

A Longitudinal Study of the Reduction of Challenging Behavior through Early Intensive and Comprehensive Applied Behavior Analysis

Charna Mintz, Ph.D., BCBA-D
Claire Schutte PsyD, BCBA-D
Sally Borella, MS, BCBA, LBA

Action Behavior Centers, Austin, TX, USA

White Paper

October 20, 2021

Abstract

This study investigated the longitudinal outcome of early intensive behavior intervention (EIBI) on the reduction of challenging behaviors across 20 children with autism spectrum disorder. Participants were 2-6 years of age at the onset of the evaluation and had received ABA therapy for an average of 27 months (range 14-37 months). Frequency of episodes of challenging behavior, including aggression, elopement, property destruction and self-injury, were collected during the start of intervention and at the termination of treatment or their most recent 3 months of care. Results indicated an 86% decrease in target behavior, sustaining across all topographies as dosage of treatment reduced by almost 20%. Greatest reductions occurred during the first year of treatment. In addition, 50% of children graduating from treatment transitioned to a general education instructional environment. These findings further support the use of EIBI in treating problem behaviors associated with ASD. Furthermore, this study provides evidence that treatment efficacy can be maintained while treatment hours are decreased. This white paper presents one model of how private providers of ABA can conduct outcome studies across their patient population.

Key words: autism spectrum disorder, challenging behavior, EIBI outcome study, early intensive behavioral intervention, applied behavior analysis

Introduction

The incidence of autism spectrum disorder (ASD), a neurodevelopmental disorder associated with impairments in social communication skills and the presence of restricted and repetitive

behaviors, continues to increase (CDC 2020). The Center for Disease Control indicates that 1 in 54 children are diagnosed with ASD as compared to 1 in 110 just 10 years prior (CDC 2020). ASD is often accompanied by challenging behaviors creating barriers to skill development and learning, impacting quality of life for both the individual and their family (e.g., Baghdadli et al. 2003; Matson & Nebel-Schwalm 2007; Emerson, 2000; Mudford et al. 2008).

Aggression, elopement, property destruction and self-injury are four commonly occurring challenging behaviors (e.g., Dawson, Matson, & Cherry 1998; Anderson et al., 2012; Fodstad et al., 2012). The presence of these maladaptive behaviors present social, health, and safety risks. For example, self-injury, in any setting, presents a threat to a child's safety. Without intervention, self-injury can increase in both intensity and severity, posing a serious risk for permanent harm. In an educational setting, self-injury also limits the opportunity for acquiring new skills while creating a stigma, limiting the development of meaningful social relationships. The prevalence of elopement in children with ASD is significant. Approximately half (48%) of children with autism will engage in some form of elopement (Autism & Safety Facts, 2019). The leading cause of death in children with ASD is drowning and 90% of these deaths are associated with wandering or eloping behaviors in children younger than 14 years of age (Autism Facts and Figures 2019). The dangers associated with elopement often lead to avoidance of family outings for errands and leisure.

There is a high demand for effective intervention to meet the growing needs of children diagnosed with ASD. Early intensive behavioral intervention (EIBI) is an evidenced based intervention supported by extensive research (e.g., Granpeesheh, Tarbox, & Dixon 2009; Peters-Scheffer et al., 2011). It has proven to lead to significant outcomes for young children with ASD, such as improvements in cognitive and adaptive skills, and successful transition to traditional classroom environments (Cohen, Amerine-Dickens, & Smith 2006; Eldevik et al. 2009, 2010; Klintwall, Eldevik, & Eikeseth 2015; Virués-Ortega, Rodríguez & Yu 2013). EIBI utilizes Applied Behavior Analytic (ABA) techniques and principles and involves 30-40 hours of intervention per week. Literature supports more significant outcomes for children who start EIBI earlier than five years (e.g., Granpeesheh et al. 2009).

