



Distance-Based Collaborations for Assessing and Treating Challenging Behavior

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Abstract

An interview-informed synthesized contingency analysis (IISCA; Hanley et al. in *J Appl Behav Anal* 47:16–36, 2014) and related skill-based treatment process can result in socially valid outcomes for clients exhibiting severe challenging behavior when implemented by professionals and then transferred to parents (e.g., Santiago et al. in *J Autism Dev Disord* 46:797–811, 2016). However, many families do not have access to professionals trained to implement functional analyses or function-based treatments (Deochand & Fuqua *Behav Anal Pract* 9:243–252, 2016). Experimenters in the present study coached three parents of children with autism exhibiting severe challenging behavior through implementing an IISCA and resulting skill-based treatment process through distance-based collaborative consulting. All parents achieved differentiated functional analyses, taught their children to emit functional replacement skills, and reduced challenging behavior relative to baseline.

Keywords Telehealth · Parent training · Challenging behavior · Functional analysis

Despite the total number of BACB (Behavior Analyst Certification Board) certificants doubling within the last 5 years (Behavior Analyst Certification Board, 2020; Deochand & Fuqua, 2016), most BCBA's (Board Certified Behavior Analysts) live along the eastern and western seaboard of the United States. This concentration of BCBA's disproportionately disadvantages families living in rural areas, in cities without specialized treatment centers, or in countries outside the United States from accessing behavior analytic services. For these families, the difficulty of securing services is compounded if they are also seeking treatment for severe challenging behavior, as the expertise and resources required to conduct functional analyses and function-based treatments can be difficult to find even in areas with high numbers of BCBA's per capita (Oliver et al., 2015; Roscoe et al., 2015).

To bridge this service gap, behavior analysts are researching how to provide functional analytic services through telehealth service-delivery models. Telehealth service-delivery allows BCBA's with specific expertise to reach clients regardless of physical distance, and initial findings from studies in this area provide cause for optimism. Functional analytic services provided to families via telehealth are cheaper than in-person functional analytic services, and may produce comparable treatment outcomes to on-site service-provision models (Lindgren et al., 2016). Recent studies have also found that caregivers can successfully conduct functional assessments and treatments without in-person implementation support. Lindgren et al., (2020), for example, taught parents of children with autism living in the United States to implement their children's functional analyses and treatments through real-time, telehealth coaching. Families taught their children to communicate and cooperate when given instructions rather than exhibit significant challenging behaviors like self-injury or aggression. Reductions in challenging behavior persisted at a 6-month follow-up, and families rated the intervention as acceptable despite the lack of in-person implementation support.

Tsami et al. (2019) extended this line of research by using real-time telehealth coaching to teach 12 families living outside of the United States to implement their children's functional analyses and treatments. Participating families did not

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use English as the primary language in their homes, so all real-time coaching was delivered both through telehealth technologies and an interpreter. The interpreter's location varied such that some interpreters were in the same room as the consulting BCBA (i.e., the United States), some interpreters were in the families' homes, and some interpreters were in a third location. The authors found that real-time coaching provided at a distance via an interpreter did not prevent parents from attaining differentiated functional analyses, reducing challenging behavior, or teaching skills. Parents achieved a high average procedural integrity, all children experienced reductions in challenging behavior, and most children used their communication responses across 100% of opportunities by the end of treatment.

These outcomes are encouraging for families living in underserved communities. If parents can teach their children replacement skills for self-injury and aggression without in-person implementation support, functional analytic services may become more accessible. However, most research on functional analyses implemented via teleconsultation investigate the use of the standard functional analysis (Iwata et al., 1994). This may limit the extent to which BCBAs can adapt their service approach or procedures to suit family preferences, as coaching families through other functional assessments and treatments of challenging behavior without published examples of how to do so safely may pose a risk to families.

One functional analysis format that may be suited to telehealth services is the interview-informed synthesized contingency analysis (IISCA; Hanley et al., 2014). The IISCA takes less time to conduct than a standard functional analysis, and is often completed in 25 min. Treatments informed by an IISCA have produced at least 90% reductions in target behaviors across participants, behavior topographies, and service settings (Coffey et al., 2020). BCBAs conducting an IISCA begin by administering an open-ended interview to caregivers, who identify when their child's challenging behaviors (e.g., aggression) and less concerning associated topographies of behavior (e.g., whining) are likely to occur. BCBAs synthesize this information into one reinforcement contingency (e.g., child keeps their toys *and* they are not asked to clean up). The influence of the synthesized reinforcement contingency over all parent-nominated behavior topographies is then assessed across matched test and control conditions. If more responding occurs during the test condition, where all purported reinforcers are contingent on challenging behaviors, than the control condition, where purported reinforcers are freely available, then challenging behavior is sensitive to the synthesized reinforcement contingency. At present, there is only one published example of an IISCA implemented in a telehealth context.

Edelstein et al. (2021) coached five families living near an outpatient clinic in the United States through conducting

IISCAs with their typically developing children. The analysis results informed a differential reinforcement of other behaviors intervention where children learned to wait for their preferred items while watching a timer, and then to play with other toys when the item they asked for was unavailable. The authors showed that an IISCA and resulting treatment process can be successful at a distance, but did not explain how to coach parents through implementing the assessment and treatment process, or describe how to conduct the differential reinforcement of alternative behavior interventions characteristic of treatments informed by an IISCA (e.g., Ghaemmaghami et al., 2016).

It is important to assess whether parents can safely implement IISCAs and resulting treatments via telehealth before recommending BCBAs use this strategy with their clients. Therefore, the purpose of this study is to determine whether a telehealth model of the IISCA and resulting skill-based treatment process is feasible. More specifically, the purpose of this study is to determine whether positive treatment outcomes can be achieved when a) parents implement IISCAs and resulting skill-based treatment processes in their homes when b) all training and implementation support is provided via real-time teleconsultation and c) differential reinforcement of alternative behavior procedures are used during the intervention.

Methods

Consent and Assent

This study was approved through a full review by the institutional review board at Western New England University. Participating parents signed informed consent forms that detailed the risks and benefits associated with the functional assessment and treatment of challenging behavior via teleconference technologies and participating children responded to assent forms individualized to each child's communication modality (e.g., writing their own name on the form, speaking or nodding their agreement). In addition, parents and children assented to participate in sessions during each meeting between the family and the experimenters.

Participants and Settings

Recruitment started in August of 2018 and ended in September of 2019. Participants were the first three parent-child dyads meeting inclusion criteria (Table 1). Inclusion criteria for parents were: previous contact with the second author for assistance with their child's challenging behavior, internet access, access to a video-recording device, some English language mastery, and an absence of functional analytic services within one hour of the family's home. Inclusion

Table 1 Participant characteristics

| Child | | | | Parent | | | | Family | |
|-------|-----|--|------------------|--------|-----|---------------|----------------|---------------|------------------|
| Name | Age | Diagnosis | Language Ability | Name | Age | Education | ABA Experience | Residence | Children in Home |
| Jade | 9 | ASD; Partial duplication of chromosome 7 | 1–3 word phrases | Mrs. J | 37 | High school | No | United States | 2 |
| Brad | 5 | ASD | 3–5 word phrases | Ms. B | 29 | College | Yes | Canada | 2 |
| Tamir | 7 | ASD | Full sentences | Mrs. T | 33 | Post-graduate | Yes | Bahrain | 4 |

ABA Experience describes whether parents implemented behavior analytic programs prior to the experiment. Children in home represents the total number of children, including the child participant, for whom the parent participant is responsible

ASD autism spectrum disorder. *SIB* self-injurious behavior, *Agg* aggression, *ABA* applied behavior analysis

criteria for children were an autism spectrum disorder diagnosis and frequent episodes of one or more forms of challenging behavior.

The first parent–child dyad, Mrs. J and Jade, were a mother and daughter living in the Appalachian region of the United States. Jade was 9 years old with dual diagnoses of autism spectrum disorder (ASD) and partial duplication of chromosome 7 who spoke in one- to three-word phrases and attended a special education classroom at school. Mrs. J had no prior experience implementing behavior analytic interventions at the time of the study. The second dyad, Ms. B and Brad, were a mother and son living in Western Canada. Brad was 5 years old, had an ASD diagnosis, and spoke in three- to five-word phrases. At the time of the study, Ms. B provided all of Brad’s school instruction and behavior analytic services at home. The final dyad, Mrs. T and Tamir, were a mother and son living in a city in Bahrain. Tamir was 7 years old, had an ASD diagnosis, spoke in full, complete, sentences, and was enrolled in a general education classroom. During the study, Mrs. T was pursuing a master’s degree in Behavior Analysis. Parents did not provide information on whether their children received any other related services (e.g., speech pathology) at school or at home.

