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Increasing Access to an ASD Imitation Intervention Via a Telehealth Parent Training Program

Allison L. Wainer · Brooke R. Ingersoll

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Abstract Systematic research focused on developing and improving strategies for the dissemination and implementation of effective ASD services is essential. An innovative and promising area of research is the use of telehealth programs to train parents of children with ASD in intervention techniques. A hybrid telehealth program, combining self-directed internet-based instruction with remote coaching, was created to introduce parents of children with ASD to an imitation intervention. A single-subject multiple-baseline design study evaluated the effect of the program on changes in parent and child behavior. Parents improved in their use of the intervention techniques and their children demonstrated concurrent increases in spontaneous imitation skills. Parents also indicated that the intervention and telehealth service delivery model were acceptable, useable, and effective. Results suggest that this hybrid telehealth program has the potential to increase access to ASD services.

Keywords Telehealth · Parent training · Autism spectrum disorder

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A. L. Wainer (✉) · B. R. Ingersoll
Department of Psychology, Michigan State University,
East Lansing, MI 48824, USA
e-mail: waineral@msu.edu

B. R. Ingersoll
e-mail: ingers19@msu.edu

Introduction

Autism spectrum disorder (ASD) is a chronic and pervasive neurodevelopmental disorder characterized by deficits in reciprocal social interaction, social communication, and the presence of restricted and repetitive behaviors (American Psychiatric Association 2013). There has been a dramatic increase in the number of individuals receiving this diagnosis over the last two decades, with prevalence rates reaching 1 in 68 (Center for Disease Control and Prevention 2014), and this population is at a particularly high risk for experiencing unmet service needs (Kogan et al. 2008). While there is accumulating evidence for ASD interventions linked with positive distal and proximal outcomes, these programs are often not successfully transported to practice settings (Lord et al. 2005; Smith et al. 2007; Stahmer 2007), in large part because of the incompatibility between services and delivery models studied in research settings and those that are available and feasible in existing clinical settings (e.g., Dingfelder and Mandell 2011; Kazdin 2008). Thus, although the number of individuals requiring ASD specific services has increased, there has not been corresponding growth in the availability of evidence-based services (Sperry et al. 1999; Stahmer and Gist 2001; Symon 2005), highlighting the need for systematic research focused on developing and improving strategies for dissemination and implementation of effective ASD services.

Parent training programs have been found to be one cost-effective and ecologically valid way to increase access to evidence-based ASD intervention. Numerous studies have established that parents can be successfully trained in strategies to improve social-communicative functioning in young children with ASD (e.g., Charlop and Trasowech 1991; Ingersoll and Gergans 2007; Koegel et al. 1996; Stahmer 1995). Yet, there continue to be barriers involved

with the dissemination of training to parents, including a shortage of trained professionals, limited financial resources and transportation, lack of child care, geographic isolation, lengthy waitlists, and extensive time commitments (Stahmer and Gist 2001; Symon 2001; Taylor et al. 2008). Thus, it is essential to consider the adaptation of effective interventions, including parent training programs, to non-traditional service delivery methods (Feil et al. 2008).

Telehealth and related technology-based applications have the potential to replace, or at the very least augment, traditional service models to increase access to evidence-based services from a distance (Baggett et al. 2010; U.S. Department of Education 2010). There are numerous benefits associated with the use of telehealth programs, including providing a cost-effective means for intervention to be accessed from anywhere at any time (Baggett et al. 2010). There is increasing evidence to suggest that such programs can reduce patient and provider costs and increase provider system coverage relative to traditional in-person service delivery models (Gros et al. 2013). Users of telehealth programs are able to interact directly with the instructional content through video, animation, and active learning tasks (e.g., quizzes; Weingardt 2004), as well as with other individuals, including expert clinicians, via email and teleconferencing mechanisms (Ingersoll and Wainer 2013b). Importantly, the number of individuals with access to internet-based and computerized technologies has grown considerably in recent years (File 2013). Additionally, telehealth services are becoming increasingly more common with over 3,000 US sites using distance-based service delivery models to provide patient care (American Telemedicine Association 2013). The use of telehealth programs to provide services has been explored across health-related disciplines, disorders, and evidence-based treatment approaches (see Gros et al. 2013 for a review). Benefits of telehealth technology, together with interest in such programs across health-related fields, and rapid increases in consumer access to computer and internet technology, suggest that telehealth applications may serve as a promising alternative service-delivery model to increase the reach of, and access to, evidence-based ASD interventions, including ASD parent training programs.

Studies of telehealth-based parent training programs have indicated that parents can be taught adaptive parenting and behavior management techniques via this service delivery mechanism (e.g., Baggett et al. 2010; Feil et al. 2008; Kacir and Gordon 1999; MacKenzie and Hilgedick 1999). Several studies have demonstrated that parents of children with ASD find such training programs to be feasible, useable, acceptable, and effective in increasing knowledge about evidence-based intervention procedures (e.g., Hamad et al. 2010; Howroyd and Peeters 2007; Jang et al. 2012), yet only recently has the impact of these

training programs on parents' fidelity of implementation been examined. Preliminary empirical studies have suggested that parents can learn to implement ASD intervention techniques with fidelity after using a self-directed training program. Nefdt et al. (2010) found that parents were able to implement pivotal response training (PRT) strategies with fidelity, provided their children with more language opportunities, and displayed greater confidence in parent-child interactions. Importantly, some parents indicated that immediate feedback or coaching from an expert clinician would have been a helpful addition to the program (Nefdt et al. 2010). Wainer and Ingersoll (2013a) piloted a web-based self-directed telehealth program to train new therapists and parents in reciprocal imitation training (RIT; Ingersoll and Schreibman 2006) and found that participants were able to learn about and increase their use of RIT techniques after utilizing the self-directed training modules. However, one third of the participants in both groups required additional live, in-person, feedback and coaching in order to achieve fidelity of implementation. Findings from both of these studies suggest that the addition of an interactive remote coaching component may be a desired, and for some a critical, element of successful telehealth parent training programs. Indeed, research has begun to explore the use of videoconferencing technology to provide feedback and support to parents of children with ASD from a distance (Baharav and Reiser 2010; Suess et al. 2014; Vismara et al. 2012, 2013).

