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RESEARCH ARTICLE

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Evaluation of a delay and denial tolerance program to increase appropriate waiting trained via telehealth

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Abstract

The literature on the systematic application of delay and denial to reinforcement is limited to specific delivery models (i.e., in-person discrete teaching) and particular settings (i.e., highly controlled laboratory or clinical settings). The purpose of the current study is threefold: 1) to extend previous research on a functional communication and delay and denial tolerance training by teaching procedures to caregivers systematically via a telehealth service delivery model, 2) to evaluate delayed access to reinforcement in different clinical populations, and 3) to modify previously published procedures in order to increase participant exposure to evocative setting events. Parents were trained to deliver all direct assessment and intervention procedures to five children, aided by in vivo coaching by their therapists. All participants were able to meet their terminal wait criterion while achieving behavior reductions greater than 90% of baseline. Implications for continued use of telehealth as a primary means of service delivery are discussed.

KEYWORDS

delay tolerance, denied access training, functional communication, synthesized contingency analysis, telehealth

1 | EVALUATION OF A DELAY AND DENIAL TOLERANCE PROGRAM TRAINED VIA TELEHEALTH

Given recent estimates that between 13% and 20% of children in the United States experience mental, emotional, or behavioral disorders each year (Ghandour et al., 2019), there is an imperative to assess and treat problem behavior effectively and efficiently via evidence-based practice. The literature on mechanisms underlying externalizing behavior problems suggests that a core skill deficit is a bias toward immediate over delayed reinforcement (Fisher et al., 2000). Without intervention, children with behavior problems are at-risk for academic failure, peer rejection, substance abuse, delinquency, later conduct disorder, and mental health diagnoses such as anxiety and depression (Ialongo et al., 1999; Moffitt, 1993; Patterson et al., 1991).

A functional analysis (FA) seeks to demonstrate a functional relationship between the identified target behavior and the environmental contingencies (Hanley et al., 2003). The procedures initially described by Iwata et al. (1982/1994) are considered the gold standard assessment tool for identifying the function of problem behavior, and have been replicated or extended in over 435 articles (Beavers et al., 2013). Briefly, the procedure involves one control condition that is, alternated with several test conditions. Each test condition includes a specific motivating operation (MO) and reinforcing consequence. If problem behavior is elevated in a test condition relative to the control, it suggests that the MO and reinforcer tested have functional control over the behavior. Typically, there are three to four test conditions, and each is associated with a single MO and reinforcer combination. For example, in a standard attention condition, therapist withholds attention, acts busy (MO), and gives a brief statement of concern contingent on problem behavior (reinforcer).

However, the "standard"[1] FA procedures may be challenging to implement in all settings. In systematic reviews of functional analyses, most studies were conducted in a hospital or school setting. Only about 10%–20% of studies occurred in outpatient settings (Beavers et al., 2013; Hanley et al., 2003). Standard FA procedures may be difficult to implement in large-volume outpatient settings due to time, insurance constraints, or the service-delivery model (e.g., clinics that focus on training parents as primary change agents). In addition, outpatient clinics may also treat children with a variety of presenting issues and diagnoses. Approximately 80%–90% of articles using an FA included children with some form of developmental disability, specifically autism in about a third of the studies (Beavers et al., 2013; Hanley et al., 2003). Externalizing behavior problems are not exclusive to individuals with developmental disabilities, and individuals without an intellectual or developmental disability diagnosis likely interact with their environments in ways that warrant distinct procedural considerations Therefore, it is important to evaluate FA procedures that could be used with a broader population in an outpatient setting.

In 2012, Hanley reviewed the implementation obstacles of the standard functional analysis procedure, recommending the use of a structured, open-ended interview to inform individualized assessment conditions, producing a test-control analysis (i.e., interview-informed synthesized contingency analysis [IISCA]). Hanley et al. (2014) demonstrated the utility of this model in an outpatient clinic serving three children with autism spectrum disorders. Functional analyses involved alternated test and control conditions; test conditions included the removal of the putative reinforcer every 30 s, which were only returned contingent upon problem behavior (Hanley et al., 2014). Unlike standard functional analysis conditions, Hanley et al. synthesized test conditions to include multiple MOs and putative reinforcers, when the results of the open-ended interview suggested validity in doing so. In addition, caregivers were trained to conduct the assessments to increase ecological validity. Results indicated that greater differentiation occurred when conditions were synthesized and when the parent implemented the analysis than when the therapist conducted sessions using isolated contingencies.

In order to extend upon this research, Greer et al. (2020) compared the results of three behavior assessments (standard FA, IISCA, and standardized-synthesized contingency analysis [SSCA]) to identify the function of problem behavior in 12 individuals. Differentiation (i.e., one or more test conditions elevated in relation to the control) was identified in the FA for 11 of 12 participants, whereas both the SSCA and IISCA produced differentiation in 8 of 12 participants (Greer et al., 2020). However, modifications to the standard FA procedure were utilized, such as screening for automatic reinforcement, changing the experimental design, and reinforcing precursors, and no modifications were made to either the SSCA or IISCA (Greer et al., 2020). Ultimately, despite the potential iatrogenic effects resulting from combining reinforcement contingencies, the authors noted that function-based treatments derived from both traditional functional analyses and synthesized contingency analyses were effective in reducing rates of problematic behavior.

