INCREASING THE DISSEMINATION OF AN EVIDENCE-BASED ASD INTERVENTION VIA A TELEHEALTH PARENT TRAINING PROGRAM

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ABSTRACT

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Systematic research focused on developing and improving strategies for the dissemination and implementation of evidence-based 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 evidence-based 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 evidence-based imitation intervention. A single-subject multiple-baseline design study evaluated the effect of the program on changes in parent knowledge and behavior, and changes in child behavior. Parents improved their knowledge and 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 evidence-based ASD services.

This dissertation is dedicated to my parents, Drs. Beth Volin and Gary Wainer, whose endless support and last minute trips to East Lansing have made this all possible.

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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). Individuals with ASD often require intensive and comprehensive intervention in these core areas of deficit, as well as in additional areas of functioning (e.g., adaptive skills, behavior management), across the life span (Maglione, Gans, Das, Timbie, & Kasari, 2012). 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 88 (Centers for Disease Control and Prevention, 2012), and this population is at a particularly high risk for experiencing unmet service needs (Kogan et al., 2008).

Importantly, the significant unmet service needs of individuals with ASD do not appear to be due specifically to a lack of knowledge about effective intervention programs. Indeed, there has been significant progress with respect to the development and validation of evidence-based services across mental health disciplines (Herschell et al., 2009), including the ASD intervention field (Lord et al., 2005). Over this period, the long-term prognosis of individuals with ASD has improved considerably, particularly when children are identified, and appropriate intensive treatment is started, early in life (Turner, Stone, Pozdol, & Coonrod, 2006). However, evidence-based ASD intervention programs linked with positive distal and proximal outcomes 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 & Madnell, 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, Whaley, Shaw, & Brame, 1999; Stahmer & Gist, 2001; Symon, 2005). Taken together these issues highlight the need for systematic research focused on developing and improving strategies for dissemination and implementation of evidence-based 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 evidence-based strategies to improve social-communicative functioning in young children with ASD (e.g., Charlop & Trasowech, 1991; Ingersoll & Gergans, 2007; Koegel, Bimbela, & Schreibman, 1996; Stahmer, 1995). Additional benefits of parent training include increases in generalization and maintenance of child skill, a reduction in parent stress, and increases in family leisure time (Koegel et al., 1996; Koegel, Schreibman, Britten, Burke, & O'Neill, 1982). 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 & Gist, 2001; Symon, 2001; Taylor, Webster-Stratton, Feil, Broadbent, Widdop, & Severson, 2008). Thus, it is essential to consider the adaptation of evidence-based 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). Broadly defined, telehealth is the "use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health

and health administration" (Office for Advancement of Telehealth). 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 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). Telehealth programs make it possible to sustain highly standardized instruction and maintain fidelity of program implementation, while also supporting individualized learning (Hollon et al., 2002; Mandel, Bigelow, & Lutzker, 1998). Users 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 & Wainer, 2013). Importantly, the number of individuals with access to internet-based and computerized technologies has grown considerably in recent years (File, 2013). The percentage of U.S. households with a computer has increased from 8.2% in 1984, to 61.8% in 2003, to nearly 76% in 2011, while the percentage of US household with internet access has gone from 18% in 1997, to 54.7% in 2003, to nearly 72% in 2011 (File, 2013). Furthermore, as of 2007, nearly 83% of adults were able to access the internet from home, work, or elsewhere (US Census Bureau 2009). Finally, telehealth services are becoming increasingly more common with over 3,000 U.S. sites using distance-based service delivery models to provide patient care (American Telemedicine Association). 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). Such telehealth programs may serve a role in the direct delivery of evidence-based interventions, as well as in training service providers to use evidence-based intervention strategies in in-person practice settings. 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.

Initial studies of telehealth-based parent training programs have indicated that parents of typically developing children can be taught evidence-based adaptive parenting and behavior management techniques via this service delivery mechanism (e.g., Baggett et al., 2010; Feil et al., 2008; Kacir & Gordon, 1999; MacKenzie & Hilgedick, 1999). For example, Kacir and Gordon (1999) adapted the parent training program, Parenting Adolescents Wisely, to a brief self-directed interactive laserdisc program. The laserdisc program used audio, video and text to deliver training and feedback, and was found to be effective in reducing child problem behaviors and improving parent knowledge and use of adaptive parenting skills. MacKenzie and Hilgedick (1999) created the Computer-Assisted Parenting Program (CAPP) to teach parents effective behavior management techniques. This program utilized a number of technology-based applications including computer simulation, written instruction, and multiple-choice questions with immediate corrective feedback; use of the program resulted in increases in parents' use of behavioral management strategies and increases in parental involvement.

Although the number of studies exploring the use of telehealth and related technological applications to train parents of children with ASD in evidence-based intervention has grown over the past several years, empirical evaluations of such programs are limited. 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, Serna, Morrison, & Fleming, 2010; Howroyd & Peeters, 2007; Jang et

al., 2012), yet only recently have researchers begun to evaluate the impact of these training programs on parents' fidelity of implementation. Examination of the effect of telehealth programs on parent fidelity is critical because parent training interventions are, by definition, multi-level. Thus, the "success" of an intervention can be affected by the transfer of information from the telehealth program to the parent, and by the parent's application of the techniques with the children. Most parent training interventions include several different intervention strategies and it is often unclear which elements of the intervention are most responsible for influencing child behavior. Therefore, a failure to find treatment effects after the use of a telehealth program could be due to problems in information transfer and/or to a set of ineffective intervention strategies. As such, the collection of parent and child behavioral data is critical for developing a more detailed understanding of the effectiveness of interventions and the systems used to deliver them.

Initial examinations of the effect of telehealth programs on parent behavior suggest that parents can learn to implement intervention techniques with fidelity. Nefdt and colleagues (2010) examined a DVD-based self-directed training program to teach parents evidence-based motivational techniques from pivotal response training (PRT). The program consisted of 14 training modules with information presented via text and audio lecture, and short video examples of each technique; parents also engaged in brief active learning tasks such as comprehension quizzes and rating of fidelity of implementation of other adults' use of the techniques. Results from this study suggested that parents were able to implement 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 & Schreibman, 2006), an evidence-based intervention to improve imitation skills in children with ASD. The program consisted of five modules and instructional content was delivered over narrated slideshows augmented with video examples and written descriptions of the techniques. Participants completed short comprehension quizzes and rated others' implementation of the RIT techniques. Results suggested that undergraduate therapists and parents 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. Moreover, parents who did not receive feedback indicated that contact with a coach would have been helpful. 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, recent research has begun to explore the use of teleconferencing technology to provide feedback and support to parents of children with ASD from a distance (Baharav & Reiser 2010; Vismara, McCormick, Young, Nadhan, & Monlux, in press; Vismara, Young, & Rogers, 2012). For example, Baharav & Reiser (2010) utilized streaming internet technology to provide live feedback and coaching to parents implementing in-home speech and language therapy. Results from this pilot study support the feasibility and effectiveness of remote coaching conducted via teleconferencing technology for parents of children with ASD attempting to implement evidence-based intervention in their homes (Baharav & Reiser, 2010).

Recognizing the potential for combining remote coaching with technology-based instruction, Vismara and colleagues (Vismara et al., 2012, Vismara et al., in press) have explored

the use of “hybrid” telehealth programs to deliver the parent curriculum of the Early Start Denver Model (ESDM; Rogers & Dawson, 2010; P-ESDM, Rogers et al., 2012) an evidence-based comprehensive ASD intervention program. Both DVD-delivered instructional content and web-based instructional content, in conjunction with weekly video-conferencing coaching sessions, have been examined as potential mechanisms for delivering the parent training (Vismara et al., 2012, Vismara et al., in press). In both studies parents engaged in self-guided instruction (via a DVD or website) and then participated in weekly hour, or hour and a half, remote coaching sessions with an expert therapist. 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; Vismara et at., in press).

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 evidence-based 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. For example, self-directed telehealth programs seem to be effective for increasing participant knowledge and may offer a cost-effective way to significantly increase the reach of parent training programs. Theoretically, once a self-directed telehealth program is developed, few resources should be necessary to enroll participants and to maintain the program. Yet, previous research suggests that self-directed programs may not provide enough support for some parents

to be able to implement evidence-based intervention techniques with fidelity (e.g., Wainer & Ingersoll, 2013a). The provision of remote coaching via video-conferencing technology may serve as an additional support to help parents implement evidence-based intervention techniques with fidelity. However, remote coaching programs require more time and financial resources at organizational, clinician, and family levels, than do self-directed 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 & McIntyre, 2011; Steever, 2011), but also in the behavioral health field more generally (O'Donohue & Draper, 2011).