Eligible parents watched a four-hour video-recording of a training describing the practical functional assessment and skill-based treatment process used in this experiment (Hanley, 2018a, 2018b). Parents then answered general questions about these procedures (e.g., “Which steps comprise the assessment process?” “The treatment process?” “How will safety be assured?”). After parent questions and concerns were addressed, families selected weekly practice dates and times. The only restrictions placed on parents’ preferences were that the practice location be consistent, that some aspect of the room be unique to sessions (e.g., table against a different wall), and that sessions be conducted at least three times each week. Mrs. J ran Jade’s sessions in her maternal grandfather’s living room three times per week. The living room included a couch,

coffee table, TV, and rocking chair. Ms. B ran Brad’s sessions in the playroom of their home three to five times per week. The playroom contained a couch, child-sized tables and chairs, several toy storage units, and a beanbag crash pad. Mrs. T ran Tamir’s sessions in the sitting area of the master bedroom three to five times per week. The sitting area contained a couch and coffee table, but the room also contained a bed, nightstand, and dresser.

Parent Coaches

The first and third authors served as parent coaches throughout the experiment. Coaches were licensed BCBAs in Massachusetts enrolled in a doctoral program in Behavior Analysis, and had a collective 6 years of experience implementing IISCA and skill-based treatment processes (e.g., functional communication training) for challenging behavior. The second author supervised coaches for approximately 30 min each week for the duration of the experiment. Coaches used laptop computers with built-in webcams and microphones to observe parents conducting assessment and treatment procedures in real-time, provide in-vivo feedback to parents, and record session videos throughout the experiment. Parents connected to and received feedback from coaches through the technology (tablets, phones, laptops, wireless headphones, device speakers) and videoconferencing platform (Skype, Zoom) of their choosing.

Experimental Design

The contingency influencing challenging behavior was assessed in a multi-element design during the IISCA, then again through a reversal to baseline following simple functional communication training. The reinforcement contingency was further evaluated across target responses

during the intervention following the logic of a changing criterion design.

Response Definitions

Challenging behavior and target skills are summarized in Table 2. Challenging behaviors included self-injury (hitting the side of the head with the heel of the hand; hitting the forehead or back of the head on a hard surface) aggression (hitting; kicking; head-butting; scratching; choking others; throwing objects at others), disruptions (tantrums; crying; breaking toys), and less concerning associated topographies of behavior (whining; yelling, swiping objects; body rocking). Target skills included two- to eight- word vocal functional communication responses (e.g., “My way, please), tolerance responses (“okay” paired with a gesture), and contextually appropriate behaviors, or cooperation with instructions (CABs; e.g., completing homework, participating in physical therapy exercises).

Data Collection and Interobserver Agreement

All IISCA and probe sessions were video-recorded, with independent observers scoring child performance and parent procedural integrity. Child performance was scored using the Instant Data program. Parent procedural integrity data were scored with paper datasheets and pencils (Online Appendix A). If parents erred, the error was marked once and was not scored again during the session. Coaches kept informal tallies of child performance measures and took procedural integrity data in real-time during sessions.

A second independent observer collected data on child performance measures and parent procedural integrity for 30% of IISCA sessions and 50% of probe sessions (Table 3). For child performance measures, each session was divided into 10-s intervals, and the total number of responses for each measure was calculated on an interval-by-interval basis. Interobserver agreement (IOA) was calculated by dividing the smaller counts by the larger counts for each measure, averaging the fractions, and converting the average into a percentage. Total count IOA was calculated for parent procedural integrity (Table 4).

Table 2 Response definitions

| Name | Challenging behavior | | | | Skills | | | | |
|-------|--|--|----------------------------------|--------------------------|----------------|----------------------------|---|---------------------|---|
| | SIB | Agg | Dis | LCATB | FCR | | | TR | CAB |
| | | | | | Simple | Interm | Complex | | |
| Jade | – | Hitting; kicking | Tantrums; crying | Whining | My way please | – | I want my way please | – | Non-preferred leisure activities (e.g., coloring, puzzles); physical therapy exercises (e.g., practicing a pincer grip) |
| Brad | Head-to-floor; head-to-wall; head-to-table | Hitting; head-butting | Tantrums | Whining | My time | – | Can I have my time? | – | Cleaning toys; table tasks (e.g., receptive identification of objects, fine motor imitation) |
| Tamir | Hand-to-head | Hitting; kicking; scratching; throwing objects at others | Breaking toys; yelling; tantrums | Whining; swiping objects | My way, please | Can I have my way, please? | Excuse me [wait for adult], can I have my way please? | Okay + hands on lap | Homework (reading, spelling, math); parent-directed games (e.g., imaginary play) |

SIB self-injurious behavior; *Agg* aggression; *Dis* disruptions; *LCATB* less concerning associated topographies of behavior; *FCR* functional communication response; *Interm* intermediate; *TR* tolerance response; *CABs* contextually appropriate behaviors; – not applicable

Table 3 Interobserver agreement of child performance measures

| Participant | CB | FCRs | TRs | CABs | Time in SR |
|-------------|------------------|------------------|------------------|--------------------|--------------------|
| Jade | 97.7% (90%–100%) | 98.7% (90%–100%) | – | 98% (91%–100%) | 95% (90%–97%) |
| Brad | 100% | 97% (93%–100%) | – | 95.3% (90%–100%) | 92.9% (83.9%–100%) |
| Tamir | 97.7% (91%–100%) | 95% (80%–100%) | 98% (87.5%–100%) | 98.7% (87.5%–100%) | 92.5% (85%–97%) |

Range is provided in parentheses where applicable

CB challenging behavior; FCRs functional communication responses; TRs tolerance responses; CABs contextually appropriate behaviors; SR reinforcement; – not applicable

Table 4 Interobserver agreement of parent procedural integrity

| Participant | Baseline | FCT | TR Training | CAB Chaining | ECM |
|-------------|----------------|------------------|-------------|------------------|----------------|
| Mrs. J | 95% (84%–100%) | 100% | – | 98.6% (96%–100%) | – |
| Ms. B | 96% (92%–100%) | 100% | – | 100% | – |
| Mrs. T | 95% (92%–96%) | 97.3% (96%–100%) | 100% | 100% | 98% (96%–100%) |

Range is provided in parentheses where applicable

FCT functional communication training; TRs tolerance response; CAB contextually appropriate behavior; ECM enhanced choice model; – not applicable

Assessment Procedures

Parent–child dyads experienced the same functional assessment and treatment package (Fig. 1). The functional assessment consisted of an open-ended interview and an IISCA. The treatment package consisted of functional communication training, tolerance response training, and CAB chaining. The purpose of the assessment and treatment process was to identify the conditions under which challenging behavior occurred, then teach children to communicate, cooperate, and accept the denial of their preferences under those same circumstances. The remainder of the Methods section outlines the procedures for each phase of the assessment and treatment process, then describes their application to each parent–child dyad.

Open-Ended Interview

Coaches first conducted open-ended interviews (Hanley, 2012) with parents. Interviews lasted approximately 60 min, and included predetermined and follow-up questions aimed at identifying: challenging behavior topographies (e.g., “What do the behaviors look like?”), events correlated with challenging behavior (e.g., “Does anything seem to trigger challenging behavior?”), children’s interests and hobbies (e.g., “What does [name] like to do?”), and potential teaching targets (e.g., “What would

it be helpful for [name] to learn?”). After the interview, coaches and families outlined an intervention plan as well as the conditions of the IISCA. Parent questions about the assessment and treatment process were answered at this time.

Interview-Informed Synthesized Contingency Analysis

The IISCA involved rapidly alternating between matched, 5-min test and control sessions (see Hanley et al., 2014). Parents provided continuous access to all purported reinforcers nominated in the open-ended interview during control sessions, and withheld reinforcers while presenting instructions every 45 to 60 s during test sessions. All reinforcers were represented contingent upon the first instance of challenging or less concerning associated behavior in the test condition. Items included in the analysis were not restricted outside of sessions.