The results of these studies are not unexpected, as previous research has demonstrated positive effects of treatment when treatment is based on functional assessment (Campbell, 2003). Hanley et al. (2014) demonstrated the positive effect of a functional assessment and treatment process to decrease problem behavior. Specifically, this treatment package included functional communication training (FCT) and systematic and gradual introduction of contingency-based delays and denials of access to reinforcement (Hanley et al., 2014). These treatments were taught in clinic and generalized into the home setting over a period of 8 to 14-weeks (Hanley et al., 2014). Results indicated that zero rates of problem behavior were observed in clinic or at home by the end of the treatment period. Extensions of delay and denial tolerance during FCT include comparing different methods of increasing the delay to reinforcement (Ghaemmaghami et al., 2016), teaching in more naturalistic environments (Luczynski & Hanley, 2013), and evaluating an omnibus versus specific mand (Slaton et al., 2017).

Despite the success of delay and denial tolerance treatments, there are some important limitations. Specifically, the presence of an alternative activity and attention during delay and denied access trials may have served as an abolishing operation for problem behavior. This may impact the generalizability of the procedures as alternative sources of reinforcement may not always be available or indicated. In fact, alternative items or attention may inoculate children to the establishing operations present in the environment. Evidence for this hypothesis can be found in the behavioral approach to the treatment of escape and avoidance related to anxiety (i.e., exposure and response prevention; Abramowitz, 1996; Grayson et al., 1982). Specifically, previous research on promoting habituation in the presence of aversive stimuli suggests that exposure with focused attention (i.e., increased attention to aversive stimuli) is more effective than exposure with distraction (i.e., engaging in alternate activities). As there is little information about how participants tolerated true periods of restricted access in the treatment condition, questions about the ecological validity of the study remain.

In addition, the literature on delay and denied access training has been limited to in-person delivery service models. The use of telemedicine has been shown to be an effective means for delivering intervention services to children with challenging behavior (Barretto et al., 2006). Although the provision of clinical service delivery via telehealth is not new (Chaet et al., 2017), current events necessitate the continued refinement of behavioral assessment and treatment procedures delivered remotely. Behavior analytic clinicians and researchers have successfully and consistently demonstrated that practitioners can train others to conduct both assessment and treatment procedures across clinics (Suess et al., 2016) and from clinics to home-based providers (Benson et al., 2018). In fact, the use of telehealth as the primary method of service delivery has been demonstrated to produce outcomes and parental acceptability comparable to in-person service (Lindgren et al., 2016). In their summary of the behavioral telehealth literature to date, Schieltz and Wacker (2020) noted that most studies, to date, have enrolled young children with autism. Thus, the need exists to extend the findings of previous research to include more diverse pediatric populations.

The purpose of the current study is to extend previous research of the use of delay and denial tolerance training (Ghaemmaghami et al., 2016) in three ways. First, although these studies have demonstrated clinically significant reductions in problem behavior using delay and denial training procedures, there has been little exploration of the effectiveness of these procedures in an online delivery model. In the current study, all procedures were conducted via telehealth. Second, most research on function-based treatments are conducted in highly controlled settings with individuals with developmental disabilities. The current study was conducted with typically developing children referred for treatment to a large-volume outpatient clinic. Third, many of the procedures in the literature attempt to minimize participant exposure to evocative events by providing alternative access to preferred items or attention. It may be that exposure to aversive setting events is necessary for habituation and socially significant improvement (e.g., Grayson et al., 1982). The current study seeks to improve the ecological validity of these treatment procedures

TABLE 1 Participant demographics

Name	Age	Sex	Race	Vocal	Family background	Target(s)
Mason	5	M	W	None	Low-to-middle single-parent income; Mother participated in all sessions	Tantrum [V, M]
Jed	4	M	B	Mild expressive language delay	Low-to-middle single-parent income; Mother participated in all sessions	Aggression Tantrum [M]
Zeke	2	M	W	Poor articulation; emerging expressive language	Middle two-parent income; Mother and father participated in all sessions	Tantrum [V, M]
Helen	5	F	W	None	Middle two-parent income; Mother participated in all sessions; Father participated periodically	Tantrum [V] Aggression
Nick	4	M	W	None	Low-to-middle single-parent income; Mother participated in all sessions	Tantrum [V, M]

Note: For sex: M, male; F, Female. For race: W, white; B, black; Vocal, any current concerns related to child's vocal speech or language. For target: V, vocal disruption, M, motor disruption.

by requiring participants to tolerate increasingly challenging situations and events, all while establishing stimulus control in a naturalistic environment (their homes).