The current study sought to examine the use of a hybrid telehealth program to introduce parents of children with ASD to an evidence-based imitation intervention, Reciprocal imitation training (RIT). RIT, as implemented by therapists and parents, has been shown to increase spontaneous imitation skills, in addition to other early social-communication skills such as joint attention, in young children with ASD (Ingersoll, 2010; Ingersoll & Gergans, 2007; Ingersoll & 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 & 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 behavior, including child imitation skills and joint engagement. Additionally, the degree to which parent use of the intervention techniques were related to child behaviors within the interaction were examined in an attempt to identify which parent behaviors most strongly influence child outcomes. A final goal of the study was to assess the acceptability of this hybrid telehealth service delivery model to parents.

METHOD

Participants

Five young boys 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 autism spectrum disorder 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, Bailey, & Lord, 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, Cicchetti, & Balla, 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.

Table 1

Participant characteristics

	Parent Education	Parent Employ-ment	Marital Status	Child Age (mo.)	Child Ethni-city	ASD Severity	Vine-land Comm.	Vine-land Soc.
Dyad 1	Graduate Degree	Not Empl-oyed	Married, living with partner	59	Asian/ Pacific Islan-der	15	65	61
Dyad 2	Some College/ Special Training	Not Empl-oyed	Single, living with partner	42	Multi-Racial	13	67	68
Dyad 3	Graduate Degree	Finance	Married, living with partner	29	Asian/ Pacific Island-er	20	64	89
Dyad 4	Graduate Degree	Finance	Married, living with partner	40	White, Non-Hisp-anic	21	79	72
Dyad 5	Graduate Degree	Techno-logy	Married, living with partner	41	Hisp-anic	24	52	65

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 Skype (4 families) or Facetime (1 family). Families who did not have an account with one of these videoconferencing programs prior to participation in the current study were provided with instructions and assistance with program download and registration. 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.

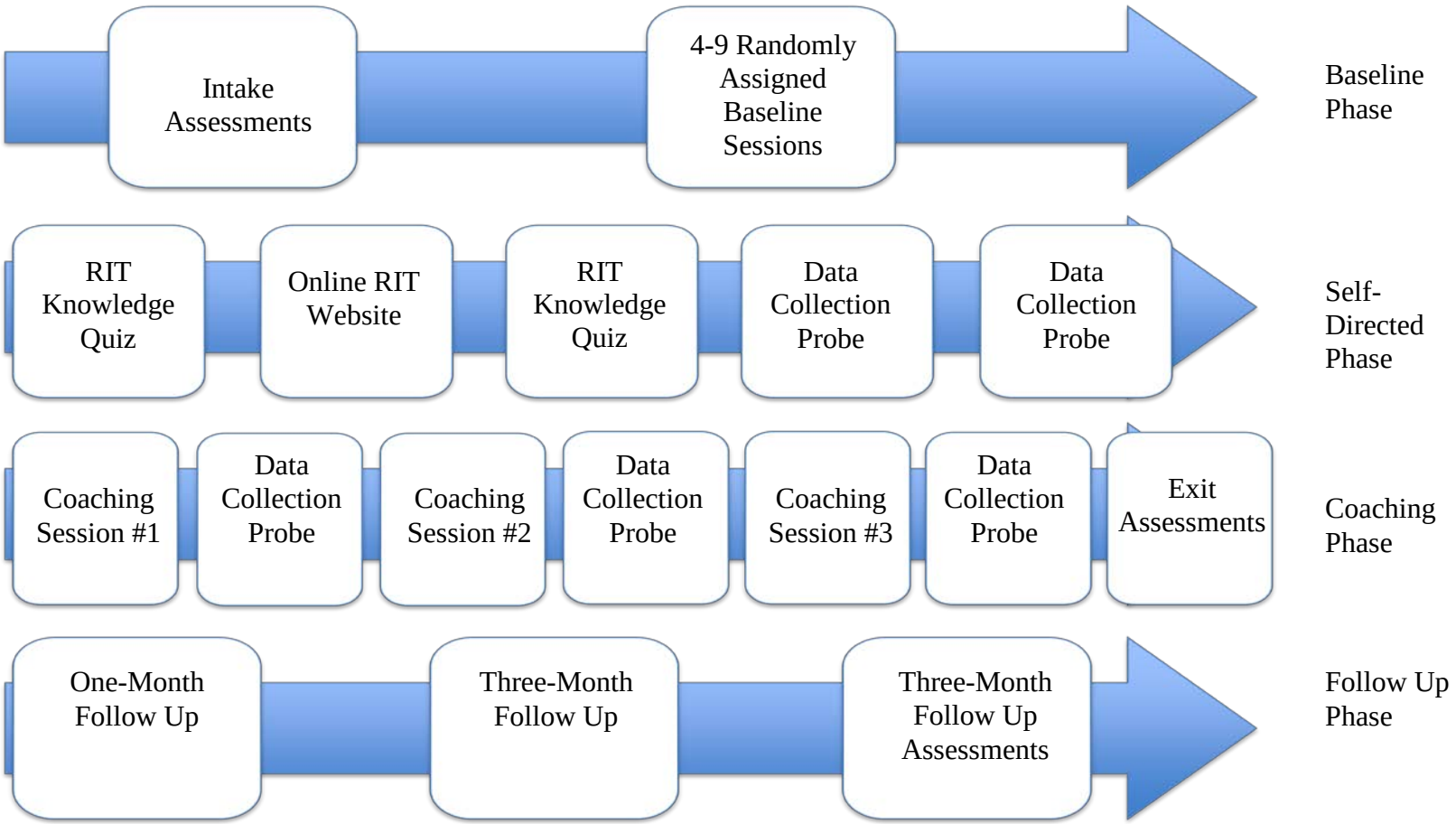
Experimental Design and Study Procedure

An IRB approved, single-subject, multiple-baseline design was conducted across the five parent-child dyads (Hersen & Barlow, 1976). Dyads were randomly assigned to between 4 and 9 baseline probes (Edgington, 1996). Although the initial study design called for the baseline phase to be completed within 2 – 3 weeks so as not to delay access to the intervention, the duration of baseline periods ranged from 2 to 7 weeks (M = 4.42 weeks) due to difficulties with scheduling and problems with technology (e.g., family losing internet access in the home for several weeks).

There were four phases involved in the current study (see Figure 1). The first phase consisted of a randomly assigned number of baseline probes as detailed above. The second phase involved completion of the self-directed portion of the telehealth program and two subsequent data collection probes (self-directed probes). The third phase of the study included three 30-minute coaching sessions and three data collection probes (coaching probes). The fourth phase of the study involved two follow-up data collection probes approximately one- and three-months after the final coaching probe.

Figure 1

Study Phases and Procedures. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation



Baseline phase.

During baseline sessions parents were asked to interact with their child as they normally would during play activities for 10-minutes. Parents were informed that the purpose of these sessions was for the parent coach to develop an understanding of the child's skills and the parent-child interaction style, and were not provided with any other instructions or feedback.

Self-directed phase.

Intervention.

The content of the self-directed telehealth intervention was adapted from reciprocal imitation training (RIT), an evidence-based intervention aimed at increasing spontaneous imitation skills in children with ASD (Ingersoll & 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 (referred to as Online RIT) 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 10 longer video examples (approximately five minutes each) 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 period, parents were given access to the Online RIT website. Before accessing the instructional content, all parents were asked to complete an RIT knowledge quiz to assess general knowledge of naturalistic behavioral techniques and specific techniques involved with the intervention. After finishing all four Online RIT lessons, parents completed the same

RIT knowledge quiz. At this time, the parent coach also observed two, 10-minute parent-child interactions. During these two self-directed data collection probes, parents were asked to practice RIT without any coaching or feedback.

Coaching phase.

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

During the 30-minute 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 phase 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.

Follow-up data collection probes were conducted approximately one- and three-months after the final coaching session for the majority of families. Due to difficulties with technology and scheduling, the final data collection probe was collected approximately five months after the last coaching session for Dyad 2.

