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Research in Autism Spectrum Disorders xxx (2007) xxx–xxx

**Research in
Autism Spectrum
Disorders**

<http://ees.elsevier.com/RASD/default.asp>

Change in autism core symptoms with intervention

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Received 1 December 2006; accepted 12 December 2006

Abstract

It is still debated what is the best early intervention approach for autism. This study compared two intervention approaches, Eclectic-Developmental (ED) and Applied Behavioral Analysis (ABA) in very young children with autism/autism spectrum disorder (ASD). Nineteen children received ED intervention, using combination of methods. Twenty children received Applied Behavioral Analysis (ABA) intervention which used behavioral principles. Children in both groups were not significantly different in their autism severity, cognitive abilities and in socio-economic background at pre-intervention time. Change in the severity of autism symptoms was assessed by the Autism Diagnosis Observation Schedule (ADOS).

The ABA group showed significantly greater improvements than the ED group at post-intervention time. Pre–post intervention differences in language and communication domain were significant only for the ABA group. Both groups showed significant improvement in reciprocal social interaction domain. However, the effect size was greater for the ABA group. Changes in diagnostic classification were noted in both groups but were more pronounced for the ABA group. Pre-treatment IQ scores were positively related to ADOS scores at pre- and post-intervention times, but not to progress over time. Behavioral intervention is more effective than eclectic approach in improving autism core symptoms in young children with autism.

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Keywords: Autism; Autism spectrum disorder; Eclectic-Developmental; Applied Behavioral Analysis; Autism Diagnosis Observation Schedule

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1. Introduction

Autism is a neurodevelopmental disability characterized by severe social, communicative and cognitive deficits, resulting in significant lifelong disability. Autism requires long-term treatment, yet, despite the severity of this disorder, some children achieve remarkable long-lasting gains.

Over the years, many studies have been published on comprehensive treatment approaches that seek to reduce the general level of impairment in autism (reviewed in Dawson & Osterling, 1997; Kasari, 2002; Rogers, 1998; Smith, 1999; Wolery & Garfinkle, 2002). These studies highlight the importance of early comprehensive intervention services, and the fact that it is critical that children be diagnosed as early as possible and referred to appropriate effective intervention services. However, research is far from unanimous regarding the type, philosophy, and intensity of treatment that would yield valuable developmental changes.

The main intervention philosophies used in special education programs for children with autism include the Developmental approach, the Developmental Individual-Difference Relationship (DIR), The Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH), and Applied Behavioral Analysis (ABA). Several programs use a combination of methods based on these practices (“eclectic intervention”) (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Wolery & Garfinkle, 2002).

The developmentally oriented approach is drawn from a developmental model of autism (Hoysen, Jamieson, & Strain, 1984; Rogers, Bennetto, McEvoy, & Pennington, 1996; Rogers & Pennington, 1991). Among the important components of the intervention are teaching imitation and developing awareness of social interactions and reciprocity. This model is interdisciplinary involving speech and language, psychology, occupational, and special education therapists. Family consultation is a major component of this program (Dawson & Osterling, 1997; Jocelyn, Casiro, Beattle, Bow, & Kneisz, 1998; Rogers & DiLlla, 1991). The Greenspan DIR approach uses three learning principles: (a) following the child’s lead and engaging in child-mediated interactions that are based on the child’s natural emotional interests; (b) semi-structured problem-solving interactions that meet specific language cognitive and social goals; (c) motor, sensory and spatial learning activities (Greenspan & Wieder, 1999). The TEACCH program emphasizes two basic principles: structuring the environment to promote skill acquisition and facilitating independence at all levels of functioning (Lord & Schopler, 1989; Ozonoff & Cathcart, 1998).