A primary goal of EIBI programs is to reduce these challenging behaviors. Reduction in challenging behavior is prioritized in a child's intervention program so that skill acquisition can take place more successfully, and the goal of preparing the child for a successful transition to a school or other more independent setting can be met. Several studies have supported the efficacy of ABA for the treatment of challenging behaviors in children with autism spectrum disorder (e.g., Foxx 2008)

In 2019, Action Behavior Centers published a white paper examining the challenging behaviors of 34 children who attended an EIBI program at a private ABA clinic for 12 months. Results demonstrated a 65% decrease in elopement, 82% decrease in aggression and a 90% decrease in self-injury. Results demonstrated that 12 months of comprehensive EIBI treatment led to a reduction of problem behavior. However, results did not fully explore a longitudinal look at the effectiveness of treatment across time nor were the results normalized to account for varying session lengths and prescribed treatment hours. The purpose of the current paper is to extend the 2019 study by evaluating the rate of behavior reduction for the original participants across multi-year intervention programs. This paper will present data depicting the occurrence of aggression, self-injury, elopement, and property destruction as a child progresses through treatment in a clinic based EIBI program.

Methods

Participants

Twenty children (4 female and 16 male) from the 2019 white paper were included in this study. Participants were a mean age of 2.9 years at the start of the study and 5.7 years at the conclusion. All participants began treatment between the ages of 2-6 and attended at least 12 months of comprehensive treatment defined as 30+ hours a week of direct intervention. All participants were diagnosed by a Pediatrician, Child Neurologist, Developmental Pediatrician, or Psychologist using DSM-5 and/or ICD-10 diagnostic criteria for autism spectrum disorder within 24 months of their first treatment session. In addition, record of formal ASD diagnosis was reviewed by a Licensed Psychologist to assure adequate diagnostic documentation. All 20 participants engaged in aggression, elopement, property destruction and/or self-injury within the first three months of treatment. Participants spent an average of 27 months in treatment ranging from 14-37 months. At the onset of the analysis, participants attended an average of 40 hours of direct treatment each week, ranging from 36.5 to 49 hours. During the last three months of treatment, weekly hours of direct therapy averaged 32.5 hours and ranged from 9-40 hours.

Procedures

Data collection

Data were collected using Catalyst, a data collection and analysis software program used for creating and monitoring ABA intervention plans. Target behavior data (individual episodes) were collected and entered in real time on Apple iPads running the Catalyst application. Data were entered by behavior therapists (BTs), Registered Behavior Therapists (RBTs), Board

Certified Assistant Behavior Analysts (BCaBAs), and Board Certified Behavior Analysts (BCBAs) during therapy sessions across environments.

Behaviors were operationally defined by the participant's BCBA, along with an individualized data collection procedure. The first author reviewed operational definitions to ensure a match between behavior observed and the label of the target behavior. Only those in which there was direct agreement were included in this study.

In order to aggregate data for this study, authors combined targets with different names from the same category. For example: "SIB" "self-injury" "SIB: Head banging" and "head hitting with high intensity" were all categorized as "self-injury." Each episode was given a single numerical count according to the participant's behavior intervention plan.

Frequency data for aggression, elopement, property destruction and self-injurious behavior were collected from Catalyst for participants at the start of treatment and close of treatment. The "starting period" was calculated as an average hourly rate by dividing the total daily hours of treatment across the period by the total hours of treatment across the same time frame. The "closing period" was calculated in the same way using an average hourly rate for the last three full months in which target behavior occurred. For participants still in treatment, the average hourly rate for their most recent three full months of intervention were used as their "closing period." For participants that exited the program, the "closing period" was defined as the last three months in which target behavior was recorded.

Participants that graduated from treatment with clinical recommendation were contacted by the first author and their treating clinician to determine current school placement for the 2021-2022 school year. Families were asked to identify placement in terms of the following categories: virtual/home school, special education school, public school with at least 51% special education services or public school with at least 51% general education services.

Operational Definitions

Aggression, for the purposes of this study, was defined as any instance of or attempt to make forceful, physical contact using any body part or item with another person, including peers and adults. This included the topographies of hitting, kicking, biting, scratching, and hair pulling.

Elopement, for the purposes of this study, was defined as any attempt or instance to physically leave (walk, run, crawl) an adult or physical instructional setting (table and chairs, desk, group of peers), without permission outside of an average of a 2-foot radius.

