The Effects of Early Intensive Behavioral Intervention on Children with Autism Spectrum Disorders: A Narrative Review

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Autism spectrum disorder (ASD), described by impaired language acquisition, limited social relationships, and restricted and repetitive patterns affect 1 in 36 children in the United States. Applied Behavior Analysis (ABA) is a heavily backed practice to treat individuals with autism; specifically, early intensive behavioral intervention (EIBI) is a subcategory of ABA used to treat young children with ASD. This review aims to summarize and compare recent empirical studies examining the effectiveness of EIBI based on Dr. Ole Ivar Lovaass (a then UCLA professor who studied ABA) treatment model. An analysis of these studies reveals the importance of duration and intensity in EIBI treatment, with higher intensity and longer duration corresponding to increased IQ scores. Therefore, EIBI is a highly effective treatment for at least some children with ASD. However, future studies should also consider metrics other than IQ and look into the individual participant changes under EIBI rather than a group as a whole.

Keywords: Autism Spectrum Disorder (ASD), Applied Behavioral Analysis (ABA), Early Intensive Behavioral Intervention (EIBI)

1 Introduction

The term autism was first coined by the Swiss psychiatrist Eugen Bleuler in 1911 to describe individuals with schizophrenia who demonstrated a loss of contact with reality [1]. In the 1940s, Leo Kanner (1943) and Hans Asperge (1944) independently described children with disorders in the areas of language acquisition, restricted and repetitive behaviors, and impaired social relationships [2,3]. Kanners initial report described a group of 11 children with extreme autistic aloneness, whereas Asperges initial report portrayed a similar but less severely impaired group of children having autistic psychopathy.

More than three decades later, autism was included in DSM-III (APA, 1980) under the category of Pervasive Developmental Disorders (PDDs). The definition of infantile autism in DSM-III emphasized characteristics of young children with autism [4]. In DSM-IV (APA, 1994), autistic disorder, Aspergers disorder, pervasive developmental disorder not otherwise specified (PDD-NOS) were separately listed [5]. In DSM-V (APA, 2013), all subcategories of the condition were folded into one umbrella diagnosis, autism spectrum disorders (ASD).

About 1 in 36 children in the U.S. have autism, and 1 in 45 adults in the U.S. have autism [6]. In general, children with ASD demonstrate persistent deficits in the domains of social communication and social interaction, restricted, repetitive patterns of behavior, interests, or activities during the early developmental periods [7]. The deficits cause clinically significant impairment in social, occupational, or other important areas of current functioning and cannot be better explained by intellectual disabilities [7].

1.1 What is Applied Behavior Analysis (ABA)?

There has been a wide range of teaching programs, interventions, therapies, and dietary regimens available to the public to help families of children with Autism. The behavioral interventions based on Applied Behavior Analysis (ABA) principles have been documented to generate comprehensive, significant, and long-term improvements. It is one of the most cited and empirically validated evidence-based practices for treating individuals with autism.

ABA is a type of intensive, structured, and systematic teaching program based on the behaviorism rooted in B.F. Skinner in 1938 [8]. The first successful implementation of ABA approaches in children with autism was dated back in 1967. However, ABA did not gain its visibility and popularity until the 1990s. Most ABA lessons are taught in a way that breaks the teaching contents into simple elements. These elements are taught to a learner using 1:1 discrete trials in which the child is presented with a stimulus (e.g., touch the cup). Once children demonstrate correct responses and behaviors, positive reinforcement (e.g., preferred edible items, toys, activities) is provided to maintain and reinforce the correct responses. If a learner demonstrates incorrect responses and inappropriate behaviors, the instructor ignores such responses and continues to prompt and reinforce

correct and appropriate responses. Over time, as the children master more skills, reinforcers will upgrade from primary reinforcers (e.g., drinks, snacks) to secondary reinforcers (e.g., verbal praises, thumps up). The ABA teaching approach also emphasizes skill generalization and skill maintenance. The teaching contents might start with simple tasks (e.g., body gestures, table manners, identifying colors, joint attention) to more complex tasks (e.g., language imitation, social skills). Children with autism often demonstrate very distinguished cognitive profiles and individual strengths and weaknesses. Thus, ABA programs are often individualized to meet each learners unique characteristics.

