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ORIGINAL ARTICLE

Conducting Functional Communication Training via Telehealth to Reduce the Problem Behavior of Young Children with Autism

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Abstract Functional communication training (FCT) was conducted by parents of 17 young children with autism spectrum disorders who displayed problem behavior. All procedures were conducted at regional clinics located an average of 15 miles from the families' homes. Parents received coaching via telehealth from behavior consultants who were located an average of 222 miles from the regional clinics. Parents first conducted functional analyses with telehealth consultation (Wacker, Lee et al. *Journal of Applied Behavior Analysis*, in press) and then conducted FCT that was matched to the identified function of problem behavior. Parent assistants located at the regional clinics received brief training in the procedures and supported the families during the clinic visits. FCT, conducted within a nonconcurrent multiple baseline design, reduced problem behavior by an average of 93.5 %. Results suggested that FCT can be conducted by parents via telehealth when experienced applied behavior analysts provide consultation.

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Functional communication training (FCT; Carr and Durand 1985) is among the most common and effective differential reinforcement programs described in the operant literature (Tiger et al. 2008). In their seminal article, Carr and Durand (1985) showed how appropriate communicative acts, or mands, could be used to reduce the occurrence of problem behavior. Following an experimental analysis of problem behavior, four students with developmental disabilities were taught to request the reinforcers that were shown to be related to increased displays of problem behavior. For example, students who showed the most problem behavior during work situations were taught to request teacher assistance. Teaching the students to use appropriate communication instead of problem behavior to obtain desired outcomes was successful in reducing each student's problem behavior.

As of 2008 (Tiger et al. 2008), over 60 cites were listed in PsycINFO® for functional communication training, with most continuing to show that FCT is highly effective in reducing problem behavior (e.g., Wacker, Harding et al. in press) and is highly acceptable to parents who conducted FCT in their homes (Wacker et al. 2011).

Most studies investigating FCT have followed the recommendation of Durand and Carr (1985) to precede the training of FCT with a functional analysis (FA). Identifying the function of problem behavior permits interventionists to implement differential reinforcement procedures effectively as a key component of intervention (Pelios et al. 1999). This two-step approach to treatment, conducting a functional analysis followed by functional communication training, has proven to be a very effective treatment package to reduce the problem behavior displayed by persons with developmental disabilities. Epidemiological studies (e.g., Asmus et al. 2004; Kurtz et al. 2003; Wacker et al. 1998) have shown that FA plus FCT can be conducted in inpatient clinics, outpatient clinics, and home settings and can result in substantial reductions in problem behavior.

Wacker and colleagues (Berg et al. 2007; Derby et al. 1997; Wacker et al. 1998, 2005) reported that FA plus FCT could be adapted and used effectively by parents in their homes when on-site coaching was available from applied behavior analysts. The collective results of these studies showed consistently that FCT programs decreased the occurrence of problem behavior by approximately 90 % when conducted entirely by a parent who had no to very little prior training in the procedures. As described by Harding et al. (2009), the on-site behavior analyst coached the parent by prompting, correcting, and praising the parent while the parent conducted the procedures.

Wacker, Lee et al. (in press) noted that the demand for behavior analysis services often far exceeds the availability of these services, even with the application of the procedures to home and outpatient clinic settings. At the University of Iowa (UI) Children's Hospital, for example, wait times for outpatient behavioral clinic appointments are often 6 months or longer, and there are fewer than 35 board certified behavior analysts currently listed in the Iowa certificant registry (Behavior Analyst Certification 2012). Children with autism spectrum disorders often engage in problem behavior at very early ages (Rogers and Wallace 2011), which makes it important to provide treatments such as FCT as part of early intervention programs. One possible

solution to this problem of treatment access is to use telehealth to conduct FCT regardless of geographic location.

Barretto et al. (2006) showed that it was possible to provide FA plus FCT via telehealth. These authors conducted FAs and brief treatment probes with two children who displayed problem behavior. All procedures were conducted by professional staff at a school or a Department of Human Services office with behavior analysts providing directions on how to conduct the procedures. This study showed that FA plus FCT could be conducted effectively, at least by professional staff, via telehealth.