Teaching Parents to Implement the Interview-Informed Synthesized Contingency Analysis

Parents participated in behavioral skills training to learn to conduct the IISCA. Behavioral skills training occurred in a one-on-one meeting between coaches and parents when children were not present, and consisted of: a set of written instructions detailing how to set up the session space for the analysis, how to interact with children during analysis

Fig. 1 Practical Functional Assessment and Skill-Based Treatment Process. *Note.* The figure depicts the order of phases in the present experiment. Arrows with a cross hatch denote when behavioral skills training with parents occurred. IISCA is interview-informed synthesized-contingency analysis, FCT is functional communication training, CAB is contextually appropriate behavior. The * denotes a step that some families chose to end early or skip entirely. See Reversal and Tolerance Response Training in the Methods section for more details.

conditions, and how to respond to challenging behavior; parents asking questions of the coach; coaches informally quizzing parents on analysis procedures (e.g., “what will you do during the control condition?”); coaches modeling procedures for parents; and parents practicing the IISCA procedures with coach feedback. Training continued until parents demonstrated skills accurately and stated they felt confident implementing the IISCA.

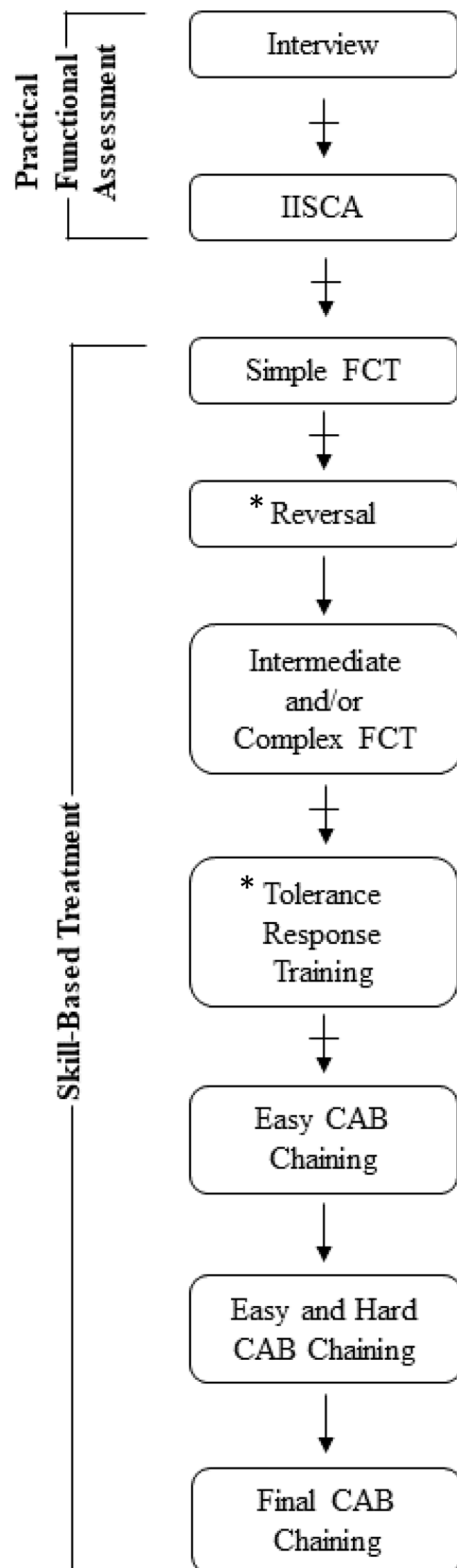
Real-Time Coaching

Following behavioral skills training, parents identified the real-time assistance they wanted to receive while implementing the IISCA with their children. Coaches told parents which condition to conduct, as well as when to provide instructions during the test condition. Coaches also provided corrections within 5 s of most errors, and occasionally praised correct implementation. If parents asked for additional support, coaches immediately provided instructions. Parents agreed to stop the IISCA if they felt it was unsafe, but this never occurred.

Individual Interviews and Analyses

Mrs. J and Jade During the interview, Mrs. J described Jade as a joyous child who liked sensory toys, watching movies, and playing with her family. Jade exhibited less concerning behavior topographies like whining, yelling, and rocking back and forth any time her preferred activities were interrupted, delayed, or denied (e.g., pausing a TV show and asking Jade to come eat dinner). If parents followed through with instructions, Jade’s behavior became more severe (hitting others) until eventually, meltdowns occurred. Mrs. J reported that talking calmly to Jade, allowing Jade to continue engaging with her preferred items or activities, offering alternative activities, and assisting in the completion of, or entirely omitting, difficult tasks (e.g., putting on shoes, occupational therapy exercises) would often stop the escalation of challenging behavior. Mrs. J asked to prioritize teaching Jade skills that would help her complete daily routines (e.g., physical therapy exercises) while parents completed their own household chores.

Based on these reports, the control condition of Jade’s IISCA consisted of continuous access to preferred toys and



activities (i.e., a Kindle™, squishy toys, coloring books, the TV), uninterrupted vocal and motor stereotypy, tickles, hugs, or games of tag initiated contingent upon her bids, and an absence of instructions. The test condition was identical to the control condition except that every 60 s, Mrs. J stopped any tickle fights or games of tag, walked over to Jade, and told her that it was time to do some work. Mrs. J then paused the TV, asked Jade to set down her toys, head over to a card table containing a variety of physical therapy exercises and leisure activities without screens (coins and cotton balls to sort into bins, small plastic toys, wooden inset puzzles), and use the items on the table instead. Reinforcers were represented contingent on the first instance of challenging behavior or less concerning associated behavior. Mrs. J listened to real-time coaching throughout the analysis with Bluetooth® headphones.

Ms. B and Brad Ms. B reported that Brad was a fun-loving child who enjoyed being outdoors and highly interactive play with his mother (singing songs, being thrown on beanbag crash pads, racing toy cars). Although Brad would hit others with an open hand or tantrum, Ms. B's primary concern was her son's head-directed self-injury. Brad would lean backward and hit his head on the floor, table, or wall when his play was interrupted or he was asked to transition to a less-preferred activity (schoolwork). Self-injury would sometimes result in cuts or bruises on Brad's head, but he did not require protective equipment and had never been hospitalized due to injury. Ms. B reported she could often prevent self-injury by asking Brad to emit a competing response (leaning forward), instructing him to "keep [his] head safe," offering him other items and activities, or simply telling him to stop. Ms. B also reported that self-injury was Brad's "last resort," and occurred only if his communication or less-concerning associated topographies of behavior (grimacing, clenching fists, yelling) did not result in more play time or a bettering of his circumstances (e.g., listening to music while waiting). Ms. B asked that Brad be taught to transition to and complete a daily activity so she could apply those skills to Brad's other routines.

During the control condition of the IISCA, Brad maintained access to his preferred items (an iPad®, cars, trucks, trains, books, and music), interactive play (singing songs, reading books, being thrown on a crash pad) was available contingent on his bids, and instructions were not presented. During the test condition, Ms. B called Brad's name, put down any toys she was holding, stood up, then asked Brad to clean up his toys, transition to a small table, sit down, and complete table tasks (e.g., matching to sample, tacting pictures) every 60 s. All reinforcers were represented contingent on the first instance of less concerning behavior (body rocking, grimacing, clenching fists, yelling) or severe behavior (hitting, tantrums, self-injury). Ms. B listened to

real-time coaching through Bluetooth® headphones during the analysis.

Mrs. T and Tamir Mrs. T reported that Tamir was a smart, affectionate boy who enjoyed playing pretend with parents, watching TV, and anything to do with superheroes, but that challenging behavior made daily routines difficult to complete. Whining and yelling immediately occurred whenever Tamir's play was interrupted (e.g., sharing with siblings, being asked to complete homework). If the interruption continued, behaviors escalated to throwing objects, aggression (hitting, kicking, or attempting to choke others), tantrums, and on rare occasions, mild self-injury (hitting the side of his head with the heel of his hand). Mrs. T reported that she could sometimes prevent Tamir's challenging behavior by ending interruptions to Tamir's play (stopping requests to do homework or share) or talking calmly to him, bringing him to a quiet place, and offering him other toys and activities. Mrs. T explained that her primary goal was to reduce aggression occasioned by parent instructions to complete daily routines or play with siblings, as self-injury occurred infrequently and was less harmful.

The control condition of Tamir's IISCA included access to preferred toys (i.e., an iPad®, Marvel™ action figures, Muppet™ puppets), parent attention (talking about TV shows, playing pretend) being provided contingent on his bids, and an absence of instructions. During the test condition, Mrs. T presented instructions to complete homework or to play following her rules every 45 s by calling Tamir's name, setting down anything she was holding, then asking Tamir to come to the coffee table to complete his homework assignments (reading books, spelling worksheets, math worksheets) or play differently (e.g., mom gets to choose what the action figures do). Reinforcers were represented contingent on the first instance of challenging behavior (aggression, throwing items, self-injury) or less concerning behavior (whining). Mrs. T listened to real-time coaching through her tablet speakers. To minimize how distracting the coach's feedback might be to Tamir, Mrs. T and the coach agreed on short phrases to use during the analysis to communicate quickly with one another (e.g., "go," "next"). Mrs. T also explained the analysis to Tamir prior to participation, so any questions he asked about the coach or analysis during reinforcement intervals were briefly answered before play resumed. Had Tamir asked any questions about the analysis or coach during instructions, Mrs. T would have asked Tamir to wait until he finished working, then answered his question during the next reinforcement interval.