Most of the treatment outcome studies concentrated on behavioral approaches in home-based programs (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Sheinkopf & Siegel, 1998), and in center-based programs (Dawson, Ashman, & Carver, 2000; Fenske, Zalsenski, Krantz, & McClannahan, 1985; Harris & Handleman, 2000). Applied Behavioral Analysis (ABA) is based on scientific principles of behavior (Skinner, 1979), and is targeted at ameliorating the core deficits in autism (communication and social delays). ABA begins with focusing on teaching small measurable units of behavior using discrete trial treatment (DTT) in mass trials. The treatment is based on systematic, step-by-step teaching using prompts and useful reinforcements. Intervention is provided for 30–40 h a week in one-on-one setting by experienced behavioral therapists. Children are taught skills including attention, basic discrimination, language and communication, daily living, socialization, play, fine and gross motor control and pre-academics. ABA is also implemented in relatively unstructured situations, using incidental teaching techniques, to enhance generalization, increase motivation, and to develop social skills (Bondy & Frost, 1994; Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991;

Table 1
 Comparative outcome studies of early intervention for children with autism

References	Intervention methods	Hours per week (h)	Age	Measures	Outcome
Birnbrauer and Leach (1993)	1. Behavioral (<i>n</i> = 9) 2. Non-behavioral (<i>n</i> = 4)	18	39 months	IQ, adaptive skills, language	4/9 improve in all measures 1/5 improved
Eikeseth et al. (2002)	1. Behavioral (<i>n</i> = 13) vs. 2. Eclectic (<i>n</i> = 12)	28.5 (both groups)	4–7 years	IQ, adaptive skills, language (receptive and expressive)	Behavioral > eclectic in all measures except for socialization
Howard et al. (2005)	1. Behavioral (<i>n</i> = 29) vs. 2. Eclectic (<i>n</i> = 16) 3. Mix methods (<i>n</i> = 16)	25–40 30 15	30–37 months	Cognitive language adaptive skills	Behavioral > eclectic and mix in all measures, except for motor skills
Lovaas (1987)	1. Behavioral (<i>n</i> = 19) 2. Behavioral 2 (<i>n</i> = 19) 3. No treatment (<i>n</i> = 21)	40 10 42 months or younger	35 months 40 months 42 months or younger	Cognitive, educational placement	Intensive behavioral > non-intensive behavioral, and no treatment
Sheinkopf and Siegel (1998)	1. Behavioral (<i>n</i> = 11) 2. School based intervention (<i>n</i> = 11)	27 11	33 months 35 months	Cognitive and symptoms severity	Behavioral > school-based intervention both measure
Smith, Eikeseth, Klevstrand, and Lovaas (1997)	PDD and MR: 1. Behavioral (<i>n</i> = 11) 2. Minimal treatment (<i>n</i> = 10)	30+ 10	3.08 years	IQ, speech, autism symptoms	1. Mild IQ and speech improvement 2. IQ decrease, few improved in speech
Smith et al. (2000)	1. Intensive treatment (<i>n</i> = 15) 2. Parent training (<i>n</i> = 13)	24.5 No child treatment	18–42 months	Cognitive, visual–spatial skills language and academic	Intensive treatment > parent training

Please cite this article in press as: Zachor, D.A. et al., Change in autism core symptoms with intervention, Research in Autism Spectrum Disorders (2007), doi:10.1016/j.rasd.2006.12.001

Koegel & Koegel, 1995; Strain, Kohler, & Goldstein, 1996; Thorp, Stahmer, & Schreibman, 1995).

The effectiveness of these various models is a major question for the scientific community that treats children with autism. Several studies compared the effect of different treatment approaches on outcome of children with autism (summarized in Table 1). Only a few studies had a control group, used standardized tests and had reliable outcome measures (reviewed in Kasari, 2002). Most of the studies compared behavioral treatment programs to interventions such as “eclectic” programs (Eikeseth et al., 2002; Howard et al., 2005), school based intervention (Sheinkopf & Siegel, 1998), parent training (Smith, Groen, & Wynn, 2000), non-specified interventions (Birnbrauer & Leach, 1993) and no treatment (Lovaas, 1987). Most studies reported behavioral intervention to be a more effective treatment approach (Birnbrauer & Leach, 1993; Eikeseth et al., 2002; Howard et al., 2005; Lovaas, 1987; Sheinkopf & Siegel, 1998; Smith et al., 2000).

