

Evaluation of Caregiver Training via Telecommunication for Rural Icelandic Children With Autism

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This article describes the development and results of behavioral training via telecommunication for three caregivers of children with autism. A single-subject, multiple baseline experimental design, replicated across caregivers, preschool children with autism, and tasks, was used to evaluate the effects of the training. Dependent measures were collected in vivo and via telecommunication and included parent, teacher, and child responses during naturalistic play. The intervention involved teaching caregivers methods to increase children's sociocommunicative behavior. Both child and caregiver behaviors increased during intervention and follow-up observations. The results indicate that training via telecommunication is a promising alternative for families that do not have access to evidence-based intervention and expertise. The results are discussed in the context of technological benefits and difficulties during data based consulting. Further development is important to understand technological variables that enhance or hinder the progress of rural children and their caregivers.

Keywords: parent training, telehealth, children, autism, rural families

Despite the documented effectiveness of behavioral interventions for children with autism (e.g., National Autism Center, 2015; Schreibman et al., 2015), not all children and their families have access to intervention or the expertise required for success. This is especially true of families living in rural areas where there are few trained professionals (Murphy & Ruble,

2012; Symon, 2001; World Health Organization [WHO], 2007).

Parents can play an important role in supporting their children's development. For instance, results from research meta-analyses indicate that comprehensive programs implemented or supplemented by parents are equally as effective or more effective than those that do not include parents (Sallows & Graupner, 2005; Strauss, Mancini, & Fava, & the SPC Group, 2013). Furthermore, numerous parent training studies, using single subject methods and direct behavioral measures, demonstrate positive child outcomes (e.g., Matsan, Mahon, & Matson, 2009; Patterson, Smith, & Miranda, 2012; Roberts & Kaiser, 2011; Suppo & Floyd, 2012).

Many parent training programs provide services to families of children with autism based on this research evidence. For example, Sunny Starts at the University of North Texas is a community-based program that involves naturalistic teaching and are informed by the evidence base of successful responsivity-based parent training approaches (Ala'i-Rosales, Cermak, & Guðmundsdóttir, 2013; Schreibman et

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al., 2015). Sunny Starts methods include frequent, preference assessments, environmental arrangements, meaningful child responses (such as social attending, communication, and play), responsive parental consequences, monitoring family enjoyment, and ongoing evaluation and revision. Parents attend sessions once per week at a community-based clinic or in the family home. In this particular model, as in many urban areas, several senior level professionals deliver or supervise the intervention and training.

Telehealth services are one way to increase access to these kinds of services. *Telehealth* (synonymous with telemedicine) refers to using information and communications technology (ICT) to provide health care to people who reside in a different physical location than the health care provider, using information and communications technology (ICT) (American Telemedicine Association, 2009; WHO, 2010). Although a promising innovation in health care, there is limited research evidence in behavioral interventions and in the few existing studies, difficulties of the technology have been noted (Alnemary, Wallace, Symon, & Barry, 2015; Boisvert, Lang, Andrianopoulos, & Boscardin 2010; Ekeland, Bowes, & Flottorp, 2012).

Limited access to community-based programs such as Sunny Starts is considered one of several health care barriers for rural families (Boydell et al., 2006; Symon, 2001). WHO (2007) stated that the geographical location of individuals with intellectual disabilities and their families affects access to services in more than half of the countries in the world. In Iceland, where the current study was conducted, Milton and Eberhard (2006) described the scarcity of experts and trained professionals able to provide intervention to children with neuropsychiatric disorders who live in rural areas. This is also true of families in other parts of the world (Hoogsteen & Woodgate, 2013; Murphy & Ruble, 2012). Many factors contribute to these circumstances. For example, travel conditions make it difficult, sometimes impossible, for rural families to travel from their local community to access necessary services. Similarly, expert travel costs and time, which would otherwise be spent on providing services, are a barrier for service institutions.

Experts have used different strategies to enable rural families to access information and participate in interventions (Boisvert et al.,

2010; Farmer & Reupert, 2013; Reese et al., 2013). These include short and intensive workshops on site at the expert's clinic (Koegel, Symon, & Kern Koegel, 2002) and self-directed learning with video examples on a DVD and written instructions (Nefdt, Koegel, Singer, & Gerber, 2010). In recent years, researched methods include telehealth procedures and the number of eLearning and telecommunication studies have increased (Aresti-Bartolome & Garcia-Zapirain, 2014; Boisvert et al., 2010; Suppo & Floyd, 2012). Unfortunately, few of these studies have a targeted focus on parents living in rural areas (Hamad, Serna, Morrison, & Fleming, 2010; Jang et al., 2012; Kobak et al., 2011; Suppo & Mayton, 2014; Wainer & Ingersoll, 2013) and even fewer assessed whether the parents could apply the knowledge they had gained. Those studies that assessed skill acquisition found some parents were able to apply the techniques but others needed additional coaching via videoconferencing to reach fidelity criteria (Wainer & Ingersoll, 2013) or generalization (Suppo & Mayton, 2014).

Along these lines, some studies specifically evaluated coaching via videoconferencing in combination with eLearning (Heitzman-Powell, Buzhardt, Rusinko, & Miller, 2014; Vismara, McCormick, Young, Nadhan, & Monlux, 2013; Wainer & Ingersoll, 2015) or with self-directed learning using written instructions on a DVD (Vismara, Young, & Rogers, 2012). The coaching sessions in all of these studies included assessment of parent and child skills, joint problem solving, and guided practice. Only one study, however, taught parents intervention techniques via video coaching combined with minimal in situ training at the start of the intervention (McDuffie et al., 2013). Outcomes between clinic setting and video coaching were compared, but no measures were included of generalization to settings outside of home.