The purpose of the current study was to conduct the same FA plus FCT treatment package by parents but to provide coaching via telehealth. Trained behavior analysts, who were located an average of over 200 miles from the outpatient clinic sites where the parents conducted the procedures, coached all sessions remotely while parents conducted sessions at the regional health clinics. Wacker, Lee et al. (in press) showed that good results occurred with the FA procedures prior to initiating FCT. Specifically, FAs were conducted within multielement designs with 20 children, and social functions were identified for 18 of the children. In this study, we report the outcomes of the second step of treatment, FCT, and evaluate if the outcomes of FCT delivered via telehealth are comparable to those obtained in previous studies when treatment was conducted in-vivo in the families' homes.

Method

Participants and Setting

Thirteen children who participated in Wacker, Lee et al. (in press) also participated in this study (see Table 1). However, the FCT baseline for Nate was based on an extended FA, not the FA presented in Wacker, Lee et al. (in press). The parents of four additional children, Mitt, Mel, Newt, and Tad, conducted FAs with the same telehealth coaching procedures used in Wacker, Lee et al. (in press), but the FAs occurred after that study was completed. With all children, the FCT step was conducted immediately following the completion of the FAs. All participants were referred by clinical staff from the UI Children's Hospital or by nursing staff from one of the five regional Child Health Specialty Clinics (CHSC) that participated in this project. To be eligible for the study, all participants met the following four criteria: (a) were between the ages of 18 and 83 months at the time of the diagnostic evaluation; (b) lived within a 50-mile radius of one of five regional medical clinics participating in the study; (c) displayed problem behavior such as aggression, self-injury, destruction, or disruption; and (d) met the diagnostic criteria for an autism spectrum disorder (ASD). Wacker, Lee et al. (in press) provides further demographic and diagnostic information. To be included in the present study, the participant must have completed both the FA and the FCT procedures. Seven participants from the Wacker, Lee et al. (in press) study did not complete FCT procedures because of changes in family circumstances (Anna, Mari), school schedules (Aaron), end of study participation (Ned, Omar), absence of an identified function (Ethan), or parents' negative perception of FCT (Piers).

Table 1 Participant demographic information

	Alias	Gender	Age in months	Diagnosis
1	Ames[a]	M	38	PDD NOS
2	Ben[a]	M	44	PDD NOS
3	Cal[a]	M	64	Autistic disorder
4	Carlos[a]	M	72	PDD NOS
5	Jack[a]	M	68	Autistic disorder
6	Jake[a]	M	66	Autistic disorder
7	Jeb[a]	M	38	PDD NOS
8	Jill[a]	F	80	Autistic disorder
9	Kyle[a]	M	56	Autistic disorder
10	Matt[a]	M	37	PDD NOS
11	Max[a]	M	29	PDD NOS
12	Mel[b]	M	30	Autistic disorder
13	Mitt[b]	M	34	Autistic disorder
14	Nate[a, b]	M	57	PDD NOS
15	Newt[b]	M	36	PDD NOS
16	Tad[b]	M	61	PDD NOS
17	Zeke[a]	M	60	PDD NOS

[a] Also participated in Wacker, Lee et al. (in press)

[b] FA baseline data not included in Wacker, Lee et al. (in press)

Participant Demographic Information

Participants were 17 children diagnosed with an ASD between the ages of 29 and 80 months who displayed a social function for problem behavior during previously conducted FAs. Two participants (Ames, Max) received two versions of FCT to address two functions; therefore, a total of 19 treatments were conducted with these 17 children.

Participating Parent, Parent Assistant, and Behavior Consultant Demographic Information

Participants' parents (16 mothers, 2 fathers) served as therapists during all FCT procedures with coaching from a behavior consultant. Parents were an average of 33 years of age. Most parents had some level of post-secondary education and 15 were married or living with the participant's other parent. Parents had no formal training in behavioral treatment prior to their participation in this study.

The on-site parent assistants were the same as described in Wacker, Lee et al. (in press) and were local individuals hired by the regional CHSC nurses as "family navigators." None of the parent assistants had a background in applied behavior analysis before their participation in this study. Parent assistants were present in the regional clinic rooms during the FAs and FCTs to provide on-site support to the parents by preparing session materials such as toys, conducting safety checks of the

clinic room, and providing physical assistance with the participants as needed by the parents. The parent assistant and the behavior consultant met briefly via videoconferencing or telephone before and after each telehealth visit, as needed, to review the procedures to be conducted, to prepare the room and materials, to discuss the results obtained, and to plan for the next telehealth visit.

