9-2020

A Randomized Clinical Trial of a Virtual-Training Program for Teaching Applied-Behavior-Analysis Skills to Parents of Children with Autism Spectrum Disorder

Wayne W. Fisher

Kevin C. Luczynski

Andrew P. Blowers

Megan E. Vosters

Maegan D. Pisman

See next page for additional authors

Authors
Wayne W. Fisher, Kevin C. Luczynski, Andrew P. Blowers, Megan E. Vosters, Maegan D. Pisman, Andy R. Craig, Stephanie Hood, Mychal A. Machado, Aaron D. Lesser, and Cathleen C. Piazza

Journal of Applied Behavioral Analysis, Vol. 53, No. 4 (September 2020): 1856-1875. DOI.

A Randomized Clinical Trial of a Virtual-Training Program for Teaching Applied-Behavior-Analysis Skills to Parents of Children with Autism Spectrum Disorder

Wayne W. Fisher
Rutgers University Robert Wood Johnson Medical School
Kevin C. Luczynski
The University of Nebraska Medical Center's Monroe-Meyer Institute
Andrew P. Blowers
The University of Nebraska Medical Center's Monroe-Meyer Institute
Megan E. Vosters
University of Houston, Clear Lake
Maegan D. Pisman
The University of Nebraska Medical Center's Monroe-Meyer Institute

Andy R. Craig
Upstate Medical Center
Stephanie A. Hood
Marquette University
Mychal A. Machado
University of Alaska Anchorage
Aaron D. Lesser
The University of Nebraska Medical Center's Monroe-Meyer Institute
Cathleen C. Piazza
Rutgers University School of Applied and Professional Psychology

Abstract

Parents play an important role in the treatment of their children's symptoms of autism spectrum disorder (ASD); thus, developing effective, efficient, socially acceptable, and accessible procedures for training parents to implement applied-behavior-analysis (ABA) interventions is critically important. One potential approach involves delivering training via a virtual private network (VPN) over the internet (Fisher et al., 2014). In this study, we conducted a randomized clinical trial to evaluate a virtual parent-training program with e-learning modules and scripted role-play via a VPN. We evaluated parent implementation of ABA skills using direct-observation measures in structured-work and play-based training contexts. Parents in the treatment group showed large, statistically significant improvements on all dependent measures; those in the waitlist-control group did not. Parents rated the training as highly socially acceptable. Results add to the growing literature on the efficacy and acceptability of virtually delivered training in ABA.

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and interaction and restricted and repetitive behavior (American Psychiatric Association, **2013**). This disorder affects approximately 1 in 59 children in the United States (Baio et al., **2018**), and the prevalence of ASD has increased substantially over the last several decades (Burd et al., **1987**). Unfortunately, outcomes for individuals diagnosed with ASD who do not receive intensive treatment remain poor. As adults, few have friends, stable employment, or live independently (Howlin et al., **2004**). Further, immediate family members are at increased risk for developing stress-related, mental-health disorders (Dumas et al., **1991**), and divorce rates for parents of children with ASD tend to be higher than those of typically developing children (Brobst et al., **2009**; Freedman et al., **2012**; Hartley et al., **2010**). The increased prevalence of ASD and its poor long-term outcomes has led to an increase in the demand for effective treatments.

Of the available treatment approaches for ASD, those based on the principles of applied behavior analysis (ABA; Baer et al., **1968**) have the most convincing empirical support (Eikeseth, **2009**; Eldevik et al., **2009**). Early intensive behavioral intervention (EIBI) is an ABA-based treatment approach that targets the core and associated symptoms of ASD in young children (Howlin et al., **2009**; Reichow et al., **2012**; Roane et al., **2016**). Early intensive behavioral intervention aims to reduce problem behavior (e.g., aggression, self-injury), which children with ASD often display (Dominick et al., **2007**), and to increase prosocial, adaptive behavior (e.g., communication, social skills). Behavior analysts generally accomplish this through a combination of structured (e.g., discrete-trial training) and naturalistic or play-based training approaches (Klintwall & Eikeseth, **2014**; Roane et al., **2016**).

Children with ASD who receive EIBI show generally positive but variable outcomes with a portion showing robust increases in levels of functioning, including pronounced gains in IQ, language ability, social behavior, and daily living skills and others showing more modest gains (Eldevik et al., **2009**; Remington et al., **2007**). Further, empirical studies suggest that EIBI produces larger treatment gains than *eclectic* alternatives. For example, Howard et al. (**2005**) compared scores of children diagnosed with ASD who received about 14 months of either EIBI or an eclectic intervention on several outcomes, including intellectual functioning, problem solving, and language and adaptive skills. Children who received EIBI outperformed peers who received eclectic treatments. Similarly, Reed et al. (**2007**) compared academic gains of children who received either EIBI or eclectic treatments. Children in the EIBI group outperformed children who received eclectic treatment after 10 months. These outcomes and numerous others (e.g., Reichow, **2012**) show that EIBI is currently the most effective treatment for children with ASD.

Although ABA is an empirically supported treatment, many children with ASD cannot access it due to geographic, economic, and time barriers, especially families living in rural areas (Antezana et al., **2017**). In addition, the recent COVID-19 pandemic has precluded most typical one-on-one EIBI services due to the risks of transmitting the virus from therapist to patient or vice versa.

Advances in telehealth technology have allowed researchers and clinicians to address the barriers that limit service access. Several empirical studies have demonstrated the feasibility of telehealth to train technicians to implement behavior-analytic procedures with high levels of fidelity (e.g., Boisvert et al., **2010**; Rispoli et al., **2011**). For example, Fisher et al. (**2014**) conducted a randomized-clinical trial (RCT) to evaluate the effectiveness of telehealth training. The researchers used e-learning modules and role-plays with feedback to teach technicians with no prior ABA training to implement structured and play-based EIBI procedures. The virtual-training group showed large improvements in their implementation of EIBI procedures compared to a waitlist-control group. Further, technicians rated the training as highly socially acceptable. The Fisher et al. study contributes to a growing literature demonstrating the utility and feasibility of telehealth for expanding access to efficient and cost-effective EIBI services to families in geographically isolated or otherwise underserved areas.