All follow-up sessions began with a 10-minute data collection probe in which parents were asked to practice RIT with their children. Next, the parent coach answered any questions and engaged in collaborative problem solving with the parent. The coach did not provide specific feedback, unless the parent reported concerns using the techniques or asked specific questions about the techniques. At the three-month follow-up, participants completed an additional feedback form addressing issues of implementation and sustainability.

Dependent Measures

Program engagement.

Parent use of the self-directed portion of the training program was tracked on the website.

Parent knowledge of RIT.

Changes in parent knowledge of RIT and naturalistic behavioral intervention techniques were assessed with a 20-question online multiple-choice exam 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 & 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*, *Linguistic Mapping*, and the *Prompting Sequence* were averaged to create an *Overall Fidelity* score. See Table 2 for behavioral definitions and Appendix A for a copy of the RIT fidelity form.

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 and Appendix B for a copy of the RIT imitation scoring form.

Social engagement and affect.

Trained observers scored the parent-child interactions for episodes of coordinated joint engagement and parent and child affect using an adapted version of the rating scale for the *Communication Play Protocol* (Adamson & Bakeman, 1998; Adamson, Bakeman, Deckner, & Brooke Nelson, 2012). Observers rated child behavior on a scale from 1 (no episodes) to 7 (frequent and rich episodes) on *Coordinated Joint Engagement.* To be considered "in" an episode of joint engagement, the child needed to be attending to the same object and/or event as the caregiver. Observers also rated *Parent Affect* on a scale from 1 (tense, disruptive, or affectively flat to the point of being expressionless and subsequently very hard to read) to 7 (smoothly modulated, appropriate, and serves to enhance other modes of communication) and *Child Affect* on a scale from 1 (disruptive, highly inappropriate, or very flat and constricted affect) to 7 (affect is smoothly modulated, appropriate, and serves to enhance other modes of

communication). See Table 2 for behavioral definitions and Appendix C for a copy of the social engagement and affect rating scales.

Table 2

Behavioral definitions

RIT Fidelity Components	
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 one to two minutes on average. Adjusts the rate of models when necessary to keep the child engaged.
Child Spontaneous Imitation	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.
Child Social Engagement	
Coordinated Joint Engagement	Describes the quantity and quality of time the child and caregiver are actively involve with the same object and/or event, with the child actively and repeatedly acknowledging the caregiver's participation in the interaction.
Affect	
Caregiver Affect	Assesses the caregiver's affect and how it influences the caregiver-child interaction.
Child Affect	Assesses the way the child's affective expressions are integrated into the social interaction with the caregiver.

Parenting sense of competence.

Changes in parent sense of competence from intake to completion of the hybrid telehealth program were examined using the Parenting Sense of Competence Scale (PSOC; Gibaud-Wallston & Wandersman, 1978). The PSOC is a 17-item questionnaire that asks about parenting efficacy (perceived skills/knowledge about being a parent) and parenting satisfaction (value and comfort associated with the parenting role). Parents were asked to rate items on a 6-point scale ranging from (0) *strongly agree* to (5) *strongly disagree*.

Parenting stress.

Changes in parenting stress from intake to completion of the hybrid telehealth program were evaluated using the Family Impact Questionnaire (FIQ; Donenberg & Baker, 1993). The FIQ assess parents' perceptions of a target child's impact on their families relative to the impact that most children have on their families. Parents were asked to rate agreement with items on a 4-point scale ranging from *Not At All* (0) to *Very Much* (3). For the purposes of the current study three of the six FIQ scales were used: Positive Feelings about Parenting, Negative Feelings about Parenting, and Impact on Social Life.

Treatment Acceptability

Parents were asked to complete a modified version of the Behavioral Intervention Rating Scale (BIRS; Elliott & Treuting, 1991) after the final coaching session to evaluate the feasibility, acceptability, and effectiveness of the intervention program and service delivery model. 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 5 for additional items). Finally, parents were asked to indicate benefits and limitations of the telehealth program in an open-ended format. See Appendix D for a copy of the modified BIRS.

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 sessions were coded by a second independent rated who was blind to intervention phase. Intraclass correlations were used to calculate reliability on parent overall fidelity (.99), child imitation rates (.94), coordinated joint engagement (.89), child affect (.94) and parent affect (.91).

Missing Data

Observational data was missing for Dyad 1 (session 1; parent fidelity, child imitation, joint engagement) and Dyad 2 (session 7; joint engagement) because of problems with session audio/video. The one-month follow-up data collection probe was not collected for Dyad 5 because this time point overlapped with the birth of a child.

Data Analysis

Paired sample t-tests were conducted to test for significant differences in participant scores on the RIT knowledge quiz, PSOC, and FIQ. Given the predicted direction of effect, one-tailed tests were used. Visual inspection of session data was used to examine changes in parent fidelity ratings, rates of child spontaneous imitation, and social engagement ratings from baseline to treatment, and at follow-up for each participant (Gliner, Morgan, & Harmon, 2000).

Multilevel modeling was use to examine the effect of study phase on behavioral outcomes, aggregated across participants (Van den Noortgate & Onghena, 2008). The random component of these models included an autoregressive lag 1 model to account for temporal nonindependence. For these analyses, missing data due to recording equipment failure (<1% of sessions) were imputed by averaging the data point immediately preceding and immediately following the missing data point.

The relationship between the parents' use of the intervention techniques and their children's rate of spontaneous imitation and joint engagement was also examined using multilevel modeling. Multilevel modeling can help identify the active treatment component(s) of an intervention package, 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. For the first set of analyses, overall parent fidelity was entered as a predictor to examine the relationship between overall parent fidelity and child behavior. For the second set of analyses, parent scores on *Contingent Imitation*, *Linguistic Mapping*, and the *Prompting Sequence* were entered simultaneously to determine which fidelity dimensions were unique predictors of child behavior when controlling for the other dimensions.

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 in to 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 minutes (range = 34 – 77) viewing all the slideshows, and an average of 7 minutes (range = 4 – 11) and 14.9 minutes (range = 1 – 24.5) on the self-check and exercise questions, respectively. On average, parents spent 12 minutes (range = 0 – 18) working on the homework plan and 13.6 minutes (range = 0 – 25) on the reflection questions.

Parent Knowledge of RIT

A one-tailed paired t-test indicated that participant scores on the RIT knowledge quiz improved significantly 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, $t(4) = 2.25$, $p < .05$.

Fidelity of Implementation of RIT

During baseline, all parents occasionally used some RIT techniques (see Figures 2 and 3). However, no parent met overall fidelity of implementation (rating ≥ 4) during any of the baseline sessions (Figure 2).

After completing the self-directed portion of the telehealth program, four of the five parents (1, 3, 4, and 5) demonstrated clear increases in overall fidelity, with parents 1 and 5 achieving overall fidelity of implementation (rating ≥ 4). Parent 2 continued to show low to moderate levels of overall fidelity.

During the coaching phase, Parent 1 and Parent 2 demonstrated increases in overall fidelity. Parent 2 achieved overall fidelity of implementation, and parents 1 and 5 maintained overall fidelity of implementation. Parent 3 did not demonstrate a clear increase in overall fidelity until the final coaching probe; however at this point overall fidelity of implementation was achieved. Parent 4 maintained moderate levels of overall fidelity, but did not achieve fidelity of implementation.

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 phase. Once parents achieved fidelity of implementation, most maintained high levels of overall fidelity at the one- and/or three-month follow up time points. While Parent 4 did not achieve overall fidelity of implementation, overall fidelity ratings at one- and three-month follow up probes continued to be higher than baseline ratings.