In the current study, we compared the impact of two comprehensive intervention approaches that differed in their treatment philosophy on improvement of the core symptoms of autism. One intervention program, the Eclectic-Developmental (ED) was mostly based on the Developmental approach but incorporated various other methods. The other intervention program, Applied Behavioral Analysis (ABA), was based on behavioral principles. Programs differed in the type of professionals involved and strategies used to accomplish progress.

The current study addressed the following questions: How do symptoms in the major autism domains change with treatment? Are there specific manifestations in autism that improve with any type of intervention or only with a specific intervention approach?

2. Method

2.1. Setting

This study compared outcome of two center-based programs for early intervention in autism. One center used Eclectic-Developmental (ED) approach, was based on principles derived from several approaches, mainly from the developmentally oriented philosophy and the DIR model, and incorporated strategies driven from the TEACCH and ABA as well. The other intervention was based solely on Applied Behavioral Analysis principles (ABA) and its curriculum included DTT, naturalistic, and incidental teaching techniques. The two approaches were similar in several aspects—both were center-based, both included preschool routines and provided services for 8 h a day, and the children enrolled were under 3 years of age. Finally, both programs received the same budget per child from the same national agencies. The two centers were located in two different counties. The authors belong to a National Autism Center that provided diagnosis services, medical and psychological supervision for both programs, and were not involved in the treatment plans.

2.2. Participants

Fifty children were examined from both early intervention programs. Children with identified medical abnormalities (e.g., seizures, hearing deficiencies) were excluded from the study. Only 39 children, 19 from the ED program and 20 from the ABA program, were matched for age, autism severity and cognitive level. All the children were diagnosed with autism using the Autism Diagnostic Interview (ADI), and met established criteria for autism/PDD-NOS according to DSM-IV criteria (American Psychiatric Association, 1994). The first group, which received

treatment based on Eclectic-Developmental (ED) principles, included 18 boys and 1 girl, aged 23–33 months (mean 28.8 months). The second group, which received intervention based on Applied Behavior Analysis (ABA) principles, included 19 boys and one girl, aged 22–34 months (mean 27.7 months). There was no significant difference in the mean age of the participants in both intervention groups. Analysis of the background data on the fathers' and the mothers' education of participants from both intervention groups did not reveal significant differences (non-parametric statistics). The authors of the present study had no role in selecting children for a specific treatment approach. Thus, there was no systematic bias in the assignment except for the children's place of residence. The children's parents signed an informed consent form approving the use of the data obtained during the diagnosis and the intervention processes for research according to IRB requirements. Children diagnosed with autism received intervention whether their parents signed the consent form or not. Parents received no monetary compensation for signing the informed consent form.

2.3. Design

Pre-intervention (PRI) evaluation (baseline) was performed within the first month of enrollment in the intervention program. The initial evaluation included the ADOS test and cognitive evaluation. All the children, being young and preverbal or having a single word only, were administered ADOS Module One. Cognitive evaluation was assessed using either the Bayley Scales of Infant Development (Bayley, 1993) or the Stanford-Binet Intelligence Scale (Thorndike, Hagen, & Sattler, 1986) according to the children's language abilities.

After 1 year of intervention children were re-assessed by the ADOS—18 children were administered ADOS Module One (9 [ED], 9 [ABA]), and 23 children, who had improved in their expressive language ability, were assessed with ADOS Module two (10 [ED], 11 [ABA]).

2.4. Instruments

2.4.1. Instruments used for the evaluation of autism severity

2.4.1.1. *ADI*. A semi-structured interview administered to parents was designed to make a diagnosis of autism according to both DSM-IV and ICD-10 criteria (Lord, Rutter, & LeCouteur, 1994).