Parental involvement in EIBI services is important to maximize their potential benefit (for a review, see Tonge, Bull, et al., **2014**). For example, research has shown that parent education and EIBI-skills training facilitate long-term management of problematic behavior and maintenance of functional communication and adaptive behavior (e.g., Scahill et al., **2012**; Strauss et al., **2012**; Tonge, Brereton, et al., **2014**). Parental involvement in EIBI services can have positive impacts on parents' mental health and well-being (e.g., Keen et al., **2010**; Tonge et al., **2006**). Given the critical role that parental involvement plays in EIBI effectiveness (Horlin et al., **2014**; McConachie & Diggle, **2007**; Parsons et al., **2017**), a natural direction for research would be to evaluate the effectiveness of telehealth-based training for parents with limited access to services.

Several empirical studies have shown that internet-based instruction, remote coaching by therapists, or a combination of strategies can (a) enhance parents' knowledge about and confidence when delivering ABA interventions; (b) increase the integrity with which they implement ABA interventions; (c) positively impact parents' mental health, and (d) produce clinically significant changes in their child's behavior (Ingersoll et al., **2016**; Nefdt et al., **2010**; Vismara et al., **2009**; Vismara et al., **2012**; Vismara et al., **2013**). Further, parents have rated virtual or telehealth training as acceptable, easy to use, and effective (Ingersoll & Berger, **2015**; Wainer & Ingersoll, **2015**).

Despite these promising results, previous studies of telehealth-based training for teaching parents to implement EIBI procedures are not without limitations. For example, researchers have measured treatment fidelity based on parent–child interactions before and after virtual training (e.g., Ingersoll & Berger, **2015**; Ingersoll et al., **2016**). Training parents and technicians to implement EIBI procedures with high fidelity is critically important to the effectiveness and efficiency of EIBI (e.g., Carroll et al., **2013**).

As parents learn EIBI techniques, however, child behavior likely will change in that appropriate behavior should increase and problem behavior should decrease with treatment. Because parents use EIBI procedures that depend on or respond to the occurrence of child behavior (e.g., ignoring instances of problem behavior), the parent may not have equivalent opportunities to use the trained procedures if child behavior changes with treatment. For example, a parent may deliver attention contingent on problem behavior less often during the posttest because their child emits fewer problem behaviors after exposure to treatment.

In addition, previously published RCTs have used virtual methods to teach parents to deliver specific models of EIBI (Project imPACT; Ingersoll & Berger, **2015**; Ingersoll et al., **2016**; Nefdt et al., **2010**; Pickard et al., 2016). One limitation of such specific models of EIBI is that children with ASD often show variable and idiosyncratic responses to specific ABA procedures and models (Jobin, **2020**; Lindauer et al., **1999**; Sherer & Schreibman, **2005**; Tiger et al. **2009**). For example, Project imPACT uses specific procedures to train parents to promote their children's social-communication skills. Although these specific procedures are clearly effective for some individuals, they are less likely to be effective for children with ASD whose most troubling issues are rituals, compulsions, resistance to change, and associated destructive behavior when someone interrupts their daily routine (e.g., Crowley et al., **2020**; Fisher et al., **2019**) Thus, providing parents with a broader variety of ABA skills is important because parents often must address skill deficits and problem behavior simultaneously, and they may have to change ABA procedures when the first one implemented is not effective.

In the present study, we conducted an RCT that evaluated a program to train parents virtually to implement EIBI skills, based on the technician-training procedure Fisher et al. (**2014**) described. The current study, like Fisher et al., differed from previous parent-training studies in two important ways. First, we assessed parent implementation of EIBI procedures while parents conducted EIBI sessions with a confederate child who emitted scripted target responses. Thus, the opportunities for the parent to respond to child-appropriate and inappropriate behavior were equivalent in the pretest and posttest. Second, the skills we taught parents were applicable to structured and play-based EIBI models used to teach a variety of skills to children with ASD.

Method

Participants and Setting

We recruited 36 adults (30 females, 6 males) who had a child diagnosed with an ASD. Figure **1** shows the Consolidated Standards of Reporting Trials Flow Diagram for this investigation (CONSORT, **2010**). Recruitment included calling and sending flyers to Exceptional Family Member Program Coordinators at military bases throughout the United States (i.e., Army, Air Force, Marine Corps, Navy) to explain the purpose of the study. We contacted and sent flyers for distribution to the directors of University Centers for Excellence in Developmental Disabilities. We also recruited parents from the Center for Autism Spectrum Disorders' diagnostic clinic at the University of Nebraska Medical Center's Munroe-Meyer Institute.