Skill-Based Treatment Procedures

The treatment for challenging behavior was an intervention package consisting of prompting and differentially

reinforcing an increasingly complex set of skills while placing challenging behavior on extinction. The goal of the treatment process was to teach children to communicate their preferences, tolerate delays or denials of said preferences, and cooperate with the instructions originally presented during the test condition of the IISCA. Procedures consistent across phases are outlined below, followed by procedures unique to each phase or participant.

General Procedures

Parent–child dyads and coaches met for one-hour virtual visits three to five times per week to conduct teaching sessions. Teaching sessions were 5-trial blocks where parents taught target skills. Teaching sessions were identical to the test condition of the IISCA except that skills were reinforced instead of challenging behavior, and children could spend an unlimited amount of time experiencing reinforcement between trials.

All target skills were initially taught through errorless prompting. If errors occurred after a skill was acquired, parents used least-to-most prompting to occasion the skill (provide a vocal, positional, or gestural prompt, then model or physically guide the skill). Physical guidance was used exclusively with Jade and only at Mrs. J's discretion, as Jade sometimes needed help sitting or standing due to her low muscle tone. In addition to the prompting procedures described above, Mrs. T and the coach explained each intervention phase to Tamir due to his language abilities. Tamir's questions were answered before starting each new phase.

Children spent a minimum of 20 s in reinforcement between trials, but there was no upper limit for reinforcement time. In addition, coaches only started timing reinforcement intervals if parents identified their children as being happy, relaxed, and engaged with their preferred items and activities. Otherwise stated, even if instructions were terminated and reinforcers were available, coaches did not begin counting time spent in reinforcement if parents said their children were discontented or bored. Instead, parents followed their children's lead or honored appropriate requests until their children were happy, relaxed and re-engaged with one or more reinforcers. Parents then waited for at least 20 s before starting the next trial, though trial presentation was further delayed if parents decided that either they or their children needed more time in reinforcement. Reinforcement intervals generally ranged from 30 s to 2 min in duration, and teaching sessions ranged from 3 to 12 min in duration. Contextually inappropriate requests (e.g., playing outside in the sprinkler during a snowstorm) were denied by parents stating that the activity was unavailable at that time. Parents redirected children to other activities if needed.

If challenging behavior or less concerning behaviors occurred during trials, parents immediately prompted and

reinforced a skill (e.g., functional communication response, the next instruction), regardless of whether this was the targeted skill in a given phase, and ended the trial. At times, parents also continued the teaching trial and represented reinforcers once children emitted the target skill without challenging behavior. Consequences were not programmed for challenging behaviors or less concerning behaviors during reinforcement intervals, but all parents agreed to leave the session space any time they felt unsafe. Mrs. J and Ms. B never left the session space due to safety. The coach prompted Mrs. T to leave the session space once, but both Mrs. T and Tamir were unharmed. Children were not required to stay in the session space, and could leave at any time for any reason. Children occasionally left the session space to find snacks or new toys. On rare occasions, children did not return to the session space. This was often because they could not carry an activity back with them (e.g., Jade making faces in a hallway mirror). In these cases, parents chose to wait for their children to finish what they were doing or to resume teaching where their children were playing outside of the original session space.

Teaching sessions continued in each phase until mastery criteria were reached. Skills reached mastery when they were emitted independently and without challenging behavior across two consecutive teaching sessions (10 trials). Once mastery criteria were met, parents conducted two consecutive probe sessions. The only difference between probe sessions and teaching sessions was that data were video recorded and collected using the Instant Data program instead of the coach's tally system. If target skills met mastery criteria during probes, the next intervention phase began. If mastery criteria were not reached, up to two additional probes were conducted. If mastery criteria were reached during the additional two probes, the next phase of the intervention began. This occurred once with Brad. If performance worsened or did not change following the additional probes (e.g., challenging behavior increased or persisted, previously mastered skills were not emitted), coaches changed the intervention procedures. This occurred once with Tamir (see CAB Chaining section below).

If scheduled visits were cancelled due to family schedule conflicts, parents were encouraged to conduct teaching sessions without the coach to give children additional practice opportunities. When conducting teaching sessions independently, parents were asked to implement the same intervention steps they previously practiced with the coach. Parents never taught new skills without the coach. Parents were asked to bring data on the number of times their children correctly implemented skills and the number of times challenging behavior occurred to the coach during their next scheduled visit, but there was no penalty for failing to collect data or conduct additional sessions. On occasion, parents also asked to conduct additional sessions on their own. Mrs.

J and Ms. B reported implementing independent teaching sessions approximately once per month.

Teaching Parents to Implement the Skill-Based Treatment Process

Training to implement the skills-based treatment process was identical to the behavior skills training described for the IISCA, and occurred prior to most intervention phases (Fig. 1). This is also when parents selected the skill topographies their children learned during a given phase (functional communication, toleration, CABs).

Real-Time Coaching

Following training, parents identified the real-time coaching they wanted to receive while implementing treatment procedures. Coaches initially told parents when to start a trial, which type of trial to implement, and the specific instructions to deliver during CAB chaining trials. By the end of the intervention, Mrs. J and Mrs. T ran sessions without these prompts. Ms. B asked prompting to continue so she could focus on the highly interactive play her son preferred (see Individual Interviews and Analyses section above for a description of Brad's reinforcement context). If parents ever decided they wanted more or less real-time coaching, coaches immediately followed the parents' lead.

As with the IISCA, coaches delivered feedback for errors and correctly implemented skills throughout the intervention. If an implementation error posed a safety risk or interfered with teaching (e.g., evoked challenging behavior), coaches provided immediate instructions. Coaches remained silent for all other errors, but prompted the correct skill at the next available opportunity. Correct implementation occasioned two different types of praise. Brief praise (e.g., "that's it") was used to confirm that a skill was implemented accurately, and occurred after parents demonstrated a skill for the first time or corrected performance based on previous feedback. Descriptive praise was used to teach parents about the impact their behavior had on their children's performance, as well as how to use child performance to determine the success of their teaching. Descriptive praise occurred after children made notable progress, like when they first cooperated with instructions, or were happy, relaxed, and engaged during reinforcement after being asked to completing a particularly difficult task (e.g., "Did you see how quickly Jade asked for tickles when she was done working? She's just as happy with you now as she was before you asked her to cooperate. You set a high bar, but she was calm the whole time. You're teaching in small steps, and she trusts that you won't push her too far or too fast. You both did great.").

Descriptive praise or corrections were initially provided between each trial, but were gradually faded such that most feedback occurred between teaching sessions (Mrs. J) or at the conclusion of a visit (Ms. B and Mrs. T). However, additional instructions were always available contingent on parent requests. Parents were not required to meet mastery criteria for procedural integrity, but if procedural integrity errors negatively affected child performance (e.g., evoked challenging behavior), or persisted across three consecutive sessions, coaches provided supplemental training to parents outside of sessions.

Supplemental Training

Supplemental training consisted of reviewing session videos and practicing implementation skills one-on-one with the coach. First, parents reviewed video clips showing both their correct and incorrect implementation of a skill during a previous teaching session. Parents then independently scored their own performance with a copy of the training rubric (Online Appendix A), and reviewed the rubric with coaches immediately prior to their next scheduled visit. If the implementation errors persisted during teaching sessions, coaches scheduled additional practice immediately prior to the next scheduled visit. During practice sessions, coaches described and demonstrated target skills, asked parents to practice skills live with another person (e.g., a spouse), praised correct skill implementation, and provided corrective feedback for errors. Practice sessions continued until procedural integrity improved.

Supplemental training occurred four times across the experiment. Videos were provided in response to errors occurring with instruction delivery during CAB chaining (Ms. B and Mrs. T), and with programming sufficient child-led time during reinforcement intervals (Mrs. T). In addition, videos and additional practice were provided to assist with the transition to the enhanced choice model (Mrs. T).

Functional Communication Training

Parents prompted and differentially reinforced increasingly complex functional communication responses (Table 4) across simple, intermediate, and complex functional communication training phases. Mastery criteria were altered for Jade and Brad during simple functional training. Jade met mastery criteria when skills were emitted independently and without challenging behavior for 8 of 10 trials (two sessions), and Brad met mastery criteria when skills were emitted independently and without challenging behavior for five trials (one session).