Figure 2

Ratings of parents' overall fidelity

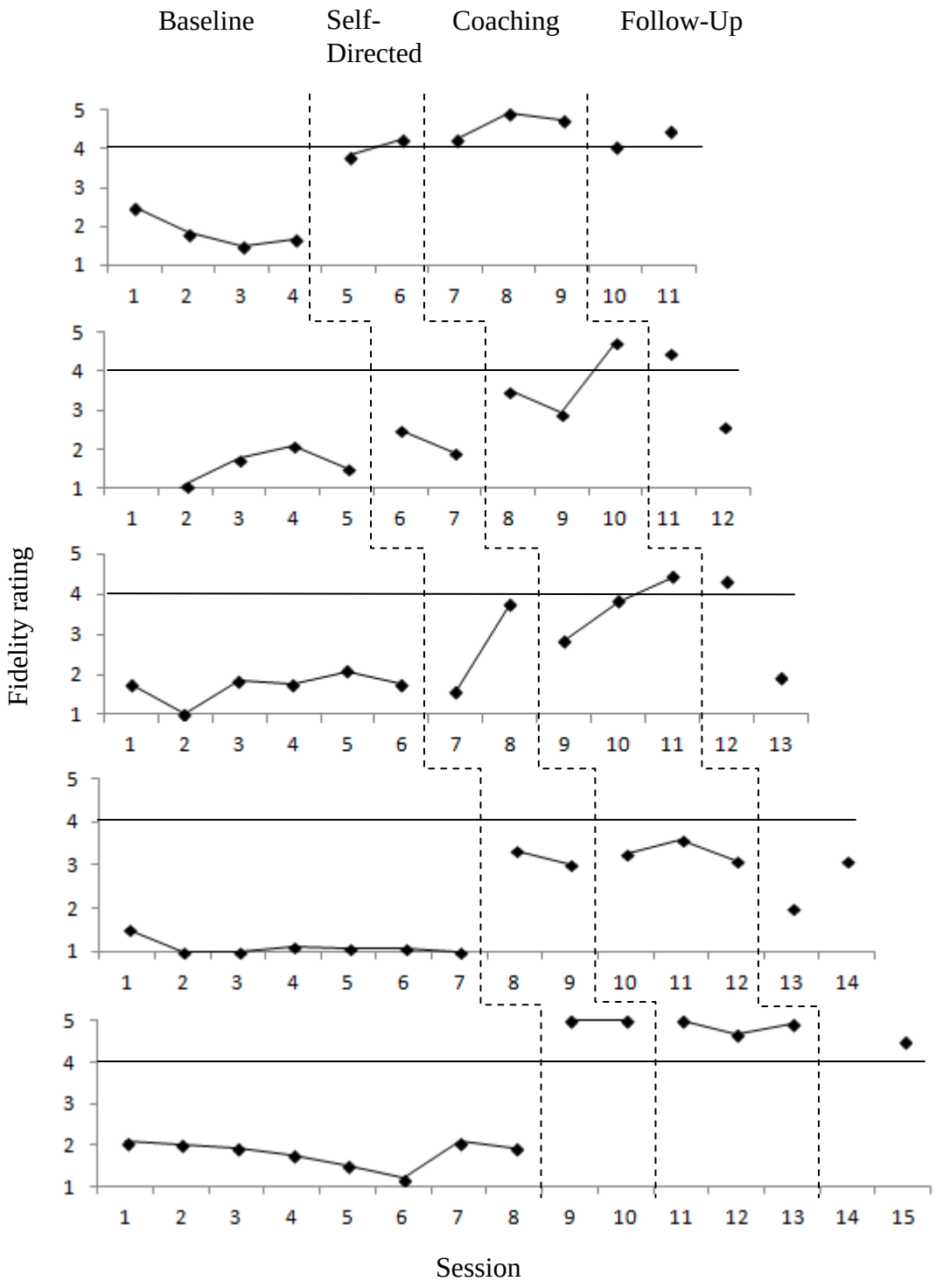
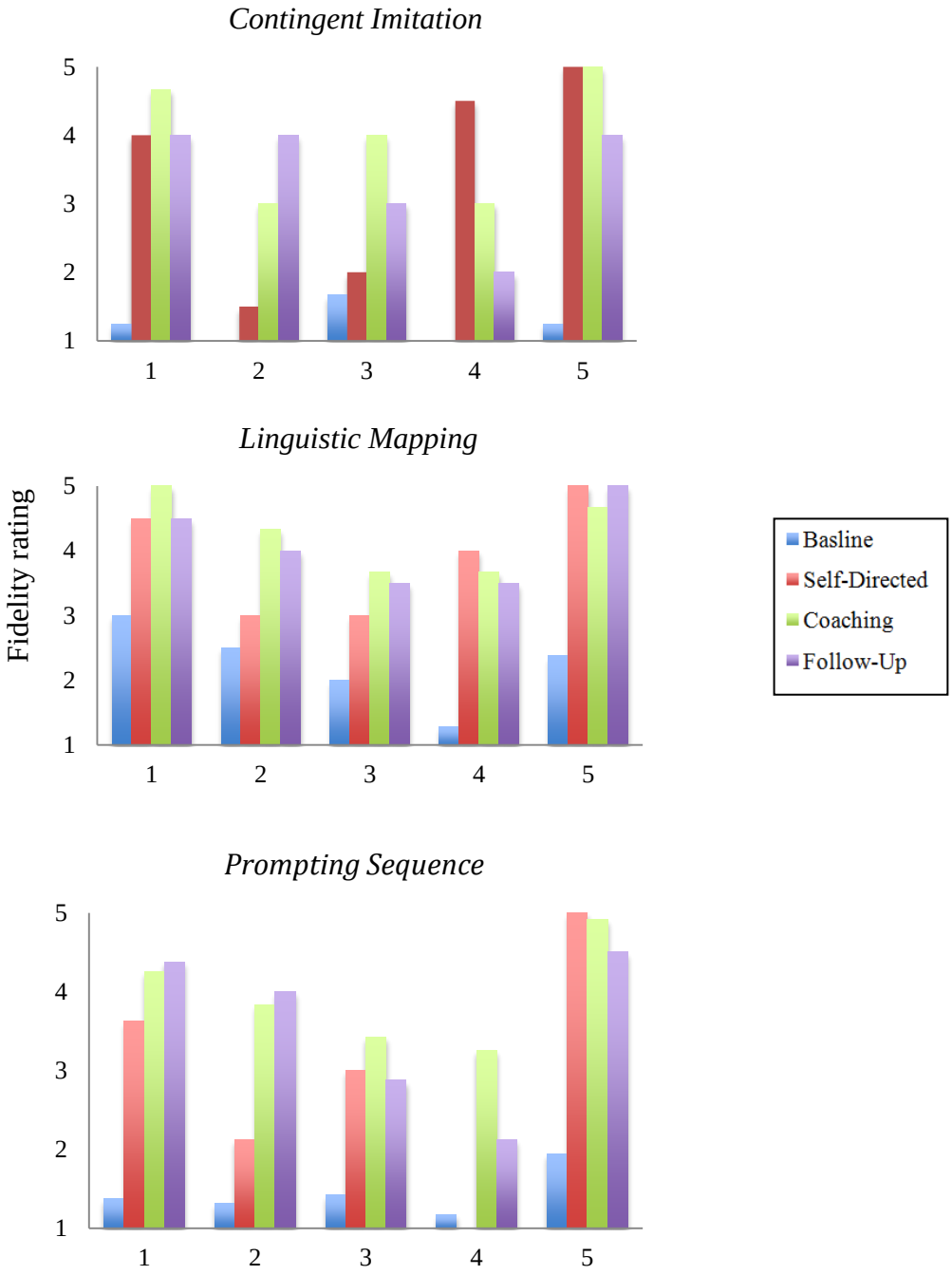


Figure 3

Parents' average fidelity of individual RIT techniques across phase



A multilevel model examining parents' overall fidelity ratings as a function of study phase revealed significant differences, $F(3,46) = 13.62$, $p < .001$. Follow-up pairwise

comparisons using Tukey's LSD indicated that the parents' overall fidelity ratings were significantly higher during the self-directed (M = 3.08, SE = .30), coaching (M = 3.53, SE = .28), and follow-up (M = 3.50, SE = .33) phases than during baseline (M = 1.59, SE = .22).

Given that overall fidelity is an average of ratings across three fidelity dimensions, multilevel models were run to examine parents' fidelity on each dimension as a function of study phase. Results revealed significant differences as a function of phase for *Contingent Imitation*, $F(3,44) = 17.07$, $p < .001$, with follow-up pairwise comparisons indicating significantly higher ratings during the self-directed (M = 3.63, SE = .35), coaching (M = 3.79, SE = .34), and follow-up (M = 2.93, SE = .39) phases than during baseline (M = 1.28, SE = .28). Results also indicated significant differences as a function of phase for *Linguistic Mapping*, $F(3,33) = 13.95$, $p < .001$, with follow-up pairwise comparisons indicating significantly higher ratings during the self-directed (M = 3.90, SE = .33), coaching (M = 4.24, SE = .29), and follow-up (M = 3.88, SE = .36) phases than during baseline (M = 2.16, SE = .22). Finally, a multilevel model revealed significant differences as a function of phase for the *Prompting Sequence*, $F(3,47) = 14.89$, $p < .001$, with follow up pairwise comparisons suggesting significantly higher fidelity ratings during the self-directed (M = 3.00, SE = .33), coaching (M = 3.88, SE = .30) and follow-up (M = 3.40, SE = .35) phases than during baseline (M = 1.49, SE = .24).

