



Parent Implementation of DTT Following Telehealth Instruction

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Abstract

Discrete Trial Training (DTT) is a method of intervention for individuals with Autism Spectrum Disorder (ASD). Applications of DTT require prescribed repetitions of instruction. DTT is typically implemented via trained instructors or teachers. However, prior analysis has demonstrated the potential of parent-implemented DTT. Prior research demonstrated that DTT training can be implemented with a high degree of fidelity using a student teacher population. However, to date, no studies have evaluated the use of a DTT telehealth training with parents of children with ASD. The purpose of this study was to evaluate the feasibility of a remote parent training method to allow parents to implement DTT in home settings. To this end, three parent participants of children diagnosed with ASD were trained to implement DTT through a telehealth modality in a nonconcurrent multiple baseline design. Results suggested efficacy of this method at DTT skills acquisition.

Keywords Parent training · Telehealth · Discrete trial training · Autism spectrum disorder · Behavior skills training

Introduction

Discrete trial training (DTT) is an empirically supported teaching technique typically used for the development of novel skill acquisition (Smith, 2001). DTT is commonly used for those who may display learning deficits, such as individuals diagnosed with autism spectrum disorder (ASD). While is an effective technique, it often requires multiple trials in a variety of contexts (Lovaas et al., 1981). This intensity of instruction poses challenges for acquisition and generalization, as it typically requires intensive clinical instruction time with a trained instructor. This difficulty became especially apparent during the Covid-19 pandemic, as DTT often requires close proximity of the instructor to the learner for extended periods of time. Such a close proximity was compromised when social distancing recommendations were established by the Centers for Disease Control and Prevention (CDC) in the Spring of 2020. Nevertheless, remote

instruction presented as a beneficial option for therapists and learners under such circumstances wherein proximity was impossible or undesirable for many individuals. Crockett et al. (2007) had already demonstrated that it was possible to effectively teach DTT instruction to parents. The circumstances of COVID-19, however, open the possibility for the use of telehealth instruction to train parents in the use of DTT. Telehealth instruction could allow parents to safely and accurately implement DTT in their own homes, as well as develop applicable skills for future behavior management. This area of telehealth instruction has not yet been demonstrated in peer-reviewed research (Ferguson et al., 2019), but could provide opportunities for the extension of this research into novel contexts and populations.

In recent years, renewed interest has been shown in the field of telehealth service provision. While prior research has been evaluated on effective remote service instruction, the requirements of the Covid-19 pandemic necessarily resulted in an increased focus on this topic (e.g., Boutain et al., 2020; Fisher et al., 2020; Gerow et al., 2021). Neely et al. (2020) noted that telehealth oriented research frequently evaluated the application of indirect service provision (i.e., parent or caregiver skill acquisition), but did not frequently evaluate child behavior outcomes. The use of a parent-implemented DTT model could help to expand research in this area as it can be used to evaluate child acquisition of novel skills following parent instruction.

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Sump et al. (2018) demonstrated that DTT instruction could be taught using a telehealth service delivery model. Nevertheless, Sump et al. (2018) limited their research population to undergraduate college students. While the effectiveness of telehealth DTT instruction is likely transferable, it is possible that the highly self-selecting population of college students might be more receptive to telehealth instruction, or to the telehealth material. Moreover, the social validity of telehealth instruction with parents in their home settings could help to expand this area of study. Therefore, the current study extended the findings of Crockett et al. (2007) and Sump et al. (2018) by using telehealth instruction to teach parents to implement DTT to their own children with autism in the home setting.

Method

Setting and Participants

The study took place in a suburban area of the Midwest United States. All observations and training took place via telehealth with participants in their home environments.

Parents

There were six potential parents for the study. Of those, four met the preset criteria: (a) no prior training in DTT, (b) no history of telehealth training, (c) had a child receiving applied behavior analysis (ABA) therapy. Of these four parents, only three decided to participate in the study. All participating children received ABA therapy from the same organization. Lori was a 40-year old, White female with a master's degree. Her child had been receiving ABA for 1.5 years in a home-based program. Cathy, a White female, aged 44-years, had a child receiving in-home ABA for 2.5 years. She held a bachelor's degree. Mary was a 41-year old, Latina female who had a master's degree and three children receiving in-home ABA for 3 years. All parents had received prior training in the principles of ABA, daily living skills, and language development, as per requirements from insurance authorizations.