Vismara et al. (2012, 2013) have examined the use of "hybrid" telehealth programs to deliver the parent curriculum of the Early Start Denver Model (ESDM; Rogers and Dawson 2010; P-ESDM, Rogers et al. 2012), an early intensive ASD intervention program. Both DVD-delivered instructional content and web-based instructional content, in conjunction with weekly video-conferencing coaching sessions, were examined as potential mechanisms for delivering the parent training (Vismara et al. 2012, 2013). Results suggested that parents were able to implement the intervention strategies with fidelity and alter their engagement styles to be more attentive and responsive to their children after the hybrid telehealth programs. Furthermore, children in both studies demonstrated gains in important social communicative behaviors (e.g., language, imitative behaviors) as their parents participated in the telehealth programs (Vismara et al. 2012, 2013).

Findings from this nascent body of literature provide initial evidence for the feasibility and effectiveness of telehealth programs to serve as alternative models for delivering training in various intervention strategies to parents of children with ASD. The research described above highlights the diversity of technology and technology-related applications, each with benefits and limitations, currently available for incorporation into telehealth

programs. Thus, an important step in developing, evaluating, and eventually disseminating telehealth programs is to understand the unique contributions of self-directed and remote interactive components in supporting parent learning and child outcomes. A more nuanced appreciation of the contributions offered by each component will make it possible to develop more cost-effective delivery models where services are offered at varying levels of intensity, depending on specific needs of the family. Indeed, suggestions for the redesign of service delivery systems to models of stepped-care have been made not only in the ASD intervention field (Phaneuf and McIntyre 2011; Steever 2011), but also in the behavioral health field more generally (O'Donohue and Draper 2011).

The current study sought to examine the use of a hybrid telehealth program to introduce parents of children with ASD to an imitation intervention, RIT. RIT, as implemented by therapists and parents, has been shown to increase spontaneous imitation skills in young children with ASD (Ingersoll 2010; Ingersoll and Gergans 2007; Ingersoll and Schreibman 2006). Furthermore, a recent pilot study suggested the feasibility of a self-directed telehealth program to train individuals in the use of these intervention strategies (Wainer and Ingersoll 2013a). The current study sought to expand on this pilot work by examining parent and child outcomes in response to the use of a hybrid telehealth program combining self-directed instruction with subsequent interactive remote coaching sessions.

The first goal of the current study was to assess the degree to which parents could learn about and effectively implement RIT after engaging in the self-directed and coaching portions of the telehealth program. The second goal of the current study was to evaluate the impact of parent participation on child spontaneous imitation. Additionally, the degree to which parent use of the intervention techniques was related to child spontaneous imitation within the interaction was examined in an attempt to identify which parent behaviors most strongly influenced child outcomes. A final goal of the study was to assess the acceptability of this hybrid telehealth service delivery model to parents.

Methods

Participants

Five young children with ASD and their parents participated in the current study. Inclusion criteria included: (a) children between the ages of 24–72 months, (b) a diagnosis of ASD by an independent licensed professional in the families' community, (c) internet access in the families' homes throughout the duration of the study (hardware and an

internet connection were available at the request of the parent), (d) no previous participation in a formal parent training study, (e) the same parent available for all baseline, data collection, and coaching sessions, and (f) parent reports of deficits in social imitation skills. Seven families were referred to the program from their local community-based diagnostic and service provision centers. One family withdrew from participation after two baseline sessions due to the high rates of social imitation reported by the parents and observed by the research staff. The other family dropped out of the study after 6 baseline sessions, but did not provide an explanation for their withdrawal. In total, five children and their mothers completed the entire study.

At intake, child chronological age ranged from 29 to 59 months. All parents completed the Social Communication Questionnaire (SCQ; Rutter et al. 2003) to obtain a measure of autism severity and the Vineland Adaptive Behavior Scales survey interview to obtain a measure of child adaptive behaviors (Sparrow et al. 2005). Families were specifically recruited from areas distant from the main study site, with all participants residing in Ontario, Canada (over 300 miles from the main study site) during study participation. Families from diverse ethnic and cultural backgrounds were represented in the current study; four of the parents indicated countries of origins other than Canada or the United States and three of the families cited that in addition to English, other languages (e.g., Bengali, Spanish) were spoken in the home. See Table 1 for a description of parent–child characteristics.

Settings and Materials

All parents completed the telehealth program using their own or family members' home computers, web-cameras, and internet connections. All data collection and coaching sessions took place in the home and were conducted over the internet-based, password-protected video-conferencing programs. All sessions were recorded using commercially available screen-recording software. Prior to the first baseline session, the parent and parent coach strategized about how to position the web-camera for optimal viewing of the parent–child interactions in the homes. The families' own toys and materials were used during all data collection sessions.

Experimental Design and Study Procedure

An IRB-approved, single-subject, multiple-baseline design was conducted across the five parent–child dyads (Hersen and Barlow 1976). Dyads were randomly assigned to between 4 and 9 baseline probes during the baseline phase (Edgington 1996). The treatment phase involved two

Table 1 Participant characteristics

	Parent education	Parent employment	Parent marital status	Child age (months)	Child ethnicity	SCQ score	Vineland Comm.	Vineland Soc.
Dyad 1	Graduate degree	Not employed	Married, living with partner	59	Asian/Pacific Islander	15	65	61
Dyad 2	Some college/ specialized training	Not employed	Single, living with partner	42	Multi-racial	13	67	68
Dyad 3	Graduate degree	Finance	Married, living with partner	29	Asian/Pacific Islander	20	64	89
Dyad 4	Graduate degree	Finance	Married, living with partner	40	White, non-Hispanic	21	79	72
Dyad 5	Graduate degree	Software development	Married, living with partner	41	Hispanic	24	52	65