Reversal to Baseline

The reversal to baseline was identical to the test condition of the IISCA. Only one session of the reversal condition was conducted to minimize the time where skills were placed on extinction. If challenging behavior had not returned to baseline levels, additional sessions would have been conducted. Brad did not experience a reversal due to Ms. B's concern over the potential occurrence of head-directed self-injury.

Tolerance Response Training

Tolerance response training consisted of children learning to emit an appropriate response after parents denied their requests. For a random 50% of trials per session, parents denied their children's functional communication responses ("no," "not right now," "sorry, not yet") and immediately reinforced the tolerance response (e.g., saying "okay"). The functional communication response was reinforced during the remaining 50% of trials. Jade and Brad initially began learning the tolerance response of giving a thumb's up, but when skill acquisition slowed, coaches asked Mrs. J and Ms. B whether they would prefer to continue teaching the tolerance response or to stop tolerance response training and move on to CAB chaining. Coaches and parents discussed the purpose of the tolerance response, strategies that might increase the rate of skill acquisition, the amount of time that might be required to teach the tolerance response, and what treatment outcomes might look like if children acquired or did not acquire the tolerance response. Both Mrs. J and Ms. B chose to stop tolerance response training in favor of starting CAB chaining sooner, as both parents reported that cooperation with daily routines was one of their greatest priorities for their children.

Contextually Appropriate Behavior (CAB) Chaining

During CAB chaining phases, children learned to complete the instructions programmed in the IISCA by relinquishing their reinforcers (easy CAB chaining), transitioning to a designated workspace to cooperate with a few instructions (easy and hard CAB chaining), then learning to cooperate with a greater number of instructions (final CAB chaining). Cooperation was reinforced for three of every five trials per session, and functional communication and tolerance responses were reinforced for the remaining two trials. Different numbers of instructions were presented for each trial where cooperation was reinforced, with the highest number of instructions increasing each time mastery criteria were met. For a complete list of possible instruction values, see Online Appendix B.

Once participants were completing up to seven instructions, one CAB trial per session was ended earlier than initially programmed by reinforcing appropriate responding at various, randomly determined points in the response chain. The purpose of the "short trial" was to ensure that all previously learned responses intermittently contacted reinforcement. During short trials, reinforcement was delivered contingent on independent correct responding that occurred prior to the completion of the programmed number of instructions. For example, if Jade began a trial where 20 instructions were programmed, the 10th instruction Jade completed or the transition to the table might be reinforced. The short trial in each session was never the trial with the lowest programmed number of instructions.

Mrs. J and Jade After mastery criteria were met during the final CAB chaining phase, the intervention was extended by teaching Jade to continue working independently while Mrs. J was in another room. Trials were identical to the final CAB chaining phase except that the distance Mrs. J stood from Jade was increased by one to two feet following each trial where Jade remained on task. If Jade stopped working, the coach asked Mrs. J to return to Jade's side, prompt her to continue working, then reposition herself farther from Jade. This process continued until Jade remained on task while Mrs. J completed a chore (making a snack, putting the dishes away) in another room.

Ms. B and Brad Three modifications were introduced during Brad's final CAB chaining phase in response to less-concerning associated topographies of behavior (e.g., whining) occurring during teaching trials. First, short trials occurred twice per session. Second, trials with any number of programmed instructions, even the lowest number, could become the short trial. Third, preferred activities that Brad enjoyed but were not nominated during the open-ended interview (e.g., breaking ice cubes rocks to retrieve the small figurines inside) were made contingent on Brad's successful transition to the work table once per session. A sixth trial was added to each session to provide additional practice with completing instructions.

Mrs. T and Tamir An additional probe session was conducted with Tamir when severe challenging behavior began recurring during teaching sessions. When challenging behavior persisted during the probe and Mrs. T reported discomfort implementing error correction and extinction procedures, an enhanced choice model of treatment (Rajaraman et al., 2022) was implemented. The enhanced choice model is a concurrent chains arrangement consisting of three contexts. In the first context (practice), reinforcers are provided contingent on skills. In the second context (hangout), reinforcers are noncontingently available. In the final context, children

opt out of the visit entirely and resume regularly scheduled activities (e.g., bedtime, free time).

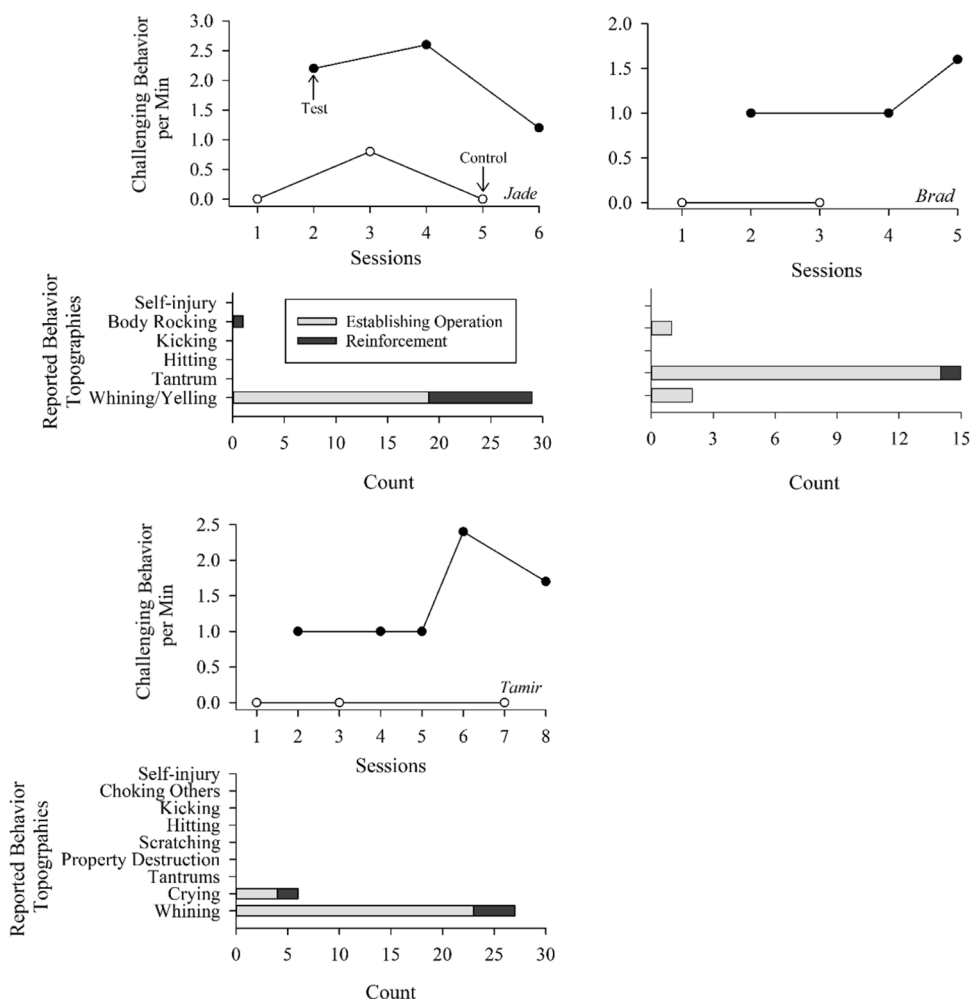
The practice context in the enhanced choice model was identical to the teaching sessions described above. The hangout context was located in a separate area of the master bedroom, and consisted of noncontingent access to preferred items and activities and some parent attention (questions were answered, but Mrs. T remained in the practice space). Opting out of the visit involved Tamir telling his mother that he did not want to participate in treatment or leaving the master bedroom for 5 min. Tamir transitioned between contexts by walking to that space or by stating his intention to transition. When Tamir re-entered the practice context, Mrs. T resumed the conditions that were in place when he originally transitioned away (i.e., reinforcement or establishing operation). Mrs. T described all procedural changes to Tamir prior to their implementation. Once the enhanced choice model was introduced, Tamir restarted the same CAB chaining levels he had previously mastered. A sixth trial was added to each session to provide additional practice opportunities emitting the tolerance response.

Estimated Costs and Social Validity

Estimated service costs were calculated by tracking the number of treatment and planning hours across each participant, and summing the values to create a grand total of costs. Hourly rates vary by region, so the hypothetical cost data from Santiago et al. (2016) were used for the calculations in the present study.