2.4.1.2. *ADOS*. The ADOS is a semi-structured, interactive schedule designed to assess social and communicative functioning in individuals who may have an ASD. The assessment involves a variety of social occasions and 'presses' designed to elicit behaviors relevant to the diagnosis of autism. The schedule consists of four developmentally sequenced modules. Only one of the modules is administered, depending on the examinee's age and/or expressive language. Each module includes a standardized diagnostic algorithm composed of a subset of the social and communicative behavior rated (Lord, Rutter, DiLavore, & Risi, 1999).

The ADOS included four separate scores in the four evaluated domains: language and communication, reciprocal social interaction, play, and stereotyped behavior and restricted interests. The current study concentrated on the total score in the language and communication and reciprocal social interaction domains of the ADOS. Scores were calculated by summing the individual scores of all the items included in this domain (not only the items used for autism diagnosis in the ADOS algorithm). Score for each item ranged from 0 (close to normal) to 2–3 (most abnormal).

2.4.2. Instruments used for the evaluation of cognitive ability

2.4.2.1. *The Bayley Scales of Infant Development-second edition (BSID-II)*. It was used for preverbal children. It is a widely used measure of infant development that has well-developed norms and good reliability and validity. It is administered to children aged 1–42 months. Derived from the scale is the Mental Developmental Index (MDI) (mean = 100, standard scores (S.D.) = ± 15) (Bayley, 1993).

2.4.2.2. *Stanford-Binet Intelligence Scale-fourth edition*. It was used for verbal children. The test measures overall cognitive development as well as four different cognitive domains—verbal, reasoning, quantitative reasoning, abstract/visual reasoning, and short-term memory skills (Mean = 100; S.D. = 15) (Thorndike et al., 1986).

2.4.3. Intervention

The Eclectic Developmental (ED) program included daily work in small-group activities supervised by special education teachers with experience in autism. In addition, each child received individual therapy from various therapists—speech and language, occupational and music therapies, and structured cognitive teaching. Each professional provided 2 h of individual sessions a week, 1 h of group therapy and 1 h consultation to the team. Parents received a weekly individual consultation by the preschool special education teacher to discuss the child's program and progress. Parents had one parents' group meeting a week, supervised by a social worker and by a clinical psychologist. They were taught how to play with their children and how to address various challenging behaviors. In addition, a supervised inclusion program in a regular preschool was added for those children who had attained sufficient skills to participate and team from typically developing children.

The ABA group attended a program based on Applied Behavioral Analysis (ABA) principles. One-on-one treatment was provided by skilled behavioral therapists for 35 h a week. Each child had a separate treatment plan addressing various developmental fields, such as imitation, receptive and expressive language, joint attention, non-verbal communication, pre-academic skills, play, fine motor skills, and adaptive daily living skills. Speech and occupational therapists consulted the professional team. The program included regular preschool activities and routines such as circle time, breakfast and lunch together and play-dates. In addition, supervised inclusion program in a regular preschool was added for those children who had attained sufficient skills to participate and learn from typically developing children. In each field goals were set according to the child's abilities, and each goal was divided into units, which were taught as separate tasks. Success in a task was defined as accurate performance in 80% of the trials based on ABA protocols (Morris, Maurice, Green, & Luce, 1996). Intervention programs were updated weekly according to daily documented data provided by the therapists. The therapists were supervised by a trained behavior analyst who designed the child's individual treatment program. The preschool special education teacher was a senior behavioral therapist who supervised the field therapists and the implementation of the routine preschool activities.

3. Results

3.1. Autism severity

In order to examine the differences between the groups at the pre-intervention time, one-way MANOVA for the ADOS scores (language and communication and reciprocal

Table 2
 ADOS scores for the ABA and ED groups at pre- (PRI) and post-intervention (POI) times

	Time		Time × Intervention			
	PRI	POI	<i>F</i>	η^2	<i>F</i> (2,38)	η^2
Language and communication						
ABA						
<i>M</i>	13.8	7.2	49.5 ^{***}	.723	9.59 ^{**}	.206
S.D.	4.3	4.1				
ED						
<i>M</i>	11.8	9.7	3.53 [#]	.164		
S.D.	4.3	3.0				
Reciprocal social interaction						
ABA						
<i>M</i>	17.9	11.1	19.2 ^{***}	.502	3.39 [#]	.074
S.D.	6.2	6.7				
ED						
<i>M</i>	16.3	13.3	5.6 [*]	.239		
S.D.	5.2	4.8				