Property Destruction, for the purposes of this study, was defined as throwing or breaking objects or visibly damaging property, including items owned by the individual.

Self-Injury (SIB), for the purposes of this study, was defined as any attempt or instance to cause physical tissue damage to one's body either with or without the use of an item. This included the topographies of head banging against an item or hitting an item against one's head, biting, scratching, pinching, hair pulling and hitting.

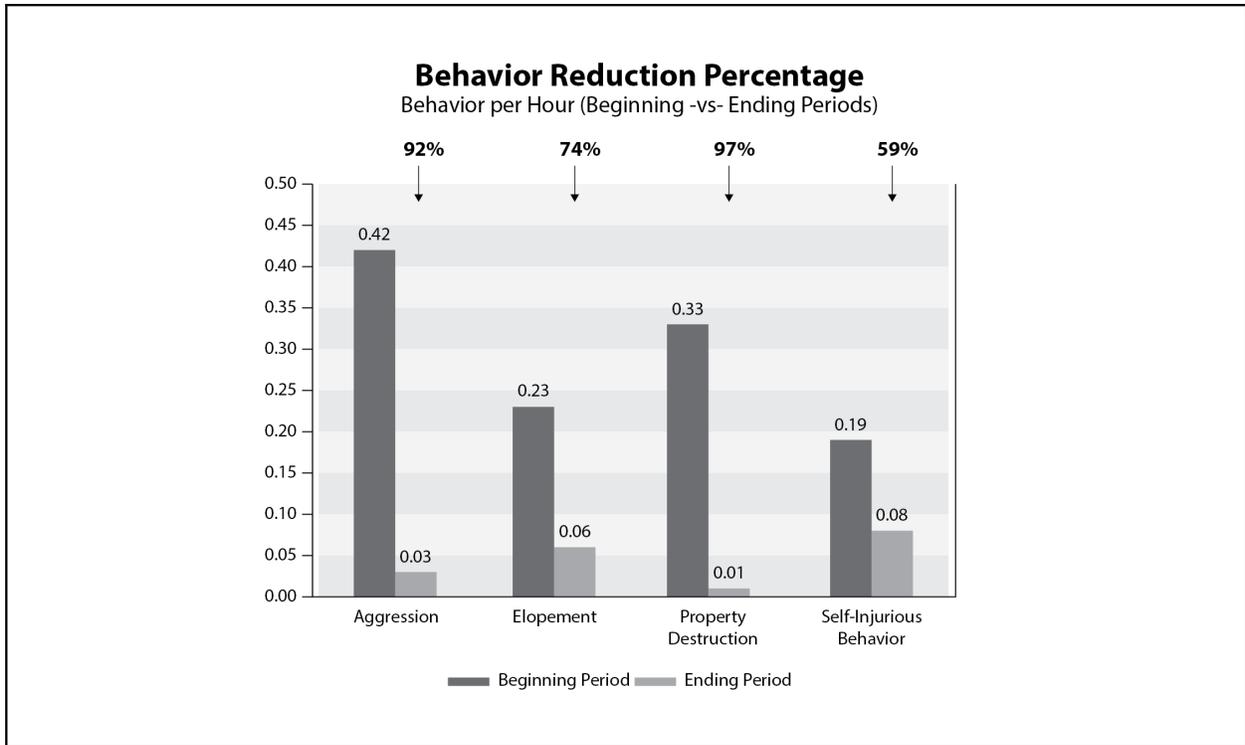
Results

All participants engaged in one or more forms of challenging behavior. Fifty percent of patients engaged in aggression, 60% engaged in elopement, 45% engaged in property destruction, and 35% engaged in SIB. More than half of the participants engaged in at least 2 different categories of challenging behavior (e.g., aggression and elopement) at the onset of treatment: 40% of participants engaged in two categories of challenging behavior and another 25% engaged in 3 different types. No participants engaged in all 4 target behaviors.

Behavior reduction across participants

Participants engaged in an average hourly rate of .30 episodes of target behavior during the starting period and an average hourly rate of .01 episodes of target behavior during the closing period, resulting in an overall reduction of 86%.