It should be noted that the effectiveness of in situ coaching (instructions, modeling, and feedback) in parent training has been demonstrated in numerous studies with families of children with autism (Barton & Fettig, 2013; Kaiser, Hancock, & Trent, 2007; Schreiber et al., 2015). Written instructions, with or without modeling, do not seem to be enough for all parents to acquire intervention skills and apply them with their children (Wainer & Ingersoll, 2013). In most of the telehealth coaching stud-

ies, including the ones that combined coaching with other approaches, parents received feedback while interacting with the child in the natural home setting (McDuffie et al., 2013; Suess et al., 2014; Vismara et al., 2012, 2013; Wainer & Ingersoll, 2015). This appears to increase the likelihood of generalization.

The dearth of telehealth parent training studies creates a lack of clarity in understanding what variables are likely to help rural families. Although all of the studies used group comparison or single-subject experimental design, only one study used direct measures (McDuffie et al., 2013). The majority of the telehealth studies on parent training used ratings on a Likert scale to measure the effects of the intervention on the parent's teaching behavior. This is problematic in that direct measures are more sensitive to change and less likely to be unreliable or create ceilings on observed phenomena (Cooper, Heron, & Heward, 2007).

Furthermore, few of the telehealth studies directly measured the child's progress, that is, almost none provided a quantitative depiction of the effects of parent behavior on the child behavior. A few described the relationship statistically, with correlation or a *t* test based on indirect measures (Vismara et al., 2013; Wainer & Ingersoll, 2015). Only one study presented a visual analysis of the relationship between parent and child outcomes, but across different behavioral dimensions (Suess et al., 2014). In fact, in a review of fidelity features in parent-implemented interventions, Barton and Fettig (2013) discussed the lack of parent and child measures as a serious limitation of the parent training research literature.

In the context of current state of research concerning telehealth methods in behavioral interventions in autism, this article describes the development and results from two pilot studies. These were the first in a series of experiments looking at the effects of telehealth methods in training of parents and teachers of children with autism. The studies examined the effects of training in situ with follow up and continued telecommunication coaching on both adult and child skills. Technical aspects were kept simple, using existing technical resources (computers and Internet connection) for best-practice intervention and consultation. Furthermore, in the first study, a family was chosen that was NOT geographically distant so that the amount of in

situ versus tele contact could be calibrated with progress. The aim of the second study was to further develop the telehealth procedures for an actually distant rural family, with most sessions conducted via telecommunication. Both studies included a behavioral training package based on previous work of the authors (Ala'i-Rosales et al., 2013). A valid single subject experimental design, with precise behavioral measures, was used to analyze the effects of the training. Finally, the relationship between the behavior change agents' skills and the children's social communication skills on the same dimension of behavior was analyzed.

Method

Participants

Two families and one special education teacher participated in this pilot study. The families were selected in collaboration with the State Diagnostic and Counseling Centre in Iceland according to predetermined selection criteria regarding age (3–6 years), diagnosis (autism), and geographical location of the family. Caregiver criteria for both families included interest and availability, no simultaneous participation in another behaviorally based program, and access to the technical resources necessary for participation. For Family 2, family criteria included living in a rural location 35 to 165 km distance from the trainer's location. The families did not receive reimbursement for participating in the study and carried all costs for Internet use during the course of their assessment and training. They gave informed consent before initiation of the study and understood the purpose of the study was to develop and evaluate a procedure for effective telehealth with rural Icelandic families.

Trainer. Kristín Guðmundsdóttir served as the trainer in the study. She was an instructor in behavior analysis at a university, held a master's degree in behavior analysis, is a board certified behavior analyst (BCBA), and had over 10 years experience in early and intensive behavior intervention for children with autism, including naturalistic teaching methods. During the study she received supervision from Zuilma Gabriela Sigurðardóttir and Shahla Ala'i-Rosales, both doctoral-level behavior analysts

with over 60 years combined experience in interventions with families.

Family 1. Helga, her son Óskar, and his special education teacher Sif (pseudonyms), participated in the first phase. Helga was 34 years old and was pursuing a graduate degree. She had not received any training in behavioral intervention methods. Óskar's father participated in the pre-intervention assessment and goal setting process. Óskar's special education teacher, Sif, was 39 years old and held a degree in Early Childhood Education. She had worked with children with disabilities for 19 years, including 10 years working with children with autism. She had no education or training in behavioral interventions.

Óskar was 5 years and 4 months at the beginning of the study. He had not received a formal diagnosis of autism before the study but had been evaluated by an independent psychologist and received a score of 38 on the Childhood Autism Rating Scale. Close to the end of training, Óskar received a diagnosis of PDD-NOS by experts at the State Diagnostic and Counseling Centre in Iceland. At the beginning of the study, he was able to communicate in what appeared to be five- to seven-word utterances, but his pronunciation made it difficult to understand his intentions. Furthermore, he had limited social attending during social interactions. Before the beginning of the study, Óskar was not enrolled in any early behavioral intervention but received various special education services for about 6 hours per week.