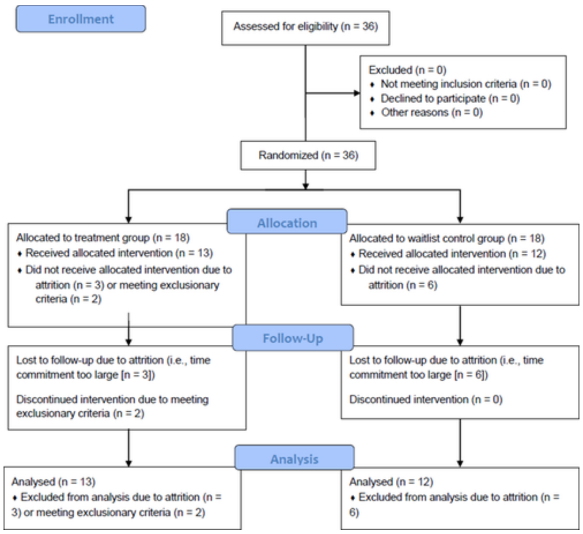

Figure 1 CONSORT 2010 Flow Chart for Participant Recruitment and Processing

We enrolled parents if they had reached at least 19 years of age (i.e., the age of majority in Nebraska), had no prior training on applied-behavior-analytic procedures, and were not receiving ongoing parent training. Three parents withdrew from the treatment group and six from the waitlist-control group due to either (a) unexpected life changes that prevented them from completing the study or (b) not being able to identify an adult to be the confederate child. We excluded two additional participants randomly assigned to the treatment group after they performed above our pretest-exclusion criterion of 60% or more correct implementation. Therefore, 25 parents (21 females, 4 males) ranging in age from 26 to 46 years completed the study, with 13 randomly assigned to the treatment group and 12 to the waitlist-control group. Table **1** shows the characteristics of parents who completed an optional demographic questionnaire.

Table 1. *Participant Demographics*

	#			
Variable	**Total**	**Test**	**Control**	**%**
Completed Survey				
Yes	13	5	8	52
No	12	8	4	48
Group Assignment				
Test	5			38
Control	8			62
Gender				
Female	11	5	6	85
Male	2	0	2	15
Age				
26 to 32	4	2	2	31
33 to 39	7	2	5	54
40 to 46	2	1	1	15
Marital Status				
Married	12	8	4	92
Never Married	1	0	1	8
Education				
Highs School	1	0	1	8
Some College	4	2	2	31

Associate's	1	1	0	8
Bachelor's	5	1	4	38
Master's	2	1	1	15
Employment				
Employed	8	3	5	62
Unemployed	1	0	1	8
Full-Time Child-Care Provider	3	2	1	23
Student	1	0	1	8
Number of Children				
One to Two	5	3	2	38
Three to Four	8	2	6	62
Family Income Level				
30 K to 39 K	1	0	1	8
40 K to 49 K	1	0	1	8
50 K to 59 K	1	1	0	8
60 K to 69 K	2	0	2	15
70 K to 79 K	3	2	1	23
90 K to 99 K	2	1	1	15
100 K to 149 K	1	1	0	8
> 150 K	2	0	2	15
Ethnicity				
Black or African American	1	1	0	8
Hispanic	2	0	2	15
White or European American	10	4	6	77

The Institutional Review Boards at the University of Nebraska Medical Center and the Autism Research Program at the Congressionally Directed Medical Research Program in the Department of Defense approved the experimental procedure. Each parent provided written, informed consent to participate in the study and for the electronic transfer of their protected health information. Each parent recruited an adult to act as a child with ASD, which we call the *confederate*, from whom we obtained written, informed consent. Adults who served as confederates were a family member who lived in the same house (e.g., spouse) or a family member who lived in a different house (e.g., grandmother). The same inclusion criteria used for the parents applied to the confederates.

Parents completed the study in their home. The researcher teleconferenced with the parent from a computer in an office at the University of Nebraska Medical Center. The parent and researcher never interacted in person at the same location. A virtual-private network that used a wired (Ethernet) or wireless encrypted connection to the internet transferred real-time audio and video between the researcher and parent's computers. We lent parents a webcam (Logitech® C525 or C615) and materials for the pretest and posttest role-plays and lent the confederate a Bluetooth headset (Plantronics™ Voyager Pro). We lent parents a laptop computer when necessary. We used the speaker in the laptop if we communicated with the parent and confederate simultaneously. See Peterson et al. (**2017**) for a description of how we selected and integrated hardware and software technologies in our virtual training.

We did not require that parents had minimal upload or download internet speeds in their home to participate; instead, we observed whether the video and audio connection were sufficient for back-and-forth interactions during the first virtual meeting. No formal measures of connectivity were collected but occasional choppy audio or video was addressed by having the family decrease the distance between their computer and router or by providing one family with a higher quality router.

A camera connected to the laptop computer in the participant's home recorded the pretests and posttests. The experimenters who coached parents during the scripted role-plays were board certified behavior analysts pursuing their PhD, and none had prior experience delivering services via telehealth. The experimenters practiced implementing the procedures with fidelity by conducting mock virtual role-play sessions with each other.

Response Measurement

Primary Dependent Measures

We used the same dependent measures as Fisher et al. (**2014**) from the *Behavioral Implementation of Skills for Work Activities* (BISWA) and the *Behavioral Implementation of Skills for Play Activities* (BISPA) to assess skills pretest and posttest.

Observers scored whether the parent implemented the skill correctly or incorrectly for each opportunity the parent had to implement the skill. We designed the BISWA and BISPA so that the parent had multiple, equivalent opportunities to implement each skill in the pretest and posttest for each measure.

The general skills the BISWA targets are *instruction delivery*, *responding to correct responses* and *problem behavior*, and *prompting*. During instruction delivery, observers scored correct implementation for *gain attention* when the caregiver used a prompt after which the confederate attended to the parent before the parent delivered the instruction, for *clear* when the caregiver used the minimum words needed to deliver the instruction, for *phrased as a demand* when the caregiver phrased the instruction as an imperative rather than declarative or interrogative statement, for *behavior specific* when the caregiver specified the action and the target stimulus, and for *waits for response* when the caregiver waited 5 s before re-presenting the instruction if the confederate did not respond to the initial instruction. When the confederate performed a correct behavior, observers scored correct implementation for *descriptive prai*se when the caregiver provided a vocal-praise statement specifying the action and target and for *reinforcement delivery* when the caregiver provided a preferred edible or tangible within 5 s of the correct response. When the confederate performed a problem behavior, observers scored correct implementation for *ignores* if the caregiver provided no differential consequence for 10 s after the occurrence of problem behavior. When the parents used prompts, observers scored correct implementation for *re-present instruction* when the caregiver repeated the instruction after the confederate did not respond or responded incorrectly to the instruction, for *model prompt* if the caregiver repeated the vocal prompt and touched the correct stimulus if the confederate did not respond or responded incorrectly after the re-presented instruction, and for *physical prompt* if the caregiver used hand-over-hand prompting if the confederate did not respond or responded incorrectly after the modeled prompt.