2 | METHOD

2.1 | Participants

Participants for the study were five children receiving treatment for problem behavior through a hospital-based outpatient pediatric behavior clinic. Demographic information for each participant is presented in Table 1. Participants were included in the study if they 1) did not meet criteria for a developmental disability (e.g., autism spectrum disorder) and were not previously diagnosed with either an intellectual disability or an expressive or receptive language disorder (confirmed by medical records), 2) were identified via indirect assessment as having socially mediated problem behavior (i.e., behavior sensitive to social positive or negative reinforcement contingencies and not hypothesized to be maintained by automatic reinforcement), 3) evidenced some use of vocal communication (i.e., babbling, manding, tacting, or use of intraverbals; confirmed during direct observation during the initial evaluation), and 4) tantrums (vocal or motor disruptive behavior) or aggression were primary behavior target(s) (identified via parent report). Potential participants' caregiver(s) were made aware of the study by their treating therapist.

2.2 | Setting and materials

Due to ongoing concerns with the COVID-19 pandemic, all assessment and treatment sessions were conducted by caregivers in participants' homes. Specific locations varied depending on the availability of private or semi-private spaces in each participant's home. Prior to the functional interview, each therapist worked with the family to provide information and specific training (protocols available upon request) about identifying an appropriate area for therapeutic sessions. The therapists emphasized the importance of trying to use the same areas during each appointment in order to maximize stimulus control. Spaces identified and used ranged from family living rooms (Mason, Zeke, and Helen) to individual bedrooms (Jed and Nick).

Therapists delivered live remote instruction, coaching, and data collection from an offsite office. Videoconferencing sessions were conducted by the behavior therapists via individual laptop computers and a broadband Internet connection using a secure videoconferencing platform. Each participant's family used their own smart device, including an iPad or tablet with an internal camera. In addition, parents were encouraged to use headphones or earbuds to allow for simultaneous coaching by therapists without undue influence on participant behavior. All direct coaching was conducted by advanced doctoral students in psychology, under the supervision of the first author (a clinical psychologist and doctoral-level board-certified behavior analyst).

Materials for each participant consisted of toys and preferred items in each home. Therapists encouraged parents to reserve high-preferred toys to be exclusively used during therapy sessions in order to control motivation. Participants' preferences were initially determined by parent report and confirmed through a brief multiple stimulus without replacement (MSWO) preference assessment (described in detail below) during sessions. Appointments with families lasted approximately 50–60 min and occurred either weekly or biweekly. Parents were encouraged to practice skills discussed in session between each appointment.

2.3 | Response measurement

Trained observers collected data using pencil and paper. Data were collected during continuous 30-s intervals and were summarized as number of responses per minute (count measures) and number of seconds (duration measures). Data were collected on the number of problem behaviors, functional communicative responses (FCRs), and wait duration. Problem behaviors varied by individual participant operational definitions, but included vocal disruptions (e.g., screaming, whining, vocal protests), motor disruptions (e.g., throwing items, banging on objects, dropping to the floor), and aggression (e.g., hitting, grabbing, biting). Observers scored FCRs based on each participant's language abilities and the reinforcers that maintained their problem behavior. Examples of communicative responses include "I want to play" (Mason, Jed), "Can I play with my ______" (Helen), "my turn please" (Nick), and "Play please" (Zeke). Independent FCRs were recorded when the correct phrasing was emitted with tone and volume deemed to not exceed conversational level and in the absence of problem behavior. Communicative responses were considered prompted if they were either vocally or physically prompted by a parent or the therapist. FCRs were prompted if an independent FCR did not occur within 5–10 s of the start of the trial. During communication training, all participants were required to meet criteria for independence (non-prompted FCRs across three consecutive sessions) prior to moving to subsequent phases of the intervention. Seconds of appropriate waiting were scored as the number of seconds that the participant waited without problem behavior or attempting to approach preferred items. The wait duration started when the participant independently requested access to the putative reinforcer and ended when the participant either (a) engaged in problem behavior or (b) met the wait criterion in the given trial and approached the reinforcer. Participants were not required to emit the FCR again following the wait criterion, but the wait duration did not end until the participant approached the reinforcer.

Interobserver agreement (IOA) was assessed by having a second observer (either a second therapist or a parent) collect data on all responses simultaneously but independently during at least 30% of functional analysis and treatment evaluation conditions for all participants. For the FA, each session's data were divided into 30-s intervals and compared on an interval-by-interval basis. Agreement percentages were calculated by dividing the number of exact agreements by the total number of intervals. IOA was calculated for each pre-defined topography of target behavior and averaged 93.2 across participants (range, 70%–100%).

For the treatment evaluations, observers' data were compared on a trial-by-trial basis, and agreement percentages were calculated by dividing the number of sessions with agreement over the total number of sessions. If both observers scored a zero, the session was scored as an agreement. Quotients were then averaged and converted into a percentage. Across participants, mean IOA was 94.8% (range, 78%–100%) for instances of challenging behavior; 98.6% (range, 95%–100%) for wait duration; and 99% (range, 96%–100%) for FCR.

