Utilizing Telehealth to Coach Parents to Implement Trial-Based Functional Analysis and Treatment

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Abstract

The trial-based functional analysis (TBFA) offers several advantages in natural settings, such as time efficiency and ecological validity. Previous studies have successfully trained or coached a variety of professionals and parents to conduct a TBFA utilizing in-person training procedures; however, no study has evaluated the effectiveness of telehealth coach or train others to implement a TBFA. Utilizing telehealth coaching, we coached three mothers of children with autism to conduct a TBFA in their home. The TBFA identified consequences maintaining challenging behavior for all three participants. Based on the results of the TBFA, we developed a functional communication training (FCT) intervention. Experimenters coached the mothers to implement the FCT intervention in their home. All interventions resulted in decreased challenging behavior and increased communication. The results suggest parents are capable of conducting a valid TBFA with telehealth coaching and support.

Keywords Trial-based functional analysis · Challenging behavior · Functional communication training

Applied behavior analysts have used functional analyses for the last forty years to identify the contingencies that reinforce and maintain challenging behavior (Beavers et al., 2013; Hanley et al., 2003; Iwata et al., 1994). The original functional analysis (FA) was effective but required resources such as an extended period of time (up to 540 min of assessment), a specialized hospital setting, and the face-to-face availability of professionals (Iwata et al., 1994). Since the original evaluation of the
traditional FA, variations designed to address feasibility concerns have been validated (Beavers et al., 2013; Hanley et al., 2003).

Trial-based functional analyses (TBFA) are a variation of the traditional functional analysis created to address certain barriers associated with the original assessment (Sigafoos & Saggers, 1995). In the initial evaluation, the experimenters evaluated three functions of challenging behavior for two children that engaged in aggression: social positive reinforcement in the form of attention, tangible positive reinforcement in the form of an edible, and social negative reinforcement in the form of task removal. In the initial minute of the trial, the experimenters reinforced challenging behavior with the putative reinforcer. After either the first emission of challenging behavior or 60 s had passed, the child had continuous access to the putative reinforcer for the next 60 s. These procedures resulted in clear differentiation among the test and control segments for both participants, which indicated the function of the aggression for each child. Since this original evaluation of the TBFA, many additional studies have used similar procedures to identify functions of challenging behavior (Rispoli et al., 2014). Thus, TBFAs may be used in the assessment and treatment of challenging behavior.

The TBFA has several advantages over the traditional FA. Researchers and clinicians can embed TBFAs within natural routines. This increases the ecological validity of results as well as the feasibility of implementing the procedures. The discrete trial format is more time efficient compared to the traditional FA. This not only reduces the human resources required to implement the procedure, but also decreases the rate of reinforcement for challenging behavior. Slight procedural variations to the TBFA, such as the duration of trials, order of test and control segments, and the duration of reinforcer access have been evaluated as well, demonstrating the utility of this approach (Rispoli et al., 2014). TBFAs have been demonstrated to identify the function of challenging behavior across a number of populations and parameters (Rispoli et al., 2014). This includes various topographies of challenging behavior, the settings in which the TBFA is conducted (e.g., school, at home), tested behavioral functions, and implementers.

Applied behavior analysts have trained others to implement TBFAs. This includes other professionals involved in the delivery of services to the individual engaging in challenging behavior such as special education professionals (Kunnavatanna, Bloom, Samaha, & Dayton, 2013a; Kunnavatana, Bloom, Lignugaris/Kraft et al., 2013b; Lejeune et al., 2018; Rispoli et al., 2016) residential staff, (Lambert et al., 2013) and head start professionals (Rispoli et al., 2015). More recently, researchers have trained parents to implement TBFAs. Gerow et al. (2019) successfully coached three mothers of young children with autism spectrum disorder (ASD). Parent training sessions took place at a university-supported clinic or university conference room and consisted of (a) written and verbal instruction, (b) explanation of the purpose of a TBFA, and coaching during TBFA implementation. Subsequent treatment took place in the participants’ homes. Moreover, mothers rated the TBFA as socially valid. Standish et al. (2021) used a partially automated training package to teach six caregivers to conduct a TBFA, interpret TBFA outcomes, and manage TBFA data. The training consisted of a partially automated PowerPoint presentation that used voiceover narration to present both instructions and modeling of background
information, definitions, and TBFA procedures. The PowerPoint also included opportunities to respond to multiple-choice questions. Following training, experimenters conducted role plays in which the participants conducted a TBFA, visually analyzed TBFA outcome data, and managed TBFA raw data. Caregivers were able to perform the aforementioned skills not only in the role play, but also during the assessment of their child’s challenging behaviors. Initial evidence suggests that professionals and caregivers alike can successfully conduct TBFAs with support. However, the current literature has only explored in-person training and coaching approaches.