Child Imitation

During baseline, children 1, 2, 3, and 4 demonstrated low and stable rates of spontaneous imitation (Figure 4). 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.

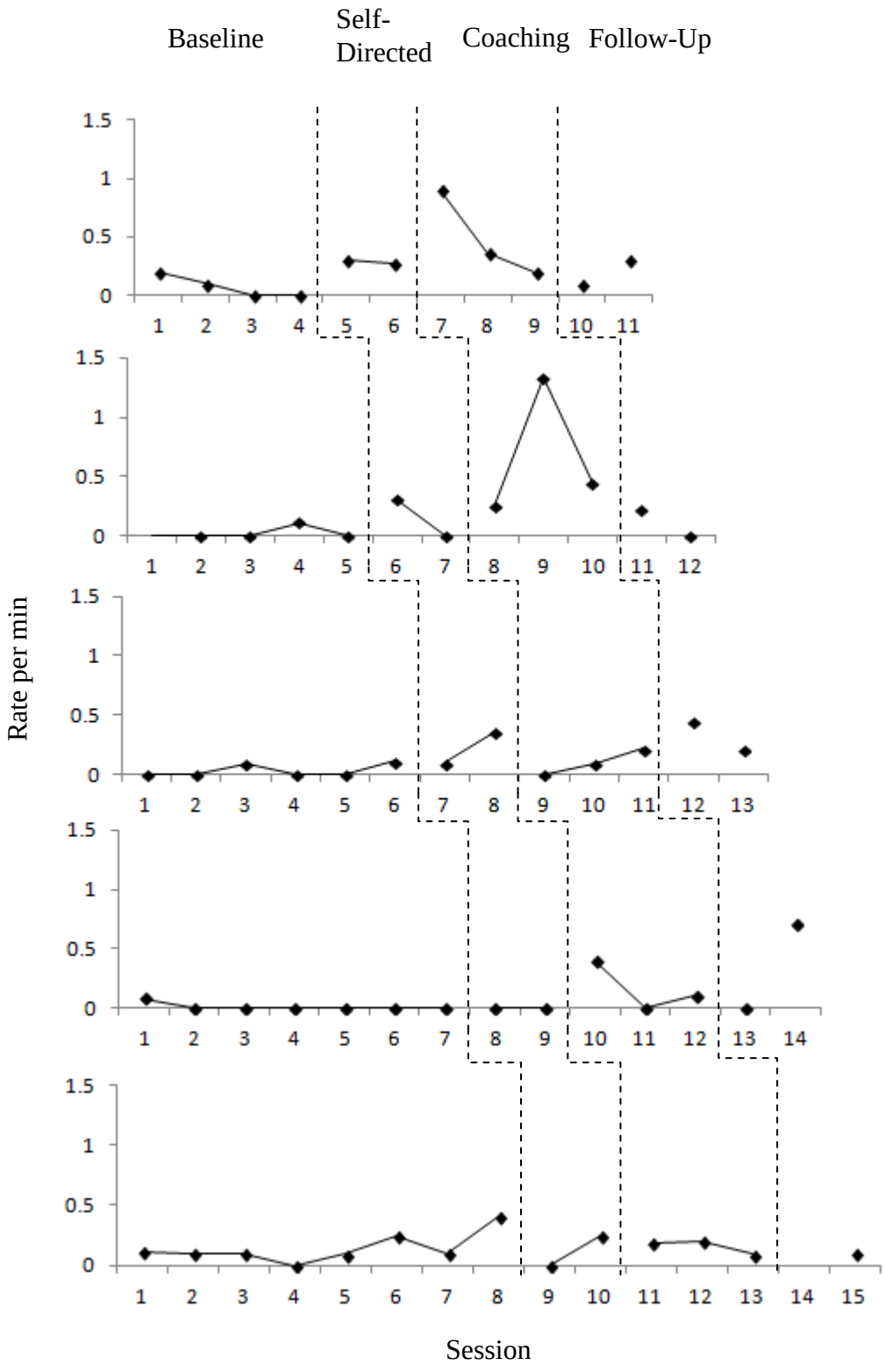
After the self-directed program, children 1, 2 and 3 showed increases in spontaneous imitation rates. Child 5 maintained moderate rates of spontaneous imitation, while Child 4 did not demonstrate any spontaneous imitation during this phase.

During the coaching phase, Child 1 and Child 2 demonstrated overall increases in spontaneous imitation rates relative to the previous phase. Child 3 showed an increasing trend in spontaneous imitation rates towards the end of the phase. Child 4 demonstrated an initial increase in spontaneous imitation, but increases were not maintained for the duration of the coaching phase. Finally, Child 5 maintained moderate rates of spontaneous imitation.

Most of the children demonstrated moderate to high levels of spontaneous imitation at the one- and three-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.

Figure 4

Child spontaneous imitation rate



A multilevel model examining rate of spontaneous imitation as a function of study phase revealed significant differences, $F(3,34) = 4.39$, $p < .05$. Follow-up pairwise comparisons using Tukey's LSD indicated a significant increase in spontaneous imitation from baseline ($M = .06$, $SE = .04$) to the coaching phase ($M = .316$, $SE = .06$); differences among the other phases were not significant, $p > .05$.

Social Engagement

During baseline, children 2 and 3 demonstrated low levels of coordinated joint engagement, while Child 1 demonstrated moderate to high levels of coordinated joint engagement (Figure 5). Children 4 and 5 demonstrated highly variable levels of coordinated joint engagement during the baseline phase.

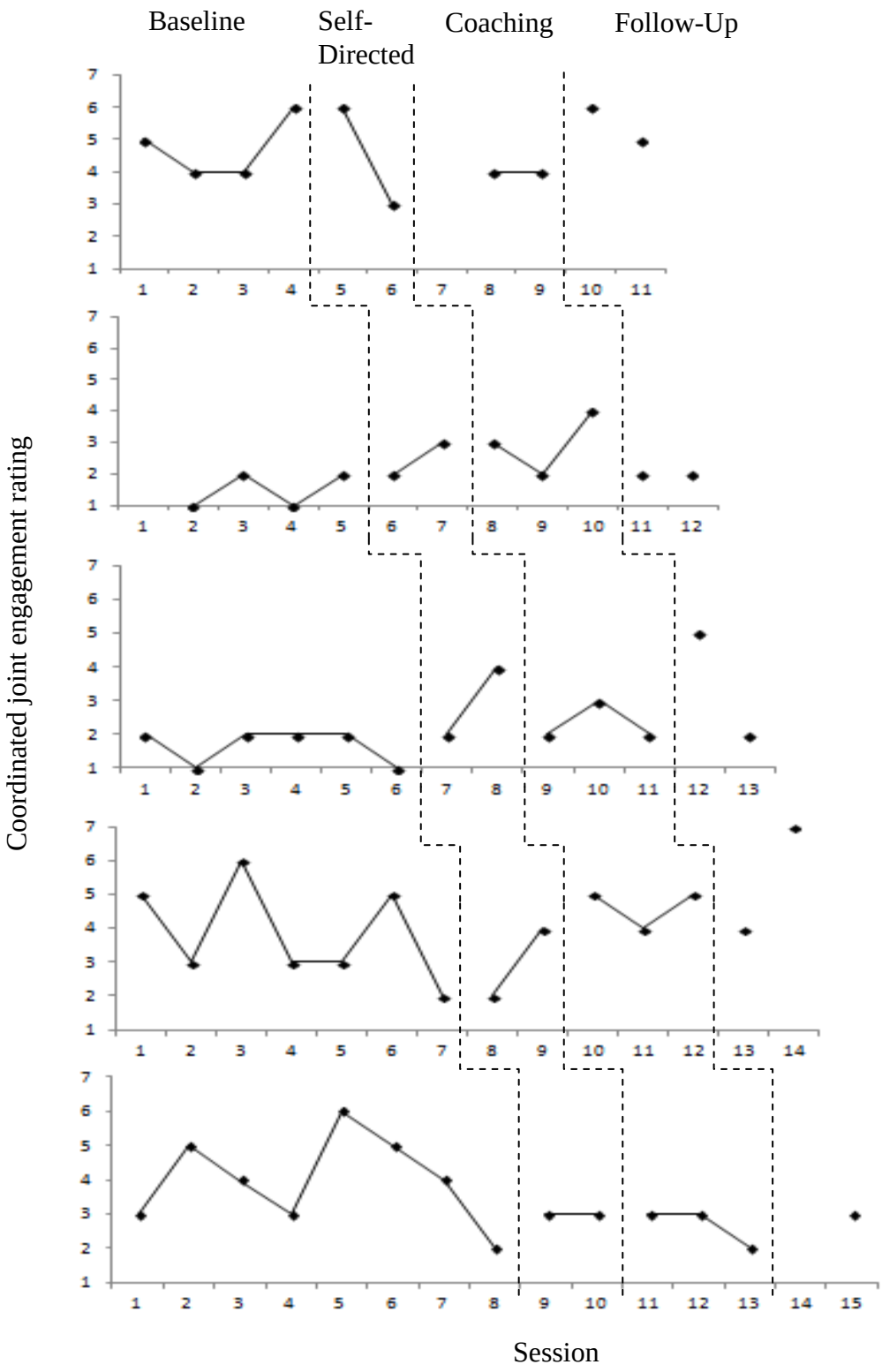
After completing the self-directed portion of the program, children 2 and 3 showed increases in coordinated joint engagement. Child 1 demonstrated a decrease in coordinated joint engagement. Children 4 and 5 did not demonstrate mean level changes in coordinated joint engagement during this phase; however, Child 5's coordinated joint engagement became less variable.