SCQ Social Communication Questionnaire

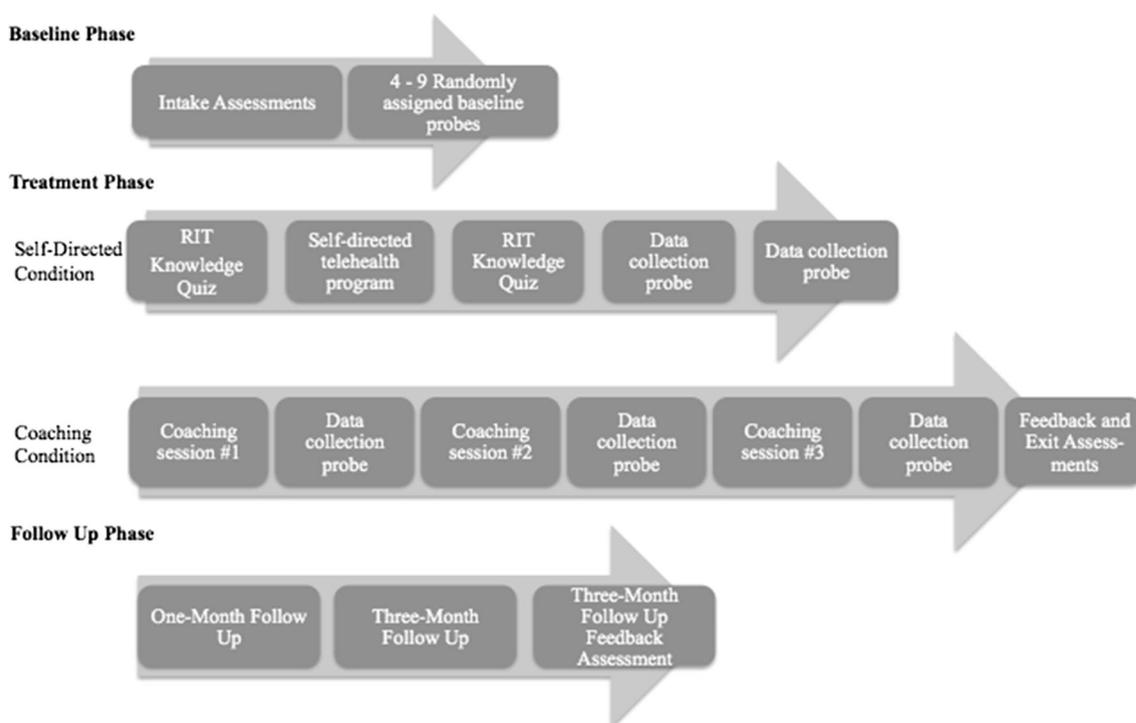


Fig. 1 Study phases, conditions, and procedures

conditions: (1) completion of the self-directed portion of the telehealth program and two subsequent data collection probes (self-directed probes) followed by (2) three, 30-min coaching sessions and three data collection probes (coaching probes). The follow-up phase involved two data collection probes approximately 1- and 3-months after the final coaching probe (see Fig. 1).

Baseline

During baseline sessions parents were asked to interact with their child as they normally would during play

activities for 10-min and were not provided with any other instructions or feedback.

Treatment

Self-directed Condition

Intervention The content of the self-directed telehealth intervention was adapted from RIT, a set of intervention strategies aimed at increasing spontaneous imitation skills in children with ASD (Ingersoll and Schreibman 2006). Parents were taught to: (1) set up their homes and

environments for successful parent–child play interactions; (2) contingently imitate their children’s actions with toys, gestures/body movements, and vocalizations; (3) use simplified language to describe objects and actions around their children’s focus of attention; and (4) use prompting and reinforcement strategies to elicit a nonverbal imitative response (i.e., object or gesture imitation) from their children.

Delivery Platform The self-directed portion of the telehealth program was delivered via a secure website developed specifically for the current study. Upon enrollment in the study, participants were able to create a unique username and password for access to the Online RIT website.

Program Structure Instructional content in the self-direction portion of the program was presented in four short lessons, each addressing one of the strategies listed above. Instruction was presented via animated slideshows with text presented on screen and a concurrent audio lecture providing more thorough explanations of the concepts. There was a corresponding printable PDF of a written manual that expanded upon the information presented in the instructional slideshow for each lesson. Participants also completed a homework plan and reflection questions for each lesson wherein they indicated their plans for practicing and use of the techniques, and wrote about implementation successes and challenges, respectively. In addition, two active learning tasks were included in the lessons. The first task, termed the “self-check,” required participants to complete several multiple choice questions related to information provided in the slideshow to ensure comprehension of lesson content. In the second task, termed “exercises,” participants viewed short clips of adult-child interactions and were asked to indicate whether or not the adult was implementing a specific RIT technique correctly. Participants were provided with feedback after each self-check and exercise question. There were a total of 40 possible instructional components (e.g., slideshow, self-check questions, homework plan) across the four lessons.

The Online RIT website also included a Video Library in which users were able to view ten longer video examples of RIT sessions with children at different developmental levels. In addition, the website offered a resources page where participants could access relevant references from the ASD intervention literature, as well as links to additional online autism resources (e.g., a link to Autism Speaks’ website).

Procedure After the baseline phase, parents were given access to the Online RIT website. Before accessing course content, all parents were asked to complete an RIT knowledge quiz. After finishing all four Online RIT lessons, parents completed the same RIT knowledge quiz. At

this time, the parent coach also observed two, 10-min parent–child interactions where parents were asked to practice RIT without any feedback or coaching.

Coaching Condition

Participants received a total of three, 30-min remote coaching sessions. The first coaching session took place immediately after participants completed the second data collection probe in the self-directed condition. The subsequent two coaching sessions began with a 10-min data collection probe, followed by 30-min of feedback and problem solving. The final data collection probe was taken on a different day, after the third coaching session.

During the 30-min coaching sessions, the parent coach answered questions, engaged in collaborative problem solving, and provided specific feedback about parents’ use of the RIT techniques observed during the session. Parents were given the opportunity to integrate the coach’s feedback and engage in additional practice. After each coaching session the parent coach sent written feedback summarizing content covered in the session and suggesting portions of the website that might be useful for the parent to review (e.g., specific videos in the video library, exercises from a certain lesson). After the final coaching session, parents completed a set of exit assessments and provided feedback about the intervention and telehealth service delivery model.