Social validity data were collected using a 7-point Likert-type scale questionnaire. A score of 1 on the questionnaire indicated the lowest rating, and a score of 7 indicated the highest rating. Social validity questionnaires were administered once following the completion of the functional analysis, and again following the completion of CAB chaining. Social validity data were also informally assessed throughout the experiment by asking parents how well they liked the intervention procedures and outcomes.

Fig. 2 Functional Analysis Data. Note Jade, Brad, and Tamir’s functional analysis data. The top panels depict the rate of challenging behavior across test and control sessions. The bottom panels depicts the number of times each response topography nominated in the interview occurred during the analysis. For Jade, self-injury was not measured



Results

Interview-Informed Synthesized Contingency Analysis

Responding during Jade’s functional analysis was elevated in the test condition relative to the control condition (Fig. 2). During one session of the control condition, challenging behavior occurred at a rate of 0.80 responses per min. Of the concerning behaviors Mrs. J reported during the interview, screaming and whining occurred most frequently. When these responses occurred, they were usually observed during the programmed EO (establishing operation; i.e., following instructions). Responding occurred exclusively

during the test conditions of Brad and Tamir’s functional analyses. Although body rocking, a purported pre-cursor to head-directed self-injury, was observed once during Brad’s analysis, severe challenging behavior never occurred. When challenging behavior occurred for either participant, responding was most likely during the programmed EO.

Skill-Based Treatment

Jade did not emit communication responses or CABs during baseline, and the majority of session time was spent in reinforcement (Fig. 3). Jade’s challenging behavior was reduced to zero rates following simple functional communication training, returned to baseline levels during the reversal, and

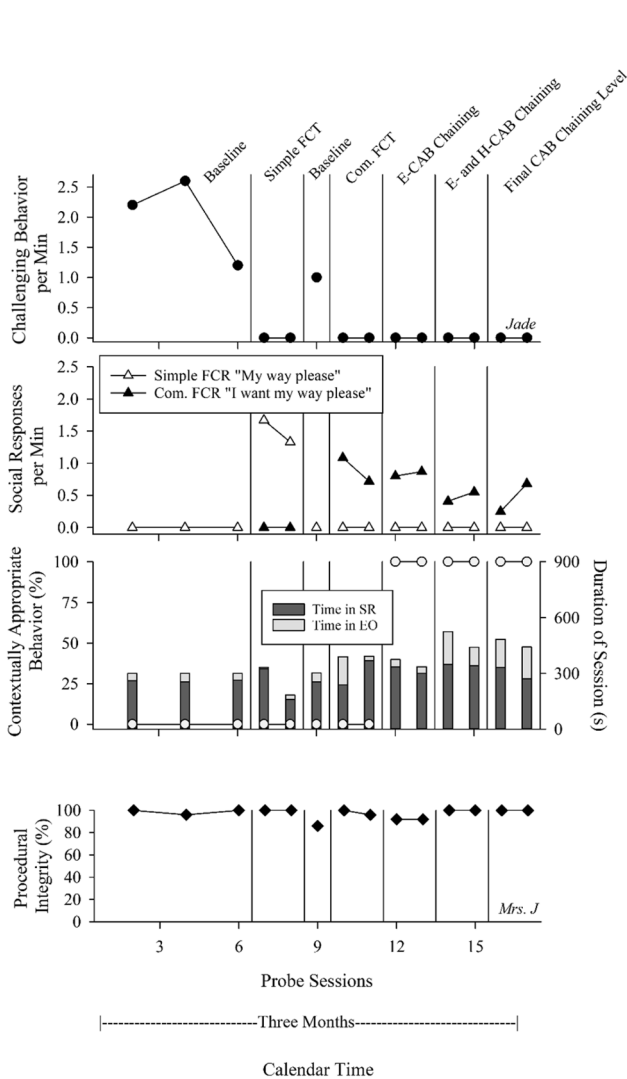


Fig. 3 Jade and Mrs. J’s Treatment Data. *Note* FCT is functional communication training, Com. is complex, E- is easy, H- is hard, CAB is contextually appropriate behavior, FCR is functional communication response, EO is establishing operation, and SR is reinforcement

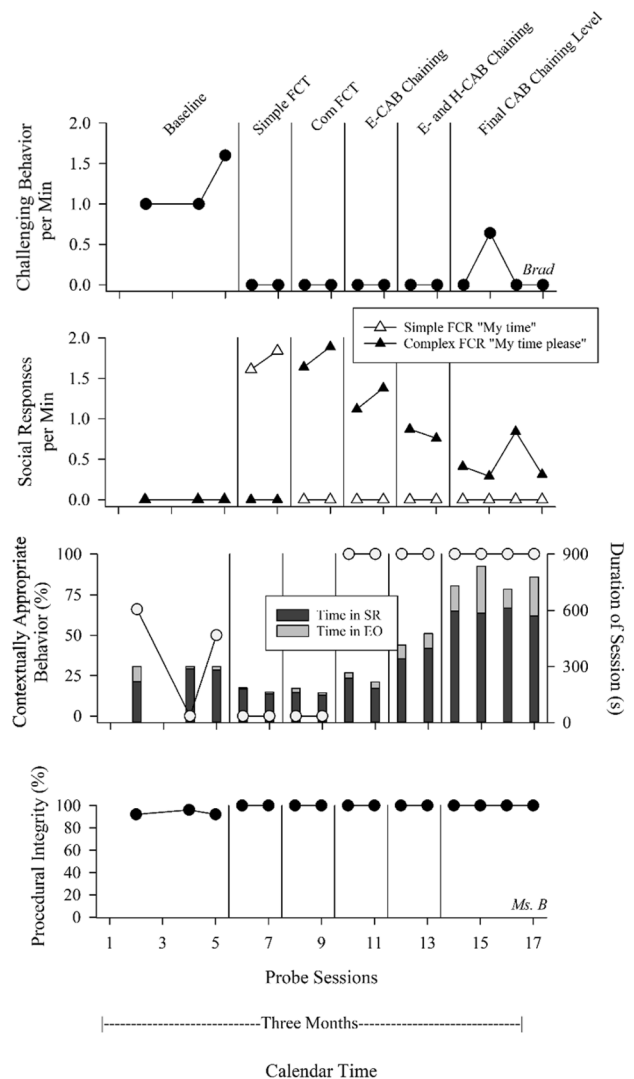


Fig. 4 Brad and Ms. B’s Treatment Data. *Note* FCT is functional communication training, Com. is complex, E- is easy, H- is hard, CAB is contextually appropriate behavior, FCR is functional communication response SR is reinforcement, and EO is establishing operation

remained at zero rates across the remainder of the intervention. Communication responses occurred at high levels during simple functional communication training probes, were eliminated during the reversal, and were re-established following complex functional communication training. CABs occurred across 100% of opportunities during CAB chaining probes, and time spent in the EO increased across treatment sessions relative to baseline. Procedural integrity remained above 80% throughout the assessment and treatment process. Mrs. J and Jade completed the assessment and treatment process in 37 visits across three calendar months.

Like Jade, Brad did not emit communication responses during baseline (Fig. 4). However, variable levels of CABs did occur. Challenging behavior fell to zero rates during functional communication training and remained low until session 15, when it occurred at a rate of 0.6 responses per

minute. Challenging behavior returned to zero rates during sessions 16 and 17. Communication responses occurred at high levels during simple and complex functional communication training probes and at lower levels across the intervention as session time increased. CABs occurred across 100% of opportunities during CAB chaining sessions, and time spent in the EO increased relative to baseline. Procedural integrity remained above 92% throughout the assessment and treatment process. Ms. B and Brad completed the assessment and treatment process in a total of 37 visits across three calendar months.

Tamir did not emit communication or tolerance responses during baseline (Fig. 5), but did emit CABs, resulting in extended EO intervals relative to those observed during Jade and Brad’s baseline conditions. Following simple functional communication training, challenging behavior fell to zero rates, returned to baseline levels during the reversal, and remained at zero rates for the majority of the intervention. Tolerance responses occurred consistently following tolerance response training, CABs occurred for at least 80% of opportunities during CAB chaining phases, and procedural integrity remained above baseline levels across all intervention probes. During enhanced choice model phases, Tamir used the hangout space during 14 of 19 visits. The average duration of time in the hangout space was 6 min (range 1 to 18 min), or approximately 10% of each visit. Tamir did not use the hangout space during any of the probe sessions depicted in Fig. 5, and never terminated a visit. Procedural integrity remained above 75% throughout the assessment and treatment process, which Mrs. T and Tamir completed in 48.5 visits across four calendar months.