The same two behavior consultants who coached the FAs in Wacker, Lee et al. (in press) coached all FCT sessions, with the exception of sessions for Mitt and Tad, which were coached by a senior behavior analyst with 20 years of experience. Behavior consultants were located at the UI Children's Hospital in Iowa City, Iowa. Behavior consultants trained parent assistants to support parents during FCT sessions and trained and coached parents to complete FCT with their children.

Regional Clinics and Teleconsultation Center

Both the CHSC and the Teleconsultation Center were the same as described in Wacker, Lee et al. (in press). Five CHSC sites in Iowa were selected for inclusion in this study (Council Bluffs, Davenport, Ottumwa, Sioux City, and Spencer). These sites were selected based on the accessibility of reliable high-speed internet, the availability of support staff, pre-existing videoconferencing capabilities, and geographical proximity to rural and underserved communities in Iowa. The dimensions of the rooms at the five clinics varied, but were approximately 5 m by 5 m.

The behavior consultants directed the FCT sessions from the Teleconsultation Center located at the Center for Disabilities and Development in the UI Children's Hospital. The Teleconsultation Center had four partitioned teleconferencing work stations with one Windows-based PC and video monitor at each station. Each PC had a basic webcam and headset attached to capture and transmit audio and video from the behavior consultant to the CHSC sites. The desktop PCs used teleconferencing software to connect consultants to the CHSC sites as well as to view and record sessions for subsequent data coding and analysis. The software allowed the consultant to manipulate the camera at the CHSC clinic to keep the child and the parent visible. Recordings had a 6-s interval audio track added to prompt data coding. Recordings were viewed for data coding using playback software that allowed data coders to slow down the playback or increase the volume as needed.

Response Definitions and Data Recording System

All procedures were digitally recorded using videoconferencing software for data collection and analysis at the UI Children's Hospital site. Trained data collectors at the UI Children's Hospital used a 6-s partial-interval recording system to code data on child behavior from the digital recordings. Problem behaviors that were reinforced during the FA were combined and labeled *target problem behavior*. The target problem behaviors for each participant were identified by the parent as the behaviors of most concern and included aggression, self-injury, property destruction, screaming, elopement, repetitive behavior, and dangerous behavior. *Aggression* was defined as any behavior that could result in tissue damage to another person (e.g., hitting, kicking, throwing items at the person). *Self-injury* was defined as any behavior that could result in tissue damage to the child engaging in that behavior (e.g., head

banging, head hitting, biting self, throwing self on floor). *Property destruction* was defined as any behavior that could result in damage to property (e.g., kicking items, throwing items, ripping books). *Screaming* was defined as loud vocalizations that were above a conversational level. *Elopement* was defined as the child's moving or attempting to move away from the parent when the parent delivered a demand or when the child attempted to leave the clinic room. *Repetitive behavior* was defined as non-functional repetitive movements of body parts or repetitive movement of objects. Repetitive behavior was targeted only for Jill, for whom it was defined as dropping to the floor and rocking repeatedly and placing her hands over or under her clothing around her groin area. *Dangerous behavior* was defined as climbing and lying on furniture and leaning or jumping off high surfaces. *Task refusal* was defined as verbal or gestural refusal to complete a task approximately 12 s after a parent demand. *Independent manding* was defined as requesting reinforcement appropriately without physical guidance or a specific prompt. *Toy engagement* was defined as physical contact with a toy or eyes oriented toward a book.

For FCT escape, trained data collectors used an event-recording procedure to record participants' task completion as described by Wacker, Lee et al. (in press). Each task was coded as either completed independently (without physical guidance) or not completed independently.

All data were collected during weekly 60-min visits in which the parents traveled to their regional CHSC and received live coaching from the behavior consultant to assist them in conducting FCT. The behavior consultants remotely recorded from one to five (M=2.59) 5-min sessions during each visit.

Interobserver Agreement

Child Targeted Problem Behavior Two independent raters collected interobserver agreement (IOA) on the percentage of 6-s intervals with target problem behavior using interval-by-interval comparisons in which the number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 %. IOA for target problem behavior was collected for 34.21 % of sessions (baseline and all FCT sessions) and averaged 97.37 % (range, 89.63 % to 100 %) across all participants.

Reduction of Problem Behavior To calculate the mean reduction in problem behavior, the mean percentage of intervals with problem behavior during the final three treatment sessions was subtracted from the mean percentage of intervals with problem behavior during baseline. This total was then divided by the baseline and multiplied by 100 %. IOA for the reduction in problem behavior was conducted for all participants by two independent raters and was 100 %.