Child Participants

All three student participants were medically diagnosed with ASD and demonstrated severe delays in social and language development based on diagnostic information and Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) scores (Sundberg, 2008). All three met the preset criteria: (a) participation in an ABA program for at least 6 months at the onset of the study; and (b) chronological age of 5 years or younger at the onset of the study. Parents

provided written permission for child and self-participation. Carter was a 5-year-old White male diagnosed with ASD level 3 who participated in his current ABA program for over 1.5 years. He was nonverbal, but was able to make simple requests via a communication device. He was able to match identical objects and to imitate simple gross motor actions. He demonstrated poor attending skills and low motivation. He frequently attempted to elope from teaching sessions when demands were placed. Sam, a 5-year-old White male diagnosed with ASD level 2, had received ABA services for 2.5 years in his home. He required prompting to engage in reciprocal conversation. He was able to independently make requests for preferred items and engaged well with others. Alex, a 5-year-old Latino male diagnosed with ASD level 3, received ABA services for 3 years. He could independently request preferred items using single-word utterances. He demonstrated poor attending skills, and engaged in tantrum behaviors when denied access to preferred items.

Trainers

Two individuals with BCBA[®] certification served as trainers in the study. They each had approximately 2 years of experience providing telehealth ABA services. The trainers were the consulting clinicians for the child participants' home ABA programs and were therefore familiar with the participants prior to the start of the study.

Materials

Materials included an internet capable device with webcam functionality and zoom application. Simple academic materials (i.e., data sheets, pencils, etc.) and teaching materials (i.e., picture cards, math facts, etc.) were provided by the parents as part of routine instruction. Stimuli identified as preferred for each child by parent and/or BCBA[®] that could serve as potential reinforcers were also available. Direct access to the preferred item was given to the child upon a correct response.

Target Behavior and Measurement

Child Targets

Child targets were selected based on parent request for specific skills and input from BCBA[®] as to appropriateness according to current level. The target selected for Carter was non-identical matching of elephants. For Sam the target was receptive identification of answers to addition problems. The target for Alex was engaging in intraverbal fill-ins for the feature of a bed (e.g. "a bed has a _____").

Child performance data were collected using a trial-by-trial format using a data sheet where the trainer scored "+"

for a correct response or “–” for an incorrect response. A response was considered correct when no prompts were provided and the child answered accurately and independently within 3–5 s. A response was considered incorrect if a prompt was used or the child erred. The total percentage of correct responses was calculated by dividing the total number of correct responses by the total number of opportunities for each session. This scoring procedure occurred for each opportunity the child participant had to engage in the targeted response.

Parent Targets

The target behavior for each parent included the steps in the DTT procedure. DTT included (a) task materials ready, (b) reinforcer nearby, (c) assure child is attending, (d) deliver the discriminative stimulus (S^D), (e) prompt appropriate response, and (f) rehearsal (present S^D again without prompt), (g) distractor (present S^D of non-targeted response in repertoire), (h) check (present original S^D without prompt), (i) deliver reinforcer if correct/error correction if incorrect. Data were collected on parent behavior using a DTT checklist, which was a task analysis that indicated each of the nine steps required to accurately implement the DTT procedure. An average percentage of correct implementation was calculated at the end of each session by dividing the total number of steps implemented correctly by the total number of steps in DTT for each trial.

Interobserver Agreement (IOA)

The third author observed DTT sessions via telehealth for IOA purposes. During each IOA session, the trainer and third author observed parent and child behaviors simultaneously, but independently, from different locations. The observers then reviewed the scoring sheets for consistency. In accordance with the single-case intervention research design standards (Kratochwill et al., 2013), IOA was assessed for 44% of sessions for each parent and child across phases, totaling 22 sessions. The IOA was calculated by dividing the total number of agreements by the total number of agreements plus disagreements, multiplied by 100, to get the total percentage of agreement. The mean IOA for child targets across sessions was at 85% and for parent implementation of DTT at 94%.