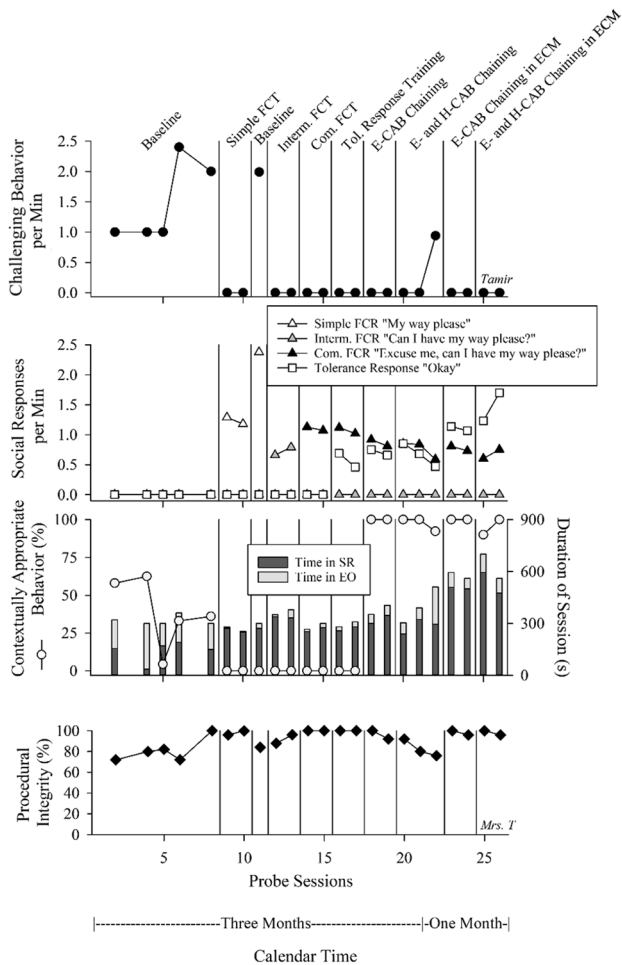


Fig. 5 Tamir and Mrs. T’s Treatment Data. *Note* FCT is functional communication training, Interm. is intermediate, Com. is complex, Tol. is tolerance, E- is easy, H- is hard, CAB is contextually appropriate behavior, ECM is enhanced choice model, FCR is functional communication response, EO is establishing operation, and SR is reinforcement

Estimated Service Costs

Table 5 describes the hypothetical, estimated cost of services across assessment and treatment processes in American dollars. Estimated costs were greater for intervention phases where participants took longer to meet mastery criteria than for intervention phases where mastery criteria were achieved relatively quickly. The total estimated cost of Jade, Brad, and Tamir’s assessment and treatment processes were \$5,875, \$5,877, and \$7,939, respectively.

Social Validity

Table 6 depicts social validity data for each parent–child dyad. Mrs. J, Ms. B, and Mrs. T found the interview to be very acceptable (average score of 6.7), found the functional analysis to be highly safe and acceptable (average score of 7), and felt very comfortable implementing the functional

Table 5 Hypothetical estimated service costs

| Steps | Participants | | | | | | | |
|---|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|
| | Jade | | Brad | | Tamir | | Average | |
| | Visits ^a | Cost ^b | Visits ^a | Cost ^b | Visits ^a | Cost ^b | Visits ^a | Cost ^b |
| 1. Interview* | 1 | 125 | 1 | 125 | 1 | 125 | 1 | 125 |
| 2. Functional analysis* | 3 | 375 | 1 | 125 | 1 | 125 | 1.7 | 208 |
| 3. Simple FCT* | 4 | 500 | 1.5 | 188 | 2 | 250 | 3.2 | 313 |
| 4. Intermediate FCT | – | – | – | – | 2.5 | 313 | 2.5 | 313 |
| 5. Complex FCT | 3 | 375 | 2 | 250 | 7 | 875 | 4 | 500 |
| 6. Tolerance response training* | – | – | – | – | 5 | 625 | 5 | 625 |
| 7. Easy CAB chaining | 4 | 500 | 1.5 | 188 | 6.5 | 813 | 4 | 500 |
| 8. Easy and hard CAB chaining | 2 | 250 | 3.5 | 438 | 5 | 625 | 3.5 | 438 |
| 9. Final CAB chaining level | 20 | 2500 | 26.5 | 3313 | – | – | 23.3 | 2907 |
| 10. CAB chaining within the Enhanced choice model | – | – | – | – | 18.5 | 2313 | 18.5 | 2313 |
| Totals | 37 | 4625 | 37 | 4627 | 48.5 | 6064 | 40.8 | 5105 |
| Report writing/planning | 3 | 375 | 3 | 375 | 4 | 500 | 3.3 | 417 |
| Supervision meetings ^c | 14 | 875 | 14 | 875 | 22 | 1375 | 16.7 | 1042 |
| Grand totals | | 5875 | | 5877 | | 7939 | | 6564 |

Table adapted from Santiago et al. (2016). All costs rounded to the nearest whole number. All visits are rounded to the nearest tenth. CAB chaining within the enhanced choice model represents both easy and easy and hard CAB chaining phases

FCT functional communication training; CAB contextually appropriate behavior

*A report writing and planning period was 1 hour in duration and occurred after each step marked by an asterisk

^aVisits between the coach and family were 1 hour in duration. Average visits are rounded to the nearest tenth

^bCost is denoted in American dollars. Hourly rate for experimenters is \$125. All costs are rounded to the nearest whole dollar

^cSupervision meetings conducted by the second author lasted approximately 30 min each week, and were half the cost of a visit (\$62.5)

analysis procedures (average score of 6.7). Mrs. J and Ms. B were satisfied with reductions seen in their children's challenging behavior during teaching sessions, (average score of 6) and felt very confident implementing the intervention procedures during teaching sessions (average score of 7). Mrs. J and Ms. B were still moderately to highly concerned about ongoing challenging behavior at home outside of the teaching context (average score of 5.5), but both parents felt confident implementing the intervention procedures outside of teaching sessions (average score of 6.5). Data were mixed as to whether the practice sessions were useful to the families' home lives. Mrs. J reported that the intervention was highly helpful to her home life (7), whereas Ms. B reported that the intervention was moderately unhelpful to her home life (3). The social validity questionnaire given to Mrs. T following the intervention was not returned.

Discussion

We coached three parents through conducting IISCAs of their children's challenging behavior at home via teleconference. The analysis results informed interventions in which challenging behavior was replaced by functional communication, toleration, and cooperation skills. The present study extends the literature on telehealth functional analytic services across populations, settings, and procedures by teaching families of children with autism living both within and outside of the United States to implement an IISCA and skill-based treatment process using differential reinforcement with unpredictable, contingency-based delays (Ghaemmaghami et al., 2016).

The purpose of this study was to evaluate whether positive treatment outcomes were possible when the IISCA and resulting skill-based treatment process was implemented by parents receiving real-time coaching via teleconference. All parents in this study achieved differentiated functional analyses, developed their children's communication, toleration,

Table 6 Social validity questionnaire results

| Question | Interview and Analysis | | | CAB Chain-ing | | |
|---|------------------------|---|---|---------------|---|----|
| | J | B | T | J | B | T |
| I found the interview proces to be <i>not acceptable/highly acceptable</i> | 6 | 7 | 7 | | | |
| I was <i>not comfortable/highly comfortable</i> during the interview process | 7 | 7 | 7 | | | |
| I found the functional analysis of my child's problem behavior to be <i>not acceptable/highly acceptable</i> | 7 | 7 | 7 | | | |
| After having witnessed it, I consider the functional analysis to be <i>not safe/highly safe</i> for my child and I | 7 | 7 | 7 | | | |
| I was <i>not comfortable/highly comfortable</i> watching/implementing the functional analysis of my child's problem behavior | 6 | 7 | 7 | | | |
| Rate the extent to which you felt comfortable implementing the SBT process in the practice context (<i>not comfortable/highly comfortable</i>) | | | | 7 | 7 | NR |
| Rate the extent to which you are satisfied with the improvement in your child's problem behavior during practice sessions (<i>not satisfied/highly satisfied</i>) | | | | 7 | 5 | NR |
| Rate the extent to which you are concerned about your child's ongoing problem behavior at home (<i>not concerned/highly concerned</i>) | | | | 5 | 6 | NR |
| Rate the extent to which you have found the assessment and treatment process helpful to your home situation up to this point (<i>not helpful/very helpful</i>) | | | | 7 | 3 | NR |
| Rate the extent to which you feel confident applying the same strategies you have implemented in the practice sessions throughout the day (<i>not confident/highly confident</i>) | | | | 7 | 6 | NR |

Table contains all questions included in social validity questionnaires given to caregivers. Numbers indicate the respondent's answer to each question on a 7-point Likert Scale-Type questionnaire, where the score 1 represents the lowest rating and the score 7 indicates the highest rating
J Mrs. J, *B* Ms. B, and *T* Mrs. T, *SBT* skill-based treatment, *CAB* contextually appropriate behavior, *NR* not returned

and cooperation skills, and reduced challenging behavior in contexts where it was reported to be severe and likely. Two of three parents also achieved treatment outcomes commensurate with those obtained by experts. Jade and Brad were both completing up to 20 instructions without challenging behavior at the end their interventions, which is within the range of instructions that participants from Jessel et al. (2018) were completing at the end of similar skill-based treatment processes.