Family 2. Anna and her son Stefán (pseudonyms) participated in the second phase. Anna was 39 years old and held a professional graduate degree and was working part time. She was nearly fluent in Icelandic, which was not her mother tongue. To carry out school programs at home, Anna had received some coaching at Stefán's school on discrete trial behavioral teaching. She had not received training in naturalistic teaching methods. Stefán's father participated in the assessment and goal setting process and was present during some of the training sessions along with Stefán's two older siblings, but they did not participate in training.

Stefán was 4 years and 10 months at the beginning of the study. He had received a diagnosis of autistic disorder (F84.0), and specific developmental disorder of speech and language (F80), according to ICD-10 from the State Di-

agnostic and Counseling Centre in Iceland. Stefán was verbal at the beginning of the study, although tests indicated his expressive language was delayed at least a year. He was bilingual, speaking his mother's tongue on a daily basis with her, but spoke Icelandic with his father and siblings. According to Stefán's parents his level of communication skills was similar in both languages, but they considered his Icelandic a bit more advanced than his mother's tongue. During the trainer's observation of his interaction with his mother during storytime and playtime, and according to his parent's report, Stefán did not frequently initiate communication with her but mainly responded to his mother's initiations with a "yes." He also did not socially attend to his mother.

Stefán had received special education services at his preschool for 2.5 years. Intervention focused on communication, instruction following, play, pre-academics, self-help, social skills, and reduction of challenging behavior. The intervention format consisted of one-on-one discrete trial teaching (5 hours per week at school and 4.5 hours at home) and eclectic group instruction. Because of scheduling issues, the home hours decreased to 2 during the course of this study.

Setting, Schedule, and Materials

Sessions took place in the families' homes, living and playrooms, and in Óskar's case, at his preschool. Baseline and training sessions with both families took place twice a week on weekday afternoons or weekends. The trainer was located in the same room as the parent, teacher, and child, during all in situ sessions, video recording as well as collecting data on their target behaviors, but during all telecommunication sessions she was located in her office.

Children's preferred toys were used during all sessions (books, playing cards, figurines, vehicles, and board games). During in situ data collection the trainer used paper and a pencil.

Technical Tools

Equipment and technical setup. Both families used their personal laptop during telecommunication sessions. Óskar's teacher used a desktop computer. Both families and Óskar's teacher used a *Microsoft LifeCam Cinema* web camera. During the telecommunication ses-

sions, the web camera was attached to computer screens. The laptops were placed so that the dyads were located about 1–1.5m from the front of the camera. An external USB *MXL-UCHAT (AC-406)* boundary microphone placed on the floor or on a chair close to the dyad was used by Anna and Stefán after Session 42.

A video camera placed on a tripod was used for recording all in situ assessments in the families' home and preschool. *Sennheiser HD202* headphones were used for data collection from video samples of assessments.

Software. *Skype* videoconferencing software was used for the telecommunication sessions and *Windows Media Player* video playing software was used for data collection from video samples of assessments. Telecommunication sessions with Óskar, Helga, and Sif were recorded with *Pamela for Skype* Professional Edition and Anna's and Stefán's sessions were recorded with *VODburner* recording software developed by Netralia Pty Ltd.

During in situ and the first 11 telecommunication sessions, a timer on a smartphone was used to keep track of the assessment time. A *Free Desktop Timer* developed by Informer Technologies Inc. was used for the same purpose after telecommunication Session 12.

Closed file system and website. Stefán's family had access to their information via a closed file system on an encrypted website only accessible to the family and the trainer with a personal username and a logon password. The website was designed for this study by Kristín Guðmundsdóttir and two employees at Stefna Software, Pálmar Edvardsson and Róbert Freyr Jónsson. The website also included instructions on technical matters, written information about the study, the intervention and behavior analysis, and autism intervention.

Internet connection. The families and Óskar's teacher used a wireless ADSL connection during the telecommunication sessions. The trainer used a high speed Internet connection via fiber optic cable with both families and a wireless ADSL connection.

Measures

Behavioral measures were based on the Sunny Starts observation code (Cermak, 2011; Townley-Cochran, 2013) and other measures from the naturalistic teaching and parent train-

ing literature (Ingersoll & Dvortcsak, 2010). Child and caregiver behaviors were recorded and scored for the first 5 min during all baseline and training sessions. The behaviors were scored by paper and pencil from a video recording by Kristín Guðmundsdóttir who served as the primary observer. A graduate student served as secondary observer. Below is a summary of caregiver and child behavior measures. The complete observation code is available from Kristín Guðmundsdóttir.

Caregiver behaviors. In each training session, the parent and the teacher were taught to evoke an initiation from the child and respond to the child's initiation. They were taught the Teaching DANCE (Icelandic: "DANSAÐU"), an acronym and mnemonic for teaching strategies based on naturalistic behavioral intervention procedures. It consists of five components: (D = decide) deciding whether it is a good time to teach, (A = arrange) identifying the child's preferences and arranging these events to allow teaching, and (N = now) responding to the child's target skill in an immediate and responsive manner. In addition, as part of the Teaching DANCE, the caregiver was taught to (C = count and contemplate) monitor progress and pursue interactions that were (E = enjoy) effective and enjoyable to both the caregiver and child. For the purpose of this study, the correct implementation of two components of the Teaching DANCE, Arrange and Now, were observed and scored as one unit (i.e., as teaching episodes). Each teaching episode included three behaviors: identifying high preference events, arranging the teaching environment, and responding to child's target behavior. Identifying high preference events was scored when the caregiver selected an event to which the child showed an interest. For example, the caregiver agent presented a choice of a bubbles and a doll to the child, the child reached for the bubbles, and the caregiver used the bubbles. Environmental arrangement was scored when access to a preferred event was regulated so that the child could not contact the event, needed assistance with the event, or came into contact with an unexpected situation regarding the event. For example, the caregiver held the bubbles but did not activate the blower until the child made a request. Responsive event delivery was scored when the caregiver gave the child the preferred event within 3 s after the child's target response.

