$; $p = .48$), nor change in CARS scores (age at intake: $r = .29$; $p = .14$; VABS at intake: $r = .28$; $p = .16$, CARS at intake: $r = −.36$; $p = .06$).

4. Discussion

The present study reports on the effectiveness of EIBI carried out in regular preschools and kindergartens, using the school's staff as therapists. Results show that after one year of intervention, children receiving EIBI scored significantly higher on standard scores of adaptive behavior, as compared to a group receiving TAU. Moreover, for the children receiving
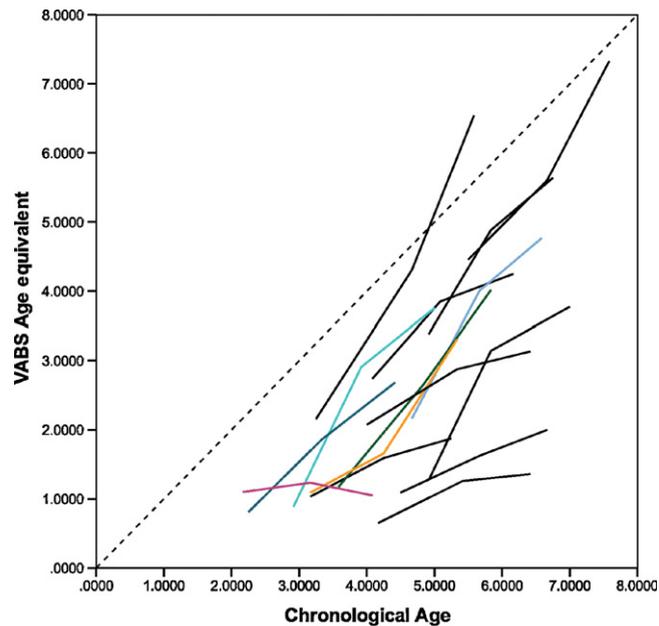
Fig. 1. Individual learning rate trajectories for all children with two-year follow-up measures (*n* = 15). Dotted line represents normal reference development.

EIBI, significant improvements were found in maladaptive behaviors and excess and deficit behaviors associated with autism. Although improvement continued between the first and the second year of treatment, largest gains were observed during the first year. Effect size on all measures at year one were moderate to large, and this is comparable to the effect sizes reported in previous studies (Eldevik et al., 2009; Virués-Ortega, 2010). These findings add to the current literature suggesting that EIBI can be carried out successfully in mainstream-community-school-settings when the treatment is carried out by the school's staff, who initially had no training or experience in EIBI. To train the parents and the therapists, and to direct and supervise the treatment, each child's treatment team received weekly consultations from a center specializing in EIBI.

No correlations were found between any of the putative predictors of treatment outcome and individual improvement. Predictors were age at intake, intake VABS score, intake maladaptive score, and intake CARS score. However, for a sub-sample of the children in the present study, a previous study investigated whether treatment gains were associated with the number and type of stimuli that function as reinforcers. Results showed that children with a large repertoire of socially mediated reinforcers (i.e., rewards given to the child by another person, such as favorite foods, verbal praise or favorite toys) benefited more from treatment. Children with many stereotypic behaviors, assumed to be an effect of a larger repertoire of automatic, sensory reinforcers, exhibited less benefit from treatment. These two dimensions taken together explained 50% of the variation in treatment gains for children after one year of EIBI (Klintwall & Eikeseth, 2011).

A limitation in the present study is that the assessments in the EIBI group were carried out by personnel responsible for supervising the child's treatment. On one hand, the assessors might have been biased towards scoring the tests lower at intake and higher at follow-up, which as a result, would overestimate treatment progress. On the other hand, an important supervisor duty is to posit detailed knowledge of the child's skill levels, adaptive behaviors, and excess and deficit behaviors associated with autism. This knowledge might have facilitated high accuracy of the scores. When quality control was performed on a subset of the Vineland assessments, the children's scores on specific items on the VABS corresponded closely with the treatment programs and treatment goals developed for the particular children at the time of the assessment, suggesting that at least for those children, assessment was not biased.

In effectiveness research, it is often difficult to recruit control groups, perform random assignment, and/or to conduct blind or independent assessment. This was the case also in the present study. However, the EIBI treatment evaluated in this effectiveness study has already been examined scientifically in several efficacy studies with stronger experimental control (Eikeseth, 2009; Howlin et al., 2009; Rogers & Vismara, 2008). Results from the present study are comparable to a number of previously published effectiveness studies evaluating EIBI (Ben-Itzchak & Zachor, 2007; Cohen et al., 2006; Eldevik et al., 2011; Perry et al., 2008; Sheinkopf & Siegel, 1998), and add to the current literature suggesting that EIBI can be carried out successfully in mainstream-community-school-settings, provided that proper measures are taken to train the parents and the staff (Eikeseth, 2010; Lovaas, 2003).

Conflicts of interest

The first and the last author have commercial interests in Banyan Center.

Acknowledgments

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