Additional Measures IOA data were collected by at least two independent raters on (a) the identified function of each participant's targeted problem behavior, (b) the type of treatment each participant received, (c) the number of sessions and visits (in weeks) to complete treatment, (d) the relevant baseline and last three treatment sessions for each participant, (e) the number of missed appointments during treatment, and (f) the treatment acceptability ratings by parents. IOA was collected for over 75 % of the results and was 100 %.

Costs We calculated the cost of round-trip mileage at the state reimbursement rate of $0.285 per mile for families to travel from their homes to the closest CHSC. This amount was added to the cost of 1 h of the consultant's paid time at $25.47/h and the cost of 90 min of paid time for the parent assistant at $16.00/h. The amount for each participant's weekly visit was then multiplied by the number of weekly visits to determine the total costs for that participant. Each participant's total costs were summed and then averaged across all participants in the sample to identify the mean cost of a weekly visit. The same procedure was used to calculate in-vivo costs; however, the mileage reimbursement for state employee travel was $0.278 per mile, and mileage from the UI Children's Hospital telehealth center to participants' homes was used. The cost of consultant hours included driving time with the cost of parent assistants removed.

Design

FCT was conducted immediately following completion of the FA for each child (Wacker, Lee et al. in press). Parents, with coaching from the behavior consultant and on-site support from the parent assistant, conducted FCT as described by Wacker et al. (1998) within a nonconcurrent multiple baseline (across children) design. Baseline, which consisted of the relevant sessions from the child's FA, ranged from three to seven sessions.

FCT Procedures

FCT sessions were conducted during weekly 60-min visits for all 17 children (see Table 2). A total of 19 FCT programs were completed as follows: FCT escape (13), FCT tangible (5), and FCT attention (1).

FCT Escape Thirteen children received the FCT escape treatment. During escape sessions, the child was first taught to comply with the task request (work) and then to mand for a break to play. Thus, FCT escape comprised a two-step chain in which compliance produced the opportunity to mand and manding produced a 1- to 2-min enriched break (with preferred toys and parent attention) to play. Each training session began with the parent providing attention to the child while the child played with toys for 20 to 30 s. After this brief period of play, the parent showed the child a picture/word card that said, "Work," and told the child, "Time to work. When we're done, you can play." The child was then directed to sit at a desk during the work task. The parent provided specific verbal directions and modeled how to complete each task (e.g. "Put the red block in the bucket."). If the child completed the task, the parent praised the child. If the child did not attempt the task, the parent provided hand-over-hand guidance. If physical guidance was needed, the parent then presented another task for the child to complete without physical assistance. The child was required to complete each task independently prior to receiving praise and the opportunity to mand (e.g. "Play") to obtain the enriched break. As training continued, the work requirement for each training session was increased within a demand fading program (Lalli et al. 1995) to the initial levels (e.g., 10 tasks) used during the FA. During initial FCT sessions, each child was required to complete two work tasks

Table 2 Results of FCT for all participants

Alias	Identified function	Treatment	Percentage of intervals of problem behavior at baseline	Percentage of intervals of problem behavior during final 3 treatment sessions	Percent reduction in problem behavior
Ames	Escape	FCT-escape	16.000	0.000	100.000
	Tangible	FCT-tangible	17.330	0.670	96.134
Ben	Escape	FCT-escape	10.670	1.330	87.535
Cal	Escape	FCT-escape	13.330	0.000	100.000
Carlos	Tangible	FCT-tangible	14.670	0.000	100.000
Jack	Escape	FCT-escape	14.000	0.000	100.000
Jake	Escape	FCT-escape	21.330	0.000	100.000
Jeb	Escape	FCT-escape	17.330	0.670	96.134
Jill	Escape	FCT-escape	6.670	0.000	100.000
Kyle	Tangible	FCT-tangible	18.000	0.000	100.000
Matt	Tangible	FCT-escape	21.330	0.000	100.000
Max	Escape	FCT-escape	22.670	2.670	88.222
	Tangible	FCT-tangible	17.330	1.330	92.325
Mel	Tangible	FCT-escape	17.000	1.330	92.176
Mitt	Tangible	FCT-tangible	10.670	3.330	68.791
Nate	Tangible	FCT-escape	23.400	0.000	100.000
Newt	Escape and tangible	FCT-escape	14.000	3.330	76.214
Tad	Attention	FCT-attention	11.000	2.000	81.818
Zeke	Escape	FCT-escape	22.860	0.670	97.069
Mean					93.496

(FCT [2]) during the course of two trials (i.e., one task per trial). When the child was successful, the work requirements were increased to 10 work tasks (FCT [10]) per session (i.e., five tasks per trial). For one child (Cal), task demands were increased to 20 tasks (FCT [20]) per session (i.e., 10 work tasks per trial).