Adjustments were made to the coaching condition protocol for one family (Dyad 2) due to problems with internet connectivity. Parent–child interactions were filmed offline and then uploaded to a secure password protected digital file sharing program accessed from a computer in another family member’s home. The parent coach reviewed the video, sent the parent written feedback summarizing observations and suggestions, and conducted a follow-up phone conversation to help the parent problem solve and answer any questions from the written feedback. This procedure was followed for all three coaching sessions for Dyad 2.

Follow-Up

Ten-minute follow-up data collection probes of parents using RIT techniques were collected approximately 1- and 3-months after the final coaching session for the majority of families. At the 3-month follow-up, participants completed an additional feedback form addressing issues of implementation and sustainability. No formal coaching occurred during the follow-up sessions; however, parents were given the opportunity to ask questions and discuss implementation challenges that had occurred over the prior months.

Table 2 Behavioral definitions

<i>RIT fidelity components</i>	
Contingent imitation	Following the child's lead and imitating the child's actions with toys, body movements, gestures, and vocalizations
Linguistic mapping	The use of simple, descriptive, and repetitive language around the child's focus of attention
Modeling	Modeling an action for imitation around the child's focus of attention
Prompting	Using physical guidance or manipulation of materials to encourage the child to imitate the modeled action if the child does not spontaneously imitate after the model
Reinforcement	Providing the child with praise and continued access to the toys after both prompted and spontaneous imitation
Pacing	Modeling an action of imitation once every 1–2 min on average. Adjusts the rate of models when necessary to keep the child engaged
<i>Child spontaneous imitation</i>	The child imitates the adult's model of an action with a toy or a gesture within 10-s of the model. The child provides an imitative response without physical guidance from, or material manipulation by, the adult

Dependent Measures

Program Engagement

Parent use of the self-directed portion of the training program, including dates and times of website access, as well as dates and times of program component access and completion, was tracked on the website.

Parent Knowledge of RIT

Parent knowledge of RIT and naturalistic behavioral intervention techniques was assessed with a 20-question multiple-choice quiz administered before and after completing the self-directed portion of the telehealth program.

Fidelity of Implementation of RIT

Trained observers scored the parent–child interactions for parent fidelity of the RIT intervention techniques using the RIT fidelity form (Ingersoll and Lalonde 2010). Observers rated the parents from one (low fidelity) to five (high fidelity) on *Contingent Imitation*, *Linguistic Mapping*, *Modeling*, *Prompting*, *Reinforcement*, and *Pacing*. The final four dimensions were averaged to create a *Prompting Sequence* score. Parent scores on *Contingent Imitation*,

Table 3 Treatment acceptability

	Mean	Range
<i>Modified BIRS</i>		
Intervention acceptability	5.7	6.0–4.0
Intervention effectiveness	4.9	6.0–1.0
Intervention usability	5.6	6.0–4.0
Telehealth program usability	5.5	6.0–4.0
<i>Additional items</i>		
Online RIT website (self-directed portion)		
The slideshows were helpful for learning about the RIT intervention	5.2	6.0–3.0
The manual was helpful for learning about the RIT intervention	5.4	6.0–5.0
The self-check questions were helpful for learning the RIT intervention	5.0	6.0–3.0
The video-based exercises were helpful for learning the RIT intervention	5.6	6.0–5.0
The homework was helpful for learning the RIT intervention	5.0	6.0–4.0
The reflection questions were helpful for learning the RIT intervention	4.6	6.0–3.0
The video library was helpful for learning the RIT intervention	5.6	6.0–5.0
The amount of information provided in the Online RIT website was sufficient for me to learn the intervention techniques	4.8	6.0–3.0
The amount of information provided in the Online RIT website was sufficient for me to feel comfortable and competent when using the intervention techniques	5.0	6.0–4.0
Remote coaching		
The coaching sessions with my child were helpful for learning the RIT intervention	6.0	6.0–6.0
The discussion and problem solving with the coach was helpful for learning the RIT intervention	6.0	6.0–6.0
The written feedback provided by the coach was helpful for learning the RIT intervention	6.0	6.0–6.0
I would have liked more formal feedback (e.g., the use of a rating form) on how well I was using the different RIT techniques	4.2	6.0–2.0
The coach was interested in me	6.0	6.0–6.0
The coach understood me	6.0	6.0–6.0
The coach understood my child	6.0	6.0–6.0
The amount of coaching I received was sufficient for me to learn the intervention strategies	5.6	6.0–4.0
The amount of coaching I received was sufficient for me to feel comfortable and competent with using the intervention strategies	5.6	6.0–4.0

Linguistic Mapping, and the *Prompting Sequence* were averaged to create an *Overall Fidelity* score. See Table 2 for behavioral definitions.

Child Imitation

Trained observers scored the parent–child interactions for child spontaneous imitation. Rate per minute of spontaneous imitation was calculated by dividing the number of spontaneous imitative responses demonstrated by the child by the number of minutes of the session. See Table 2 for behavioral definitions.

Treatment Acceptability

Parents were asked to complete a modified version of the Behavioral Intervention Rating Scale (BIRS; Elliott and Treuting 1991) after the final coaching session. Parents were asked to evaluate the feasibility, acceptability, and perceived effectiveness of the intervention program and service delivery model (Table 3; 1 = strongly disagree, 6 = strongly agree). For the current study, the BIRS was modified to better reflect the goals of the intervention (e.g., acquisition of child imitation skills) and the components of the service delivery model (e.g., online self-directed instructional content, remote coaching). Parents were also asked to rate additional items assessing the usability of the telehealth program using the same rating scale (see Table 3 for additional items). Finally, parents were asked to indicate benefits and limitations of the telehealth program in an open-ended format.

Parents also completed a feedback form at the 3-month follow up. They were asked about their experiences with using the Online RIT website and the RIT intervention techniques over the previous months. They were also asked to provide suggestions about how to support continued use of the Online RIT website and the intervention strategies.