Treatment Fidelity

Treatment fidelity was measured using the DTT checklist, which assessed the level of adherence to the DTT procedures. The checklist was completed for DTT sessions during the intervention and maintenance phases, following mastery by the parent participant. Treatment fidelity was

demonstrated at 99%. Treatment fidelity of the training protocol was assessed using an author developed checklist. The checklist assessed the trainers' ability to accurately follow research procedures for training, effectively describe and demonstrate the DTT procedures, and provide feedback in a productive manner. The checklist was completed following sessions where feedback was provided to parent participants. Treatment fidelity was demonstrated at 100% across participants.

Social Validity

Social validity for DTT was assessed using an author-developed social validity rating scale, adapted from the Treatment Acceptability Rating Form-Revised (TARF-R; Reimers et al., 1992). The scale consisted of nine questions on acceptability of the DTT procedure, comfort with use of technology and telehealth delivery, and acceptability of training via telehealth. Some questions were “*I feel confident in my implementation of DTT following telehealth training*” and “*I feel confident using telehealth*”. The responses were scored using a 5-point Likert-type scale from 1 (*disagree*) to 5 (*agree*). The parents completed the rating scale at the completion of data collection. The mean score from the three parent participants was 4.7 (range = 3–5).

Experimental Design and Procedures

The effect of telehealth instruction on parent implementation of DTT was assessed through the use of a multiple baseline across participants design. In this design, participants were asked to complete the task (DTT) with no guidance until a baseline rate of responding was established (Kratochwill et al., 2013). Telehealth training was then provided to parents for effective use of DTT interventions by a trained therapist. Participants moved from baseline to the experimental condition in a staggered manner. The order of movement to the experimental condition was selected randomly. The experimental conditions included baseline, training of DTT procedures (intervention), and maintenance. Data were collected separately on parent implementation of DTT, and child performance in targeted skill acquisition programs. All DTT sessions took place in a one-to-one instructional format, two sessions per day, 1–2 days per week, for approximately 12 weeks.

Baseline

The trainer collected data during 5-min observation sessions on parent implementation of DTT. After all relevant items were identified and prepared, the therapist asked the parent to instruct their child to complete the task. The parents were provided a copy of the DTT checklist, and no

additional directions or feedback were provided during this time. Data were collected on parent performance as well as child responses. Upon the occurrence of 5 trials of instruction, or after the designated 5-min instructional time, baseline sessions were terminated. All sessions took place in the participants' home with observations from the trainer via telehealth.

Telehealth Training and DTT Sessions

Following the completion of baseline data collection, the parents received training in DTT methods. Individual training was conducted using a behavior skills training (BST) method, which has demonstrated success as a skill acquisition instruction method (Fetherston & Sturmey, 2014; Ryan et al., 2008). BST instruction included (a) an in-depth explanation of the steps included in DTT, (b) answering and asking questions about DTT, (c) observing a video model of DTT being implemented with students, (d) engaging in role-play scenarios, and (e) receiving feedback during role-play via telehealth consultation. Training materials included a task analysis of DTT procedures, videos of 1:1 DTT sessions recorded by the researchers demonstrating various types of targets, and data sheets. The training materials were consistent across all parent participants. The parents received behavior-specific praise for engaging in correct implementation of DTT, and specific corrective feedback for errors made. The child participants were present during the feedback phase of the BST.

Parents were asked to identify skills of interest to work on with their child and the BCBA's then developed targets accordingly, based on need and appropriateness in the home environment. Reinforcers were also identified by the parent in consultation with the trainer. Once asked by the trainer to begin the DTT session, parents readied their materials and implemented the teaching procedures as directed. All sessions took place in the participants' home with the BCBA® trainer observing via telehealth. Parents were asked to complete at least 5 trials for each session.

Corrective feedback was provided contingent on the occurrence of any errors and the trial was restarted. Data were collected by the trainer for each trial of parent implementation of DTT and child skill acquisition targets. The maintenance phase was introduced when a score of 100% accuracy on the implementation of DTT across three consecutive sessions was achieved.