After the child completed the required work task, the parent presented either a "Play" card or a microswitch with a "Play" card attached and said, "Do you want to do more work or play?" or "Tell me if you want to play." For some children, the parent showed a piece of the work task and asked the same question. Over time, a more general prompt was typically delivered such as, "Tell me what you want." If the child emitted the target mand or other appropriate, functionally equivalent mand, he or she was praised and received a 1- to 2-min break to play with toys with the parent. If the child did not emit an appropriate mand but was not engaging in targeted problem behavior, the parent gave a more specific prompt, such as "Say, 'play,'" or "Touch the card if you want to play," or provided hand-over-hand assistance in touching the card. Targeted problem behavior during work activities was blocked in

a neutral fashion (i.e., did not result in escape). If the child engaged in targeted problem behavior during play activities, the break was ended and the child was required to return to work. Nontargeted problem behavior was ignored.

FCT escape was used for seven children who had only an escape function, for three children who had an escape plus tangible function, and for three children who had only a tangible function (see Table 2).

For the three participants who had only a tangible function, the same set of procedures was conducted but with an added focus on the child's relinquishing possession of the tangible items (e.g., toys and candy for Mel) to come to the work table and complete the task. For these children, task engagement was conducted to increase the time the child was away from the tangible item(s). Matt's FCT was the same as the FCTs described above. Matt had to relinquish the tangible items(s) when presented with the work card, then walk to the work table and sit down, comply with the demands presented, and request to play, and then he could engage again with the tangible items(s). The amount of time away from the toys increased with the increase in amount of work required during demand fading. The other participants were allowed to bring a toy to the work area and place the item on a designated spot (Safe-Spot) where the toy remained until the work had been completed. The Safe-Spot was usually a laminated picture card. The wait times were similar to those for Matt and were dictated by the delay produced by task engagement. For Nate, we also faded the placement of the Safe-Spot from next to him to across the room. Wait times ranged from 20 s to more than 1 min.

FCT Tangible Five children received the FCT tangible treatment, which involved the child's requesting toys after having to wait for increasing periods of time. FCT again comprised a two-step chain in which appropriate waiting produced the opportunity to mand and manding produced brief (1- to 2-min) access to toys. Each FCT training session began with the parent providing attention to the child while the child played with toys for 20 to 30 s. After this brief period of play, the parent removed or blocked access to the toys the child was playing with for a specified period of time but permitted access to other toys and continued to provide attention. Following the delay, the child was then required to mand (e.g., "more") to obtain the toys. The parent told the child to request the toys by saying "more," signing "more," or touching a "more" word card. The targeted mand was the word "more" or "more toys, please," but any appropriate, functionally equivalent mand also produced access to the toys after the specified wait time. A timer was used to indicate the time remaining before a mand was honored. The timer was set and shown to the child, and when the timer sounded, the child was prompted to mand for toys. The parent often told the child, "When we're done waiting, you can play." As training continued, the wait requirement was increased within a fading program to levels selected by the parent (e.g., 2 min). One child, Mitt, did not have to wait an increased amount of time and did not use a timer per his parents' preference. For Ames and Max, who each received two FCT treatments, the wait time was yoked to the amount of time they were without the tangible items while engaged in the work phase of the FCT escape treatment described previously. For Carlos and Kyle, the required wait time began at 2 s and was increased to 2 min over the course of treatment.

Targeted problem behavior during wait times was blocked in a neutral fashion (i.e., did not result in access to toys). If the child engaged in targeted problem behavior during toy play, the play was ended and the toys were removed from the child for the specified wait time. Nontargeted problem behavior was ignored.

FCT Attention Only one participant, Tad, received the FCT attention treatment, in which he was taught to request attention when adult attention was removed. To begin, Tad had access to his mother's attention while he played with toys for 20 to 30 s. After this short play period, Tad's mother removed her attention and instructed Tad to say, "Play, please," to regain her attention. His mother provided attention for 1 to 2 min when Tad requested attention using the targeted mand. All problem behavior (e.g., throwing toys, climbing on furniture) was neutrally blocked and did not result in access to adult attention. If problem behavior occurred during reinforcement, his mother removed her attention.

