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Implementation of a Parent-Mediated Discrete Trial Teaching Intervention for Children with Autism Spectrum Disorder

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Abstract

For young children with autism spectrum disorder (ASD), early intensive intervention is imperative. The Bridge Skill Development Program is a parent-mediated intervention designed to "bridge the gap" during the period after a diagnosis of ASD while children wait for intensive intervention. This program introduces applied behavior analysis (ABA) teaching techniques, including the use of parent-mediated discrete trial teaching (DTT), to promote skill acquisition of target behaviors. Significant improvements were observed across four target behaviors taught to all participants. The program also aims to connect participants to intensive ABA programming.

Keywords Parent-mediated · Early intervention · Discrete trial teaching · Autism

Introduction

Applied behavior analysis (ABA) is one of the most widely used and empirically supported treatments for autism spectrum disorder (ASD; Fuller & Kaiser, 2020; Peters-Scheffer et al., 2011). In short, tenets of ABA stress that behaviors are targeted (*applied*), conceptualized within the context of the child's real-world environment (*behavioral*), and are data-driven (*analytical*; Baer et al., 1968). The gold standard

Clinical Utility Suggestions

● The present study is a pilot program intended to "bridge the gap" between the time of diagnosis and access to intensive ABA services for young children newly diagnosed with ASD.

● The Bridge program illustrates the application of ABA and parent-mediated intervention within a clinical practice setting.

● Pilot data support the efficacy of this intervention on improving targeted cognitive and social-communication skills in young children with ASD.

● Further consideration of attrition, as well as ongoing efforts to increase access to early intervention, are needed.

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components of ABA interventions are that services should be intensive, individualized, and comprehensive; delivered in a one-to-one format before generalizing to group activities and natural environments; include treatment goals guided by developmental milestones; use multiple behavior analytic approaches; and train caregivers as active co-therapists (Maurice et al., 2001). Recent meta-analyses support the efficacy of such early, intensive interventions for social communication, language, and cognitive outcomes (Fuller & Kaiser, 2020; Peters-Scheffer et al., 2011). Best practice recommendations are to begin intervention early, because early childhood appears to be a critical period for impacting long-term outcomes (Fuller & Kaiser, 2020).

In addition, emerging research exists on parent-mediated interventions (PMI) being particularly advantageous for children with ASD. PMIs enlist caregivers as the child's primary therapist by first learning skills from a professional and then practicing the techniques in the child's natural environment, maximizing generalizability. Thus, caregivers play an active role in their child's treatment and interventions can be individually adapted. Though methodologies vary, recent meta-analyses and studies demonstrate positive outcomes when involving caregivers as interventionists (Conrad et al., 2021; Nevill et al., 2018). Further, Liu and Schertz (2021) found that trained caregivers demonstrated high fidelity to intervention procedures, providing further support for reinforcing the caregiver's active role in the child's treatment.

Although discrete trial teaching (DTT) has been successfully implemented by educators, there are limited studies on the use of parent-mediated DTT for young children with ASD. Those studies utilizing DTT with caregivers have yielded positive outcomes, including an increase in skill development of target behaviors (Lafasakis & Sturmey, 2007) and effective implementation of DTT by both mothers and fathers (Ünlü et al., 2018). Therefore, building upon the limited literature available and utilizing principles of ABA, an 11-week curriculum-based, early intervention program was created to serve young children with ASD. The present study evaluates the effectiveness of this parent-mediated DTT program delivered at an academic medical center.

Cincinnati Children's Hospital Medical Center (CCHMC) emphasizes early detection and intervention for children with ASD. The medical clinic utilizes an interdisciplinary model with an accelerated diagnostic approach to diagnose children with ASD as young as 18 months, facilitating entry into early intervention. To "bridge the gap" between early diagnosis and entry into intensive ABA services, providers at CCHMC offer a curriculum-based, PMI-driven treatment, called the Bridge Skill Development Program ("Bridge"), designed to address core cognitive and social-communication deficits in young children with ASD. Providers coach caregivers to lead daily ABA intervention in the home, using DTT methods, with the goal of mastering target behaviors. Participants are connected with a social worker who guides families in accessing intensive ABA services by the conclusion of Bridge. The goal of the current study was to understand the efficacy of the program in (1) facilitating entry into early intervention services; (2) connecting families with more intensive services; and (3) increasing child skill development.

Method

Participants

During the 24-month pilot period, participants in Bridge were recruited at CCHMC. All participants were referred to Bridge at the time of ASD diagnosis. Inclusion criteria included: children ages 3 years, 11 months and younger with a diagnosis of ASD, standardized measures reflecting cognitive or receptive language skills equivalent to 12 months or higher, and the absence of recurrent aggressive behavior. Caregivers were contacted by an intake coordinator regarding the program and ABA therapy. During this initial contact, the coordinator discussed the caregiver's interest and availability, the participant's current skills and behavior, and the attendance policy. Interested families were added to the waitlist and scheduled in the order in which they were added.

Once scheduled, caregivers were sent a "welcome" email with program expectations and goals.