Telehealth refers to the provision of health care services via two-way communication using audio and/or visual communication technology (Baretto et al., 2006). The provision of services via telehealth is well established in the field of psychiatry and psychology (Vandenbos & Williams, 2000); however, the field of applied behavior analysis (ABA) did not adopt this approach until recently (Tomlinson et al., 2018). Some early telehealth services began to emerge in the 1970s using telephones and bug-in-ear technology (e.g., Bowles & Nelson, 1976; Patterson, 1974) and transitioned to the use of videoconference technology in the early 2000s. In Baretto et al. (2006) were the first to use videoconference technology to coach school professionals to conduct a functional analysis.

Telehealth offers many advantages to behavior analysts and the clients we serve (Ferguson et al., 2019; Neely et al., 2021; Tomlinson et al., 2018). Telehealth increases access to populations that may be unable to access in-person services for a number of reasons such as living in a geographical region with little to no available services, lack of transportation, or health conditions that make travel or in-person services difficult or risky. Telehealth reduces both the time and financial costs of travel for the provider and/or the client. In fact, telehealth can reduce the cost of behavior analytic services up to 50% (Horn et al., 2016; Lindergren et al., 2015). Moreover, there is a national shortage of Board Certified Behavior Analysts (BCBAs; National Autistic Society, 2017). The increased accessibility and reduced travel associated with telehealth can result in increased number of clients served with this shortage of skilled providers. Finally, telehealth services have been viewed favorably by parents and caregivers (Ferguson et al., 2019; Neely et al., 2021; Salome et al., 2017; Tomlinson et al., 2018). More recently, the global COVID-19 pandemic resulted in a rapid adoption of a telehealth service model as face-to-face professional treatment was frequently deemed unsafe for either the client or the professional (Neely et al., 2021). With the many known benefits of telehealth and the growing interest in this service delivery model, research to explore the effectiveness of various approaches to assessing challenging behavior with this model is warranted.

Several recent reviews have summarized the use of telehealth to deliver behavior analytic services (Ferguson et al., 2019; Neely et al., 2021; Tomlinson et al., 2018). Findings from these reviews not only summarize the current state of the telehealth delivery model, but have identified recommendations for future research. Ferguson et al. (2019) found that in most studies, parents or caregivers served as interventionists; for example, experimenters coached a parent to implement an intervention with their child. The incorporation of parents as implementers promotes generality, yet
another benefit of this service delivery model. Moreover, just under half of included studies used telehealth assess and treat of challenging behavior, specifically to conduct a functional analysis and implement functional communication training (FCT; Ferguson et al., 2019).

These reviews identified about 15 studies that conducted an FA via telehealth (Ferguson et al., 2019; Neely et al., 2021; Tomlinson et al., 2018). The majority of studies coached parents to conduct an FA, with the remaining coaching school professional such as teachers. All but one study coached the implementer to conduct a traditional FA (Iwata et al., 1994). Gerow et al. (2021) expanded upon research by coaching parents to conduct a brief FA in their home. Among the 7 children whose parents were coached to conduct a brief FA, the assessment identified a function of challenging behavior for four participants. For one participant, additional sessions, equating to a traditional functional analysis, was necessary. For another, the brief FA yielded a false positive result, and for the last participants, results were inconclusive due to near-zero rates of challenging behavior. Challenging behavior was successfully treated with FCT among four participants. The results of Gerow et al. (2021) indicate that parent coaching via telehealth can be used to support parents in conducting FA methodologies other than the traditional FA, specifically a brief FA. This current study expands upon this line of research to evaluate the utility of telehealth in coaching parents to conduct a TBFA.

The purpose of this study was to evaluate (a) the ability of caregivers to conduct a trial-based functional analysis (TBFA) in home, with coaching via videoconference (b) the ability of caregivers to conduct a function-based treatment in home, with parent coaching via videoconference, and (c) the validity of the results of a caregiver-conducted TBFA in home.

**Methods**

**Participants**

Participants were recruited from a larger project in which therapists were providing caregiver coaching, via telehealth, related to caregiver-selected goals for their children with ASD. To be included in this study, participants must (a) have a diagnosis of ASD, (b) be 17 years or younger, and (c) engage in challenging behavior. For safety purposes, we excluded participants if caregivers reported the child engaged in self-injury or aggression that was likely to cause injury to self or caregiver during telehealth sessions. Additional resources were provided to families to assist them in identified services better suited to their needs.