Inter-observer Reliability

Approximately 25 % of all sessions (across conditions) were coded by a second independent rater who was blind to condition. Intraclass correlations were used to calculate reliability on parent overall fidelity (.99) and child spontaneous imitation rates (.94).

Data Analysis

The small sample size in the current study limited the use of statistical analyses to test for significant differences in participant scores on the RIT knowledge quiz. However, Cohen's *d* was calculated to examine the magnitude of the difference between parent scores on the RIT knowledge quiz before and after completing the Online RIT website. Visual inspection of session data was used to examine changes in parent fidelity ratings and rates of child spontaneous imitation (Gliner et al. 2000). Multilevel modeling was used to examine the relationship between parent use of the intervention techniques and

child rate of spontaneous imitation (Van den Noortgate and Onghena 2003). Multilevel modeling can help identify the active component(s) of an intervention, by examining which, if any, of its individual components are related to outcomes, after controlling for both within and between participant variance on the outcome. First, overall parent fidelity was entered as a predictor to examine the relationship between overall parent fidelity and child spontaneous imitation. In a second analysis, parent scores on *Contingent Imitation*, *Linguistic Mapping*, and the *Prompting Sequence* were entered simultaneously to determine which fidelity dimensions were unique predictors of child spontaneous imitation when controlling for the other dimensions. The random component of these models included an autoregressive lag 1 model to account for temporal nonindependence.

Results

Program Engagement

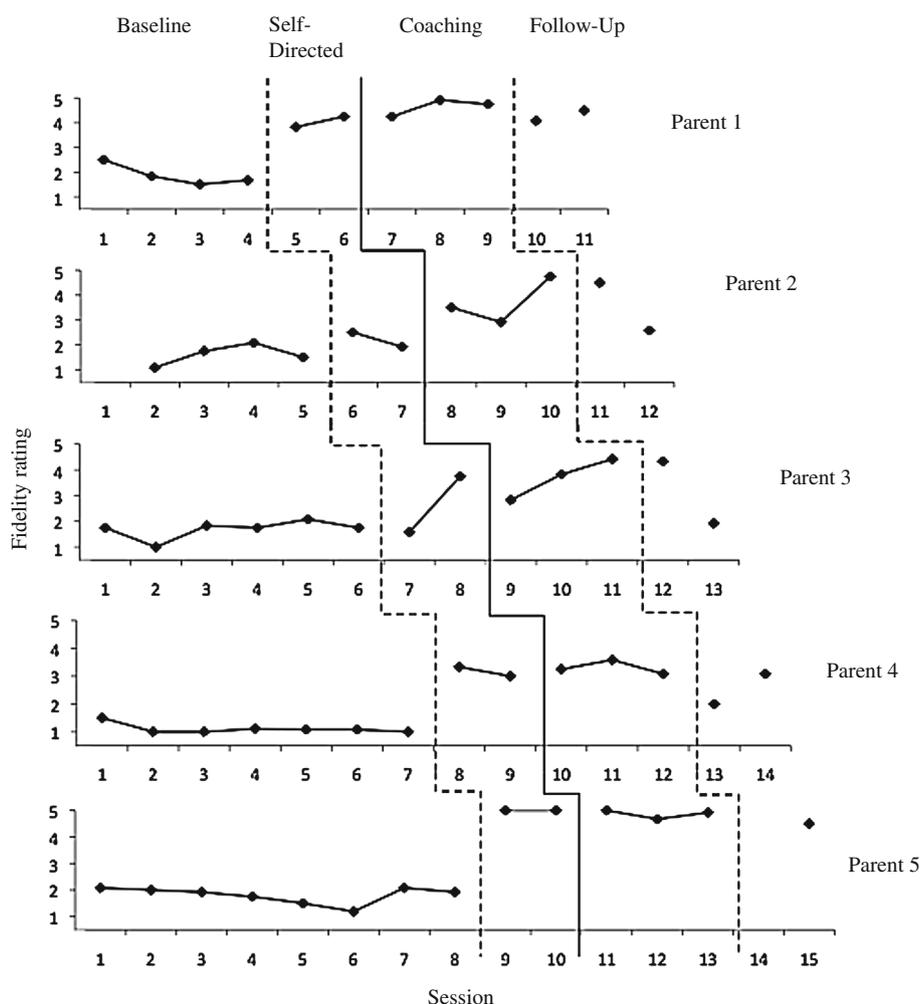
The amount of time between initial access to the Online RIT website and completion of the final instructional component ranged from 21 to 73 days ($M = 35$). During this time, parents logged into the program between 4 and 11 times ($M = 8$). The most common time of access was Lunch (10:00 a.m.–1:59 p.m.; 11 log-ins), followed by Dinner (6:00 p.m.–9:59 p.m.; 10 log-ins), Night (10:00 p.m.–1:59 a.m.; 10 log-ins), Afternoon (2:00 p.m.–5:59 p.m.; 8 log-ins), and then Morning (6:00 a.m.–9:59 a.m.; 4 log-ins). Of the 40 total instructional components included in the website, parents completed between 12 and 40 components ($M = 33$). They spent an average of 52.5 min (range = 34–77) viewing all the slideshows, and an average of 7 min (range = 4–11) and 14.9 min (range = 1–24.5) on the self-check and exercise questions, respectively. On average, parents spent 12 min (range = 0–18) working on the homework plan and 13.6 min (range = 0–25) on the reflection questions.

Parent Knowledge of RIT

Calculation of Cohen's *d* (1.04) suggested a strong effect in the change from participant scores on the RIT knowledge quiz from the start ($M = 11.60$, $SD = 3.78$) to the completion ($M = 15.20$, $SD = 3.11$) of the self-directed portion of telehealth program.

Fidelity of Implementation of RIT

During baseline, all parents demonstrated low and stable ratings of fidelity; no parent met overall fidelity of implementation (rating ≥ 4) at any point during baseline (Fig. 2).