During the coaching phase, children 2 and 4 demonstrated increases in coordinated joint engagement. Children 3 and 5 maintained moderate to low levels of coordinated joint engagement. Child 1 demonstrated more stable moderate levels of coordinated joint engagement during this phase.

With the exception of Child 2, most of the children demonstrated relatively high levels of coordinated joint engagement during the follow-up probes.

Figure 5

Ratings of child coordinated joint engagement



A multilevel model examining coordinated joint engagement as a function of study phase failed to demonstrate a significant effect, $F(3,43) = .44$, *n.s.*

Relationship between Parent Fidelity and Child Behavior

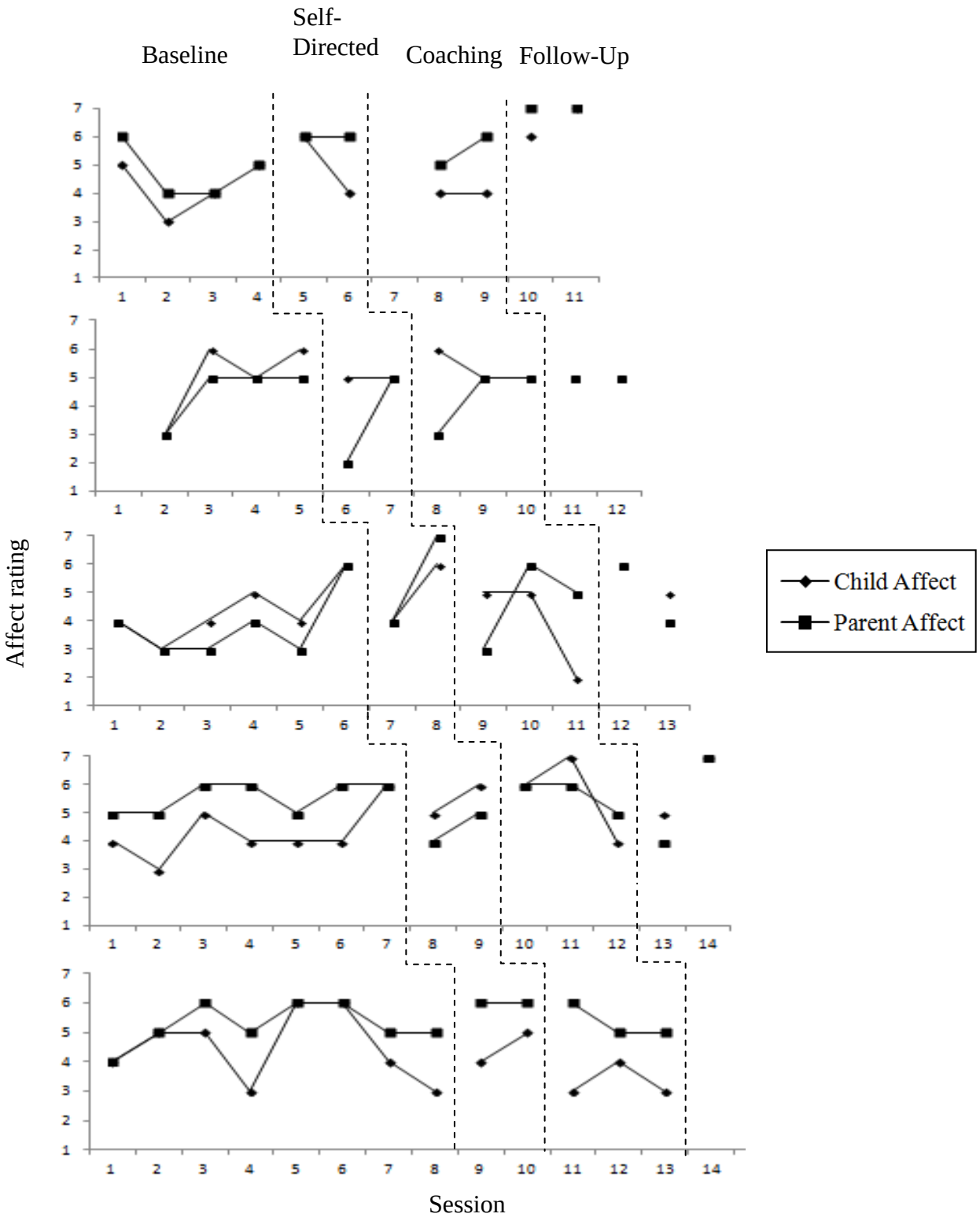
Multilevel modeling was also used to examine the association between child social communicative behavior and parent fidelity ratings. A multilevel model examining the relationship between parent overall fidelity and child spontaneous imitation failed to reveal a significant relationship, $F(1,33) = 2.28$, *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. A multilevel model examining the relationship between coordinated joint engagement and overall parent fidelity revealed a significant effect, $F(1,53) = 4.60$, $p < .05$. When the fidelity dimensions were entered in a model simultaneously, there were no significant effects of *Contingent Imitation* ($F(1,59) = .427$, *n.s.*), *Linguistic Mapping* ($F(1,57) = .97$, *n.s.*), or the *Prompting Sequence* ($F(1,54) = 1.56$, *n.s.*) on child coordinated joint engagement.

Affect

There were few consistent trends within or across phases in parent and child affect (Figure 6). However, visual analysis of the single subject graphs suggest that parent and child affect were strongly associated, such that changes in one of the individuals' affect corresponded with changes in the other's affect. That is, within dyads and across probes, parent and child affect increase and decrease at similar points.

Figure 6

Ratings of parent and child affect



Parenting Sense of Competence & Parenting Stress

Although means appeared to change in the expected directions, there were no significant differences between participant scores on the three Family Impact Questionnaire subscales (Positive Feelings about Parenting, Negative Feelings about Parenting, Impact on Social Life) from intake to completion of the hybrid telehealth program. Means on the Parenting Sense of Competence Scale appeared to decrease from intake to program completion; however, these changes were not significant either. See Table 3 for means and Table 4 for individual participant scores.