Three children and their mothers participated in this study. See Table 1 for participant characteristics and Table 2 for parent characteristics. For all participants, the experimenter developed safety procedures such blocking. Additionally, experimenters and caregivers collaboratively developed a criterion for terminating a session due to threats to safety. No sessions were terminated based on threats to safety that met the individually developed criteria (Table 3).
| Participant | Age  | Gender | Race  | Diagnosis                                      | Topography of challenging behavior | Topography of mand                  |
|-------------|------|--------|-------|-----------------------------------------------|-----------------------------------|-------------------------------------|
| Scarlett    | 4 years | Female | White | Autism                                        | Yell, Hit, Kick, Throw           | Touch picture card                  |
| Porter      | 4 years | Male   | White | Autism, Sanfilippo syndrome                  | Self-Injury, Hit, Throw           | Touch picture card and one-word vocalization |
| Amos        | 9 years | Male   | White | Autism, visual impairment, epilepsy, hydrocephalus, attention deficit hyperactivity disorder, sensory processing disorder | Self-Injury, Yell, Hit, Kick, Throw | Touch picture card                  |
Settings and Materials

All sessions were conducted in the participants’ home in a room selected by the mother. Scarlett and Porter’s mother conducted sessions in the living room, while Amos’s mother conducted sessions at the kitchen table. Experimenters and data collectors conducted sessions via videoconference from their own homes.

Sessions were conducted via VSee® videoconferencing software. Amos and Scarlett’s mothers used tablets with a cellular plan we provided for them. Porter’s mother opted to use her personal technology. The mothers were instructed to place their laptop, tablet, or phone so that the experimenters and data collectors could see both the mother and the child during all sessions. Experimenters and data collectors used a laptop computer with a speaker and built-in camera. Some experimenters and data collectors opted to use external microphones, headphones, and/or web cameras, based on personal preference.

All other session materials were items the families already owned and had accessible. Preferred items were identified via a paired choice preference assessment.
Items identified as highly preferred were included in the tangible condition and those identified as moderately preferred were included in the attention condition of the TBFA. Task demands implemented in the escape condition of the TBFA were identified in collaboration with the mother and were also restricted to items in the family’s possession. All three participants were taught to request access to reinforcing consequences utilizing a picture card. The research team created 2-inch square picture cards with line drawings representing preferred toys (Scarlett and Porter) and representing a request for a break (Amos). The research team mailed the picture cards to the family.

**Measurement**

At least one experimenter and one data collector attended all sessions. Experimenters and data collectors were in their own homes (i.e., separate locations). On some occasions, a second data collector attended sessions in order to measure interrater reliability.

Challenging behaviors were identified and defined in collaboration with the participant’s mother. Scarlett’s target behaviors included yelling, hitting, kicking, and throwing. *Yelling* was defined as non-word sounds that were above a typical indoor speaking volume or pitch. *Hitting* included swiftly swinging hand or arm in the direction of another person. *Kicking* was defined as swiftly swinging foot or leg in the direction of another person. *Throwing* was defined as forcefully launching an item at least 6 inches away from her body in a way that was not functional for that item (e.g., throwing a ball did was not considered throwing with this definition). Porter’s challenging behavior included self-injury, hitting, and throwing. *Self-injury* was defined as contact between his open hand and his head that did not appear to serve a functional purpose (e.g., scratching an itch, moving his hair from his eyes). Definitions of hitting and throwing were identical to those used for Scarlett. Amos’s challenging behavior included self-injury, yelling, hitting, kicking, and throwing. For Amos, *self-injury* was defined as contact of an open mouth to any part of his body. Definitions of yelling, hitting, kicking, and throwing were identical to those used for Scarlett.

To evaluate the accuracy of TBFA results, FCT was implemented based on the results of the TBFA. Scarlett’s target mand was to touch a picture card, which was defined as fingertip or open palm making contact with the picture card. Porter’s target mand was touching the picture card with any part of his hand and saying the word *blocks*, within 5 s of one another. Porter’s mother specifically requested the combined use of picture cards and vocalizations as Porter was able to communicate with words, but was experiencing a regression of vocalizations. His physician predicted such regression may continue; therefore, his mother wished to provide Porter with additional communication topographies in the event of future vocal communication regression. Amos’s target mand was to pick up a picture card and place it in or near his mother’s hand.

During the TBFA, observers recorded if challenging behavior occurred or did not occur across each trial. FCT sessions consisted of five trials. During FCT, observers
recorded the percent of trials in which challenging behavior or an mand occurred. Additionally, they recorded if the mand occurred independently or after the mother delivered a prompt, but only independent mands were graphed.

**Interobserver Agreement**

A second observer collected data in order to evaluate interobserver agreement (IOA). During the TBFA, an agreement was scored if both observers recorded the challenging behavior occurred or did not occur in each trial. IOA was calculated by dividing the number of trials with agreement by the total number of trials (2) and multiplying by 100 to obtain a percentage. For Scarlett, IOA was measured during 94% of TBFA trials and mean IOA was 97%. For Porter, IOA was measured during 90% of TBFA trials and IOA was 100%. Finally, IOA was collected during 100% of TBFA trials for Amos and was 100%.