From September 2019 to September 2021, 23 participants completed Bridge and were seen by an assigned team that included a licensed psychologist, psychology student, social worker, and clinical assistant. Clinical assistants were trained in data collection methods to track in-session data and to collect, store, and graph data collected via homework practice.

A chart review of participants was completed. Individuals who completed both pre- and post-treatment measures were assigned an identification code to maintain confidentiality and included in the statistical analysis of outcome measures. If post-treatment data collection was not completed, the participant did not "complete" the program, and their data were excluded from this study. The median age of participants who completed Bridge was 32 months old (range: 18–39 months old). Twenty (87%) participants were male. Seventeen (74%) participants were white, three (13%) were Black, and two (9%) were Asian. All participants were non-Hispanic ($n = 23$). Most (83%) participants resided in Ohio ($n = 19$) and four (17%) in Kentucky. All participants had secondary diagnoses of global developmental delay (82.6%) or mixed receptive-expressive language disorder (17.4%). The median wait time to begin Bridge after referral was 51 days (range: 2–118 days).

Measures

Outcome measures of Bridge included a pre- and post-measure of individual skills taught within the curriculum. In addition, caregivers were asked to complete approximately 10 min of daily practice and document results on a simple data form.

Pre- and Post-treatment Measurements

During the first appointment, each participant completed pre-treatment data collection on current abilities in seven areas (making eye contact; imitation with objects; imitation of motor movements; matching objects, pictures, and colors; and following single-step instructions). During the final appointment, post-treatment data collection was led by the caregiver (coached directly by the psychologist) on the same target areas measured at pre-treatment. Due to differences in patient presentation and the individualized nature of the intervention, the same set of target behaviors were not taught to all participants. However, a core set of four target behaviors were taught to all participants, including making eye contact, imitating object use, matching objects, and following single-step instructions.

Homework Measurement

Participation in Bridge required daily practice between the caregiver and participant to increase skill development between sessions. Caregivers were encouraged to practice two sets of 10 trials daily, which was estimated to take approximately 10 min. Two sets of 10 were recommended to maintain the participant's motivation to practice but minimize caregiver burden. At the onset of treatment, caregivers were provided a simple data form to document homework practice between sessions. Caregivers were asked to return forms to the Bridge team the day before their next session, so the data could be analyzed, used to inform treatment planning, and graphed to track progress. Graphs were shared with caregivers at multiple points in the series to demonstrate development and continued needs.

Treatment Structure

Bridge initially involved 10 consecutive, weekly, parent-mediated sessions that were each 50 min in duration. In March 2021, the 10-week curriculum was expanded to 11 weeks to include one caregiver-only appointment focused on behavioral and reinforcement strategies applied during Bridge and applicable to shaping behavior in general (e.g., ignoring attention-seeking behavior, consistent and immediate reinforcement). At least one primary caregiver attended all Bridge appointments with the participant.

The first appointment was led directly by the psychologist in clinic to ensure the participant's pre-treatment skills were collected according to the protocol and model procedures for the caregiver. Subsequent appointments were coached by the psychologist but led by the caregiver, either in-person or over telehealth, depending on preference or learning style. A telehealth option was not initially offered when the pilot began in September 2019; however, telehealth became available to participants following the onset of the coronavirus pandemic in March 2020.

Most skills were practiced in a highchair to reduce opportunities for elopement and distraction. Other skills were taught out of a highchair to elicit generalization of skills in everyday tasks (e.g., cleaning up toys on the floor). Sets of 10 trials were led by the caregiver and assigned for daily homework. Trials consisted of presenting a reinforcer, giving a direct command (e.g.: "give it to me"), and providing either reinforcement for positive result or guided teaching for negative result. The caregiver sat directly across the participant to deliver prompting and reinforcement while the psychologist verbally coached the teaching procedure of each skill. Two or more sets of 10 trials were used to teach each new skill in session.

In addition, each participant was connected to a social worker with specialty knowledge in establishing intensive ABA services. All participants were contacted by the social worker at least two times during treatment and provided standardized information on local ABA providers, insurance coverage, and state-specific funding options.

Results

Descriptive Statistics

A total of 34 participants completed at least two sessions of Bridge, with 23 participants completing the entire series. Of those 23 participants, 82.6% ($n = 19$) were either enrolled or in the process of enrolling in intensive ABA services by the end of treatment. At pre-treatment, an average of 10.56 skills were assessed ($SD = 1.64$), whereas an average of 10.00 skills ($SD = 1.96$) were assessed at post-treatment. Of note, the number of skills assessed at pre- and post-treatment varied between the child participants due to factors such as disruptive behavior preventing data collection and the addition or subtraction of target behaviors based on individual developmental level and caregiver goals.