The skills the BISPA targets are descriptive praise, delivery of reinforcement, and extinction. Observers scored correct implementation for *descriptive praise* when the caregiver provided vocal-praise statements specifying the action and target stimulus when the confederate performed an appropriate behavior, for *reinforcement delivery* when the caregiver provided a preferred edible or tangible within 5 s of the confederate emitting an appropriate target response, and for *extinction* when the caregiver provided no differential consequence for the remainder of a trial after the occurrence of confederate problem behavior.

A researcher converted the number of correct implementations of skills during the BISWA and BISPA on the pretest and posttest to a percentage after dividing the number of opportunities in which the parent implemented the skill correctly by the total number of opportunities the parent had to implement the skill. Percentage of correct skill implementation provides an overall measure of the parent's implementation accuracy across skills. However, this measure does not capture whether parents consistently implemented each skill with high fidelity and does not account for differences in the opportunities the parent had to implement each skill. Therefore, a researcher converted number of mastered skills to a percentage after dividing the number of skills for which the parent performed at 90% or greater by the number of opportunities the parent had to implement the component skill.

Procedural Fidelity of the Confederate's Responses

Observers scored the fidelity with which the confederate implemented the scripted responses. Scripted responses during the BISWA were *independent correct* defined as the confederate touching the card the parent specified within 5 s of the parent's initial instruction; *prompted correct* defined as the confederate touching the card the parent specified within 5 s of a model or physical prompt; *incorrect* defined as the confederate touching a card that was the different from the one the parent specified; *prompted incorrect* defined as the confederate touching a card that was different from the one the parent specified after the model prompt; *no response* defined as the confederate not touching a card or engaging in problem behavior for 5 s following the instruction; *stereotypy* defined as the confederate engaging in repetitive body rocking or contorting their hand in front of their face for 5 s following an instruction; *aggression* defined as the confederate lightly hitting or kicking the parent with their body or objects; *disruption* defined as the confederate banging surfaces, throwing or swiping instructional materials, and stomping the floor; *echolalia* defined as the confederate repeating one or several words the parent said; and *negative vocalizations* defined as the confederate crying or screaming at a volume above conversational level. Scripted responses during the BISPA were *joint attention* defined as a gestural or vocal response to direct parent attention to an item or activity; *initiate conversation* defined as verbal statements not in response to a parent's question, excluding requests for edibles or tangibles; *functional play* defined as initiating play with a toy in the manner in which the toy was intended; *describes other's emotions* defined as statements describing the parent's affect or showing empathy for the parent's emotions; *initiates play* defined as a gestural or vocal response to initiate play with the parent; *aggression* defined as lightly hitting or kicking the parent; *disruption* defined as swiping materials, banging the table, or stomping the floor; *echolalia* defined as repeating all or part of words the parent said; *negative vocalizations* defined as crying, yelling, or screaming above conversational level; *stereotypy* defined as body rocking or hand flapping for 5 s after the parent delivered an instruction. Observers scored whether the confederate performed or did not perform the behavior the script prescribed for the trial. Observers only scored correct performance if the confederate preformed the behavior exactly as the operational definition described it.

Social-Validity Measures

We developed a 13-item, social-validity questionnaire to measure parents' satisfaction with the virtual-training program (see Social-Validity Questionnaire in Supporting Information), which was similar to the questionnaire used by Fisher et al. (**2014**). Parents rated (a) the web-based technology, including the use of Blackboard® or Box™ to deliver the e-learning modules and quizzes, the virtual-meeting platform, the quality and reliability of video and audio during the virtual role-plays; (b) the content, including the breadth of information, the organization of the modules, amount learned from the modules, and the use of role-plays during training; (c) their interactions with the researcher (the *behavioral consultant* in the questionnaire) about scheduling, during role-plays, during feedback, and during weekly updates; and (d) their overall satisfaction with the virtual-training program and whether they would recommend it to others who were unable to receive in-person or on-site training. Parents scored each item on a 7-point Likert scale ranging from “1” for “strongly disagree” to “7” for “strongly agree,” with higher scores reflecting greater satisfaction with the rated item. The experimenter emailed the social-validity questionnaire to the parent, the parent completed the questionnaire in the absence of experimenter, and the parent returned a digital or scanned copy of the questionnaire via email. Parents' responses were not anonymous.

Interobserver Agreement, Observer Blinding, and Procedural Integrity

Two independent observers scored target responses from video recordings of the role-plays for 30% of the BISWA and 35% of the BISPA pretests and posttests to assess interobserver agreement. Observers were blind to group membership during the pretest because a researcher randomly assigned parents to groups after they completed the pretests. About one half the posttest interobserver-agreement observations included an observer who was blind to group membership, which allowed us to assess observer bias.

We scored an agreement if both observers scored the occurrence or both observers scored the nonoccurrence of a skill during a given trial. We divided the number of agreements per trial by the number of trials and converted the ratio to a percentage. Mean agreement across pretests and posttests between observers was 87% (range, 82% to 99%) for the BISWA and 87% (range, 77% to 96%) for the BISPA. Mean agreement between blinded and unblinded observers was 91% (range, 81% to 99%) for the BISWA and 83% (Range, 77% to 96%) for the BISPA. Thus, we obtained satisfactory interobserver agreement for both the blinded and unblinded observers.

Observers scored the procedural fidelity of the confederates' scripted responses for 30% of the pretests and posttests. Mean procedural fidelity during the pretests and posttests across confederates was 97% (range, 92% to 100%) and 100% for the BISWA and BISPA, respectively.