During FCT, an agreement for challenging behavior was scored if both observers recording the challenging behavior occurred or did not occur in each trial. Next, IOA was calculated by dividing the number of trials with agreement by the total number of trials (5) and multiplying by 100 to obtain a percentage. For Scarlett’s challenging behavior and target mand, IOA was measured during 100% of baseline and 95% of FCT sessions. IOA for challenging behavior was 100% for baseline and a mean of 86% for intervention sessions. Mean IOA for the mand was 83% for baseline and 100% for intervention sessions. For Porter, IOA was measured during 100% of baseline and 66% of FCT session. IOA for challenging behavior was 100% for baseline and a mean of 88% for intervention sessions. IOA for the target mand was 100% for baseline and a mean of 96% for intervention sessions. For Amos, IOA was measured during 100% of baseline and 100% of FCT session. IOA for challenging behavior was 100% for baseline and intervention sessions. IOA for the target mand was 100% for baseline and a mean of 98% for intervention sessions.

**Procedural Fidelity**

Observers collected data on parent implementation of the TBFA and FCT procedures. Observers used a task analysis for each TBFA condition as well as baseline and intervention conditions of the treatment evaluation. The observer noted which steps were implemented correctly during the entire session as well as which steps were implemented incorrectly during some or all of the session. Procedural fidelity was calculated by dividing the number of steps with correct implementation by the total number of steps and multiplied by 100 to obtain a percentage.

Procedural fidelity was measured for 94% of TBFA trials for Scarlett, and her mother’s mean fidelity of implementation was 94%. Procedural fidelity was measured for 100% of TBFA trials Porter and his mother implemented all trials with 100% fidelity. Procedural fidelity was measured for 100% of TBFA trials for Amos and his mother’s mean fidelity of implementation was 97%.

Procedural fidelity was measured for 84% of FCT baseline and intervention sessions for Scarlett and her mother’s mean fidelity of implementation was 98%. Procedural fidelity was measured for 57% of FCT baseline and intervention sessions for
Porter and his mother implemented all trials with 91% fidelity. Procedural fidelity was measured for 100% of FCT baseline and intervention sessions for Amos and his mother’s mean fidelity of implementation was 99.7%.

**Experimental Design**

The TBFA consisted of 6–9 pairs of trials (i.e., control and test) per condition, with the specific number of trials determined by stability of data. The order of trial conditions was randomized. An ABAB design was implemented to evaluate FCT treatment (Kennedy, 2005).

**Procedures**

**Parent Coaching**

Parent coaching was conducted on a one-on-one basis, utilizing behavior skills training (BST; Ward-Horner & Sturmey, 2012). Prior to a session, the experimenter provided written instructions to the mother using a screen share function. Written instructions were similar to the procedural fidelity instructions for experimenters, but written in lay terms. The experimenter read the instructions and solicited questions from the parent prior to implementing procedures. During the session, the experimenter provided vocal instructions. The experimenter praised the parent when she implemented steps correctly and immediately corrected any errors. At the end of the session, the experimenter provided performance feedback consisting of praise for steps conducted correctly and a review of steps implemented incorrectly. Before ending the session, the experimenter summarizes steps implemented correctly and incorrectly. The experimenter then provided the mother an opportunity to practice any steps she implemented incorrectly and provided an opportunity for her to ask additional questions.

**Trial-based Functional Analysis**

The TBFA consisted of six to nine 2-min trials of each condition. The order of conditions was randomized. The first min consisted of a control segment followed by a test segment in the second min. If challenging behavior occurred during the control segment, the parent did not respond, but the segment was ended and the test segment was initiated. If challenging behavior occurred during the test segment, the condition-specific reinforcer was delivered.

During the control segment of the attention condition, the mother placed moderately preferred toys within reach of the participant. She delivered attention at least every 5 s. During the test segment of the attention condition, the mother instructed the participant that she needed to engage in a different activity and then initiated this task, staying within 1.5 m of the participant. The activity was selected by the mother as an activity that typically required her attention (e.g., cleaning). If the participant engaged in the target challenging behavior, the mother provided attention in
the form of calming and redirecting statements (e.g., “Please do not throw this. I’m cleaning up, so you can play with your toys”) for the remainder of the 1-min trial.

During the control segment of the tangible condition, the mother provided the participant with access to his/her highest preferred toys. During the test segment of the tangible condition, the mother removed the toy, keeping it within sight. If the participant engaged in the target challenging behavior, the mother returned the toy for the remainder of the 1-min trial.

During the control segment of the escape condition, the parent provided the participant with neutral toys and made no demands of the participant. During the test segment, the parent removed the toys and presented non-preferred tasks (e.g., school work). The mother delivered least-to-most prompting, beginning with verbal instruction, modeling, and then physical guidance, to assist the participant in completing the task. If the participant engaged in the target challenging behavior, the work task was removed for the remainder of the 1-min trial. The inclusion of neutral items to the control segment was to promote the likelihood of participants remaining within camera view, rather than leaving to access toys and leisure items freely available in their home. However, a limitation of this modification is the possibility of a confounding variable; specifically, challenging behavior may have been evoked by the removal of the items rather than the task demand. Anecdotally, we did not observe any challenging behavior occur in the short time between item removal and the placement of the demand.