* $p < .05$.
 ** $p < .01$.
 *** $p < .001$.
 # $p = .07$.

social interaction) and one-way ANOVA for the IQ scores were performed. These analyses did not revealed significant difference between the groups at pre-intervention time in their ADOS scores ($F(2,36) = 1.05, p = .359, \eta^2 = .055$) (Table 2) and their IQ score (ED group, $M = 79.6, S.D. = 17.0$; ABA group, $M = 76.1, S.D. = 15.2; F(1,32) = .41, p = .53, \eta^2 = .013$).

In order to assess the changes in ADOS scores at post-intervention time, and because groups did not differ significantly at the pre-intervention time, 2×2 MANOVA (intervention group \times time) with repeated measure was performed. The MANOVA yielded significant time-effect ($F(2,36) = 20.0, p < .001, \eta^2 = .526$), indicating significant post-intervention progress. In addition, the interaction of time \times intervention group was significant ($F(2,36) = 4.75, p < .05, \eta^2 = .209$). Univariate ANOVA was applied for each domain separately (Table 2). For the language and communications domain significant differences between the groups (ED, ABA) were found ($p < .01$). For the reciprocal social interaction domain differences between the groups almost reached significance ($p = .07$).

In both domains the ABA group improved more than the ED group (Figs. 1 and 2). Paired comparisons tests for each intervention group separately showed that the pre- and post-intervention differences were significant for the ABA group on language and communication domain and reciprocal social interaction domain (Table 2). For the ED group, the pre–post intervention difference was significant only for the reciprocal social interaction domain. However, the effect size was smaller than that found for the ABA group. For the language and communication domain in the ED group, pre–post-intervention difference did not reach significance (Table 2).

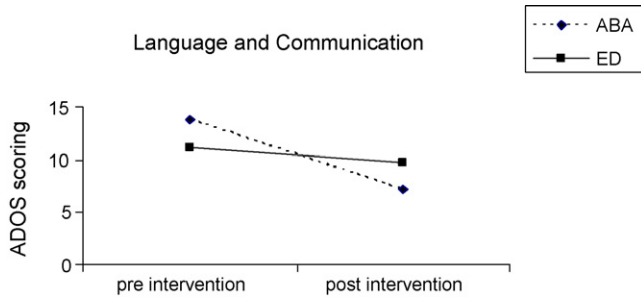


Fig. 1. Language and communication score means for both intervention groups at pre- and post-intervention times.

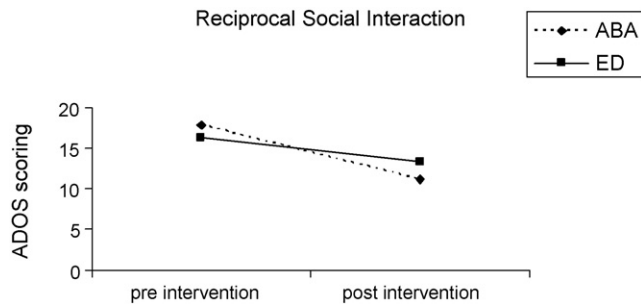


Fig. 2. Reciprocal social interaction score means for both intervention groups at pre- and post-intervention times.

3.2. Stability of diagnosis

To assess stability of diagnosis, ADOS criteria for autism/autism spectrum were applied for children of both groups at pre- and post-intervention times. The child’s diagnosis category was based on reaching the cut-off points for autism/autism spectrum on the ADOS composite score for language and communication, and reciprocal social interaction domains (ADOS algorithm). At pre-intervention time, 37 children were diagnosed with autism (18 from the ED group and 19 from the ABA group) and 2 children with autism spectrum (1 from the ED group and 1 from the ABA group).