1.2 Early Intensive Behavioral Intervention (EIBI): Lovaas Treatment

Ivar Lovaas, then a professor at UCLA, published a paper in 1973 based on his intensive ABA treatment of 20 children with autism. The conclusion pinpointed the three most prominent predictors of treatment gains: intensity of treatment, family involvement, and child age[9]. After that, Lovaas devoted his efforts to early and intensive behavioral intervention (EIBI) that heavily involved families. EIBI is a specialized, intensive subset of ABA developed to maximize early developmental gains in children with ASD. In 1987, Lovaas published a groundbreaking paper based on his work with 19 children who participated in a minimum of two-year intensive behavioral treatment (an average of 40 hours of ABA treatment per week), with two control groups[10]. IQ was frequently used as an outcome measure, along with adaptive functioning and language skills[10]. The children in the experimental group had an average age of 32 months during the intake. At the follow-up, nine (47%) of the 19 children showed average intellectual and educational functioning, eight (42%) obtained an average IQ score in the mild intellectual disabilities range, and two children were placed in classes for autism/intellectual disabilities, with an IQ in the profound range. Compared to the control group 1, the experimental group showed an overall IQ increase of 30 points, whereas the experimental group and the control group 1 showed comparable baseline data. Nevertheless, Lovaas study was not left unchallenged. Lovaas was asked by skeptical reviewers to collect more control group data and then was asked whether the findings could be replicated in other centers. In the next ten years, his efforts were reflected in several replication studies (e.g., Eikeseth et al. 2007; Sallows & Graupner, 2005)[11,12]

2 Research questions and methods

This paper aims to summarize recent empirical studies examining EIBI rooted in the Lovaas treatment model to compare and contrast the key elements of these studies. A few research questions are listed below. First, what were the characteristics of the participants involved in these EIBI studies? Second, what were the key elements of these EIBI studies? Third, what were the main outcomes of these EIBI studies?

In the following section, a literature review was conducted to summarize, compare, and contrast major empirical studies based on the 1987 Lovaas study. The search key words included the following: early, intensive, behavioral intervention or ABA, and children. The inclusion criteria were empirical case-control comparison studies of EIBI for children with autism; studies involving early intensive behavioral intervention following Lovaass treatment model; the age at intake should be less than 5 years; the number of participants should be at least 10; the minimum duration of treatment should be one year; and available data on IQ or other standardized measures to allow calculation of treatment outcomes. The databases included PsycINFO, Academic Search Complete, ERIC, MEDLINE, ProQuest, and Education Database. Eleven studies met the criteria and closely followed Lovaas model for intervention. Three of the studies had follow-up data collected years after the initial treatment.

3 Review of Empirical Studies Utilizing Early Intensive Behavioral Intervention (EIBI) Based on Lovaas Model

3.1 Characteristics of Participants

All of the studies recruited very young participants, ranging from 30 to 53 months old at the time of intake evaluation. Participants in the control groups had comparable ages. Only one of 11 studies (Eldevik et al., 2006)[13] addressed age at intake evaluation as a predictor of outcome measures and reported null findings. The diagnosis categories included autism spectrum disorders, children with autism, and pervasive developmental disorders. Most studies focused on children with mean IQs ranging from 50 to 60. Eldevik et al. (2006) focused on children with a baseline IQ in the 40s[13]. Magiati et al. (2007) focused on children with a baseline IQ in the 80s[14]. Not all studies reported the ages of diagnosis and the ages at which the intervention started. Most of the studies recruited 11 to 20+ participants for the treatment groups and a similar number of participants for the control groups.

3.2 Characteristics of Intervention

The key elements of the 11 studies were summarized in Table 1. Of the 11 studies, three provided EIBI in less than two years. The rest of them provided EIBI for at least two years. Most studies had an intensity of 25 to 40 hours of EIBI per week, whereas only one study provided 12.5 hours of EIBI per week[13]. The report of actual hours of intervention was variable, as some studies had very accurate documentation of therapy hours for their participants, and some studies only provided

an estimation. Four studies reported that EIBI (i.e., Smith et al., 2000; Eikeseth et al., 2002, 2007; Sallows & Graupner, 2005) was more intensive during the first year, and the intensity decreased the following year[11,12,15,16]. All children in the EIBI groups received similar treatment, which varied in intensity and duration; the children in the control groups received variable treatments, such as parent-directed invention, eclectic public-school service, and mixed interventions. Three studies involved two control groups, and the rest involved one control group.