Treatment Evaluation

The purpose of the treatment evaluation was to validate the results on the TBFA. Specifically, FCT matched to the function of challenging behavior that was identified by the TBFA was implemented for all three participants (Carr & Durand, 1985). For Scarlett and Porter, FCT was used to teach a socially appropriate mand to gain access to tangibles. For Amos, FCT was used to teach a socially appropriate mand to request a break from work tasks.

Each session consisted of five 1-min trials. During the beginning of each trial, the mother arranged antecedents consistent with an establishing operation for the function identified in the TBFA. That is, for Scarlett and Porter, the parent provided brief access to their highest preferred item, then removed access keeping the item within sight. For Amos, his mother instructed him to complete tasks in a school workbook.

During baseline sessions, contingent upon challenging behavior, the putative reinforcer was delivered for the remainder of the 1-min trial (i.e., access to the highest preferred item for Scarlett and Porter and a removal of task demands for Amos). Mands were ignored.

Prior to the first FCT intervention condition, the experimenter coached the mother to implement teaching trials in which the parent immediately prompted the participant to emit the selected mand after the presentation of the establishing operation. In other words, for Scarlett and Porter, the mother was coached to remove of the highest preferred toy then immediately prompt the participant to emit the mand to access to this toy. Amos’s mother was coached to present work
from his school workbook and then immediately prompt him to emit the mand for a break from work. During teaching trials, contingent upon the prompted mand, the putative reinforcer was delivered for the remainder of the 1-min trial. Challenging behavior was placed on extinction. Teaching trials continued until the participant displayed no challenging behavior for two consecutive sessions. A single teaching trial was implemented again prior to the introduction of the second FCT intervention condition. An additional teaching trial was implemented for Scarlett during the second FCT phase. Scarlett was ill for two weeks at which time they did not participate in research sessions. During her first session after this absence, a teaching trial was implemented due to her prolonged absence from intervention sessions.

Intervention sessions were identical to teaching trials with one exception, and the prompt for the mand was delayed by 3 s. Specifically, if the participant failed to mand within three seconds of exposure to the establishing operation, the mother was coached to prompt the mand. In other words, if Scarlett and Porter failed to mand within 3 s of toy removal, the parent prompted the mand. Similarly, if Amos did not mand for a break from work within 3 s of presentation of the school workbook, his mother prompted him to mand. Challenging behavior was placed on extinction.

A modification was made to the procedures implemented for Amos’s FCT intervention beginning with session 13. During the initial teaching trials and first five intervention sessions, Amos was prompted to remove a picture card affixed to a board with hook and loop fastener and place the card in his mother’s hand. The board was placed to the side of his work materials. After Amos failed to independently emit this response after five intervention sessions, the experimenter consulted with his mother who believed the task of visually locating the board to remove the picture card was particularly difficult for Amos due to his visual impairment. With his mother’s input, the FCT intervention was modified so that the card would be placed directly on his work materials to minimize the visual scanning necessary to find the card and he would only be expected to touch the card, rather than place it in his mother’s hand. A single teaching trial was implemented again to prompt the modified mand expectation prior to implementing intervention sessions. At the end of this study, written instructions were provided to his mother to shape this communication response to more closely resemble the originally selected response if she desired to do so.

Social Validity

After completing the TBFA, the experimenter implemented a social validity questionnaire based on the Treatment Acceptability Rating Form-Revised (Reimers et al., 1991). The questionnaire consisted of eight questions regarding the acceptability, contextual fit, and potential disadvantages of the TBFA. The experimenter shared the written statements using a screen share function and then read each question aloud. Parents were asked to respond to each statement using a 6-point scale from strongly disagree to strongly agree.
Results

Trial-based Functional Analysis

The TBFA results for the three participants are displayed in Fig. 1. Scarlett demonstrated the highest percentage of challenging behavior in the test segment of the tangible condition (83%). Challenging behavior was also observed in the test segment of the attention condition (17%). No challenging behavior was observed during either the test or control segment of the escape condition. These results suggest the challenging behavior to be multiply-maintained by social positive reinforcement. Although the TBFA identified two functions of challenging behavior, Scarlett’s mother requested to target the tangible function for treatment.

Porter engaged in challenging behavior during the test segments for all three conditions: attention, tangible, and escape. However, the highest percentage of challenging behavior was demonstrated in the test segment of the tangible condition (43%). The results of Porter’s TBFA suggest the challenging behavior to be multiply-maintained by both social positive reinforcement (i.e., tangible, attention) and socially negative reinforcement (i.e., escape). The tangible function was targeted for treatment by request of Porter’s mother.