As seen from Table 3 and Fig. 3, after 1 year of intervention diagnosis within the autism spectrum remained stable (89.7% of the children). In the ABA group 20% did not meet criteria for autism/ASD and 20% changed from autism to ASD diagnosis at post-intervention time. In the ED group 15.8% moved from autism to ASD diagnosis. Change of diagnostic classification was significantly higher for the ABA group than for the ED group $\chi^2 = 3.90, p < .05$.

Table 3
 Stability of autism/ASD diagnosis at pre- (PRI) and post-intervention (POI) times

Intervention	Autism		ASD		Off autism spectrum	
	PRI	POI	PRI	POI	PRI	POI
ED	18	15	1	4	0	0
ABA	19	11	1	5	0	4

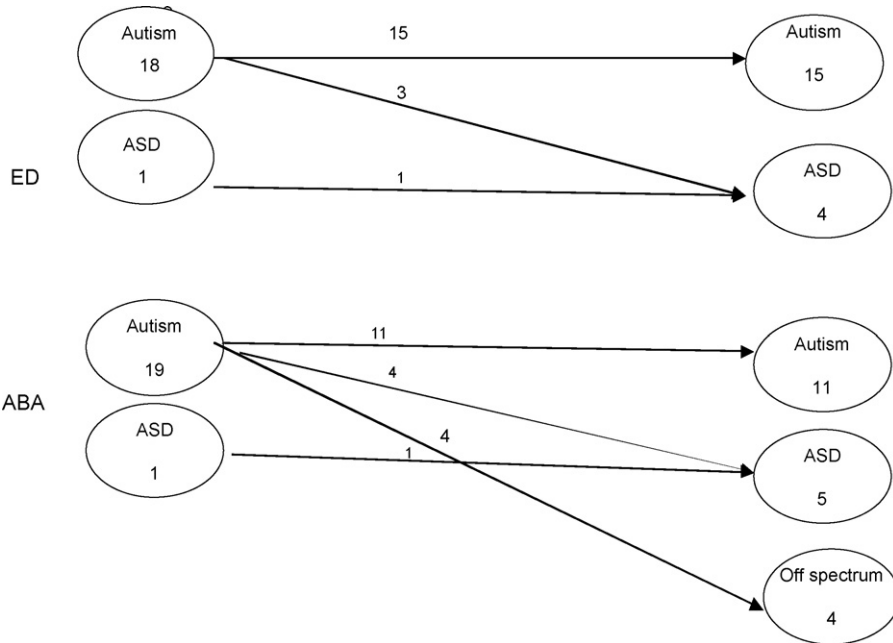


Fig. 3. Changes in autism diagnosis in both groups after 1 year of intervention.

3.3. IQ scores

The cognitive abilities of 36 children were assessed at pre-intervention time (20 children from the ABA program and 14 from the ED program). IQ scores ranged from 50 to 109 points ($M = 77.6$, $S.D. = 15.8$, median = 79) and were not significantly different between the groups. The subjects were divided into two groups according to their IQ scores: low (under 80 points) and high (80 points and over). The outcome in the ADOS domains at post-intervention time was assessed by $2 \times 2 \times 2$ MANOVA [IQ group \times intervention group \times time] with repeated measure on time and yielded IQ group main effect ($F(2,29) = 6.96$, $p < .01$, $\eta^2 = .324$). The high IQ group performed better than the low IQ group in pre-and-post intervention times. Univariate tests indicated that in language and communication ($F(1,30) = 10.08$, $p < .01$, $\eta^2 = .252$) and in reciprocal social interaction ($F(1,30) = 11.92$, $p < .01$, $\eta^2 = .284$) high IQ group achieved better ADOS scores than the low IQ group at pre–post-intervention times. However, no significant interaction of IQ group \times time was found. In this analysis the ABA group achieved better post-intervention outcome as reported before (time \times intervention group interaction: ($F(1,29) = 3.84$, $p < .05$, $\eta^2 = .209$) but no IQ group \times intervention group interaction was found.