Maintenance

In the maintenance phase, instructional expectations and student targets remained the same. These sessions took place 2, 4, and 6 weeks following parent mastery of the DTT procedure. No prompts were provided during the maintenance

phase, but trainers did provide feedback upon conclusion of the sessions.

Results

This study examined the effects of Telehealth training on the implementation and maintenance of DTT by parents of children with ASD, as well as child skill acquisition. Data indicated that the telehealth delivery of training was successful in increasing performance levels across all three parents. Figure 1 shows the percentage of correct DTT implementation for all parents for baseline, training, and maintenance phases as well as child performance on skill acquisition. These data demonstrate that with the implementation of Telehealth training and ongoing feedback, the

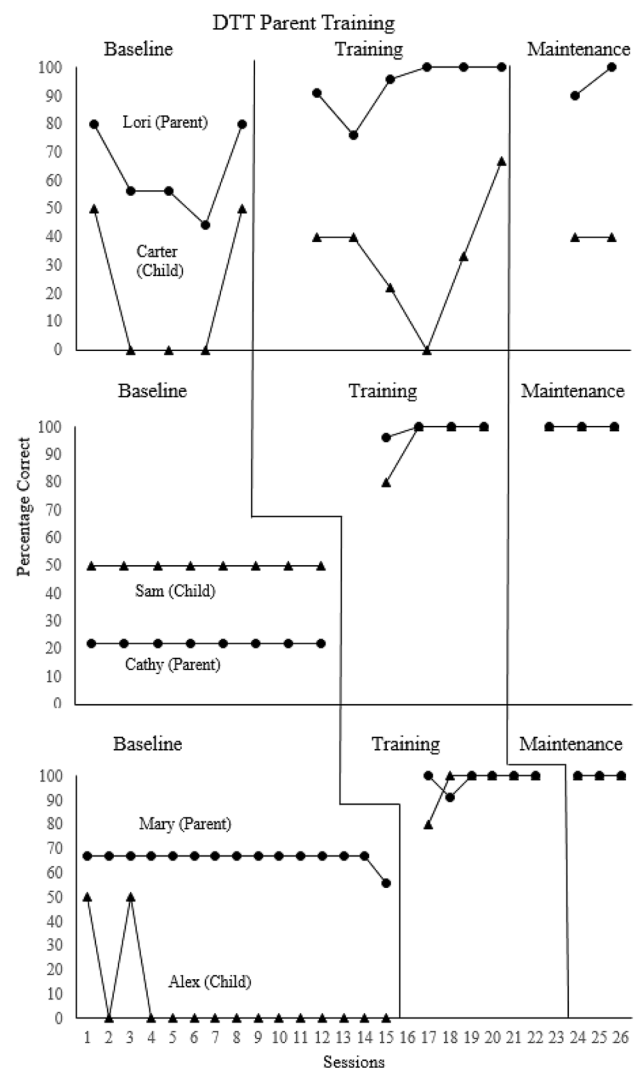


Fig. 1 Percentage correct of parent implementation of DTT skills, and child performance on skill acquisition of tasks

mean percentage of correct steps of DTT systematically increased across the three parents. At the baseline phase, the mean percentage of correct implementation across parents was 49% (range = 22–66%). The mean increased to 97.5% (range = 94–99%) during the training phase, and to 99% (range = 96–100%) in the maintenance phase, indicating that the skills were maintained at levels higher than those exhibited at baseline. Experimental control was demonstrated by the change in behavior across parents consistent with the implementation of the independent variable.

Parent Progress Related to Increases in DTT

All parents demonstrated gains in their ability to implement DTT procedures during the training phase. It should be noted that all parents demonstrated some of the steps in the DTT procedure during baseline. Cathy, Lori, and Mary completed steps C, D, and E respectively. These steps include items such as, preparing materials, having reinforcers ready, and requiring attending from the child. Accuracy on these steps can likely be attributed to previous observation of ABA sessions.