For all FCT procedures, parents were asked to practice for 10 to 15 min per day at a time that was convenient for them in addition to the FCT sessions conducted during the telehealth appointments. The investigators provided parents with written instructions on conducting FCT. Parents were also given procedural demonstrations and prescriptive feedback during the weekly telehealth visits.

Results

The results for the 17 participants and 19 FCT treatments are summarized in Table 2. The average reduction in problem behavior across all 19 FCT treatments was 93.5 %. The average number of sessions needed to complete treatment was 21 and ranged from 6 to 42 sessions. Total time from the beginning to the completion of treatment averaged 13 weeks and ranged from 4 to 21 weeks. Missed appointments added an average of 5.68 weeks per FCT treatment with a range of 1 week to 11 weeks missed.

Figure 1 shows the results of six individual FCT treatments that were selected to show the treatment results for each function within a nonconcurrent multiple baseline design. The treatment results obtained via telehealth were comparable to those obtained via the in-vivo FCT treatments conducted in the children's homes in previous projects. For example, in our most recently completed in-home project (Wacker et al. 2004), an average reduction of 94.14 % was achieved with the 12 children who completed treatment, and treatment was completed, on average, within 40 sessions and 13.41 months (Wacker et al. 2011). The Wacker et al. (2004) project evaluated the long-term effects of treatment, and thus additional analyses (e.g., extinction probes) were embedded within treatment sessions, which extended the duration of treatment. If one considers only the number of sessions or the duration of time needed to reach the criterion of a 90 % decrease in problem behavior, the most recent in-vivo project required 25.5 (range, 13 to 46) sessions whereas the current telehealth project required 16 sessions to reach the same criterion. These data indicate that both the overall effects of treatment on problem behavior and the time needed to complete treatment were comparable.

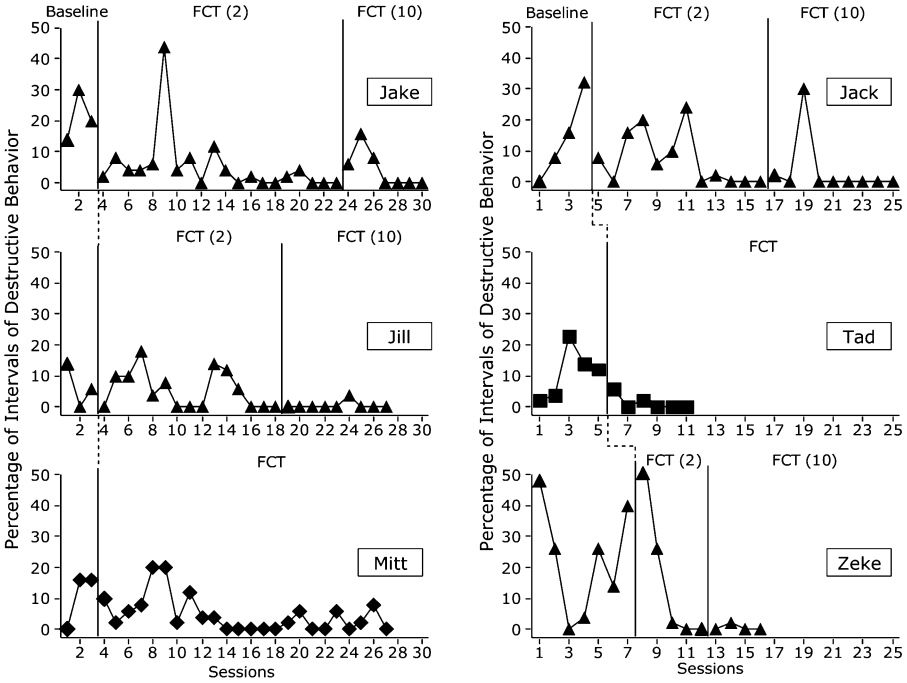

Fig. 1 The results of functional communication training (FCT) for six representative participants. Jake, Jill, Jack, and Zeke received FCT escape (*closed triangles*); Mitt received FCT tangible (*closed diamonds*); Tad received FCT attention (*closed squares*)

Parents rated the overall acceptability (Reimers and Wacker 1988) of the treatment procedures within 1 week of completing treatment. Acceptability was assessed using a 7-point Likert-type scale, with 1 indicating *very unacceptable* and 7 indicating *very acceptable*. In response to the question, "How acceptable do you find the treatment to be regarding your concerns about your child?" the average rating obtained from the 16 parents who completed the survey was 6.47. For the most recent in-vivo project, the average rating obtained from 11 parents was 6.18, showing that both projects were perceived by parents as highly acceptable.