For example, the caregiver immediately blew a bubble when the child said "bubble" and began to pop bubbles with the child.

Child behaviors. Social attending was scored for Óskar during all interactions with his mother and teacher and for Stefán while he was making requests. Social attending included any orientation of the child's face or eyes, to eyes, or face of the behavior change agent (parent or teacher). The behavior ended when the child's face or eyes oriented away from the behavior change agent's eyes or face. Requesting included spoken words, word approximations, phrases or sentences that were directed to the behavior change agent, asking for an item or information (e.g., questions), specifying an action or an activity to be completed or requesting information, permission, or attention. A new request was scored if it occurred 3 s or after the end of the last verbalization of the child, or when the child asked a different question with different content.

Research Design

A multiple baseline experimental design was used to evaluate the effects of the training. With Family 1, a multiple baseline across two people, Helga and Sif, was used, and with Family 2 a multiple baseline across two settings, storytime and playtime, and two behaviors, requesting and attending, was used. The behavior change

agents' and children's behaviors were observed repeatedly during baseline (a) and then each of them received training (b), first in situ and then continued via telecommunication.

Interobserver agreement. Interobserver agreement calculations were based on the occurrence of the caregiver's teaching episodes (a free operant) during each 5-min assessment. An episode-by-episode interobserver agreement of scored occurrences and nonoccurrences of the participants' target behaviors was calculated (similar to interval-by-interval [IOA]), using the following formula: Number of episodes agreed divided by number of episodes agreed + number of episodes disagreed \times 100. Interobserver-agreement was calculated for approximately 30% of assessments for each participating dyad, across each setting and experimental phase. Agreement measures were distributed between in situ assessment and telecommunication assessments, and play materials in Anna's and Stefán's case. A trained observer scored the assessments. Table 1 displays the results of the interobserver agreement.

Procedures

Intake process and rapport building. An initial meeting with each child's parents was held, either in the family's local community (Helga and Óskar) or via telecommunication (Anna and Stefán) to explain the study. Written

Table 1
Percentage of Inter-Observer Agreement (Episode-by-Episode of Scored Occurrences and Nonoccurrences) of Helga's, Sif's, and Óskar's Target Behaviors During Baseline and Training and Anna's and Stefán's Target Behaviors During Baseline, Training, and Follow-Up for Storytime and Playtime

Target behavior	<i>M</i>	Range
Behavior change agent's teaching episodes		
Helga (mom)	88,7	75–100
Sif (teacher)	88,4	66,6–100
Óskar's social attending		
With Helga (mom)	84	50–96,1
With Sif (teacher)	81,8	70,3–97,4
Anna's teaching episodes		
Storytime	87,6	50–100
Playtime	82	33–100
Teaching social attending during playtime	86,2	0–100
Stefán's requesting		
Storytime	82	25–100
Playtime	81,4	58,8–100
Social attending when requesting during playtime	87,5	0–100

informed consent was obtained, information was provided to each family as necessary, and the first home visit was scheduled. At the same time, the trainer started developing rapport with the families. For example, the trainer chatted with the adult and played with the child and assessed the child's preference for events. Rapport building continued during the following sessions and was maintained throughout the intervention (Ala'i-Rosales et al., 2013). These meetings lasted 1 to 3 hours.

Preintervention assessments and goal setting. Intervention goals for the children were selected in collaboration with the parents. The goals were focused on increasing social communication skills of the child, such as eye contact and verbal initiations, as these behaviors are core deficits of autism (American Psychiatric Association, 2013). Each family provided information about their child's social communication by answering questionnaires based on modified and translated Sunny Starts (Ala'i-Rosales et al., 2013) and Ingersoll and Dvortcsak (2010) tools. The parents also participated in setting specific goals for their child through discussion and review of assessments. Stefán's family chose improved requesting and attending and Óskar's family chose attending. In Stefán's case, goals were also based on information from a criterion-referenced assessment (Partington, 2006). Electronic versions of the questionnaires were made available for Stefán's parents on the study's website (they downloaded, filled in electronically, and uploaded to closed file system). Preassessments lasted for approximately 2 weeks for both families.

Baseline. Baseline assessments were conducted in situ with Helga, Óskar, and Sif, and in situ and via telecommunication with Anna and Stefán. They were conducted during a preferred play activity with both families and also during storytime with Stefán. The adults selected materials for each assessment. They were asked to interact as they usually did with the child but received no further information or instructions regarding teaching procedures.

Training. Training consisted of a package of behavior intervention procedures based on the Sunny Starts program. The parent and teacher were taught in Icelandic using a translated and adapted version of the Sunny Starts Teaching "DANCE", as previously described in this article.