Procedure

Study Overview

First, dyads of parents completed the BISWA and BISPA pretests. Second, the researcher randomly assigned parents in each dyad to groups. Third, the parent of the dyad in the treatment group participated in training. The researcher conducted the BISWA and BISPA posttests with the parent in the treatment group when they completed training. The researcher noted the number of weeks that elapsed from pretest to posttest for the parent in the treatment group. The researcher then conducted the posttest with the corresponding parent in the control group after approximately the same number of weeks elapsed from the pretest. Thus, the number of weeks between the pretest and posttest were approximately the same for parents in each dyad. We informed parents assigned to the wait-list control group that we placed them on our regular clinical parent-training waitlist, which at the time of this study had a delay of 3 to 8 months for enrollment. If a parent received parent-training services elsewhere, the type of training and the number of hours received would have been included as a covariable in the data analysis; however, this did not occur for any parent. After the posttest, the parent had the option to participate in our virtual-training program or our regular clinic-based, parent-training services pending availability.

Randomization

A researcher randomized parents to groups in dyads. After the researcher enrolled two parents into the study and obtained informed consent, the researcher conducted the pretests with each parent individually. After each parent in the dyad completed the pretest, a researcher randomly assigned one parent to the treatment group and one parent to the wait-list control group.

Pretest and Posttest

We used the BISWA and the BISPA in the pretest and posttest to assess the effects of our virtual-training program on parents' use of skills for teaching their child with ASD during structured work and naturalistic, play-based activities, respectively. The parent implemented the skills with a confederate during scripted, role-play activities. A researcher gave the parent materials to conduct the pretests and posttests. The researcher used the

Bluetooth headphones to instruct the confederate when and how to respond on each trial of the role-plays. The headset prevented the parent from hearing and anticipating the confederate's behavior. Confederates did not receive training prior to the study; we told them the purpose of each phase and asked them to follow the guidance provided by the researcher.

BISWA

During the pretest and posttest, the parents role-played a receptive-identification with error-correction activity in which they presented picture cards of common objects, vocally named the object, and instructed the confederate to select the card of the named object. Receptive identification was the format for the parent to demonstrate the skills they learned in training (e.g., prompting, reinforcement). Receptive identification is an excellent activity to use to assess trained skills because the parent must use multiple skills common to structured EIBI models. Also, receptive identification is an important skill for the child with ASD to acquire that impacts overall development and the acquisition of spoken language (Fisher et al., **2019**; Grow & LeBlanc, **2013**).

The parent and confederate were seated at a table during the receptive-identification activity. The number of opportunities the parent had to give clear instructions, behavior-specific instructions, and instructions phrased as a demand was 36 per skill; re-present instructions was 30; ignore problem behavior was 18; use a model prompt was 16; use a physical prompt was 14; gain the confederate's attention was nine; use descriptive praise and deliver reinforcement was six per skill; and wait for a response was five. In total, the BISWA provided 212 opportunities for the parent to demonstrate and for observers to measure the parent's performance of the 11 trained skills.

The confederate signaled the parent to start the trial, and the trial ended when the parent responded to the confederate's behavior(s). The number of times the confederate engaged in the scripted response per pretest or posttest was five for independent correct response, no response, aggression, and echolalia; four for disruption and negative vocalization; and two for prompted correct response, incorrect response, prompted incorrect response, stereotypy. The researcher instructed the confederate to engage in one response on some trials and two responses on others. The confederate emitted the same response twice in one trial when the trial included error correction.

BISPA

During the pretest and posttest, the parent role-played playing with the confederate as they would with their child with ASD. The trial began when the confederate engaged in the scripted response and ended when the parent responded to the confederate's response. For example, if the first trial began with the confederate displaying aggression 20 s into the role-play, the trial ended when the parent responded to that aggressive response. The parent had 30 opportunities to use the trained skills.

Virtual Parent Training

E-Learning Modules

Parents in the treatment group completed nine multimedia modules, each lasting between 35 and 60 min. A researcher used Adobe® Presenter to create narrated slides with embedded schematics, pictures, and videos of the target skills. The modules described behavior-analytic principles, skill-acquisition procedures, and behavior-reduction procedures. Parents accessed the modules via a secure Blackboard website, a content-delivery service commonly used by universities, or a Box™ account, a secure cloud-based platform for sharing folders and files. The parent progressed through the e-learning modules independently and at their own pace. A researcher asked parents to set weekly goals and provided weekly email feedback on whether the parent met the goal.

The modules included: (a) ethics, least restrictive environment, and vulnerable populations; (b) preference assessments and positive reinforcement; (c) verbal behavior; (d) response prompting; (e) natural-environment teaching; (f) compliance; (g) preventing problem behavior; (h) integrating structured-training strategies, and (i) integrating play-based training strategies. The last six modules included a scripted role-play session. Parents completed a written quiz after every module and had to score 80% or better before proceeding to the next module.

Scripted Role-Plays

Six e-learning modules had associated role-plays, which the researcher guided the parent and confederate to complete via teleconference after the parent met the 80% criterion on the corresponding e-learning-module quiz. Before the role-play began, the researcher instructed the parent to demonstrate the target skills the e-learning module presented. For example, the parent demonstrated least-to-most prompting at a 5-s prompt delay during a receptive-identification activity before the role-play for the response-prompting module began.

The procedure for the role-play with the parent and confederate was like the pretest and posttest activities described for the BISWA and BISPA. The parent implemented a receptive-identification task with the confederate to role-play skills during structured work activities and played with the confederate to role-play skills during play activities. The researcher used the Bluetooth headphones to tell the confederate how to respond on each trial. The trial started when the confederate signaled during the receptive-identification activity or engaged in a response during play and ended when the parent responded to the confederate's behavior. Each role-play included 20 trials, which provided multiple opportunities for the parent to practice the relevant skills.