Fig. 2 Ratings of parents' overall fidelity

During the self-directed condition, parents 1, 4, and 5 demonstrated immediate increases in fidelity levels with ratings in the high to moderate to high range. Parents 1 and 5 achieved fidelity of implementation (rating ≥ 4) during this condition. Parent 3 demonstrated a more gradual increasing trend in fidelity with ratings in the moderate to high range. Parent 2 demonstrated low to moderate levels of fidelity that overlapped with baseline ratings.

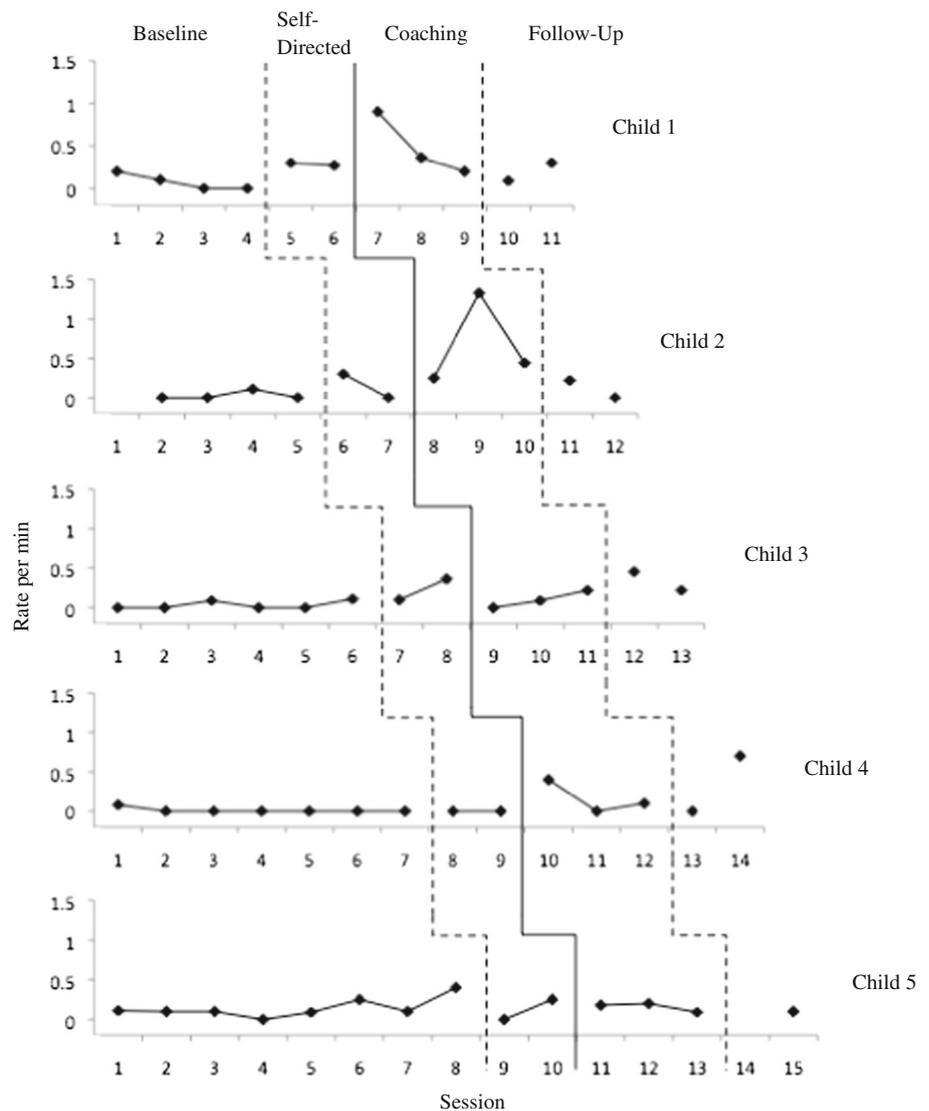
During the coaching condition, Parent 5 maintained high and stable levels of overall fidelity. Parent 1 demonstrated an increase in overall fidelity levels with ratings that were high and stable. Parent 2 demonstrated a gradual increasing trend to high levels of fidelity, and achieved overall fidelity of implementation during this condition. At the beginning of the coaching condition, Parent 3 demonstrated moderate levels of fidelity that overlapped with levels during the previous condition; a delayed increase in fidelity level was observed during the final coaching probe at which point overall fidelity of implementation was achieved. Parent 4 demonstrated moderate levels of fidelity that overlapped with levels observed during the previous condition.

Four of the five parents (parents 1, 2, 3 and 5) achieved overall fidelity of implementation at some point during either the self-directed and/or the coaching conditions. Once parents achieved fidelity of implementation, most maintained high levels of overall fidelity at the 1- and/or 3-month follow up time points. While Parent 4 did not achieve overall fidelity of implementation, overall fidelity ratings at 1- and 3-month follow up probes continued to be higher than baseline ratings.

Child Imitation

During baseline, children 1, 2, 3, and 4 demonstrated low and stable rates of spontaneous imitation (Fig. 3). Child 5 demonstrated low rates of spontaneous imitation during initial baseline probes, but showed an increasing trend in rate during the second half of the phase.

During the self-directed condition, children 1 and 2 demonstrated immediate small increases in level of spontaneous imitation rates. Child 3 demonstrated a gradual increasing trend in spontaneous imitation rates. Child 5

Fig. 3 Child spontaneous imitation rate

demonstrated moderate rates of spontaneous imitation that overlapped with rates during the baseline phase. Child 4 did not demonstrate any spontaneous imitation during the self-directed condition.

During the coaching condition, Child 2 demonstrated immediate, yet variable, increases in spontaneous imitation levels relative to the previous condition. Child 3 showed an increasing trend in spontaneous imitation rates towards the end of the condition; however, no consistent improvement from the self-directed condition to the coaching condition was observed. Child 1 and Child 4 demonstrated immediate increases in spontaneous imitation levels relative to the previous condition, but these increases were not maintained for the duration of the coaching condition with both children demonstrating subsequent decreasing trends in spontaneous imitation rates. Child 5 maintained moderate rates of spontaneous imitation that overlapped with rates observed during the previous condition.