3.3 Outcomes of Intervention

The most consistent data that can be compared across studies were IQ scores reported in these 11 studies. The increase in IQ score varies from 30 points to non-significant changes. Nine studies reported a significant mean increase in IQ scores in the EIBI group. Only two studies reported non-significant changes from intake to post-treatment evaluations (i.e., Eldevik et al., 2006; Magiati et al., 2007)[13,14]. It is worth noticing that Eldeviks study in 2006 recruited participants with IQs in the relatively low range (the 40s), and the EIBI intensity was low (i.e., 12.5 hours/week), and minimum improvement was reported. On the other hand, Magiatis study recruited participants with relatively high IQs (in the 80s) and reported an average of 32 hours of EIBI, with minimum improvement reported. Studies that rendered more treatment outcomes recruited participants with a baseline IQ in the 50-60s range. Many studies reported data on other measures, such as language, speech, symptom severity, and adaptive functioning. However, such measures are much less consistent than reports on IQ gains. Among the 11 studies, eight reported data on adaptive behaviors, seven reported data on expressive language, and seven reported data on comprehension skills, with the outcome data favoring the EIBI groups. Some studies reported outcome measures at time 1 and time 2. The data presented in Table 1 suggest that most gains from EIBI were made during the first year, and fewer gains were made during the subsequent year. More optimal outcomes were observed in children with a baseline IQ in the 50s-60s. When the baseline IQ was in the lower range (i.e., in the 40s) or in the higher range (i.e., in the 80s), the treatment outcome was limited.

4 Discussion

The present review examined eleven studies utilizing EIBI based on the Lovaas model among young children with ASD. All studies involved the treatment and control groups. Collectively, EIBI is highly effective for at least some children with ASD, evident in the significant IQ increases among nine out of the 11 studies. It is critical that EIBI starts when the children are very young, such as at the ages of 2 to 4 years old. It remains clear that the intensity and duration of EIBI affect the treatment outcomes, with higher intensity and longer duration corresponding to better outcome measures as a general trend. EIBI enhances not only the cognitive abilities of children with ASD but also other domains, such as language, speech, adaptive functioning, and daily living skills.

The ethical and practical considerations of high-intensity EIBI warrant further discussion. There might be potential drawbacks along with the increased intensity of EIBI, such as stress on children, family burden, and accessibility challenges. Future researchers are encouraged to consider the balance between increasing behavioral compliance and the overall well-being and autonomy of children with ASD.

The EIBI demonstrated effectiveness in some of the children with autism. To ensure broader clinical implications based on EIBI, future researchers might want to explore how EIBI can be better implemented with the current educational policies and long-term developmental outcomes. There are many practical challenges associated with the implementation of EIBI, such as accessibility, the costs of treatments, and ethical considerations. By addressing these social, financial, and practical issues, it will enhance the applicability and social validity of EIBI.

However, there are several limitations to this paper. First, although the IQ scores were relatively universal across all studies reviewed, there were substantial variations in terms of what instruments were used to measure IQ, such as some used Wechsler scales (Lovaas, 1987; Sheinkopf & Siegel, 1998) and others used Stanford-Binet and Bayley (e.g., Smith et al., 2000)[10,15,17]. There were more variations in the measures of other skills, such as language, communication, and adaptive functioning. The scores derived from different testing instruments made the comparison difficult to conduct. The inconsistencies observed in multiple studies underscore the importance of using standardized, replicable methodologies in future research to ensure comparability across studies.

Second, IQ remained as one of the most prominent variables used to measure treatment gains. It is plausible that IQ is a relatively more uniform metric and a relatively well-studied variable used to evaluate childrens overall functioning, allowing comparisons across studies. In addition, behavioral discrete trials used in EIBI are more suitable to teach concrete skills such as knowledge acquisition, as reflected in IQ testing, than spontaneous language or social interaction. The treatment gains in language skills, social skills, communication, and social relatedness are also important indicators of successful treatments, which warrant further examinations in future studies.

Third, among the studies that were reviewed, many did not use randomized controlled trials. Thus, potential issues might include selection biases due to parents preferences, prior history of being exposed to behavioral intervention, and lack of equivalence between the treatment group and the control group. Some studies included eclectic or mixed treatments in the control groups, making it difficult to attribute improvements solely

to EIBI. Lack of randomized controlled trials and heterogeneity in control groups make causal inference difficult to reach. Future researchers should consider more studies based on randomized controlled trials to ensure a stronger causal inference, minimize selection biases, and reduce confounding variables.

Fourth, although there was relatively intact data about the hours of EIBI received by the treatment groups, some studies provided data based on actual documentation of therapy hours, and some provided estimations of such hours. Data were much less rigorous about the hours of other therapy or services received by the control groups.