2.4 | Design

A multielement design was used to compare rate of problem behavior during test and control conditions of the FA for each participant. The treatment analysis used a changing criterion design with embedded reversal over waiting behavior in order to evaluate the effects of progressively longer intervals of delay to reinforcement (Cook et al., 2015). Functional control was demonstrated by showing that levels of incompatible, alternative responses (i.e., appropriate waiting) increased following successive changes in reinforcement contingences. Performance criteria was established a priori, prior to each successive stepwise intervention phase. The initial criterion was set at 5 s for all participants to introduce the wait training program and increase the probability that participants would successfully contact reinforcement. Thereafter, the criterion was altered in each subphase to control the progression of behavior change. At each criterion, the occurrence of problem behavior caused the trial to terminate and restart. If the participant waited for the specified criterion, the trial ended when they approached the requested reinforcer, thereby allowing the wait duration to exceed the criterion. Specifically, waiting behavior was permitted to go above and below the criterion level in any given trial. Each data point reflects one trial. When participants waited for the appropriate amount of time in the absence of challenging behavior for three consecutive trials, the therapist implemented the next subphase. Finally, to bolster experimental control of the intervention over waiting behavior, performance criteria were reverted and then reinstituted prior to the terminal wait criterion. In the final phase of treatment, trials at the terminal wait criterion were interspersed with FCR denial trials.

2.5 | Procedure

2.5.1 | Functional interview

Prior to direct assessment, each participant's caregiver participated in a functional interview developed by the first author with their child's therapist (see Supporting Information S1). Components of the functional interview, which informed the subsequent FA, included: a) identifying and defining a target behavior; b) identification of antecedents likely to evoke any of the identified behaviors within the response class; and c) identification of consequences of the target behavior. Questions included information about response class hierarches (e.g., “what are examples of small behaviors that may lead up to the bigger ones”), contexts likely to trigger challenging behavior (e.g., “are there specific routines or times of day that trigger problem behavior?”), and parent responses to challenging behavior (e.g., “what do you tend to do in response to big behaviors?”). Questions were presented in a semi-structured interview, although they were occasionally individualized based on parent responding. Additional components of the interview included recording relevant medical and educational history, estimated current level of functioning of the child, and potential strengths and preferences in order to facilitate case conceptualization and course of treatment.

2.5.2 | Preference assessment

Parent were trained to conduct a simple preference assessment procedure described below using a behavioral skills training format (i.e., verbal instruction, modeling, rehearsal, and feedback) with their therapist prior to using the procedure with their child. Once they had achieved mastery in practice, parents then prompted their children to choose different types of toys (e.g., trucks, blocks, dolls, super heroes) from those readily available in their homes. Specifically, the therapist told the participants that they can select any toy from the available sample, and the process was repeated until 3–4 different toys were identified. From that smaller sample, a MSWO preference assessment was conducted (DeLeon & Iwata, 1996). Due to anecdotal observations of rapidly shifting preferences common among the patient population, the MSWO was repeated prior to each test condition requiring tangibles.

2.5.3 | Functional analysis: Synthesized contingency analysis

Prior to the synthesized contingency analyses, each family was provided with a written document called a "Teach" developed by the first author (see Supporting Information S1). The purpose of the Teach was to review the purpose and procedures of the analysis with programmed opportunities for modeling, role play, and feedback from the therapist. Each Teach was individualized with information collected from the structured interview, including setting events and operational definitions of behaviors targeted for reduction. Once parents were able to independently model the analog procedures, they were ready to move on to implementing the assessment with in vivo coaching from the therapist.

The hypothesized function(s) of each participant's problem behavior (i.e., access to preferred tangibles, access to attention, escape from demands, or any combination of these functions) was derived from the results of the functional interview. Specifically, the variables hypothesized to reinforce all target behaviors were assessed during the analysis. These analyses involved alternating between a test and control condition in a procedure similar to that outlined by Hanley et al. (2014). All conditions were 5 min in duration and conducted by the caregiver. The therapist provided directive procedural coaching via a bug-in-ear system using headphones.

Tangible + Attention Test (Mason, Zeke, Helen). Prior to session, participants had brief access to preferred tangible items and parent attention. At the start of session, the tangible items and attention were removed. In addition, Zeke's functional interview suggested that he was likely to engage in tantrum behavior when he attempted to communicate his needs but could not be understood. Therefore, during the test, his parents ignored appropriate communication requests. For all three participants, contingent on problem behavior, the tangible item and attention were returned for about 30 s. For Mason, tangible items included action figures and a tablet device and his mother provided attention by commenting on his play. For Zeke, tangible items included toy cars and trucks, and his parents gave attention by playing with his preferred toys with him. For Helen, tangible items included Barbies, and parents provided attention in the form of statements of concern and physical touch (e.g., cuddling her).