Table 3

Mean Parenting Sense of Competence and Parenting Stress Scores

Measures	Intake		Program Completion		
	M	SD	M	SD	T Score
Parenting Sense of Competence Scale	3.47	.53	3.28	1.11	.61
Family Impact Questionnaire					
Positive Feelings about Parenting	1.71	.85	2.05	.79	1.60
Negative Feelings about Parenting	1.00	.58	.83	.19	.91
Impact on Social Life	.60	.54	.36	.30	.99

Table 4

Individual Participant Scores on the RIT Knowledge Quiz, Parenting Sense of Competence Scale, and Family Impact Questionnaire

	RIT Knowledge Quiz		PSOC		FIQ					
					Positive Feelings		*Negative Feelings*		*Impact on Social Life*	
	Pre	Post	Intake	Program Completion	Intake	Program Completion	Intake	Program Completion	Intake	Program Completion
Parent 1	9 (45%)	12 (60%)	3.38	3.81	2.29	2.57	.71	.71	.33	.22
Parent 2	14 (70%)	14 (70%)	4.00	3.89	2.86	2.83	.29	.71	.56	.67
Parent 3	8 (40%)	13 (65%)	2.72	1.44	1.43	1.43	1.86	1.14	1.44	.22
Parent 4	17 (85%)	18 (90%)	3.67	4.22	1.29	2.43	1.14	.86	.67	.67
Parent 5	10 (50%)	19 (95%)	3.11	3.06	.71	1.00	1.00	.71	.00	.00

Treatment Acceptability

Parents responded favorably to the intervention and service delivery model on the modified BIRS (Table 5) completed at the end of the coaching phase. They indicated that RIT was highly acceptable (*M* = 5.69, Range = 6.00 – 4.00), effective (*M* = 4.93, Range = 6.00 – 1.00) and usable (*M* = 5.6, Range = 6.00 – 4.00), and that the self-directed portion of the telehealth program was highly usable (*M* = 5.47, Range = 6.00 – 4.00). Parents provided informative responses to the additional questions about the different aspects of the telehealth service delivery model (Table 5). While they responded favorably to all parts of the self-directed program, the video-based instructional components (e.g., video library, video-based exercises) were rated especially highly. Furthermore, parents indicated that the remote coaching was a favorable and helpful component of the program. 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."

Table 5

Treatment Acceptability

	Mean	Range
Modified BIRS		
Intervention Acceptability	5.69	6.00 – 4.00
Intervention Effectiveness	4.93	6.00 – 1.00
Intervention Usability	5.6	6.00 – 4.00
Telehealth Program Usability	5.47	6.00 – 4.00
Additional Items		
Online RIT Website (Self-Directed Portion)		
The slideshows were helpful for learning about the RIT intervention.	5.2	6.00 – 3.00
The manual was helpful for learning about the RIT intervention.	5.4	6.00 – 5.00
The self-check questions were helpful for learning the RIT intervention.	5.0	6.00 – 3.00
The video-based exercises were helpful for learning the RIT intervention.	5.6	6.00 – 5.00
The homework was helpful for learning the RIT intervention.	5.0	6.00 – 4.00
The reflection questions were helpful for learning the RIT intervention.	4.6	6.00 – 3.00
The video library was helpful for learning the RIT intervention.	5.6	6.00 – 5.00
The amount of information provided in the Online RIT website was sufficient for me to learn the intervention techniques.	4.8	6.00 – 3.00
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	6.00 – 4.00
Remote Coaching		
The coaching sessions with my child were helpful for learning the RIT intervention.	6.00	6.00 – 6.00
The discussion and problem solving with the coach was helpful for learning the RIT intervention.	6.00	6.00 – 6.00
The written feedback provided by the coach was helpful for learning the RIT intervention.	6.00	6.00 – 6.00
I would have liked more formal feedback (e.g., the use of a rating form) on how well I was using the RIT techniques.	4.2	6.00 – 2.00
The coach was interested in me.	6.00	6.00 – 6.00
The coach understood me.	6.00	6.00 – 6.00
The coach understood my child.	6.00	6.00 – 6.00
The amount of coaching I received was sufficient to learn the intervention strategies.	5.6	6.00 – 4.00
The amount of coaching I received was sufficient to feel comfortable and competent with using the intervention strategies.	5.6	6.00 – 4.00

Parents completed an additional feedback questionnaire at the 3-month follow-up and indicated that the one- and three-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, receiving social support, getting recommendations about additional intervention services). Four out of the five parents reported that they use RIT intervention techniques 5 or more times per week (the fifth parent indicated that she used the techniques once or twice 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 keep 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 phase 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 evidence-based 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 an evidence-based imitation intervention.

The primary goal of this study was to assess the degree to which parents were able to learn about and effectively implement RIT after engaging in the various components of the hybrid telehealth program. Program use was associated with significant increases in parent knowledge about RIT and naturalistic intervention, and all parents demonstrated meaningful improvements in their abilities to correctly implement the intervention strategies in response to the program. Two parents achieved fidelity of implementation after engaging in only the self-directed portion of the program, while another two parents achieved fidelity of implementation of RIT during the remote coaching phase 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 phases. 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., in press; Wainer & 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., in press, Wainer & Ingersoll 2013a). Importantly, parents demonstrated differences in program engagement that may have impacted learning and implementation across the study phases. For example, the two parents who achieved fidelity of implementation during the self-directed phase completed 90% or more of the Online RIT website components, while the two parents who achieved fidelity of implementation during the coaching phase 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 in to 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 & McIntyre, 2011). Future research should examine the feasibility and cost-effectiveness of stepped-cared 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 behaviors such as imitation and social engagement. Visual inspection of session data indicated that most of the children demonstrated an increasing trend in spontaneous imitation skills concurrent with parent participation in the program. Two of the children showed clear increases in spontaneous imitation immediately after their parents' completed the self-directed portion of the telehealth program, and maintained improvements for the duration of the study. Another two demonstrated increases in spontaneous imitation at various times while their parents were engaged in the coaching phase of the program. Although the last child did not demonstrate improvements in his spontaneous imitation rates, he showed moderate levels of spontaneous imitation across the study phases, 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.

Multilevel modeling supported the contention that the children increased their spontaneous imitation rates as their parents' participated in the telehealth program. Interestingly, parents' 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 & Mandell, 2011; Rogers, 2003). Additionally, the complexity of interventions may influence response acquisition and impede behavioral change in parent training programs specifically (Allen & 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, participating in telehealth programs. Additionally, results from the current research offer further evidence for the suggestion 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, 2010; Ingersoll & Wainer, in press; Stahmer, Schreibman, & Cunningham, 2011).

Previous research has indicated that the use of RIT techniques is effective for increasing coordinated joint engagement (Ingersoll & Schreibman, 2006; Lewy & Dawson, 1992). Yet, in the current study, clear increases in coordinated joint engagement concurrent with parent participation in the program were observed for only one child. In earlier studies examining the relationship between RIT and joint engagement, the intervention was implemented at greater levels of intensity (e.g., 40-60 minutes per session, three sessions per week for 10 weeks) than was likely the case in the current study. As such, it is possible that the lack of consistent gains in social engagement observed in the current study were due to issues of intervention dose and intensity. Additionally, previous studies of RIT utilized trained therapists who were instructed to act in a contrived way (e.g., model an action for imitation once per minute, but do not make any other social initiations) during baseline or comparison sessions in order to standardize the interactions. However, during baseline sessions in the current study, parents were instructed to

interact with their child as usual. Moderate to high levels of coordinated joint engagement observed during baseline sessions suggest that parents were already using other effective strategies to elicit engagement from their children during usual play interactions. Thus, it is possible that obvious changes in coordinated joint attention were not observed because of parents' strong ability to elicit their child's attention prior to learning the RIT intervention techniques. Nonetheless, results from multilevel modeling revealed that parents' overall fidelity of RIT was related to the children's coordinated joint engagement, suggesting that the correct implementation of the RIT intervention, as a whole, may have some effect on child joint engagement. Furthermore, in the qualitative feedback, all parents mentioned that RIT helped improve their children's social engagement. Although these data suggest a relationship between RIT and social engagement, additional research in needed to understand the specifics of this association.

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, Radtke, & Stern, 1994) and better learning outcomes (e.g., Romanov & 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 & 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, Valle, Filene, & Boyle, 2008). Thus, although coaching may not be necessary for some parents to learn evidence-based interventions, 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 size and a lack of comparison data. Future research using randomized clinical trials 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). Randomized clinical trial research is also required to establish the effectiveness of RIT as implemented by parents, especially when compared to other parent- and therapist-implemented social communication interventions. Additionally, information about parents' fidelity of enactment of the intervention is lacking. 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 & 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

computer and 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 in important next step in expanding the accessibility, reach, and impact of telehealth programs (Vismara et al., in press).

Summary

This study provides initial evidence for the effectiveness of a hybrid telehealth program for disseminating training in evidence-based 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 evidence-based 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.