The graph below depicts the reduction specific to each targeted behavior. There was a 92% decrease in aggression, a 74% decrease in elopement, a 97% decrease in property destruction and a 59% decrease in SIB.



A paired-samples t-test was run on a sample of all 20 patients to determine whether there was a statistically significant mean difference in rate per hour of all targeted behavior between the starting and closing periods. There was a statistically significant (95% confidence level) mean decrease in the overall rate ($t=4.41, p < .000$) as there was with each target behavior evaluated (see chart below).

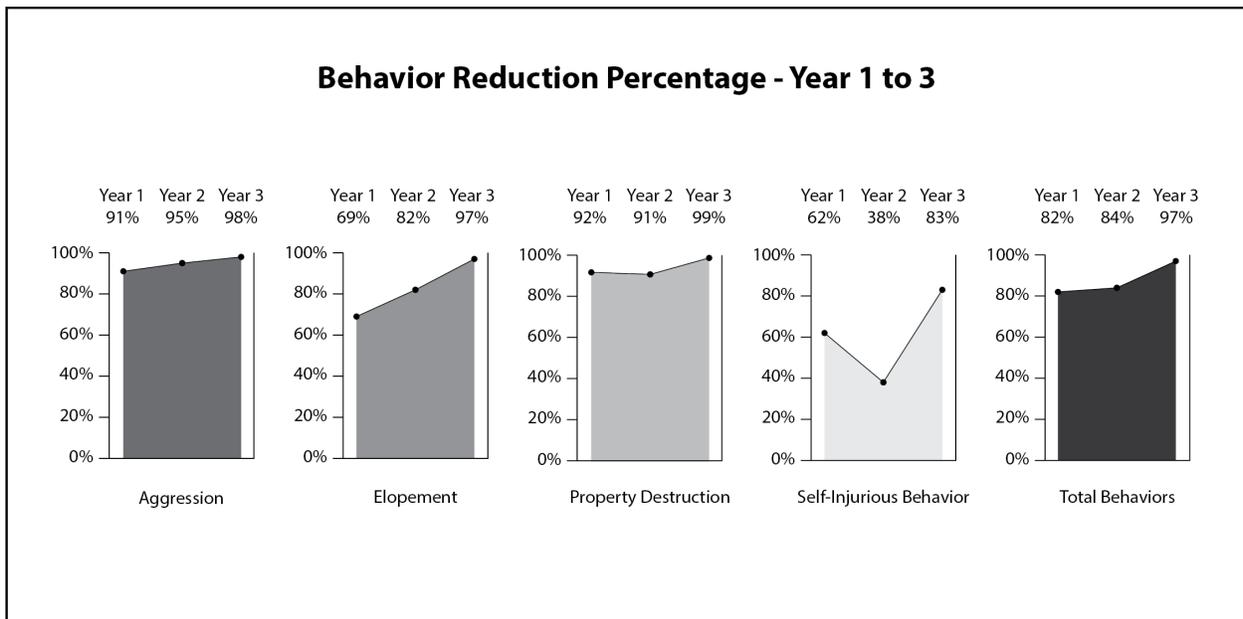
Estimation for Paired Difference	95% CI for μ difference	T-Value	P-Value
Aggression	(0.00474, 0.04360)	3.45	0.03
Elopement	(0.0682, 0.1914)	4.64	0.00
Property Destruction	(0.1447, 0.3486)	5.58	0.00
Self-Injurious Behavior (SIB)	(-0.0011, 0.4790)	2.44	0.05
Overall Behaviors	(0.0915, 0.2570)	4.41	0.00

Behavior Reduction Across Time

Due to the longitudinal nature of the analysis, an evaluation of reduction rates over time was conducted. Participant's data were included in up to 3 analyses based on the number of months of treatment that they received. Participants that attended up to 12 months of treatment were included in the Year 1 analysis. Participants that attended up to 24 months of treatment were

included in both the Year 1 and Year 2 analysis and participants that attended up to 36 months were included in all three analyses. For example, if a participant attended 30 months of treatment, data for months 1-12 were included in Year 1, data for months 1-24 were included in Year 2 and data for months 1-30 were included in Year 3. All 20 participants received at least 14 months of treatment, resulting in their data being included in both the Year 1 and Year 2 analyses. Of the 20 patients, 14 received up to 36 months of treatment, resulting in their data being included in the Year 3 analysis.