Correct steps for Lori increased from a mean of 59% (range = 44–80%) at baseline to a mean of 94% (range = 44–100%) in training, and remained high at maintenance checks with a mean of 96% (range = 78–100%), as shown in Fig. 1. Following training there was a dramatic increase in correct implementation for Cathy. At baseline the mean of correct implementation was 22%, which she consistently scored throughout the baseline phase. In the training phase the mean increased to 99% with a range of 89–100%, and implementation remained at 100% at maintenance checks. Similarly, Mary's data demonstrated immediate increases with training. At baseline the mean of correct implementation was 66% (range = 56–67%), with an increase to 99.5% with a range of 91–100% in training, and maintaining at 100%. These results indicate that the introduction of the telehealth training protocol was successful in increasing parent performance in DTT across all three participants. A functional relationship was demonstrated between the telehealth training and the increase in parent implementation of DTT through the replication across parent participants. Parent maintenance of DTT was demonstrated up to 6 weeks following training and feedback sessions. In addition, parents were able to engage in correct implementation of DTT across various environments in the home and/or with novel teaching materials including multiple exemplars and targets, thereby demonstrating generalization.

The percentage of all nonoverlapping data points (PAND), a non-regression based calculation, was used to calculate effect size and to determine the effectiveness of training in IT (Parker et al., 2011). The PAND comparing baseline and training in DTT was 100% for Cathy and

Mary, demonstrating a highly effective treatment. While the PAND for Lori was 77% indicating a moderately effective treatment.

Child Skill Acquisition Related to Parent Performance

Telehealth training of parents in DTT was found to be effective in increasing child skill acquisition targets above baseline levels. As the parents demonstrated acquisition of DTT during sessions, there was a corresponding increase in child performance data. At baseline, the mean for skill acquisition targets across child participants was 26%. However, the mean increased to 75% (range = 34–97%) following parent telehealth training, and to 80% (range = 40–100%) during the maintenance phase (see Fig. 1). Results suggest that as parent implementation became more accurate, their respective children began to make progress toward acquiring targeted skills. Figure 1 presents the percentage of correct skill acquisition targets for child participants during baseline, DTT sessions, and maintenance. At baseline, the mean correct responding for Carter was 20% (range = 0–50%), increasing to a mean of 34% (range 0–67%) in training, and leveling out at 40% in the parent maintenance phase. Carter was the only child participant that did not meet criteria for mastery on his target. Sam had a mean baseline score of 50%, which increased rapidly to 95% (range = 80–100%) with the introduction of parent DTT, and maintained at 100%. Alex's progress accelerated quickly from a baseline mean of 7% (range = 0–50%) to a training mean of 97% (range = 80–100%). Alex maintained the skill at a mean of 95% with a range of 80–100%.

Discussion

The results of this study indicated that parent-implemented DTT interventions can be conducted with a high degree of fidelity following telehealth BST. This expands on prior research that has investigated the ability to disseminate behavior analytic instruction techniques (e.g. Fisher et al., 2020). Prior research in parent training has suggested that high levels of fidelity can be observed in parent implementation of ABA instruction following the use of parent training (Gerow, 2018). This line of research has been further expanded through the use of telehealth as an instructional modality, allowing for parent training to be implemented in the client's own home with fidelity and minimal barriers to access (Fisher et al., 2020; Sump et al., 2018). The results of the present study were consistent with the areas of prior research that evaluated the ability to disseminate interventions through the use of parent and telehealth training, respectively.

Prior research in the field of telehealth instruction has demonstrated the effectiveness of this form of instruction. However, prior analyses of telehealth research (e.g., Ferguson et al., 2017; Tomlinson et al., 2018) have noted that while client outcome measures were often collected, the results demonstrated less consistent outcomes than those of trainee acquisition, necessitating further study to determine which interventions demonstrated benefits to clients. In addition, prior research might not have clearly demonstrated the benefits of interventions to client behavior due to a potential lack of experimental control at the level of client outcomes (Neely et al., 2021). The inclusion of client outcome measures in a nonconcurrent multiple baseline analysis is an effort to assess client outcome measures in a manner that demonstrates experimental control, and future research should seek to include more analyses of the relationship between trainee and client outcome measures.