The number of instructions completed by Jade, Brad, and Tamir were similar to those in Jessel et al. (2018), but participants in the present study spent less time working compared to participants in previous research studies. By the end of their treatment processes, Jade, Brad, and Tamir spent approximately 10% to 25% of session time in the EO interval, whereas the participants in Hanley et al. (2014) and Santiago et al. (2016) spent 40% to 50% of session time in the EO interval. Time spent cooperating could have been increased, but parents in this study reported being more interested in applying their children's skills across other daily routines than in increasing time spent in the EO interval, so time spent in the EO interval was not increased. Future studies might investigate whether increasing the amount of time spent in the EO influences an intervention's generality.

All treatment outcomes were achieved while keeping families safe. Children were referred to the present

study for the treatment of severe challenging behaviors like aggression and self-injury, but self-injury and aggression never occurred during IISCAs, and did not frequently occur during the intervention. Brad emitted self-injury during the intervention, but when he did, it was redirected by Ms. B. Tamir never emitted self-injury during the intervention, and Mrs. T only left the session space once due to property destruction. It is unclear which components of the intervention contributed most to the families' safety, but providing extended access to synthesized reinforcement, allowing children to leave the session space, and individualizing treatment procedures may have played a role.

Extended time in reinforcement may have contributed to participant safety by allowing parents to make judgment calls about when to run trials. Parents had a clearer understanding and a clearer view of their children's body language than the coaches viewing sessions on Zoom, and were in a better position to detect whether reinforcement was experienced by children. If trials were conducted when reinforcement was programmed but not experienced by children, challenging behavior may have been more likely to occur. In addition, allowing children to leave the teaching space for any reason may have provided an alternative for challenging behavior, as may have been the case with Tamir, who often left the teaching space to take breaks in the hangout space until he decided he was ready to learn again.

Teaching procedures were individualized to family preferences and child skills throughout the study. Some modifications, like omitting reversals or incorporating an enhanced choice model of treatment, may have promoted safety by allowing for clinical decisions to be made based on children's responses to the intervention. These same modifications also limit comparisons about the effects of the intervention over behavior and the contribution of each element of the intervention toward behavior change. It is possible to conduct a component analysis to further understand the individual effects of each intervention component on treatment outcomes, but such component analyses might pose a safety risk because certain intervention components may be effective at producing behavior change together, but not separately. Future researchers may be interested in conducting large-N studies to examine the effect of different treatment packages across participant populations.

Social validity outcomes obtained in this study were comparable to those in previous research (e.g., Santiago et al., 2016) in that parents were highly satisfied with their children's performance during teaching sessions, were comfortable implementing the assessment and treatment procedures, and were confident in applying those procedures outside of sessions. However, both Mrs. J and Ms. B reported that they were still concerned about ongoing challenging behavior at home, and results were mixed as to whether the skills children learned were relevant to daily routines. These data may reflect the progress families made in reaching their initial treatment goals. All parents in the present study stated that they wanted their children to be successful across a variety of daily routines, but teaching occurred in only one context. Ratings were highest for Mrs. J, who achieved her goal of teaching Jade to complete routines independently while she tended to chores around the house. Ratings were lowest for Ms. B, who taught Brad to complete one daily routine. Taken together, the social validity data imply that the procedures and outcomes of the intervention were socially valid even if the scope of the intervention was not. Future researchers might conduct multiple social validity assessments to detect shifts in parent priorities during tele-consultations, or investigate ways for parents to implement interventions at their own pace.

One limitation of this study is that skill maintenance and generalization were not assessed. As this study is the first telehealth adaptation of the IISCA and skill-based treatment process to international families, our primary goal was to determine whether treatment outcomes similar to those achieved by experts were possible. Future research should be dedicated to assessing the extent to which parent and child skills transfer to other contexts, and to evaluating strategies that promote skill transfer and maintenance when they do not.

Another limitation is that Mrs. J and Ms. B never conducted teaching sessions without in-vivo coach feedback. This was due to parent preference. Mrs. J intermittently solicited feedback on her performance during EOs, and Ms. B asked coaches to tell her which trials to run during teaching sessions so she could focus on creating an engaging reinforcement context for Brad. However, other studies (e.g., Gerow et al., 2018) have found that when given the opportunity, parents can learn to implement similar function-based treatment processes without in-vivo coach feedback and with at least 80% treatment integrity. Future studies might investigate the optimal level of professional support for families receiving and telehealth services.

One final limitation is that the intervention took three to four months to complete. Telehealth services may require parents to balance caregiving, working, and teaching, so it is important to understand the factors that moderate the speed or success of such treatment processes. In the present study, the entire consultation took at least 35 h and three months to complete. Increasing the number of hours that coaches and families meet each week might reduce the number of months families require telehealth services even if total treatment time remains the same. Participant characteristics may also moderate treatment speed, but their role in the present study is unclear.

As some factors may influence treatment speed, other factors may influence whether a treatment outcome is successful. One factor that might preclude a successful treatment outcome is a lapse in procedural integrity related to providing reinforcement and progressing EOs. These errors may cause increases in challenging behavior due to the degradation of the reinforcement contingencies programmed during the intervention, as may have been the case with Tamir. It is unclear how other variables, such as cultural background, parent education, or knowledge of behavior analysis influenced the outcomes of this study. Ms. B and Mrs. T, for example, were actively providing behavior analytic services and attending a graduate program in behavior analysis during the study, respectively. This means that Ms. B and Mrs. T were not truly naïve participants, and may have found it easier to access behavior analytic services or use behavior analytic teaching strategies than Mrs. J, who had no previous behavior analytic experience. However, all parents achieved successful treatment outcomes despite differences in culture, education level, or previous behavior analytic experience. All parents in the present study also required minimal supplemental training, with Mrs. J requiring none. Future researchers might investigate how participant characteristics moderate treatment speed or outcomes.

Rather than educational background or previous behavior analytic experience, a second factor that may have influenced outcomes in the present study is the support that parents had for their other children in the home while they were

conducting research sessions. Ms. B ended her participation in part because she was the primary caregiver in her household, and research sessions prevented her from caring for her other child as the COVID-19 lockdowns began. Likewise, Mrs. T was often the only caregiver present in the home during sessions, and was balancing her own graduate studies, daily responsibilities, and her other children's needs in addition to research participation. In contrast, Mrs. J had other family members available to provide childcare while she and Jade participated in research sessions. Future researchers might investigate how resources such as childcare influence intervention outcomes, as well as how to optimize telehealth interventions such that all families, regardless of resources, might sustainably integrate teleconsultative services into their daily routines.

The findings from the present study add to the evidence supporting the use of telehealth models of functional analytic service provision to families around the globe. Telehealth services may allow families to receive care for loved ones who exhibit challenging behavior regardless of whether their communities have direct access to BCBA's trained in the implementation of functional analyses and function-based treatments. Infrastructure for telehealth services may be improving following the rise in teleconsultation during the COVID-19 pandemic, but more research will need to be conducted on how to provide telehealth-based services safely and sustainably before they can be widely recommended to all families in need of support.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10803-023-06085-5>.

Author Contributions RLM was responsible for project conceptualization, training data collectors, training parent coaches, parent coaching, data collection, data analysis, and manuscript writing. GPH was responsible for project conceptualization, participant recruitment, supervising RLM and MJC, data analysis, and manuscript writing. MJC was responsible for parent coaching, data collection, data analysis, and manuscript writing.

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Declarations

Ethical Approval This study was approved by the Western New England University Institutional Review Board.

Informed Consent Informed consent was obtained from all participants included in the study.

Competing interests The second and third authors work at a company that trains behavior analysts to implement interview-informed synthesized contingency analyses and skill-based treatment processes, but participants in this study were not affiliated with the company, and did not pay for services.

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