All training sessions started with rapport building for several minutes with the family. This was followed by a 5 min video assessment of the adult-child dyad's skills conducted under the same conditions as baseline assessments. Meanwhile the trainer recorded data on the child's target behavior and use of targeted components of the Teaching "DANCE".

During the first in situ training session, the teaching goals for the child were reviewed and the basics of the Teaching "DANCE" were explained and modeled by the trainer. With Óskar's mother and his teacher, the decision to shift to the telecommunication component was made when the frequency of his mother's and teacher's skills had increased from baseline. With Stefán's family, it was decided to run only one training session in situ because of the long driving distance and for the purpose of developing the telehealth procedures. During all telecommunication sessions, technical issues such as interruption of the Internet connection, bad sound or the position of the web camera, were resolved following the 5 min assessment. Part of the training included a review of progress over time via review of graphs of caregiver and child behavior. With Helga, Óskar, and Sif, the trainer faced the paper version of the graph toward the web camera, but with Anna and Stefán, an Excel graph was shown to Anna with the trainer sharing her screen via the telecommunication software. Meanwhile the child was engaged in a preferred activity in the same room. Then, during all telecommunication sessions, each caregiver continued interacting with the child (i.e., they practiced the "DANCE" with guidance from the trainer). Throughout practice, the trainer taught the caregiver to use the decide, arrange, and now components of the Teaching "DANCE" by giving positive and corrective feedback on their "DANCE" skills, along with discussion related to the caregiver's and child's target skills. Each caregiver was instructed to practice the Teaching "DANCE" between the training sessions. At the end of all training sessions, the trainer provided the caregiver with a written summary (paper copy or electronic) of what they had agreed should be practiced between training sessions.

The first in situ training session lasted approximately 2 hours for Helga, Óskar and Sif and approximately 2.5 hours for Anna and

Stefán. All subsequent sessions (in situ sessions and telecommunication) lasted approximately 1 hour.

Exit meeting and follow-up assessment.

Parents were provided with a verbal and written review of the intervention procedures and outcomes upon completion of the study. One month following the last training sessions, follow-up assessments were conducted with Anna and Stefán during playtime and storytime. No training was provided but the data on Anna's and Stefán's progress was reviewed and discussed. No follow-up assessments were conducted with Helga, Sif, and Óskar because of summer travel circumstances.

The study with Helga, Óskar, and Sif as participants spanned 1 year and a total of 10.5 months for Anna and Stefán. Total training time over the course of the study was 12.5 hours for Helga, Óskar, and Sif. As it took more time to achieve stability in their behavior gains across more settings (3 to 5 stable data points), training lasted 53 hours for Anna and Stefán.

Results

Helga, Óskar, and Sif

Figure 1 displays the effects of the "DANCE" training package on the frequency of Helga's and Sif's teaching episodes and Óskar's frequency of social attending. Assessments were conducted both in situ and during Skype telecommunication sessions (gray shading).

During baseline, both Helga's and Sif's frequency of teaching episodes stayed at zero levels throughout the phase (Assessments 1–4). When training was implemented with Helga, the frequency of her teaching episodes increased significantly (Assessments 5–6), decreased slightly when returning back from Christmas break (Assessments 7–12), but increased again with a steep increasing trend during the majority of the training phase (Assessments 13–16) until it stayed fairly stable for the last three training sessions (Assessments 18–23). Frequency levels of Helga's teaching epi-

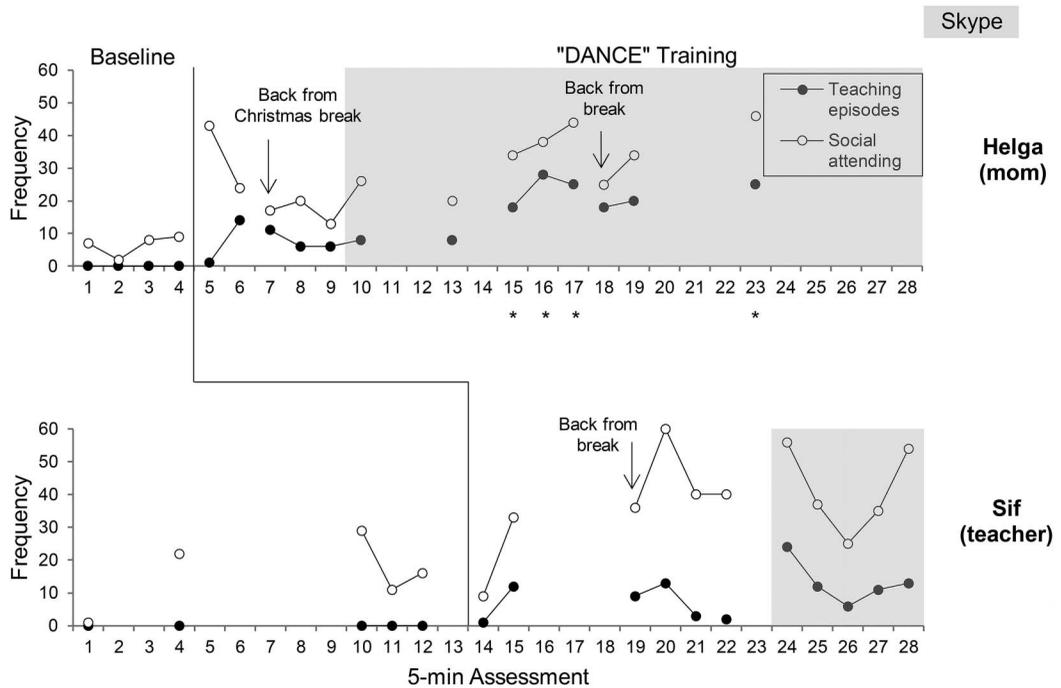


Figure 1. Teaching episodes for Helga and Sif and frequency of social attending for Óskar. Gray shading indicates telecommunication sessions. Assessments labeled with an asterisk represent data collected live.