That fact that these instruction techniques were completed in the families' home environment suggests the social significance of these methods. As noted by Crockett et al., (2007), greater applications of home-based instruction can help recipients of ABA services apply their findings outside of the confines of school and clinical application. The use of home-based telehealth services helps to address the need for parents and other direct service providers to become more directly involved with the applications of ABA services in the client's home setting. In addition to these benefits, telehealth modalities of service provision can help to address the concerns of individuals in need of evidence based service delivery who may lack access due to geographic or economic barriers (Antezana et al., 2017). Applications of telehealth instruction allow for a broader dissemination of behavior analytic techniques and interventions to existing and novel service populations.

In addition to the treatment fidelity observed in this study, child performance outcomes suggest that parent implementation of DTT interventions in this manner are appropriate targets for training. The fact that child acquisition of skills related directly to the parent implementation of DTT supports the perspective that telehealth interventions can be applied to improving child behavior outcomes in the acquisition of novel academic skills. Adverse effects of this intervention (e.g., severe problem behavior) were not reported in the course of this study, thereby supporting the assumption that parent implementation of telehealth interventions of this type are feasible for parents to implement without the immediate assistance of ABA service providers on site. Similar to Fisher et al. (2020), the information obtained from parents via the social validity questionnaire suggested parent comfort and support with telehealth training based instruction.

While the results of post telehealth training were promising, results for Lori might be nonrepresentative of the overall trend of trainee acquisition due to variable performance

demonstrated by her child, Carter. During initial training, Carter responded correctly in the first and third trial, resulting in Lori's responding to those components being not applicable, and thus dropped from the data set. This resulted in an initially inflated score for Lori's responding, which was not representative of other levels of responding across participants. In addition, Carter showed slower acquisition of responding as compared to other participants, and resulted in him being the only child participant to not reach criteria.

Although the desired outcomes were achieved, there are limitations to this study. First, all three participants had some familiarity with behavior analysis training, and contact with ABA service provision prior to the start of the study. Participant familiarity with the ABA trainers may have implications with the trainee's comfort with soliciting or receiving feedback, and additional research with novel trainers might be considered for further study. While this familiarity is likely for the majority of participants who would benefit from DTT instruction, expansion of this research should also determine whether parents without familiarity with ABA intervention would show a similar level of treatment fidelity when trained via telehealth instruction. Secondly, parents who participated in this study necessarily had access to telehealth capable technology at the onset of the study. If the results of this study are to assist in the dissemination of behavior analytic techniques to novel populations, future research should evaluate the considerations of introducing telehealth instruction to a novel environment and the effects this may have on treatment fidelity. Another potential limitation of this study is the lack of researcher fidelity assessment. Although fidelity was assessed for direct implementers of the intervention (trainer and parent trainee) no additional fidelity was assessed for researcher fidelity. In addition, the scope of this study was limited to the implementation of DTT. While this is a valuable intervention that requires both training and high fidelity in order to maximize benefits outcomes, it is a relatively straightforward form of intervention. Future studies in this area should evaluate other forms of behavior instruction and determine the extent to which they can be implemented with fidelity as well. Finally, future research should consider applications of pyramidal training as a supplement to telehealth instruction. Pyramidal training has been demonstrated in past research to benefit patient outcomes and to allow for a greater degree of dissemination of the intervention to other family members or additional staff (Neely et al., 2019). One-on-one telehealth training, in the style reported in the study, is a reasonable intervention in the course of service provision. However, the use of a pyramidal training methodology can serve to expand the applicability of training without exhausting the resources of ABA service provision. Future research should evaluate the feasibility of pyramidal training using telehealth service provision.

In conclusion, the use of telehealth BST was effective in teaching parent implementation of DTT skill instruction, which impacted child skill acquisition. The application of telehealth instruction in this manner has the benefit of allowing telehealth service provision on the part of remote service in cases where it would be unsafe or infeasible for behavior analysts to provide direct face to face parent instruction or services (Antezana et al., 2017). If telehealth instruction is validated in this manner, its use could allow for greater dissemination of behavior analytic instructional methods and service provision in typically underserved populations.

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Declarations

Conflict of Interest The authors have no conflicts of interest to disclose in regards to this research.

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