Fifth, although the treatment outcomes were generally positive for the EIBI groups, there were considerable individual variations among the participants. The present review only examined the group-based outcomes without further examinations of individual responses to intervention. Future researchers are encouraged to present individual developmental patterns under the EIBI condition and examine predictors that affect outcome measures (e.g., baseline IQ, language skills at intake, social relatedness at intake, parental involvement). Future studies should explore predictors of individual success in EIBI intervention, highlighting the need to tailor treatment to individual needs, rather than apply the treatment uniformly. This study exclusively examined studies based on Lovaass model, which was established in the 1980s. Current best practice of EIBI might have evolved considerably, and the conclusions from this study might not reflect the most recent EIBI practice.

5 Conclusion

The data presented in this review suggest that EIBI shows promising outcomes in young participants. The intensity and duration of EIBI largely affects its effectiveness. Many studies did not utilize randomized controlled trials, which should be encouraged in future research. There are substantial variations of variables collected across different empirical studies, and more standardized assessments should be implemented. Individual responses to EIBI warrant further examination. Overall, this paper underscores the importance of implementing EIBI among young children with ASD.

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Study	Duration of EIBI Treatment	# for Treatment and Control Groups[a]	Age at Intake (months)[a]	Hours of EIBI	Intake IQ[a]	Follow-up IQ[a]	Other Areas
Lovaas, 1987; McEachin et al., 1993	Minimum of 2 years	T=19, C1=19, C2=21	T=34.6, C1=40.9	40 hours/week	T=53, C=46	T=83.3, C1=52.2, C2=57.5	Higher adaptive behaviors and personality scores
Smith et al., 1997	2 or more years	T=11, C=10	T=36, C=38	30+ hours/week	T=28, C=27	T=36, C=24	More expressive speech
Sheinkopf & Siegel, 1998	16 months	T=11, C=11	T=33.8, C=35.3	27.02 hours/week	T=62.8, C=61.7	T=89.7, C=64.3	Significant effects on symptom severity
Smith et al., 2000	2 or more years	T=15, C=13	T=36.07, C=35.77	24.52 hours/week (year 1), then reducing	T=50.53, C=50.69	T=66.49, C=49.67	Improved visual-spatial skills, language, academics; no improvement in adaptive functioning or behavioral problems
Eikeseth et al., 2002, 2007	31.4 months	T=13, C=12	T=31.4, C=33.3	28 hrs/week (year 1), 18 hrs/week (year 2)	T=61.92, C=65.17	T=79.08 (FU1), T=86.9 (FU2), C=69.5 (FU1), C=71.9 (FU2)	Fewer aberrant behaviors and social problems
Sallows & Graupner, 2005	4 years	T=13, C=10	T=35, C=37	39 hrs/week (year 1), 37 hrs/week (year 2), decreasing later	T=50.85, C=52.10	T=73.08, C=79.60	Outcomes similar for treatment and control groups
Howard et al., 2005, 2014	14 months	T=29, C1=16, C2=16	T=30.86, C1=37.44, C2=34.56	2540 hours/week	T=58.54, C1=53.69, C2=59.88	T=89.88, C1=62.13, C2=68.81	Significant differences in cognitive, expressive, receptive, communication, self-help, and social skills
Cohen et al., 2006, 2014	3 years	T=29, C1=16, C2=16	T=30.86, C1=37.44, C2=34.75	2530 hours/week	T=60.57, C1=53.69, C2=61.00	T=89.43 (Yr3), C1=64.43 (Yr3), C2=71.77 (Yr3)	Better on measures of cognitive, language, and adaptive functioning
Eldevik et al., 2006	20 months	T=13, C=15	T=53, C=49	12.5 hours/week	T=41.0, C=47.2	T=49.2, C=44.3	Limited progress in adaptive behaviors, except communication
Magiati et al., 2007	2 years	T=28, C=16	T=38.0, C=42.5	32 hours/week	T=83.0, C=65.2	T=78.4, C=65.3	No significant group differences
Remington et al., 2007	2 years	T=23, C=21	T=35.7, C=33.6	2030 hours/week	T=61.43, C=62.33	T=68.78 (Yr1), T=73.48 (Yr2), C=58.90 (Yr1), C=60.14 (Yr2)	Robust differences in intelligence, language, daily living skills, and social behaviors

[a] T = treatment group; C = control group; C1/C2 = control groups 1 and 2; FU1/FU2 = follow-ups; Yr1/Yr2 = year 1/year 2.

Table 1 Summary of Intervention and Participant Details