Most of the children demonstrated moderate levels of spontaneous imitation at the 1- and 3-month follow up probes, with four out of the five children (children 1, 2, 3, and 4) maintaining higher than baseline rates of spontaneous imitation during at least one of the follow-up time points.

Relationship Between Parent Fidelity and Child Spontaneous Imitation

A multilevel model examining the relationship between parent overall fidelity and child spontaneous imitation failed to reveal a significant relationship, $F(1,33) = 2.28$, n.s.; however, when the fidelity dimensions were entered simultaneously in a model, both *Contingent Imitation* [$F(1,50) = 6.33$, $p < .05$] and the *Prompting Sequence* [$F(1,60) = 12.03$, $p < .05$] explained unique variance in child spontaneous imitation.

Treatment Acceptability

Parents responded favorably to the intervention and service delivery model on the modified BIRS (Table 3) completed at the end of the coaching condition. They indicated that RIT was highly acceptable, effective, and usable, and that the Online RIT website was highly usable. Parents provided informative responses to the additional questions about the different aspects of the telehealth service delivery model (Table 3). While they responded favorably to all parts of the self-directed program, the video-based instructional components (e.g., video library, video-based exercises) and remote coaching were rated especially highly. In response to the open-ended question about the benefits of the program, parents reported improvements in their children's social engagement, imitation skills, and play skills. In response to the open-ended questions about the limitations of the program, parents noted challenges associated with the remote coaching sessions including difficulty with accessing the video-conferencing program and difficulty maintaining the child's engagement in front of the video camera. They indicated that additional information about teaching other kinds of imitation (e.g., specific techniques for teaching gesture or vocal imitation), additional video examples in the video library, and additional coaching sessions would have been helpful. One parent suggested making the videos of the parent-child interactions available so that they could "see our progress and learn from our mistakes".

Parents completed an additional feedback questionnaire at the 3-month follow-up and indicated that the 1- and 3-month follow-up sessions were beneficial for supporting continued use of the RIT techniques, as well as for other reasons (e.g., checking in about other behaviors or receiving social support). Four out of the five parents reported that they use RIT intervention techniques 5 or more times per week. When asked about barriers associated with continued use of the intervention strategies, one parent noted personal time constraints, while another noted challenges with picking toys and activities that kept her child engaged long enough to use the strategies. Suggestions for helping support parents' continued use of the intervention techniques included additional coaching sessions, sending "helpful tips" emails, and developing an expanded video library with children at much higher and much lower developmental levels.

Parents reported accessing the Online RIT website between 0 and 3 times after completing the coaching condition of the study. Specifically, they reported viewing the slideshows, video library, homework/reflection questions, and resources section of the Online RIT website. Reported barriers to the continued use of the Online RIT website included limited time, incompatibility of the

website with ipads and iphones, and poor internet connections which made the slideshows and videos play more slowly. A suggestion for ensuring continued use of the Online RIT website included offering monthly web-tutorials where a facilitator could talk about specific techniques, show video clips and conduct a live Q&A session for parents joining in via teleconferencing programs.

Discussion

The discrepancy between the demand for and the availability of effective interventions for children with ASD necessitates the exploration of alternative service delivery models. The current study sought to examine the use of a hybrid telehealth program to introduce parents of children with ASD to a naturalistic imitation intervention.

The primary goal of this study was to assess the degree to which parents were able to learn and effectively implement RIT after engaging in the various components of the hybrid telehealth program. Use of the hybrid telehealth program was associated with increases in parent ability to correctly implement the intervention strategies. Two parents achieved fidelity of implementation after engaging in only the self-directed condition, while another two parents achieved fidelity of implementation of RIT during the remote coaching condition of the intervention. Although one parent did not achieve fidelity of implementation of RIT, she showed large improvements in her fidelity ratings from baseline to the self-directed and coaching conditions. It is important to note that her child was already demonstrating relatively complex play skills at the start of the study. Thus, he appeared to find some of the techniques (e.g., contingent imitation) a bit boring. Additionally, when she would model an action for imitation, her son would often expand on the action, rather than imitating it exactly. Her relatively lower levels of fidelity may have been due to the fit between her child's needs and the goals/procedures of the intervention, rather than to her ability to implement the techniques as specified. Indeed, considering the fit between an individual's and family's needs and a given intervention is critical for program adoption, implementation, and sustainability (Rogers 2003).

Taken together, these results contribute to the emerging body of literature suggesting parents are able to implement social communication intervention techniques with fidelity after engaging in a telehealth program (e.g., Nefdt et al. 2010; Vismara et al. 2013; Wainer and Ingersoll 2013a). Furthermore, these data are consistent with previous work indicating that a self-directed program may be sufficient for some, but not all, parents to learn the intervention; others may require additional support, in the form of remote coaching and feedback, in order to implement the

techniques with fidelity (Vismara et al. 2013; Wainer and Ingersoll 2013a). Importantly, parents demonstrated differences in program engagement that may have impacted learning and implementation across the study conditions. For example, the two parents who achieved fidelity of implementation during the self-directed condition completed 90 % or more of the Online RIT website components, while the two parents who achieved fidelity of implementation during the coaching condition completed less than 90 % of the website components (Parent 2 = 88 %, Parent 3 = 30 %). Additional research is needed to understand the relationship between program utilization and parent fidelity, with the ultimate goal of informing the development and structure of self-directed telehealth programs to support parent engagement and learning.

The variability in parent engagement and learning observed in this and other studies suggests that a hybrid telehealth program may lend itself well to a stepped-care service delivery model. For example, parents whose children demonstrate imitation deficits could be triaged into a low resource-intensive self-directed program; if sufficient engagement or learning does not occur, more intense support, such as remote coaching, could be provided as indicated. Scaling hybrid telehealth programs to stepped-care delivery models could allow for a large number of individuals to be served, while ensuring a mechanism to provide more intensive levels of support and care when necessary (Steever 2011). Indeed, there is an identified need for flexible parent training programs and interventions that can be tailored to individual needs and treatment response (Phaneuf and McIntyre 2011). Future research should examine the feasibility and cost-effectiveness of stepped-care models of telehealth parent training in order to encourage the dissemination and adoption of such programs on a larger scale.