Tangible Test (Jed, Nick). Prior to session, the participant had brief access to a preferred tangible item. At the start of session, the parent restricted access to the item. Contingent on problem behavior, the parent returned it for about 30 s. For Jed, the tangible items were identified via a paired forced choice rather than an MSWO prior to each test and included items such as Legos or Magnet-tiles. Tangible items for Nick included toy trucks, play doh, and puzzles.

Control (All). In the control condition, the parent allowed uninterrupted access to preferred tangible items. Parents provided noncontingent attention by playing with their child during the control. Jed's mother was coached to refrain from play demands, which often involved inadvertently restricting his access to toys as a part of her interactive style. Zeke's parents also acknowledged vocalizations with phrases such as "good job, Zeke!"

2.5.4 | Treatment evaluation

Treatment for all children included three phases: 1) teaching a simple FCR as a replacement for problem behavior (Carr & Durand, 1985), 2) progressively introducing delays to access preferred items or attention (or both) by a relevant caregiver, and 3) introducing denials of preferred items. The therapist coached parents to conduct 3–10 practice trials during each scheduled appointment. Appointments were conducted in areas of the house similar to those where the functional analyses were held. All appointments began with a brief MSWO preference assessment as described above.

Baseline. Test condition sessions from the functional analysis were used as the baselines for all participants.

Functional communication training. The therapist coached parents to teach each child to use a simple FCR using behavior skills training. Specific responses were taught based on the functional variables maintaining problem behavior (e.g., "I want to play"). Each participant was initially taught to communicate in conjunction with a picture card exchange in order to facilitate physical prompting, ensuring errorless skill acquisition. Following a correct response, participants were given immediate access to the identified reinforcer for about 30 s to 2 min (depending on the hypothesized time required to “consume” the reinforcer). At the end of the interval, the reinforcer was removed and participant was required to mand for the reinforcer once again. All problem behavior was placed on extinction. Mastery was met for all participants once problem behavior was eliminated and FCRs were emitted independently for at least three consecutive trials.

Delay tolerance training. Following the acquisition and maintenance of appropriate requesting (as defined above), the therapist introduced a delay to reinforcement by orienting the participant to a digital or color timer with the required wait time pre-selected following an appropriate request. Using behavioral skills training and a visual cue, the therapist coached parents to teach each participant an alternative response to the delayed access prompt which included “calm hands,” “quiet mouth,” and “calm body” (i.e., “waiting behavior”). Prior to initiating delay training trials, caregivers reinforced demonstration of appropriate waiting behavior by providing high quality attention (e.g., behavior-specific praise). The delay to reinforcement was then introduced, requiring participants to demonstrate appropriate waiting behavior for the duration of the interval prior to accessing requested reinforcement. During the prescribed wait interval, participants were not permitted to engage with any items or access adult attention (although preferred items remained in the room throughout). All problem behavior was placed on extinction. A timer signaled the end of the specified wait interval, and was paired with a verbal prompt from caregivers (e.g., “Good job waiting!”). However, participants' wait ended when they approached the reinforcer (permitting participants the opportunity to wait longer than the prescribed wait time). The delay was increased when the FCR was independent and the rate of problem behavior was zero for three consecutive sessions; contingent on any instance of inappropriate waiting behavior that did not include topographies of problem behavior previously defined (e.g., out-of-seat behavior, interrupting), the wait timer was paused and the participant was required to independently demonstrate appropriate waiting behavior within 5-s. If the participant engaged in target problem behavior (e.g., tantrums, disruption, or aggression) or did not demonstrate appropriate waiting behavior within a 5-s interval, the session ended and a new session began. Terminal wait criteria were established a priori in collaboration with parent preferences and according to developmentally appropriate expectations (i.e., the first author provided information about waiting norms relative to participants' age).

Denial Tolerance Training. Following successful delay tolerance training, the therapist coached parents to introduce denied access on a variable schedule. In this treatment phase, one of every three sessions included a denied access condition. Two of every three sessions involved continued practice of delay tolerance training at the terminal wait criterion. Determination of the order of training phases was predetermined prior to the start of the appointment. For denied access sessions, the therapist coached parents to respond to each appropriate request with a denial statement (e.g., “that's not available, but if you can stay calm you can do something else”). Contingent on the participant's demonstration of appropriate behavior (as defined previously), the clinician coached parents to offer alternative, lesser preferred, items or activities with which to interact. The denied item(s) remained unavailable for the remainder of the appointment. For instance, during a denied access session, following an appropriate request for an iPad, the item would be restricted both during the trial and for the remainder of the appointment. The parent would then provide praise if the participant demonstrated appropriate behavior and offered an alternative item. Parents were coached to provide praise after participants demonstrated 3–5 s of appropriate behavior, and their attention remained available for the duration of the trial. All items remained in the session room for the duration of the appointment. Problem behavior during the denied tolerance trials was placed on extinction in a procedure similar to the delay tolerance training procedure.