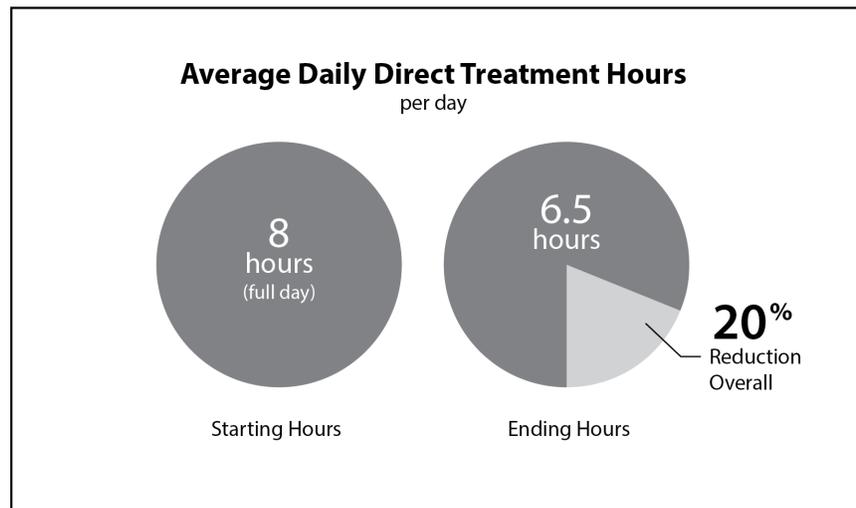
The graph below depicts the reduction of target behavior across length of treatment. The largest decrease in target behavior occurred within the first 12 months of treatment with an 82% overall reduction in Year 1, an 84% reduction within 2 years of treatment and a 97% reduction within 3 years of treatment. This pattern was repeated for 3 of the 4 topographies; the greatest gains were experienced within the first 12 months of treatment with subsequent gains across the years. For SIB, there was an increase in Year 2 as compared to Year 1 and a subsequent decrease in Year 3. These data were due to the increase of SIB for one participant during their second year of treatment.



Treatment Reduction Across Time

As rate of target behavior decreased over time, so did the number of weekly direct treatment hours. There was a 20% reduction in treatment hours from the starting to closing period of this analysis. For Participants that received 12 months of treatment, we saw a 3% reduction in

treatment hours. For participants that received 12-24 months of treatment, direct treatment hours reduced by 20% and for those participants that received more than 24 months of treatment, direct therapy hours reduced by 18%. In addition to the overall reduction in treatment hours, 30% of patients discharged in Year 2 and another 55% discharged in Year 3

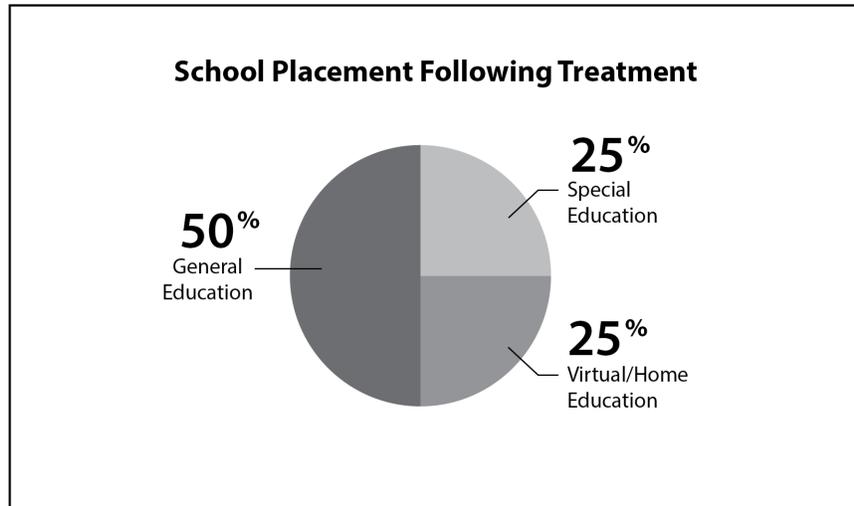


Patient-specific behavior change

An individual analysis was conducted comparing rate of total targeted behavior per hour from the starting period to the closing period, normalizing the data for differing session lengths across authorization periods. Sixty percent of patients experienced a 75% or greater reduction in targeted behaviors, 30% experienced a 74-50% reduction, and another 15% experienced less than a 50% reduction. Target behavior decreased for each participant.