Given that an ultimate goal of parent training is to support the development of child skills, this study also examined the impact of parent participation on child spontaneous imitation. Visual inspection of session data indicated that some of the children demonstrated increasing trends in spontaneous imitation skills concurrent with parent participation in the program. Two of the children showed small increases in spontaneous imitation immediately after their parents' completed the self-directed website, and maintained improvements relative to baseline for the duration of the study. Another two demonstrated increases in spontaneous imitation at various times while their parents were engaged in either the self-directed and/or the coaching conditions of the program; however, the individual session variability observed for these children makes it difficult to draw conclusions about overall improvements in spontaneous imitation. Although the last

child did not demonstrate improvements in his spontaneous imitation rates, he showed moderate levels of spontaneous imitation across the study conditions, suggesting that his imitation skills were relatively well developed at intake and/or that his mother entered the study with other effective strategies for teaching and eliciting spontaneous imitation from her child. Although the majority of children demonstrated changes in their spontaneous imitation skills within interactions with their parents, the clinical significance of such changes remain unclear.

Multilevel modeling revealed that parent use of two of the RIT strategies, *Contingent Imitation* and the *Prompting Sequence*, uniquely predicted spontaneous imitation rates. Thus, not all components included in RIT may serve as "active ingredients" in promoting spontaneous imitation skills. Diffusion of innovation theory suggests that the perceived complexity of an intervention can strongly influence innovation adoption, implementation and maintenance (Dingfelder and Mandell 2011; Rogers 2003). Additionally, the complexity of interventions may influence response acquisition and impede behavioral change in parent training programs specifically (Allen and Warzak 2000). Thus, considering ways to decrease the perceived complexity of interventions, perhaps by limiting the number of techniques introduced to only those "active" components, may be an important step in supporting parents' implementation of interventions during, as well as after, participation in telehealth programs. Additionally, results from the current research offer further evidence that interventions that promote both parent responsiveness and the use of effective prompting may be particularly beneficial for supporting the development of early social communication skills in children with ASD (e.g., Ingersoll and Wainer 2013a; Stahmer et al. 2011).

Given that the adoption and implementation of a program is dependent on users' perceptions of the acceptability of the intervention (Rogers 2003) the final goal of the study was to assess the social validity of this hybrid telehealth service delivery model in serving parents of children with ASD. With respect to the self-directed Online RIT website, parents rated the video-based instructional components most favorably. This finding is not surprising given that previous research suggests that video is a powerful online teaching tool (Anaraki 2004); it allows for visual and auditory learning and demonstrates learning objectives in context, and has been found to be associated with an enhanced learning experience (Wetzel et al. 1994) and better learning outcomes (e.g., Romanov and Nevgi 2007). Parents also rated the coaching sessions as particularly useful and acceptable. Previous research suggests that collaboration and dialogue are important in the learning process (Bonk and Cunningham 1998), and that too little interaction may serve as a source of

dissatisfaction with online learning (Casebeer et al. 2004). Additionally, components of the parent coaching sessions, including opportunities for practice and feedback, have been identified as particularly important for producing positive intervention outcomes (Kaminski et al. 2008). Thus, although coaching may not be necessary for some parents to learn intervention strategies, it may be a desirable element of telehealth programs and could influence other factors such as parent engagement and sustainability of the intervention. While additional research in this area is needed, it is clear that program developers must consider a balance between ensuring social validity, positive program outcomes, and maximum dissemination and impact.

The primary limitations to the current study include a small sample, and a lack of comparison data. Importantly, the demographics and education level of the families in the study are not necessarily representative of those of many families presenting for treatment in community settings. Additionally, there were a limited number of data collection probes for each of the treatment conditions in the study. Practical reasons such as scheduling and concerns about withholding treatment, and then feedback, from participants precluded the collection of behavioral data until stability had been achieved in each condition. Future research using large randomized clinical trials, with diverse samples, is necessary to establish the effectiveness of this service delivery model; in particular, use of non-inferiority methodology will be especially useful in elucidating how this service delivery model compares to traditional in-person service delivery models including individual and group parent training formats (Gros et al. 2013). It is likely that the amount, duration, and context of parent practice of the intervention techniques would influence both parent and child behavioral outcomes (Wainer and Ingersoll 2013b). Although it is difficult to collect this kind of information, technology-based applications, such as “practice” calendars or automatic email practice reminders, could be integrated into telehealth programs to understand and support ongoing parent use of the intervention strategies. Furthermore, it is likely that factors such as general and computer/internet literacy, as well as ease of access to computer and internet technology, could strongly influence participant engagement and program outcomes. In support of this contention, the one family in the current study who experienced problems with internet connectivity at home, also reported limited familiarity with technology, took the longest amount of time to complete the self-directed portion of the program, and felt discouraged and demotivated in the face of the technological problems that arose. Interestingly, this family, and others, reported feeling comfortable with other forms of technology including smartphones and tablets. Examining the use of these delivery platforms and their effects on program

engagement and outcomes will be an important next step in expanding the accessibility, reach, and impact of telehealth programs (Vismara et al. 2013).

Summary

This study provides initial evidence for the effectiveness of a hybrid telehealth program for disseminating training in a naturalistic imitation intervention to parents of young children with ASD. Hybrid telehealth programs, particularly those provided via a model of stepped care, may serve a significant role in increasing access to interventions for those on lengthy waitlists or living in areas with limited services. As empirical evaluations of this, and other, telehealth programs become more common, research questions beyond the acceptability and general effectiveness of the program, including the cost-effectiveness, reach, referral processes and characteristics of program completers and non-completers must be explored to determine how telehealth programs can fit within the larger context of ASD intervention services. Furthermore, policy, administrative, and staffing issues, such as HIPPA compliance and data security, licensing and credentialing policies, reimbursement schedules by third-party payers (Gros et al. 2013), and availability of staff to provide remote support must be considered as these hybrid telehealth programs are transported into practice settings.

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