Amos engaged in challenging behavior in the test segment of the tangible condition (28%) and the escape condition (57%) as well as during the control segment of the escape condition (28%). Amos also engaged in challenging behavior during control segment of the attention condition (28%), but not during the test segment. The results of Amos’s TBFA suggest the challenging behavior to be multiply-maintained by both social positive reinforcement (i.e., tangible) and social negative reinforcement (i.e., escape). Escape-maintained challenging behavior was targeted for treatment by request of Amos’s mother.

Treatment Evaluation

Scarlett

Scarlett’s FCT results are displayed in Fig. 2, with the top panel displaying challenging behavior and the bottom panel displaying independent mands. Scarlett engaged in challenging behavior a mean of 91% of trials across baseline sessions. Challenging behavior was high and stable in both baseline phases. During FCT intervention, challenging behavior decreased to a mean of 18% of trials. There was an immediate decrease in challenging behavior from baseline to intervention, followed by an immediate increase from baseline to intervention, and then an immediate decrease when intervention was reinstated. The decrease from the second baseline phase to the second intervention phase was not a differentiated than the previous decrease; however, after the second teaching trial in that phase, challenging behavior immediately dropped to zero levels for the remainder of all sessions. There was very little overlap across phases, except for a single session in baseline and a single sessions in intervention.
Fig. 1 TBFA results
Scarlett emitted very few independent mands across baseline sessions ($M = 8\%$). During intervention, her independent mands increased ($M = 55\%$). Independent mands were low and stable during the initial baseline condition. They immediately increased in the first intervention session, but data were variable, ranging from occurring 20% of 100% of trials, but ending with an increasing trend. Independent mands immediately decreased during the second baseline and immediately increased upon the second intervention condition. Initially, independent mands were variable with a decreasing trend; however, following another teaching trial, mands increased and the condition ended with an increasing trend.

Fig. 2 FCT results for challenging behavior (top panel) and independent mands (bottom panel) for Scarlett. Note, TT = teaching trials.
Porter’s FCT results are displayed in Fig. 3. Porter engaged in challenging behavior a mean of 96% of trials across baseline sessions. During baseline, challenging behavior was high and stable. During FCT intervention, challenging behavior decreased to a mean of 27% of trials. During the first intervention phase, challenging behavior immediately dropped to near-zero levels and was stable throughout the phase. During the second intervention phase, the decrease was not as pronounced as the first, but demonstrated a decreasing trend, reaching zero levels, but maintaining some variability.

Fig. 3 FCT results for challenging behavior (top panel) and independent mands (bottom panel) for Porter. Note, TT = teaching trials
Porter emitted very few independent mands across baseline sessions ($M = 12.5\%$). During baseline, independent mands were not only low, but also stable. With the exception of a single session in the second baseline phase, no independent mands were emitted. An immediate increase in independent mands occurred during the first intervention phase, but data were variable. During the second intervention phase, there was not an immediate change, but a rapid increasing trend occurred during the fourth session of this phase. Overall, independent mands were emitted a mean of 50\% of trials.

Amos’s FCT results are displayed in Fig. 4. Amos engaged in challenging behavior a mean of 25\% of trials across baseline sessions. Challenging behavior was variable in both baseline phases, but more so in the first baseline phase. During the second baseline condition, challenging behavior failed to return to the levels observed during the first baseline condition. During FCT intervention, challenging behavior decreased to a mean of 6.25\% of trials. A dashed phase line just before session 13 indicates when the modified mand was introduced. Prior to modifying the mand, challenging behavior was slightly variable; however, after modifying the mand, challenging behavior remained at a zero level.

No independent mands were emitted during baseline. During intervention, mands increased ($M = 35\%$). There was no change in independent mands between the first baseline phase and the initial intervention sessions. After modifying the mand response, there was an immediate increase and stable responding. There was no overlap between baseline and intervention sessions with the modified mand.

**Social Validity**

Parents were asked to respond to each statement using a 6-point scale from strongly disagree to strongly agree, with a score of 1 indicating strongly disagree and a score of 6 indicating strongly agree. The social validity questionnaires indicated the caregivers found the TBFA acceptable and feasible to utilize within their natural environment. Scarlett mother’s ratings were a mean of 5.25 indicating that she agreed to strongly agree with statements. Porter mother’s ratings were a mean of 5 indicating she agreed with statements. Amos mother’s ratings were a mean of 6 indicating that she strongly agreed with the statements.

**Discussion**

The purpose of this study was to evaluate parent-implemented TBFA and subsequent function-based intervention with coaching via videoconference. We also sought to evaluate the caregivers’ perceptions of the procedures. For each of the three participants, the TBFA results yielded information about the function of challenging behavior. The TBFA indicated each participant engaged in multiply maintained challenging behavior. One of the identified functions was targeted in the treatment evaluation for each participant, based on parent preference. The subsequent function-based treatment yielded decreases in challenging behavior and increases in
communication for all three participants. Furthermore, social validity ratings indicated the parents found the TBFA to be acceptable. Together, these results support the use of parent-implemented TBFA, with coaching delivered via telehealth.