sodes remained higher for the majority of the Skype telecommunication sessions at home than during training in situ at preschool. During Óskar's baseline while playing with his mother, there was low but stable frequency of social attending (Assessments 1–4). When the “DANCE” training was implemented with his mother, there was an immediate and large increase of his responding right at the beginning of the training phase (Assessment 5), which was variable throughout the phase, but above baseline levels (Assessments 7–23).

Sif's frequency of teaching episodes remained at zero levels when training was implemented for Helga (Assessments 10–12) but increased significantly when training for Sif was implemented (Assessments 15 and 19), then continued with a steep decreasing trend after two sessions (Assessments 20–22). When training continued via telecommunication, the frequency of Sif's teaching episodes increased considerably (Assessment 24), but continued with a decreasing trend (Assessments 24–26) until it stabilized above baseline levels toward the end of the training phase (Assessments 27 and 28). During Sif's baseline phase, Óskar's frequency of social attending was variable. His frequency of responding decreased slightly at the beginning of Sif's training (Assessments 14) but continued with a large increase and stayed at high but variable levels for the majority of the training phase (Assessments 15–28). Comparison of Óskar's and his mother's and his teacher's data patterns show correspondence. When the frequency of teaching episodes changed as training was implemented with each caregiver, the frequency of Óskar's social attending changed in the same direction.

Anna and Stefán

Figure 2 displays the effects of the “DANCE” training package on Anna's frequency of teaching episodes and the frequency of Stefán's requesting and social attending. Three sessions labeled with asterisks represent data collected live during a telecommunication session. They were collected this way due to technical difficulties with the video recordings.

The frequency of Anna's teaching episodes in the baseline phase during storytime (Figure 2, top panel) stayed at zero levels throughout the phase (Assessments 1–6). When training was

implemented, there was an immediate increase in the frequency of her teaching episodes which stayed fairly stable until training was implemented during playtime (Assessments 7–13). During baseline, the frequency of Stefán's requesting during storytime was at low but variable levels (Assessments 1–6). When training was implemented with his mother there was an immediate increase in his responding and continued quite stable (Assessments 7–13) until training for requesting during playtime was implemented. Stefán's frequency of requesting was quite variable throughout the training phase (Assessments 7–54), but stayed at very high levels with the exception of a steep decreasing trend during the middle of training (Assessments 25–29).

Anna's frequency of teaching episodes during playtime (Figure 2, center panel), stayed fairly stable throughout the baseline phase (Assessments 4–13), but with a slight increase in frequency when training was implemented for storytime (Assessment 10–12). When training was implemented during playtime there was an immediate increase in frequency of teaching episodes (Assessment 14). Although this increase stayed variable during the majority of the training phase, the level of frequency remained above baseline levels for the majority of the phase. During an assessment phase after the Christmas break, Anna's responding continued at lower but variable levels as during training before the break (Assessments 19–22). Following a booster in situ session (Assessment 26), Anna's responding increased and remained variable but above baseline levels for the majority of the phase until the end of training (Assessments 26–56). A booster session included training with modeling and guided practice as during the first in situ training. When the “DANCE” training package was implemented for social attending, there was a decreasing trend of the frequency of teaching episodes during playtime (Assessments 48–50). However, the frequency levels increased again (assessment 51) and stabilized toward the end of the training phase remaining above baseline levels. During the baseline phase during playtime (Figure 2, middle panel), Stefán's frequency of requesting was variable (Assessments 4–13). His requesting started at fairly low levels but increased just before training for storytime was implemented and stayed at those levels through-