The researcher provided behavior-specific praise if the parent and confederate correctly implemented the skill and scripted behavior, respectively. The researcher described the correct response and the error if the parent or the confederate implemented their respective responses incorrectly. Next, the researcher instructed the parent and confederate to practice the skill again in the same trial. The final two role-plays focused on the parent integrating the skills learned in the previous modules. These final two role-plays continued until the parent implemented the skills without feedback with 90% or greater accuracy for one 20-trial role-play. Mean duration for parents to complete the virtual parent training was 5.2 months (range, 1.6 to 10.7). The total duration of training time required of the experimenters per participant for the scripted role-plays was about 6 to 10 hr across 8 to 10 virtual appointments.

Results

Direct-Observation Measures: BISWA and BISPA

Figure **2** depicts percentage of opportunities implemented correctly and Figure **3** depicts percentage of skills mastered on the BISWA (top) and BISPA (bottom) for parents assigned to the waitlist-control (left) and treatment (right) groups. The assessment period, pretest and posttest, is on the x-axis. A line-and-scatter plot with open circles as the marker depicts each parent's change in performance, and the gray bar depicts group means. This figure allows inspection of individual and group performances.

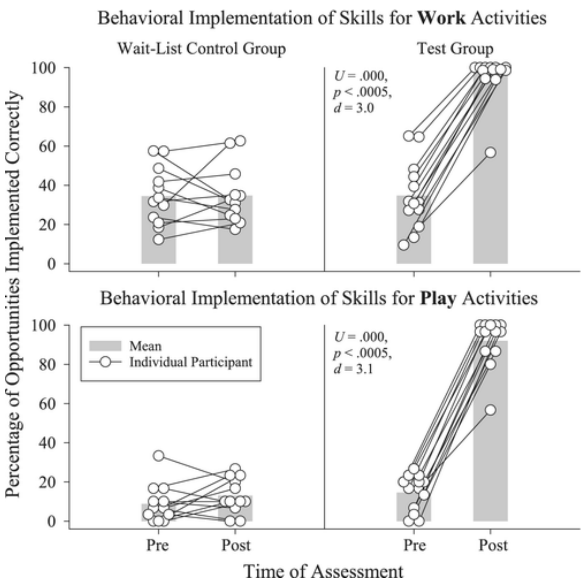

Figure 2 Percentage of Opportunities Implemented Correctly on the BISWA and BISPA
Note. U denotes the Mann–Whitney U test, p the corresponding probability value, and d the effect size.

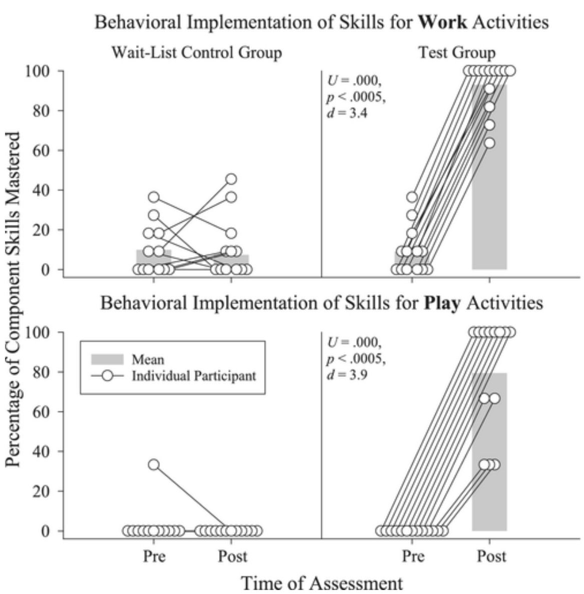

Figure 3 Percentage of Skills Mastered on the BISWA and BISPA
Note. U denotes the Mann–Whitney U test, p the corresponding probability value, and d the effect size.

Percentage of opportunities implemented correctly on the BISWA was low to moderate for parents in the treatment (M = 35%, SD = 17%) and control (M = 35%, SD = 15%) groups at the pretest. Percentage of opportunities implemented correctly increased for parents in the treatment group (M = 99%, SD = 2%) but not for the control group (M = 35%, SD = 19%) at the posttest. Percentage of opportunities implemented correctly on the BISPA also was low for parents in the treatment (M = 14%, SD = 10%) and control (M = 9%, SD = 10%) groups at the pretest. Percentage of opportunities implemented correctly increased for parents in the treatment group (M = 92%, SD = 12%) but not for the control group (M = 13%, SD = 9%) at the posttest. Parents in the treatment group showed clear improvement whereas parents in the control group showed little or no improvement.

Percentage of skills mastered on the BISWA was low for parents in the treatment (*M* = 15%, *SD* = 9%) and control (*M* = 10%, *SD* = 13%) groups at the pretest. Percentage of skills mastered increased for parents in the treatment group (*M* = 93%, *SD* = 12%) but not for the control group (*M* = 11%, *SD* = 15%) at the posttest. Every parent in the treatment group showed clear improvement in the percentage of skills mastered, except one parent who only mastered 60% of the skills.

Percentage of skills mastered on the BISPA was zero for parents in the control group except one (*M* = 3%, *SD* = 10%) and for all parents in the treatment group (*M* = 0%) at the pretest. Eight parents in the treatment group mastered all skills, two mastered 70% of the skills, and three mastered 33% of the skills (*M* = 80%, *SD* = 29%). By contrast, none of the parents in the control group mastered any skills (*M* = 0%) by the posttest.

Statistical-Analysis Procedure

The experimental design and statistical analyses followed the intent-to-treat principle, which is designed to prevent bias by including data from the groups to which each participant was randomly assigned regardless of any changes (White et al., 2011). This is a conservative approach to the intent-to-treat principle relative to data smoothing or creating missing data points based on group mean. We conducted the statistical analyses with the 25 participants who completed the pretests and posttests and excluded the data from the 11 participants who did not complete both assessments.