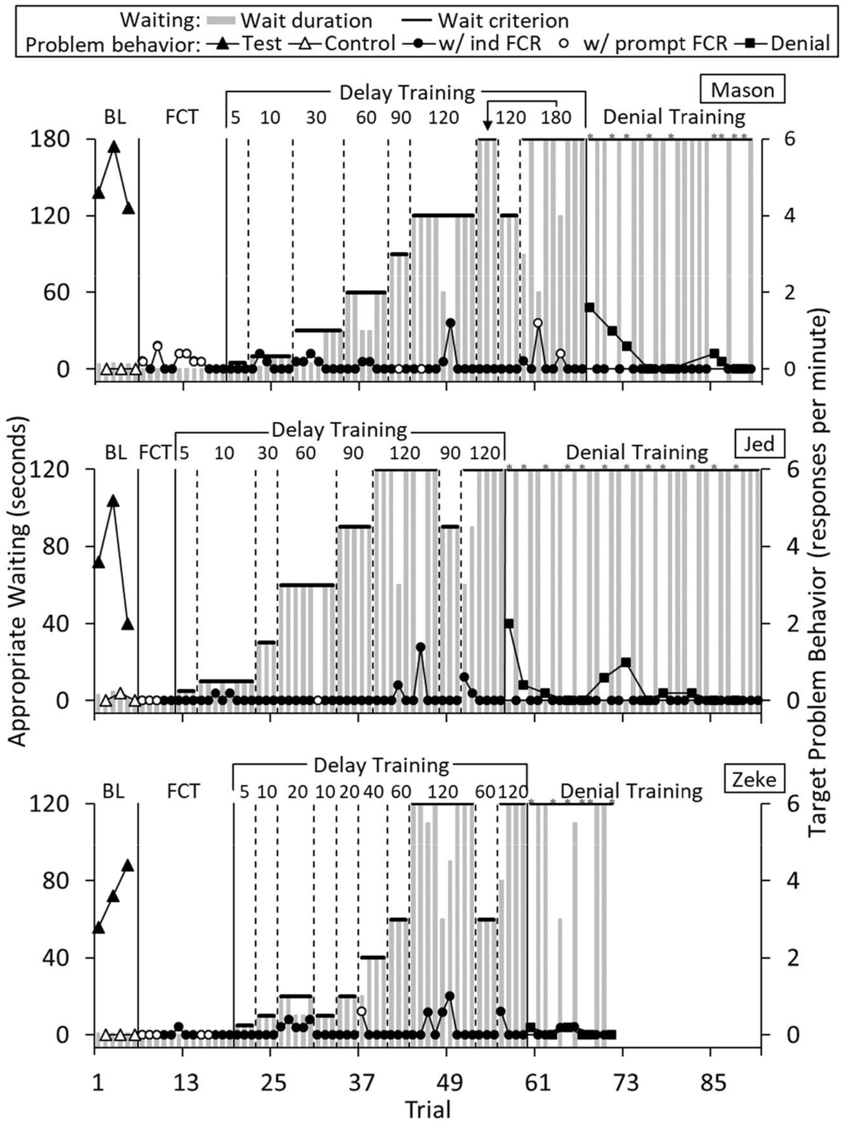

FIGURE 1 Results for Mason, Jed, and Zeke. Numbers in Delay Training phase are the wait criterion in seconds. Asterisks in the Denial Training phase indicate that wait duration was the entire session. BL, baseline; FCR, functional communication response; FCT, functional communication training; IND, independent; prompt, prompted

3 | RESULTS

3.1 | Functional assessments

The interview resulted in hypotheses that each participant's problem behavior was maintained by social positive reinforcement in the form of adult attention, tangible items, or both. Results of the synthesized contingency analysis are shown in the first phase (labeled baseline) of Figures 1 and 2 for each participant. Responses per minute of problem behavior occurred at higher rates in test conditions (*Ms* = 4.87, 3.60, 3.60, 0.67, and 2.80 for Mason, Jed, Zeke, Helen, and Nick, respectively) relative to the control (*Ms* = 0, 0.07, 0, 0, and 0, respectively). Nick's analysis (Figure 2, bottom panel) only consisted of two test conditions, as his parents were wary of evoking problem behavior in the home.