Wacker, Lee et al. (in press) provided a cost comparison for conducting the FAs via telehealth or in vivo. They estimated that the average weekly cost of delivering FA via telehealth to 20 participants was $58 per child; the average weekly in-vivo cost per child would have been $335 with therapist travel to family homes factored in. We conducted a similar comparison of FCT costs using the same estimates of parent's mileage to travel to the CHSC site, 1 h of the behavior consultant's time, and 90 min of the parent assistant's time to conduct the weekly FCT sessions. We then added the costs for the FA used for baseline measures. The estimated average total cost for FA plus FCT was approximately $60.00 per visit for the 192 weekly visits; this resulted in a total cost of $11,500.00 for the telehealth group. Costs would have been approximately $291 per visit for treatment conducted in vivo, and costs for 192 weekly therapist visits to homes would have totaled $55,872. To conduct in-vivo visits, consultants would have spent over 1,100 h of driving time in addition to the time working with families. The cost to set up a single video workstation at the UI

Children's Hospital was approximately $1,800, which covered teleconsultation equipment and software. Existing teleconferencing equipment was available for use at each of the five CHSC sites. Costs to use the clinic rooms at the CHSCs were not included in the cost comparisons because rooms were used at times when they were not needed for other clinic activities. Even if facility and equipment costs were included in the estimates, however, the costs for behavioral treatment through telehealth were dramatically lower than for in-home behavior therapy.

Discussion

Wacker, Lee et al. (in press) concluded that the results from their telehealth delivery of FAs were comparable to in-vivo delivery (Wacker et al. 2011) but estimated a substantial reduction in cost by using the telehealth system. Similar outcomes were obtained for the FCT phase of this study. Every child showed at least a 68.7 % reduction in targeted problem behavior, and the majority showed a reduction of over 90 %. These results strongly suggest the utility of telehealth services as part of early intervention programs for children with autism who display challenging behaviors. The treatment package of FA plus FCT can be conducted via telehealth by trained behavior analysts with minimal training of parents, and this appears to be a highly efficient and effective treatment, whether delivered in vivo (Wacker et al. 1998) or via telehealth.

Barretto et al. (2006) and the current investigation have shown that behavioral treatments can be delivered effectively via telehealth. However, a number of second-generation questions remain to be answered. Although behavioral treatments can be conducted effectively via telemedicine, under what conditions should telemedicine be considered? Some children and families may not receive as much benefit from telehealth-delivered treatments as from in-vivo treatments, and subsequent researchers need to identify these subgroups. For example, are there some behaviors (e.g., severe or low frequency) or child or family characteristics that do not lend themselves to telehealth-delivered services? A related question concerns the types of assessments and treatments that can be delivered via telehealth. Functional analysis and functional communication training are both highly structured and involve consistent procedures. Perhaps these types of highly consistent procedures can be provided through telehealth with greater integrity than procedures that require more interpretation.

As future researchers address the best conditions for delivering telehealth services, further analyses of the treatments themselves need to be conducted. For example, analyses of treatment integrity are needed, which will require families to record sessions that are not co-conducted by trained behavior analysts. Perhaps very high integrity is needed for families to achieve the highest level of success with telehealth-delivered treatments. Poor integrity may result in greater resistance to the effects of treatment, as discussed by Volkert et al. (2009). In these cases, alternative parent training models need to be evaluated in conjunction with the behavioral treatments.

Although we conducted relatively "standard" functional analysis and functional communication training procedures, future investigators might want to study if other procedures, such as trial-based functional analyses (Bloom et al. 2011) or latency to first target response (Call et al. 2009) might be effective using this technology.

It is likely that the technology of telemedicine will interact with the procedures implemented via telemedicine, the clients receiving those treatments, and the clinicians providing treatment. Analyses of these interactions will be challenging, but they appear to be critical for understanding the promising results achieved to date for delivering behavioral treatment through telehealth. Although providing treatment through telehealth should not necessarily replace intensive early intervention programs for children with autism, the FCT procedures tested in this study can show parents how to reduce their children's problem behavior and may help the children achieve more success in educational and therapeutic programs.

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