Skill Development

Descriptive statistics regarding pre- to post-treatment improvements in skill development are included in Table 1. The dependent variable of this study was the change in target behaviors measured at pre- and post-treatment, which was assessed using paired-sample t-tests. To account for multiple comparisons across the core target behavior domains, Bonferroni corrections were applied to the t-test results. All presented results reflect significance relative to Bonferroni-corrected p-values of $0.05/4 = 0.0125$. At post-treatment, participants demonstrated mastery (i.e., at least 8 out of 10 correct responses per set) on significantly more skills than at pre-treatment, with the number of skills meeting mastery increasing more than two and a half-fold from pre- to post-treatment. On average, participants achieved mastery of four new skills ($MD = 4.82$, $SD = 1.83$) throughout the program. Significant pre- to post-treatment improvements in the number of correct responses out of 10 trials were observed across all these target behavior domains, with large effect sizes.

Discussion

The Bridge Skill Development Program was designed to "bridge the gap" during the period after a new diagnosis of ASD. The initial 24 months of data suggest that Bridge is achieving this goal, as the median wait time is 51 days from the time of referral. A primary aim of the program is to empower caregivers and connect participants to ABA

Table 1 Pre- to post-treatment improvements in skill development

	Pretreatment M (SD)	Postreatment M (SD)	t	p	Cohen's d
Skills Mastered[a]	27.8 (15.7)	71.9 (18.9)	12.88	<.001	2.54
Core Target Behaviors[b]					
Eye Contact	78.3 (24.6)	93.5 (8.1)	3.10	.005	0.83
Imitating Object Use	58.7 (36.3)	94.3 (9.2)	4.81	<.001	1.34
Matching Objects	48.7 (40.1)	86.4 (14.3)	4.72	<.001	1.25
Following Instructions	49.1 (41.2)	89.5 (18.2)	4.79	<.001	1.27

Mastery is considered to be 80% correct response or higher

[a]Percentage of assessed skills mastered at pre- and post-treatment

[b]Percentage (correct out of 10 trials) at pre- and post-treatment

services. Most participants were enrolled in or in the process of establishing ABA services by the conclusion of Bridge. Furthermore, clinically significant increases in targeted cognitive and social-communication skills support parent-mediated discrete trial teaching methods, such that caregivers can effectively implement this intervention at home.

Several aspects of the present study make it a particularly meaningful contribution to the literature. First, the present study differs from previous PMI studies in that outcomes were a direct and objective measurement of the specific intervention targets (e.g., eye contact, imitation, matching, following instructions), rather than subjective measures of broader outcome domains (e.g., adaptive functioning). In comparison to previous PMI studies, including those using DTT, which have largely focused on group training programs, we examined the efficacy of an individual PMI treatment model. Further, although some studies of PMI used play- or language-based intervention approaches, Bridge used a set curriculum of target behaviors and behavioral teaching techniques. However, the individual nature of Bridge treatment also allowed for tailored skill development based on each family's goals and needs. In addition, other studies have tested parent-mediated DTT on sample sizes of fewer than 10. Our study contributes to the small but growing literature on the efficacy of DTT as an individually delivered, parent-implemented intervention using a slightly larger sample size of 23. Lastly, Bridge is unique in that the involvement of social work is a built-in component of the program and directly provides resources and guidance to families who are seeking to establish ABA services. Of those who completed Bridge, 82.6% of participants were enrolling in or scheduled to begin ABA services by the conclusion of Bridge. Thus, children who participate in Bridge are connected to ABA at a high rate, though future research can compare our numbers to local, state, or national averages.

The team continues to consider attrition rates and factors that may affect participants' ability to complete Bridge. During the 2-year period, 67.6% of participants completed the program. As the program strongly

encourages daily practice at home, the intervention requires organization and effort beyond what may be expected with traditional outpatient interventions. In terms of positive impact, the utilization of telehealth allowed the team to provide services to children throughout the ongoing pandemic and in rural areas of Ohio and Kentucky where ABA services are not easily accessible. Telehealth challenges included internet connectivity issues and limited access to interpreter services via telehealth. Therefore, the efficacy of this treatment modality continues to be explored.

In the future, the team intends to collect data on the behavior change of the caregivers mediating the intervention to better understand procedural fidelity and rate of homework completion. It is also important to acknowledge that the post-treatment increases in skill development may have been affected by caregiver-led data collection at the post-treatment session in comparison to psychologist-led data collection at the pre-treatment session. Future directions could include pre- and post- data collection by both the psychologist and caregiver. Interobserver agreement for pre- and post-treatment data collection will also strengthen the validity of the study.

In summary, the Bridge Skill Development Program allowed participants to access an autism-specific intervention soon after an ASD diagnosis, increased targeted skills, empowered caregivers by teaching effective intervention strategies, and largely guided connection to intensive ABA services by the conclusion of the program. Future work is needed to identify ways to decrease attrition, improve availability of treatment to underserved populations, and systematically track caregiver procedural fidelity. Given the interdisciplinary involvement in the program (i.e., psychology, social work, clinical assistants), sustainability and generalizability are also important next steps to consider. The team continues to focus on treatment access to Bridge by training additional providers, increasing clinical support, and improving referral pathways.

Declarations

Conflicts of Interest The authors have no financial or nonfinancial interests that are directly or indirectly related to the work submitted for publication.

Ethical Approval This study is approved by Cincinnati Children's Hospital Medical Center Institutional Review Board (2022-0273).

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