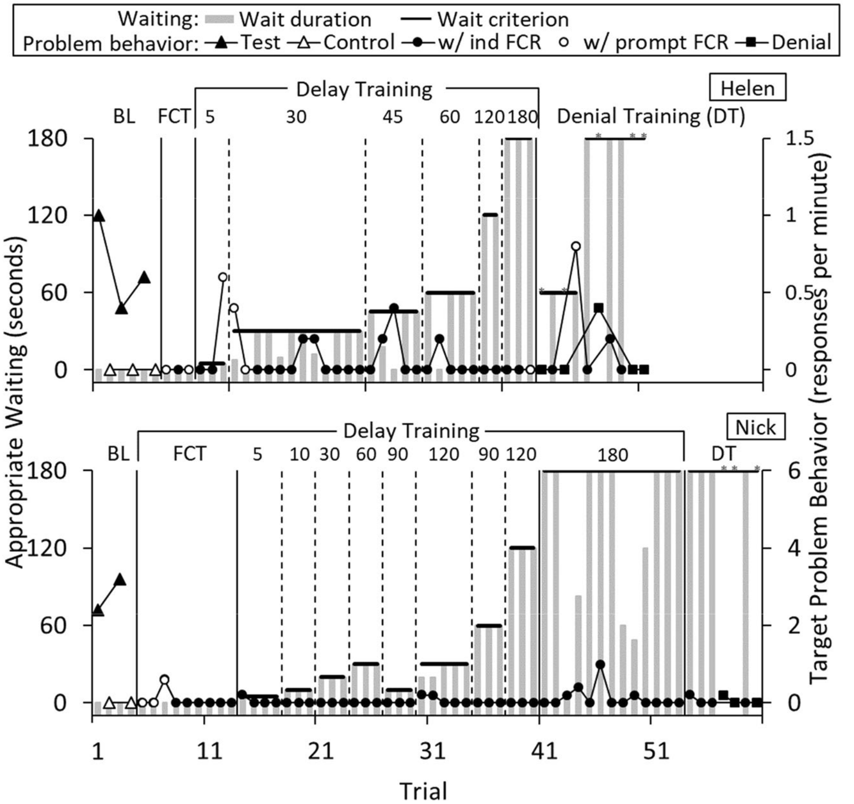

FIGURE 2 Results for Helen and Nick. Numbers in Delay Training phase are the wait criterion in seconds. Asterisks in the Denial Training phase indicate that wait duration was the entire session. BL, baseline; FCR, functional communication response; FCT, functional communication training; IND, independent; prompt, prompted

3.2 | Treatment evaluations

Figures 1 and 2 show the results of the treatment evaluation for each participant. The test conditions of the synthesized contingency analyses served as the baselines from which to evaluate the effects of teaching functional communication responses and delay and denial tolerance skills (i.e., appropriate waiting) with all participants. The primary dependent variable, duration of appropriate wait behavior per session, is graphed on the primary *y*-axis of each figure and displayed as gray bars. The rate of problem behavior is shown on the secondary *y*-axis and displayed as line graphs. Data suggest that participants' ability to engage in appropriate waiting was near zero during baseline.

During the FCT phase (second phase of all panels), waiting duration remained at zero. After they emitted the FCR, they received immediate access to the preferred items, attention, or both. FCRs only occurred once per session (at the start of the session); closed circles indicate rate of problem behavior during sessions with an independent FCR and open circles indicate rate of problem behavior during sessions with a prompted FCR. FCT resulted in immediate elimination of problem behavior for Jed and Helen (Figures 1 [middle] and 2 [top]), and quick acquisition of appropriate requesting behavior. Mason (Figure 1 [top]) required 10 trials for problem behavior to be extinguished and stable independent appropriate requesting to occur. Nick (Figure 2 [bottom]) acquired the functional communication response in four trials and problem behavior was extinguished. Zeke (Figure 1 [bottom]) took 11 trials to before independent FCRs were acquired, and engaged in zero problem behavior in all but one trial.

In delay training, appropriate waiting behavior matched the waiting criterion for all participants throughout all phases and reversals of the waiting criterion. For certain sub-phases, each participant demonstrated slight variability before reaching stability of the wait criterion. For instance, Mason mastered a 5-s delay in three trials, but took six trials to stabilize at 10-, 30-, and 60-s delays. Problem behavior was reduced to zero to near-zero levels across all trials for all participants (*Ms* = 0.08, 0.04, 0.11, 0.09, and 0.06, respectively). Relative to baseline, rate of problem behavior was reduced by over 97% for four participants (Mason, Jed, Zeke and Nick). Helen (Figure 2 [top]) initially demonstrated variable waiting durations and rates of problem behavior. Wait duration and rate of problem behavior stabilized as the delay criterion increased, with the most efficient responding occurring at the terminal wait criterion. Throughout delay training, problem behavior was reduced by 86%. However, it should also be noted that Helen's baseline rates of challenging behavior were significantly lower than the other participants, with the most problematic session consisting of one response per minute. Zeke (Figure 1 [middle]) appeared the most adaptable to the changing delay criteria, with relatively low rates of challenging behavior throughout the evaluation.

During the denial training phase, Mason, Jed, and Helen demonstrated reactivity to the unsignaled introduction to denied access trials, evidenced by increases in challenging behavior. Helen's increase in problem behavior occurred later in the denied access phase than other participants, which may have been the product of carryover from the previous wait trial. Zeke and Nick had relatively low rates of problem behavior and maintained waiting duration during the denial training phase. During the denial trials, waiting behavior was not scored because access was never given to the requested items. The mean reduction in problem behavior in the denial phase relative to baseline was 93.3% (range, 70% [Helen] to 100% [Mason, Jed]) during delay trials and 93.4% (range, 88% [Helen] to 98.1% [Zeke]) during denial trials.