It is worth noting that Amos engaged in challenging behavior in the control segments of the attention and escape condition. One possible hypothesis is that Amos failed to discriminate contingencies associated with the conditions; however, the trials in which he engaged in challenging behavior during the control segments were not isolated to initial trials, suggesting that this was not a result of lack of discrimination, which would have likely occurred in initial trials, but resolved with
subsequent exposure to trial contingencies. A second hypothesis is that Amos's challenging behavior was automatically maintained; however, the result of a parent interview conducted prior to the TBFA did not indicate a likelihood of automatically maintained challenging behavior. Moreover, behavior was not elevated across test and control of all conditions, further suggesting that challenging behavior was not automatically maintained. It is possible that additional trials or a different FA methodology (e.g., brief FA) may have yielded clearer results. However, FCT to treat escape-maintained behavior successfully decreased challenging behavior and increased mands, suggesting that challenging behavior was in fact maintained, in part, by negative reinforcement.

For all three participants, function-based treatment yielded decreases in challenging behavior and increases in communication; however, Scarlett and Amos’s results were not ideal. During the second FCT intervention phase, Scarlett’s challenging behavior decreased relative to baseline, but did not return to the low levels observed in the first intervention phase. During this time, Scarlett’s family cancelled several sessions as her two younger siblings were ill and her mother was the sole caretaker of all three children during sessions. The inconsistent sessions may have contributed to the persistent challenging behaviors. After session 20, Scarlett also became ill and no sessions were conducted for two weeks. Upon her return, she conducted a teaching trial prior to resuming intervention sessions. Challenging behaviors immediately dropped to zero levels. Similarly, as session cancellations became frequent during the second intervention phase, the percent of trials with independent mands decreased, but increased again following the teaching trial. Collectively, this suggests that the inconsistent sessions may have influenced the results. For Amos, challenging behavior increased in the second baseline condition, relative to the zero levels observed during intervention, but failed to return the levels observed in the initial baseline condition. This compromised the strength of experimental control, suggesting changes in challenging behavior may be, in part, influenced by other variables. For all participants, we maintained a trial-based approach to FCT (i.e., session consisted of five trials) rather than transitioning to a time-based approach (e.g., 5-min sessions). We selected a trial-based structure with the hope that its similarity to the structure of the TBFA would facilitate the parents’ ease in implementing FCT procedures with fidelity. However, time-based sessions may have yielded clearer results with stronger experimental control.

For some individuals, FA results can be influenced by implementers (Ringdahl & Sellers, 2000) and settings (Lang et al., 2010). These findings have important implications for the assessment and treatment of challenging behavior. FA results based on an assessment conducted one context may not reflect the function of the challenging behavior in other contexts, possibly leading to reduced efficacy of interventions if the FA is implemented in a different context than the intervention context. The findings from this previous work highlight the importance of conducting FAs in the context in which the intervention will be implemented, to the extent possible. Similar to previous work with parent implementers (e.g., Gerow et al., 2019, 2021; Wacker et al., 2011), parents conducted the FA in the home with the family’s materials. The present study described a methodology for conducting a TBFA via telehealth and including typical implementers, settings, and materials. When the home
is the target intervention setting, practitioners and researchers can consider using a similar methodology, as appropriate.

In the present study, a social function was identified for all three participants based on the results of the TBFA. This study adds to the growing body of the literature supporting the use of TBFA (e.g., Gerow et al., 2019; Kunnavatana, Bloom, Samaha, & Dayton, 2013a; Kunnavatana Bloom, Samaha, & Lignugaris/Kraft, et al., 2013b; Lejeune et al., 2018; Rispoli et al., 2016). TBFA may be particularly appropriate in natural settings, since the FA methodology includes short trials that can be embedded into typical routines in the natural environment (Rispoli et al., 2014). The TBFA also does not require repeated presentations of the antecedent condition in the test portion of the trials, since the test portion is terminated contingent upon the first instance of challenging behavior. Together, these features of the TBFA may make this FA methodology particularly appropriate for the home setting with parent implementers. In the present study, parents implemented the TBFA with a high degree of fidelity, replicating the findings from previous work with face-to-face coaching (Gerow et al., 2019) and providing preliminary evidence that parents can effectively implement the procedures with coaching via telehealth. Together, these results, along with the previous literature, indicate parents can implement the TBFA with a high degree of fidelity in home.

It is important to note that a BCBA-level therapist provided one-on-one coaching to the parent and watched each session. The purpose of the study was not to teach parents to implement the TBFA independently, but rather to conduct the TBFA in the typical context in order to gather information related to the function of the child’s challenging behavior in the target intervention setting (i.e., the home with a parent implementer). Based on this study and the methodology included in previous work, a professional with expertise in FA should attend each session to provide coaching and support to the parent.