4. Discussion

This study examines the effect of two different methods of early intensive intervention (Eclectic-Developmental and Applied Behavior Analysis) in very young children with autism, and focuses on changes in the severity of the autistic symptoms using quantitative measures. Both intervention groups show improvement in reciprocal social interaction after 1 year of intervention, however advancement in this domain is more pronounced in the ABA group.

Discrepancies between the intervention groups are more apparent in language and communication, as only the ABA group shows significant progress.

Previous studies also report that early intervention can produce significant behavioral changes (review Rogers, 1998; Smith, 1999). The current study emphasizes the importance of the type of intervention used.

Most previous pre–post intervention studies in autism compare behavioral intervention to other philosophy based approaches as shown in Table 1 (Birnbauer & Leach, 1993; Eikeseth et al., 2002; Howard et al., 2005; Sheinkopf & Siegel, 1998; Smith et al., 2000). These studies report behavioral intervention results in better outcomes (Schreibman, 2000). This study adds to previous reports by concentrating on improvement of core autistic features, while others report on progress mostly in cognitive abilities (Birnbauer & Leach, 1993; Eikeseth et al., 2002; Howard et al., 2005; Lovaas, 1987; Sheinkopf & Siegel, 1998), language and adaptive skills measures (Birnbauer & Leach, 1993; Eikeseth et al., 2002; Howard et al., 2005) educational placement (Lovaas, 1987) and symptoms severity (Sheinkopf & Siegel, 1998).

Two previous studies that specifically compare behavioral to eclectic interventions report as well advantage for ABA intervention. These studies examined outcome of cognitive, adaptive and language skills (Eikeseth et al., 2002; Howard et al., 2005). Taking the past and current findings, it appears that the ABA approach improves developmental outcome and targets specific deficits in autism more than “eclectic” intervention. Possible explanation for the ABA advantage lies in the use of structured teaching setting, well defined learning goals and using simple instructions with many repetitions until the goal is achieved. Teaching attention and learning skills in the beginning of the intervention is highly important as children with autism have difficulties diverting their attention to various stimuli in the environment. Some children with autism have difficulties learning from the natural environment, therefore, unstructured flexible and incidental teaching as used in ED programs appears less suitable for them. ABA differs also in the teaching format from ED programs. Teaching basic skills in one-on-one setting is perhaps superior to teaching in group format. In addition, social reward plays an important role in the learning of typically developing children. Unfortunately, children with autism do not always respond to these types of social rewards. Therefore, using an individualized reward system that is derived from the child’s preferences, as used in ABA, seems to be a crucial factor in modifying behavior patterns and progress in learning. ED intervention involves multiple transitions per day from one activity or therapy to another which results in significant variation in the way intervention is provided. In ABA, teaching is more consistent, both in the methods used and in the physical environment and changes are made gradually according to the child’s progress. ABA is based on established protocols and therefore is applied more consistently and is less affected by the differences between the individual therapists. In this study, the ABA group showed more significant progress than the ED group especially in measures of language and communication. It is possible that structured teaching is more effective for learning skills that comprised the communication domain.

Another question the current study addresses is whether the child’s initial cognitive level affects outcome. The results show that children with higher IQ scores have better language and communication and reciprocal social skills both before and after the intervention. However, children with higher IQ do not improve significantly more than children with lower IQ scores. Previous studies also report that cognitive skills in autism correlate with better social and communication abilities (Ben Itzhak & Zachor, 2006; Gillberg & Steffenburg, 1987; Harris & Handleman, 2000; Stevens et al., 2000; Szatmari, Bryson, Boyle, Streiner, & Duku, 2003; Volkmar, 2002; Volkmar, Cohen, Bergman, Hooks, & Stevenson, 1989; Waterhouse et al., 1996).