Before conducting the statistical tests, a researcher calculated routine descriptive statistics; checked the data for outliers using boxplots; and examined the statistical assumptions of normality, independence of measures, and heterogeneity of variance before selecting an appropriate parametric or nonparametric test (Leech et al., 2011). Results showed that several dependent measures violated the assumption of normality (skewness or kurtosis >1.0 or < -1.0). A researcher performed common data-transformation procedures (i.e., square-root, cubed-root, and log-transformed data) to correct these violations, but no procedure normalized the data to acceptable levels. Therefore, we used the Mann–Whitney *U* test, which is the nonparamentric equivalent of an independent *t*-test (Leech et al., 2011), to compare the treatment and control groups on the dependent measures. The four dependent measures were (a) the percentage of opportunities implemented correctly on the BISWA, (b) the percentage of skills mastered on the BISWA, (c) the percentage of opportunities implemented correctly on the BISPA, and (d) the percentage of skills mastered on the BISPA. Because we compared the two groups on four dependent measures, we used the Bonferroni correction and set our alpha level at .01 (.05/4 = .0125) for each individual test such that the experiment-wide, Type-I error rate remained below .05.

We performed preliminary Mann–Whitney *U* tests to determine whether the treatment and control groups differed on the four dependent measures on the pretests. Results of these preliminary tests produced nonsignificant results (*p*s > .10). We then conducted Mann–Whitney *U* tests comparing the groups on the four posttest measures.

Figures **2** and **3** show the Mann–Whitney *U* test results comparing the treatment and control groups on the BISWA and BISPA for the percentage of opportunities implemented correctly and the percentage of skills mastered, respectively. Each of the four tests produced a U statistic of .000, indicating that the posttest score for each participant in the treatment group exceeded the largest posttest score of the control group for each dependent measure. In addition, the *p* values for the four tests fell well below our conservative criterion value of .01 for statistical significance, and thus the per-experiment error rate remained below .05. Finally, Figures **2** and **3** also show the corresponding Cohen's *d* effect sizes for the four Mann–Whitney *U* tests, and all effect sizes are considered large (i.e., ≥.8; Cohen, 1988).

Treatment Duration and Outcomes

Because we allowed parents to complete the e-learning modules at their own pace, their treatment durations varied considerably (from 1.6 to 10.7 months). To conduct a preliminary analysis of whether treatment duration may have affected how well parents in the treatment group performed on the outcome measures, we calculated correlation coefficients between the number of days parents required to complete the treatment and the four dependent measures. None of these correlation coefficients reached the .05 criterion for statistically significance (mean r value = .03; range, -.34 to .16; df = 13).

Social Validity

Table **2** presents social validity ratings for the parents in the treatment group who completed the virtual-training program. The mean satisfaction rating with the virtual-training program was 6.0 (range, 5.2 to 6.5). The lowest satisfaction was with Blackboard for accessing the e-learning modules, and the highest satisfaction was with the audio and visual quality during role-plays. The mean satisfaction rating with the content of the virtual-training program was 6.6 (range, 6.3 to 6.5), with high satisfaction with the information, the role-play, the quality and organization of the e-learning modules, and the amount learned during training. Parents had high satisfaction with their interactions with the researcher (M = 6.7; range, 6.6 to 6.9), including the researcher's ability to answer questions; the option of self-pacing the training; and the flexibility in scheduling meetings and role-plays. The mean rating for overall satisfaction with the training was 6.6 (range 5 to 7), and the parents indicated they would recommend the training to others.

Table 2. *Social Validity Results for 11 Parents in the Treatment Group Who Completed the Social-Validity Measure*

Summarized Questions	*M*	*SD*	Range
Technology			
Accessing Virtual Meeting and Initiating Audio and Video	6.5	0.7	5-7
Reliability of Audio and Video During Role-Plays	6.2	1.2	3-7
Reliability and Quality of Audio and Video of Role-Plays	6.1	1.2	3-7
Blackboard to Deliver e-Learning Modules and Quizzes	5.2	1.8	2-7
Content			
The Amount I Learned	6.3	1.0	4-7
Design Quality and Organization of Modules	6.5	0.7	5-7
Role-Plays as a Training Component	6.5	0.8	5-7
Amount and Type of Content in e-Learning Modules	6.5	0.7	5-7
Consultant Interactions			
Communications with Consultant	6.9	0.3	6-7
Consultant's Ability to Answer Questions	6.6	0.5	6-7
Completing the Program at Preferred Pace	6.6	0.7	5-7
Flexibility of Meeting and Role-Plays	6.8	0.4	6-7
Overall Satisfaction	6.6	0.7	5-7

Discussion

The current RCT evaluated the effectiveness of a virtual program to train parents with no prior experience with ABA to implement EIBI procedures typically used with children diagnosed with ASD. The virtual-training program included online, e-learning modules and role-plays with feedback conducted via teleconferencing. We completed the training without parents and researchers ever meeting in person at the same location and time. Parents in the treatment and control groups showed equivalently low levels of correct skills on the pretest. The treatment group showed marked improvement in correct skills on the posttest whereas the control group showed small or no appreciable changes on the posttest. We observed large effect sizes on the four dependent measures for the differences observed between the treatment and control groups during the posttest.

Results of the current study add to the growing body of literature on the effectiveness of virtually training parents to implement EIBI skills in several potentially important ways. First, we evaluated the effects of our virtual-training program using an RCT. Smith (**2013**, **2014**) argued that behavior analysts should evaluate their practices using RCTs more often. One reason is that medicine and most other disciplines consider the synthesis of such trials in meta-analyses as the gold standard for identifying evidence-based interventions.