In this study, there were several benefits of using telehealth to coach parents. First, the use of telehealth allowed us to provide coaching in the home, without requiring the therapists to travel. This reduction in travel time may allow practitioners to serve more children in the same amount of time. In addition, telehealth allows professionals to visit homes in a less intrusive manner than in-person visits, which may be more acceptable for some families. A portion of this study occurred during the COVID-19 pandemic and the use of telehealth allowed us to continue providing parent coaching without face-to-face interactions. The use of telehealth may be particularly appropriate in times when face-to-face services are associated with increased risk, such as during the COVID-19 pandemic.

There are also several considerations to be made related to the use of telehealth to provide parent coaching in the assessment and treatment of challenging behavior. First, telehealth coaching requires the use of Internet and technology, which may not be accessible for all families. For the present study, we provided all needed technology (including cellular service) for families who requested technology. However, this may not be feasible in some cases. Second, Internet or cellular connectivity problems can arise, disrupting session. Although we did not experience Internet or cellular connectivity problems during this study, practitioners should be prepared for such complications. Third, the use of technology requires parents to
prepare technology in advance. On some occasions, the mothers forgot to charge the device prior to sessions. This could be resolved by charging the device during the session, but was disruptive as this limited the mother to specific spaces that could be viewed from a charging device. Finally, the limited camera view often presented challenges. Frequently participants moved out of camera view, particularly Scarlett and Porter who were 4 years of age and frequently on the move. Similarly, on a few occasions the participant bumped or kicked the table in which the device was sitting, thus knocking the device over and limiting the experimenter’s. In most cases, the mothers were able to move tablets to follow their child to allow for continuous data collection, but at times, we had to restart sessions because the child had been out of view for a significant portion of the session. We recommend practitioners reference Lee et al. (2015) for additional considerations and troubleshooting guidance when developing and implementing telehealth services.

The severity of challenging behavior should also be taken into consideration for telehealth services. In this study, families were not included if the child engaged in challenging behavior that was too severe. Telehealth services may not be appropriate for children with severe challenging behavior, due to the lack of in-person support from a professional with expertise in challenging behavior. Practitioners should consider the extent to which telehealth coaching is appropriate for the child based on the topography and severity of challenging behavior.

Limitations

There are limitations to this study that warrant discussion. First, the TBFA results indicated multiple functions for all participants and the treatment evaluation targeted one of those functions. Although the treatment evaluation results provide support for one of the identified functions from the TBFA, we did not evaluate the extent to which false positives or false negatives occurred within the TBFA results. Second, the criterion to terminate teaching trials was based solely on challenging behavior being at zero levels; however, it would have been prudent to include a criterion for independent manding. While Scarlett and Porter demonstrated high levels of independent mands during the first intervention phase, Amos did not. Had the criteria also included independent manding, this would have likely resulted in improved manding during the initial FCT intervention phase. Finally, the results of this study would be improved if we had conducted schedule thinning after the treatment evaluation (Hagopian et al., 2011). All three participants were simultaneously participating in a larger, short-term project in which therapists were providing caregiver coaching to address additional caregiver-selected goals for their children with autism. As a result, after a successful reduction of challenging behavior, the remaining time participating in the larger project was allocated to other caregiver-selected goals. However, we provided each mother and the parent coach who would be supporting other caregiver-selected goals with instructions to thin the schedule of reinforcement for the mand, but did not collect data on its implementation or the effect of schedule thinning on challenging behavior and independent mands.
Future Research

Based on the previous literature and the results of this study, there are several potential directions for future research. The present study and Gerow et al. (2019) provided information related to the use of parent-implemented TBFA. Other methodologies, such as traditional FA and brief FA (e.g., Gerow et al., 2021; Suess et al., 2016; Wacker et al., 2013), have been evaluated with parent implementers. Given the support for multiple FA methodologies and the potential strengths and limitations associated with each methodology, future research should evaluate the relative accuracy, feasibility, and acceptability of each FA methodology when implemented by parents, particularly using a telehealth coaching model. These data may also be useful in evaluating the extent to which false positives and negatives occur with each FA methodology. In the present study and in the previous literature, the parent coaching procedures included multiple components. Future research should conduct a component analysis of the common parent coaching procedures. It may also be helpful for future research to evaluate parents’ preference for in-person versus telehealth coaching.

Conclusion

Parent involvement is integral to the effective and sustained treatment of challenging behavior. The current body of the literature and the results of this study provide support for the inclusion of parents in the assessment and treatment of challenging behavior. In addition, the use of telehealth can improve access to services and reduce barriers associated with delivering services. It is important to note that a therapist with expertise in FA attended all sessions and that children were not included if they had severe challenging behavior. Telehealth may not be appropriate for all children. Based on the findings of this study and the previous literature, practitioners and researchers should consider the use of telehealth to provide coaching to parents in the assessment and treatment of challenging behavior.

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