Treatment integrity errors did occur during the evaluation, with the most common type occurring due to therapists moving to the next wait subphase without meeting the criteria of three consecutive sessions without problem behavior and with an independent FCR. Specifically, these errors occurred with Mason (Figure 1 [top], trials 39–41), Jed (Figure 1 [middle], trials 31–33; 45–47), Zeke (Figure 1 [bottom], trials 26–30), and Helen (Figure 2 [top], trials 10–12; 27–29; 35–36). In addition, Helen's treatment evaluation did not include a reversal during the delay fading phase, though the therapist did programmatically reduce the wait time to 60 s during denied access trials and return to the terminal wait criterion at 180 s.

4 | DISCUSSION

The current study sought to evaluate whether procedures originally described by Hanley et al. (2014) could be extended and provided exclusively via telehealth. Results suggest that the procedures described reduced the frequency of participants' problem behavior while simultaneously shaping their use of adaptive communication. In addition, the current study suggests that parents can be trained to adequately gain stimulus control over their children's challenging behavior via a telehealth service delivery model.

Similar to the conclusions suggested by Ghaemmaghami et al. (2016), the use of contingency-based delays were effective in developing participants' tolerance for delayed reinforcement. The authors noted that the response contingency during the delay was essential to effective progressive delay-tolerance training; however, neither tolerance responses nor alternative activity prompts were provided in the current study. Instead, we used a differential reinforcement of alternative behavior (DRO) paradigm wherein participants were required to demonstrate appropriate "waiting behavior" during delay training in order to access reinforcement. These response requirements are consistent with Hanley et al. (2014), who noted that requiring specific behaviors during delay training is an important procedural component. The rationale for this procedural change was to increase the generality and ecological validity of wait-training procedures—children are often in situations where they need to tolerate delays in the absence of alternate activities. Denied access trials were constructed to both provide opportunities for participants to demonstrate tolerance of relevant evocative contexts as well as provide access to alternate, lesser preferred activities. These sessions were designed to be consistent with scenarios articulated by caregivers as being challenging in their homes, where participants' access to highly preferred activities would be restricted but other leisure activities would otherwise be available.

Delays in the current study were signaled using both a vocal response from the caregiver (i.e., “first you have to wait”) as well as via a digital timer. The use of the digital timer may be an essential component in the maintenance of stimulus control across trials and appointments. Specifically, participants were anecdotally observed to focus intently on the timer as it counted down, which may have aided in the tolerance of increased delays. Such responding mimics procedures found in previous research on habituation during exposure treatment (Grayson et al., 1982), wherein participants were required to focus their attention on an aversive stimulus in lieu of distracting themselves with alternate items. The potentially important role of the timer was highlighted when one participant, Zeke, demonstrated variable responding during trials where parents were unable to locate the timer used in previous wait sessions (trials 48 and 49). It is possible that reliance on the timer itself in order to facilitate appropriate waiting could be viewed as a limitation of generality of the current procedures, and future research should fade the use of a countdown clock as a signal for waiting.

Additional limitations of the current study include the absence of a programmed fading procedure. Therapists were trained by the first author to provide errorless teaching strategies to caregivers as they learned the procedures, followed by gradual fading of directive coaching as caregivers demonstrated mastery. However, the fading procedure was not programmed systematically and did not occur uniformly across caregivers. As such, there was likely considerable variability in the amount of scaffolding provided to caregivers by their therapists. Future research should examine the rate of acquisition and mastery of skills in order to ensure the efficiency of the intervention package. Moreover, we did not collect data on either therapists' or caregivers' procedural fidelity. Indeed, a few procedural errors were evident as the delay criterion was occasionally increased prior to stable responding (e.g., Mason progressed to 90-s wait with only two sessions at the prior criterion).

It is important to highlight that participants in this study were typically developing children that displayed somewhat mild topographies of aggressive and tantrum behavior. While these behaviors were significant enough for caregivers to pursue behavioral treatment for their children, their inclusion could be a potential limitation. However, child behavior problems are common among typically developing children and warrant effective treatment, particularly because early child behavior problems predict later problems in school, difficulty with social relationships, substance abuse and delinquency (Ialongo et al., 1999; Moffitt, 1993; Patterson et al., 1991). The research on function-based behavioral interventions largely focus on children with intellectual and development disabilities, though the benefit of thEis technology is broadly applicable across demographics. Therefore, it is important to establish and continually evaluate effective interventions for all children.

The results of the current study suggest that caregivers can be trained to systematically implement functional analysis and complex treatment evaluation procedures via telehealth, without having had any in-person training. Parents demonstrated the ability to create dedicated spaces for therapy in their homes, adequately set up audio/visual technology in order to facilitate data collection from trained observers, and adhere to the study procedures with ongoing coaching from their therapists. As the use of telehealth as a primary model for service delivery continues to grow in demand and popularity, the procedures described in this study contributes to the growing literature on evidence-based online caregiver training models.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTE

[1] We use the term "standard" here to refer to the procedures described by Iwata et al. and variations of those procedures.

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