However, only Ben-Itzhak and Zachor (2006) examine the correlation between pre-intervention cognitive ability and controlled intervention outcome. The researchers report that high IQ predicts better achievements only in receptive language skills but not in other investigated developmental domains after 1 year of intervention. ADOS is not necessarily affected by receptive language level which may explain why in the current study there is no IQ effect on progress in autism core symptoms. Several studies use IQ as an independent and an outcome measure at the same time which adds a level of bias toward positive outcome (Matson, 2006). In the current study IQ is used only as the independent measure. Of interest in this study is that there is no interaction between pre-intervention IQ skills and type of intervention used. Children in the ABA group improved more than children in the ED group, regardless of their baseline IQ level. This finding points to the advantage of ABA intervention for a range of cognitive abilities in children with autism.

In this study, diagnosis of autism of all the participants is overall quite stable with 90% remaining within the autism/ASD categories. However, changes in diagnostic classification are different in each of the intervention groups. Change from autism to ASD category was quite similar in the two groups. However, change from autism/ASD to off-autism spectrum classification occurs in 20% of the ABA group and none in the ED group. Other studies look at diagnostic classification as an outcome measure of intervention, but they lacked use of rigorous methods for autism diagnosis (Eaves & Ho, 2004; Lovaas, 1987; Sheinkopf & Siegel, 1998; Strain & Cordisco, 1994; Wolery & Garfinkle, 2002). The findings of the stability rate of ASD diagnosis as reported by Eaves and Ho (2004), in whose study only 6% of the children moved from autism to PDD-NOS are different from those reported here. Change in the core symptoms of ASD over time is one of the most important outcome measures for programs claiming to improve ASD significantly (Matson, 2006). This study is innovative for the use of standardized instrument (ADOS) to measure quantitative changes in autism core symptoms with intervention. ADOS is a valid, reliable observational measure of the unique social and communication deficits in autism that requires reliability in the coding system (Lord et al., 2006).

The variables of language and communication and reciprocal social interaction in this test correlate with core social-emotional deficits in autism (Lord et al., 1999; Robertson, Tanguay, L'Ecuyer, Sims, & Waltrip, 1999; Tanguay, Robertson, & Derrick, 1998). Although the ADOS test was not originally intended to measure change, it is possible to use the standard behavioral sample as a measure of response to treatment (Lord & Corsello, 2005). ADOS has been used in several studies of medication effect (Belisito, Law, Kirk, Landa, & Zimmerman, 2001; Owley et al., 2001). To date, the majority of outcome studies do not use one of the primary measures of autism as an outcome measure (Rogers, 1998). A minority of studies that look at reduction of autism symptoms used the Autism Behavior Checklist (ABC) (Krug, Arick, & Almond, 1980), or the Childhood Autism Rating Scales (CARS) (Jocelyn et al., 1998; Ozonoff & Cathcart, 1998) which are not based on DSM-IV criteria.

The current study has stringent matching criteria in reference to the children's age, profile and intensity of intervention in both studied groups. Prior to intervention, children in both comparison groups are not significantly different in their global diagnosis (autism, autism spectrum), nor in their autism severity in language and communication, and in reciprocal social domains as measured by the ADOS. Most previous studies include children who fulfill the diagnostic criteria for autism or PDD-NOS but do not match their groups for the severity of the specific core domains in autism. In the current study children are not different in their cognitive abilities as measured by IQ tests, or in their socio-economic background. In addition, both intervention groups have the same number of weekly school-based hours and the same

government-allocated budget per each child. Each program uses the treatment time and budget according to their basic intervention philosophy.

The current study shows that very young children with autism improve significantly with early intervention. However, the type of intervention applied has a major impact on this progress. Change in core autism symptoms is more apparent with intervention based on ABA principles in comparison to ED intervention. Future research may also look at the profile of children who gain more from a specific intervention and investigate the long-term outcome of ABA versus ED interventions. This may help parents and therapists to choose the best intervention program for each child.

Acknowledgement

This research was supported by a grant from the Ministry of Education in Israel. We thank ALUT—The Israeli National Alliance for Children with Autism for the cooperation provided within their early intervention programs.

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