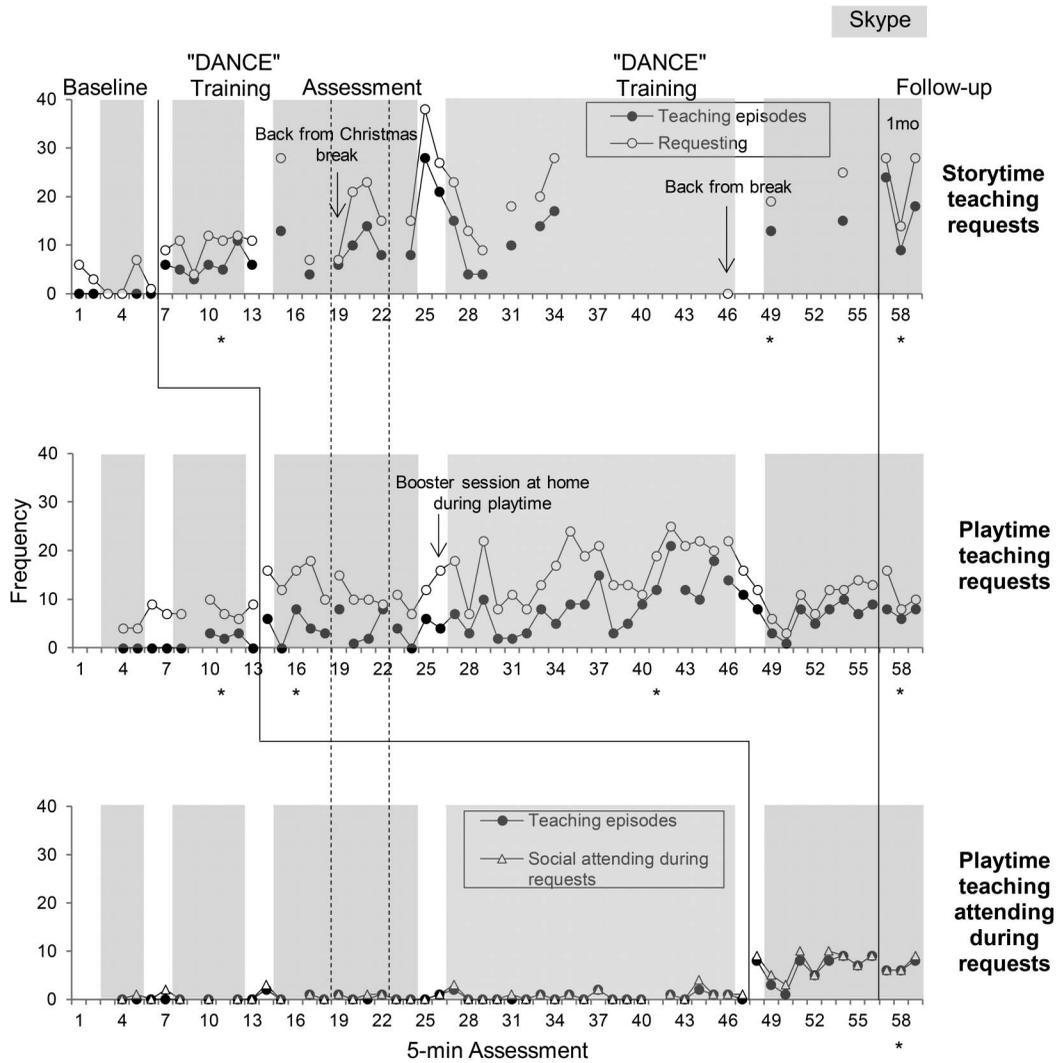


Figure 2. Teaching episodes for Anna and the frequency of Stefán’s requesting and social attending during storytime and playtime. Gray shading indicates telecommunication sessions. Assessments labeled with an asterisk represent data collected live.

out the training phase (Assessments 7–13). However, when the “DANCE” training package was implemented during playtime with his mother, there was an immediate further increase in the frequency of his requesting, which stayed mostly above baseline levels throughout the phase (Assessments 14–56). Although the pattern of the data path was quite variable throughout the phase, it stabilized at the end of the training phase (Assessments 53–56).

When teaching Stefán social attending during playtime requests (Figure 2, bottom panel), the

frequency of Anna’s teaching episodes during baseline stayed at fairly stable low levels (Assessments 4–47). When the “DANCE” training package for social attending during Stefán’s requesting was implemented, there was a clear increase in the frequency of teaching episodes right at the beginning of training (Assessment 48). After a small decreasing trend (Assessments 48–50), the frequency of teaching episodes increased again and stayed stable throughout the training phase (Assessments 51–56). Stefán’s frequency of social attending

while requesting was low but stable during the majority of the baseline phase (Assessments 4–47). There was an occasional increase in the frequency of social attending while Stefán was requesting after the first training session of requesting during playtime (Assessment 14), after the booster session (Assessment 27), and at the end of the phase (Assessment 44). When training for social attending was implemented there was an immediate increase above baseline levels (Assessment 48), which continued with a decreasing trend at the beginning of the phase (Assessments 48–50) but increased again and remained stable throughout the training phase (Assessments 51–56).

The increase in Anna's and Stefán's responding during storytime, playtime, and with social attending was maintained (Assessments 57–59) after the completion of training. Comparison of data patterns across all settings show correspondence during the training phase between Anna's teaching episodes and Stefán's social attending.

Discussion

The purpose of this study was to develop and evaluate a telehealth training protocol to be used with caregivers under conditions of limited access to behavioral expertise. The results from the two families show that teaching caregivers via telecommunication, following in situ training, was effective in increasing their skills. This is in accordance with the results of McDuffie et al. (2013) who started training in situ followed by parent education lessons and continued via teleconference. McDuffie et al., however, interspersed the in situ training of different parent skills over four weeks with training via telecommunication following each in situ training. Many of the telehealth parent training studies did not measure the maintenance of the parent's skills, but the results from this study are in agreement with those that did (Vismara et al., 2012, 2013; Wainer & Ingersoll, 2015). In addition, the results from this study showed that the behavior change agents' progress had direct positive effects on their children's skills. That is, when training was implemented with all caregivers, changes in the frequency of teaching episodes resulted in similar changes in both of the children's responding. Three telehealth studies measured the effects of the parent's learned skills on the child's behavior (Suess et

al., 2014; Vismara et al., 2013; Wainer & Ingersoll, 2015). Each of these studies, unlike the present investigation, reported mixed outcomes in terms of child benefit.