APPENDICES

Appendix A

Online RIT Fidelity Form

Figure 1A
Online RIT Fidelity Form

RIT Component	Low Fidelity 1	2	3	4	High Fidelity 5
Contingent Imitation Imitate child's appropriate toy play, gestures, and vocalizations.	Does not imitate the child's gestures, vocalizations, and toy play.	Imitates a few of the child's gestures, vocalizations, and toy play, but misses the majority of opportunities.	Imitates the child's gestures, vocalizations, and toy play about 50% of the time, but misses many opportunities.	Imitates more than 50% of the child's gestures, vocalizations, and toy play when the child is appropriately engaged, but misses opportunities.	Imitates almost all of the child's gestures, vocalizations, and toy play throughout the session when the child is appropriately engaged.
Linguistic Mapping Use simplified, repetitive language around child's attentional focus.	Does not use simplified language around the child's attentional focus, language is too complex, or does not use any language.	Uses simplified language around the child's attentional focus for some of the session, but misses the majority of opportunities or majority of language is too complex.	Uses simplified language around the child's attentional focus up to 50% of the time, but misses many opportunities or much of the language is too complex.	Uses simplified language around the child's attentional focus for more than 50% of the session, but misses opportunities or some language is not appropriate for child's level of language.	Uses simplified language around the child's attentional focus throughout the session. Most of the language is appropriate for child's language level.
Model Model actions around child's focus of interest	Models actions that are inappropriate for child's level/interest or does not recruit child's attention.	Models some actions that are appropriate for child's level/interest but also many that are not, or often fails to recruit the child's attention.	Models some actions that are appropriate for child's level/interest and recruits child's attention some of the time.	Models actions that are appropriate for child's level/interest more than 50% of the time and recruits child's attention the majority of the time.	Models actions that are very appropriate for child's level/interest and recruits child's attention.

Figure 1A (con't).

PACING Model an action every 1 to 2 minutes on average. Adjusts rate when necessary to keep child engaged.	Does not model any actions for imitation. Pacing significantly disrupts child's engagement or learning.	Models actions at a significantly lower or higher rate throughout session (1-2 models). Pacing somewhat disrupts child's engagement or learning.	Models actions at a somewhat lower or higher rate throughout session (3 or 12 models). Pacing does not significantly disrupt child's engagement or learning.	Models at an appropriate rate for some, but not all of the session (4 or 11 models). Pacing does not significantly disrupt child's engagement or learning.	Models actions at an appropriate rate throughout session (5-10 models). Pacing is appropriate for keeping child engaged and learning.
PROMPT Physically prompt child to imitate after 3 presentations of action.	Does not physically prompt child to imitate action after presenting the action 3 times. Or physically prompts the child to imitate all actions before 3 models.	Prompts child to complete action after third trial a minority of the time. Prompting often does not result in imitation, or often physically prompts before 3rd model.	Prompts child to complete action after third trial up to 50% of the time, but misses many opportunities, prompting does not result in imitation or prompts before 3rd model.	Prompts child to complete action after third trial the majority of the time, but misses opportunities or prompting occasionally does not result in imitation, or prompts before 3rd model.	Consistently prompts child to complete action after third trial if child has not spontaneously imitated. Follows through such that the trial ends in imitation.
PRAISE Animatedly praise child's spontaneous or prompted imitation.	Does not praise child's spontaneous or prompted imitation or consistently praises incorrect responses.	Praises a minority of the child's spontaneous and prompted imitations, but misses the majority of opportunities or praises multiple responses.	Praises some of the child's spontaneous and prompted imitations, but misses many opportunities or praises incorrect responses.	Praises the majority of the child's spontaneous and prompted imitation, but misses some opportunities or praise is provide for an incorrect response.	Praises all of the child's spontaneous and prompted imitation throughout the session. Praise is withheld for incorrect responding.

Appendix B

Online RIT Imitation Scoring Form

Figure 1B

Online RIT child imitation scoring form

CHILD: SCORER:

DATE: Primary Rely

SESSION:

	Toy	Action	Verbal Marker	Object Imitation			Gesture Imitation			Prompt Level			Vocal Imitation
1				S	P	None	S	P	None	VP	PP	FP	
2				S	P	None	S	P	None	VP	PP	FP	
3				S	P	None	S	P	None	VP	PP	FP	
4				S	P	None	S	P	None	VP	PP	FP	
5				S	P	None	S	P	None	VP	PP	FP	
6				S	P	None	S	P	None	VP	PP	FP	
7				S	P	None	S	P	None	VP	PP	FP	
8				S	P	None	S	P	None	VP	PP	FP	
9				S	P	None	S	P	None	VP	PP	FP	
10				S	P	None	S	P	None	VP	PP	FP	

S = Spont.	# of S	VP = Verbal Prompt
P = Prompted	# of Minutes	PP = Partial Physical Prompt
	Rate Per Minute	FP = Full Physical Prompt

Appendix C

Social Engagement and Affect Rating Scales

Figure 1C

Coordinated joint engagement rating scale

CHILD'S **COORDINATED** JOINT ENGAGEMENT

1	2	3	**4**	5	6	**7**
No episodes of the coordinated joint engagement state		Spends about a third of the scene in coordinated joint engagement that is of moderate quality, or briefly in coordinated joint engagement in a highly striking manner.			Frequently in rich and varied episodes of coordinated joint engagement.	

Figure 2C

Child affect rating scale

CHILD **AFFECT**

1	2	3	**4**	5	6	**7**
Affect is either disruptive, highly inappropriate, or very flat and constricted		Affect appears mellow or content as opposed to flat; affect does not impede communication, but neither does it enhance it			Affect is smoothly modulated, appropriate, and serves to enhance other modes of communication	

Figure 3C

Parent affect rating scale.

PARENT **AFFECT**

1	2	3	**4**	5	6	**7**
Tense, disruptive, or affectively flat, to the point of being expressionless and subsequently very hard to read		Mellow or content as opposed to flat; affect does not impede communication, but neither does enhance it			Smoothly modulated, appropriate, and serves to enhance of modes of communication	

Appendix D
Modified Behavioral Intervention Rating Scale

Figure 1D

Modified Behavioral Intervention Rating Scale

Please evaluate the format of Online RIT by checking the number that best describes your agreement or disagreement with each statement. Please check only one number for each item.

	Strongly Disagree (1)	(2)	(3)	(4)	(5)	Agree (6)
This is an acceptable intervention for my child's social imitation skills.						
Most parents would find this intervention appropriate for teaching social imitation skills.						
The intervention was effective in teaching my child social imitation skills						
I would suggest the use of this intervention to other parents.						
Most parents would find this intervention suitable for teaching social imitation skills.						
I use this intervention at home.						
The intervention did not result in negative side effects for my child.						
The intervention would be an appropriate intervention for a variety of children.						
The intervention is consistent with other interventions I have used with my child.						
I like the procedures used in the intervention.						
The intervention was a good way to teach social imitation skills to my child.						
Overall, the intervention was beneficial for my child.						
The intervention quickly improved my child's social imitation skills.						
The intervention will produce lasting improvement in my child's social imitation skills.						
My child's social imitation skills will remain at an improved level after the intervention is discontinued.						
Using the intervention not only improved my child's social imitation skills at home, but also in other settings (e.g., classroom, community).						
Other behaviors related to social imitation were also improved by the intervention.						
The goals of the intervention are important to my child's functioning at home.						
The goals of the intervention are regarded as important outcomes by most parents.						

Figure 1D (con't.)

I use the intervention with my child regularly.						
It was easy to find information on the Online RIT website.						
I used the website to complete the self-directed portion of the Online RIT program.						
I understood the audio and text information that was presented.						
The slideshows were helpful for learning the RIT intervention.						
The manual was helpful for learning the RIT intervention.						
The self-check questions were helpful for learning the RIT intervention.						
The video-based exercises were helpful for learning the RIT intervention.						
The homework was helpful for learning the RIT intervention.						
The reflection questions were helpful for learning the RIT intervention.						
The video library was helpful for learning the RIT intervention.						
The amount of information provided on the Online RIT website was sufficient for me to learn the intervention techniques.						
The amount of information provided on the Online RIT website was sufficient for me to feel comfortable and competent using the intervention techniques.						
The coaching sessions with my child were helpful for learning the RIT intervention.						
The discussion and problem solving with the coach were helpful for learning the RIT intervention.						
The written feedback provided by the coach was helpful for learning the RIT intervention						
I would have like more formal feedback (e.g., use of a rating form) on how well I was using the different RIT techniques.						
The coach was interested in me.						
The coach understood me.						
The coach understood my child.						
The amount of coaching I received was sufficient for me to learn the intervention strategies.						
The amount of coaching I received was sufficient for me to feel comfortable and competent using the intervention strategies.						
I would recommend this program to other parents of young children with social imitation difficulties.						

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