School placement following treatment

Of the 20 participants, 11 graduated from treatment with clinical recommendation. Eight families responded to the survey. Fifty percent of participants attended a general education classroom at least 51% of their day, 25% of participants attended a special education classroom as their primary learning environment and another 25% attended home or virtual school.



Discussion

The objective of our study was to analyze the effectiveness of EIBI at reducing problematic behaviors related to autism spectrum disorders over time, normalizing the unit of analysis to account for varying session lengths. Significant decreases were found across all behaviors following a minimum of 14 months of therapy. The largest decreases were seen in the rate of property destruction and aggression with moderate decreases in elopement and self-injurious behavior. This evaluation also demonstrated a sustained decrease in target behavior while treatment hours were reduced. An initial evaluation of school placement revealed that 50% of participants surveyed attended a general education classroom following clinically recommended graduation from treatment.

These findings have meaningful implications, as literature has clearly shown that reduction in challenging behavior contributes to better skill development and lowered risk to health, safety, and social functioning. Challenging behaviors are associated with elevated levels of parent stress (Rivard 2014); therefore, decreasing these behaviors may improve quality of life for not only the child, but also the family unit. Finally, with the reduction in challenging behaviors, children are better prepared for a successful transition to a school setting in a less restrictive environment.

Findings also helped identify rate of reduction for individual participants as compared to others receiving treatment for similar topographies. On an individual scale, this allows for on-going treatment evaluations as well as increasing clinical support to staff providing treatment in situations in which target behavior is not decreasing at an average expected rate. Supervisory clinicians, including clinical directors (supervisory BCBA's at each clinic site), regional clinical directors, and clinical leadership team members are able to use these data to manage quality outcomes across a portfolio of centers. On a larger scale, this information allows for creating a

knowledge base to help identify potential barriers to response to treatment and mitigate those barriers as quickly as possible.

Limitations

While each target behavior met the inclusionary definition for this study, there were varying degrees of severity that may have impacted the overall results. For example, elopement was defined as any attempt or instance to physically leave (walk, run, crawl) an adult or physical instructional setting (table and chairs, desk, group of peers), without permission outside of an average of a 2-foot radius. There is a socially significant difference between moving 3 feet away from the instructional table without permission and running out of the clinic without permission. Future studies may want to consider adding an additional analysis that considers severity of the targeted behaviors and/or the risks associated with them.

While it is noted that more than 50% of participants discharged in years 2 and 3, the organization did not have standardized means to document the reason for discharge, nor was there a mechanism by which to receive ongoing updates. The inclusion of these data may have generated more robust findings.

Future Direction

There is an increasing need for outcome studies amongst private providers of ABA to maintain quality assurance and ensure companies are maintaining best practice, high standard of care, and most simply, that their intervention is effective. The findings of this study are promising, but replications and further evaluations of designing outcomes measures for larger populations are needed. In addition, a more extensive evaluation of school placement following the termination of treatment as well as the family's stress level both at the start and closing of treatment should be considered for future studies.

Acknowledgements

We would like to thank Dr. Dorothea Lerman, Dr. Russ Lang, and Dr. Linda Leblanc for their feedback on this paper. We would also like to thank all staff involved in supporting this study and all of the administrative staff past and present, who help support our mission.

Financial Support

No financial support was received to fund this study.

Conflict of interest

This study was conducted by employees of Action Behavior Centers as a part of an ongoing internal evaluation of clinical outcomes.

Ethical standards

All procedures performed were in accordance with ethical standards. For this type of study, a retrospective review of data that has been de-identified, formal consent is not required.

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