Precaution should be taken interpreting Helga's and Sif's results due to gaps in between sessions, with month long breaks on average because of family life circumstances. Such gaps in data are not optimal for experimental reasons, as the researcher does not have information about nor control of other variables possibly affecting the participants' responding during that time. Their responding was also quite variable during the training which could be attributed to these breaks. It could also been due to the different types of play materials. However, Helga's and Óskar's frequency of responding increased whenever training resumed. The break did not seem to have as much of an effect on Sif's and Óskar's responding. During that time, however, the intervention was being implemented with Óskar and his mother. The same explanation can possibly be applied to the discrepancy of Sif's and Óskar's behavior during baseline, where Óskar's frequency of social attending is quite high. The majority of the assessments during Sif's baseline, took place when Helga's training had started. However, the type of play materials could also affect the frequency of social attending, as during two of the baseline assessments the dyad was facing each other playing a card game and responding was higher. During the other assessments they were engaged in different activities, such as construction toys and figurines.

Anna's responding was quite variable during the training phase for both storytime and playtime. This could be related to difficulty generalizing to different types of play materials. She found it more difficult to arrange certain types of play materials like figurines. It was not until they started playing a simple board game that the frequency of her teaching episodes stabilized. It is important to note that some degree of variability is appropriate and to be expected based on the materials and the goal of maintaining enjoyable interactions. Children and parents are not static and engage in different activities that produce different rates of responding. What is important is that the parent can help the child learn under the different conditions.

One of the challenges was that it was not possible for the trainer to model the target be-

haviors via the telecommunication sessions. This made it sometimes difficult to guide Anna. She also asked for access to recordings from the in situ and telecommunication training in order to watch and learn from them. As modeling is such an important part of effective training, it will be worthwhile to develop methods to effectively model criterion responses via telehealth.

Data on the trainer's procedural integrity was not collected with either family. The training was not recorded for a majority of the sessions, due to limitation of the recording software used with Óskar's family and space limitation of the secure storage for the video files with Anna and Stefán. For this reason, only the assessments were recorded. Also, the main purpose of the study with Helga, Sif, and Óskar was to develop and evaluate the training and assessment procedures. Data on the procedural integrity of the caregivers' behaviors was collected, that is, number of teaching episodes which appear in the figures for each family. Future studies will include data on trainer procedural integrity.

As expected, technical issues occurred in the telecommunication sessions, with poor sound and video quality with both families and frequent disruptions of the Internet connection with Anna and Stefán during majority of the sessions. This made scoring of target behaviors and training via telecommunication more challenging. For example, it was difficult to hear clearly what Stefán was saying during most of the first 36 telecommunication sessions because of poor sound quality. After some experimentation with sound settings we provided the family with an external boundary microphone after Session 43. This improved the sound to acceptable levels, resulting in fewer number of unintelligible verbalizations and increased observation reliability.

Poor video quality resulted in a very grainy picture which made it sometimes difficult for the observer to score nonverbal behaviors, especially social attending with Óskar and Stefán. The causes of poor video quality were explored systematically with Anna and Stefán. Possible explanations can be traced to upload speed of the family's Internet connection which determines the transfer rate of information from the sender to the user (the family to the trainer). Anna's and Stefán's family lived in a very rural area and had a slow ADSL connection that was

at times below the recommended telecommunication software speed.

Adequate picture and sound quality of video samples is important for accurate and reliable scoring. This is in part reflected in this study, by a few instances of low interobserver agreement of the data with both families, as the ranges show in Table 1. None of the telehealth studies that included a video coaching component using an Internet-based telecommunications software (as opposed to teleconferencing equipment), described difficulties with quality of the video samples and thus no information is available on potential effects on scoring accuracy (McDuffie et al., 2013; Vismara et al., 2012, 2013; Wainer & Ingersoll, 2015). This could be due, in part to a reliance on indirect measures. Likewise, the possibility of video quality affecting the observer's behavior has not been discussed in the telehealth research literature on parent training nor in the behavioral literature on data collection. According to error analysis of the IOA data, other factors may have contributed to the low interobserver agreement, such as complex play behavior of the child and low frequency of responding. In these cases, each instance of disagreement lowers the percentage of agreement between the observers compared to a sample with higher number of occurrences. Despite occasional low IOA ratings, the mean scores were acceptable or 0.80 and above for all the data collected. However, this is an issue that still warrants discussion. Early studies on direct observation discuss the effects of behavior sample complexity on interobserver's agreement, for example the number of different responses to be observed, or ambiguity of the participant's behavior (Kazdin, 1977; Lerman et al., 2010). It may be useful to examine the effects of ambiguous behavior (poor audio/visual) on the observer accuracy.

Related to this, disrupted Internet connection was experienced quite frequently with Anna and Stefán, resulting in interrupted communication between the trainer and the family. It did not seem to affect outcomes. In many rural areas, for example in Iceland, the quality of the Internet connection is not very good with low and unstable Internet speed (Póst- og fjarskiptastofnun, 2014). Thus, it will be interesting to explore this further and systematically monitor factors affecting the quality of the Internet connection, such as Internet speed and weather.

The results from this study indicate that training caregivers via telecommunication is a promising alternative for families of children with autism that live far from an expert and thus do not have regular access to evidence-based intervention and the required expertise for success. It should be noted that the caregivers in both families held a higher education degrees and had easy access to the Internet at their home and at their work. The findings may be different for families of differing educational backgrounds and economic resources. In any case, it is important to continue to develop the technical aspects and problem solving related to parent training via telecommunication and extend the telehealth behavioral parent training literature.

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