Behavior analysts sometime criticize RCTs and other group-comparison studies because they evaluate change at the group level rather than at the individual level, which may obscure individual variation in response to treatment. For example, Barlow and Hersen (1973) observed that statistically significant changes in the mean of an experimental group over a control group can be due to large changes for a small minority of cases even when most cases showed no change or worsened. In the current study, we evaluated changes from the pretest to the posttest for the treatment and control groups for individual participants and at the group level. Analyzing and presenting data at the individual and group levels may alleviate concerns behavior analysts have had about group-comparison studies. An alternative for evaluating interventions with both single-case and randomized-group designs is the approach Peterson et al. (**2016**, **2019**) used, in which they introduced ABA treatments for food selectivity using single-case designs. They also compared results of the ABA treatment group with those of the comparison or control group, respectively, using an RCT.

Second, our virtual-training program included many skills common to EIBI models based on the principles and procedures of ABA. The e-learning modules covered topics such as positive reinforcement and assessing preferences, promoting verbal behavior, response prompting, compliance training, natural-environment training, prevention of problem behavior, and two modules focused on integrating the strategies. By contrast, most prior virtual parent-training studies have focused on specific treatment models (e.g., Project ImPACT, which trains parents to promote their child's social-communication skills). Providing parents with many ABA skills is important because parents must often address skill deficits and problem behavior simultaneously, and children with ASD often show variable and idiosyncratic responses to specific ABA procedures and models (Jobin, **2020**; Lindauer et al., **1999**; Sherer & Schreibman, **2005**; Tiger et al. **2009**).

Third, we assessed the effects of training under both structured and play contexts. Thus, not only did the virtual-training program provide broad training, but our dependent measures also covered the two major training models used in EIBI (Roane et al., **2016**). The BISWA evaluated the effects of the virtual-training program using a receptive-identification activity. This activity allowed parents to use trained skills, and researchers to evaluate parents' implementation of those skills. One advantage of receptive identification as the assessment format is that it requires the parent to use skills that are characteristic of structured training, including delivering multiple, clear discriminative stimuli; using prompts; conducting prompt fading; using reinforcement and error correction; and addressing problem behavior. The BISPA evaluated parents' use of skills in a play context to measure the effects of the virtual-training program. Parents had the opportunity to respond to several appropriate (e.g., joint attention, initiating conversation) and problem (e.g., aggression, echolalia) behaviors that are common targets for children with ASD. Thus, the BISWA and the BISPA covered different but complementary skills parents might use with their child with ASD.

Finally, the parents assigned to the treatment group generally rated the virtual-training program as socially acceptable. The mean rating across parents was 6.6 on a 7-point scale (94% of the possible total), with no parent providing a rating of less than 5. The only item on the social-validity measure that had a mean rating less than

6.0 was for Blackboard as the method to deliver the e-learning modules and quizzes. Notably, we switched to using Microsoft Box after receiving the negative feedback from parents about Blackboard.

These contributions to the literature on virtual parent training with e-learning modules and confederate-based role-play should be evaluated relative to several study limitations. First, our sample included mostly females (n = 21; 84%) and a few males (n = 4; 16%), which limits the generality of the findings to male parents. However, the two males in the treatment group outperformed the males and females in the waitlist-control group on the posttest, which may mitigate this limitation. In addition, research on parent training commonly includes more females than males (e.g., Antonini et al., **2014**; Wade et al., **2017**).

A second limitation is that by allowing parents to complete the e-learning modules at their own pace, some parents required the better part of a year to complete the training program. Although we found no significant correlations between treatment duration and the four outcome measures, parents that required a long time to complete the training probably contributed less to their child's behavioral programming during the delay than those that completed the training more quickly.

A third limitation is that we did not measure parent performance on every skill the virtual-training program taught, and, therefore, the influence of each e-learning module, especially those without a corresponding scripted role-play, on parent's mastery of the content remains unknown. For example, we taught parents to conduct preference assessments and to promote verbal behavior, but we did not assess their competencies in these areas. Assessing parent performance on every skill covered in the virtual-training program would have been impractical. Nevertheless, future researchers should evaluate parent competencies for other specific skills taught during the virtual parent-training program.

A final limitation is that we did not assess each parent's performance with their child. It is worth noting that prior research suggests that the posttraining performance with a confederate is predictive of performance with a child for therapists implementing preference assessments (Higgins et al., **2017**) and for parents implementing functional communication training (Simacek et al., **2017**). Nevertheless, future research should evaluate whether parent fidelity remains high following this virtual-training program when parents implement the procedures with their children.

Researchers should also compare the efficacy, efficiency, and cost savings of the current telehealth approach to a traditional in-person approach, similar to the comparison modeled by Geiger et al. (2018) of e-learning versus in-person teaching of receptive-identification procedures. Another research direction would be to evaluate whether similar outcomes could be obtained with the experimenter playing the role of the confederate remotely during scripted role-plays rather than requiring the presence of another adult in the parent's home, which would simplify the training procedures.

REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual for mental disorders* (5th ed.). American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596.

Antezana, L., Scarpa, A., Valdespino, A., Albright, J., & Richey, J. A. (2017). Rural trends in diagnosis and services for autism spectrum disorder. *Frontiers in Psychology*, **8**, 590. https://doi.org/10.3389/fpsyg.2017.00590.

Antonini, T. N., Raj, S. P., Oberjohn, K. S., Cassedy, A., Makoroff, K. L., Fouladi, M., & Wade, S. L. (2014). A pilot randomized trial of an online parenting skills program for pediatric traumatic brain injury: Improvements in parenting and child behavior. *Behavior Therapy*, **45**(4), 455– 468. https://doi.org/10.1016/j.beth.2014.02.003.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, **1**(1), 91– 97. https://doi.org/10.1901/jaba.1968.1-91

Baio, J., Wiggins, L., Christensen, D. L., Maenner, M. J., Daniels, J., Warren, Z., … Dowling, N. F. (2018). Prevalence of autism spectrum disorder among children aged 8 years—autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *MMWR Surveillance Summaries*, **67**(6), 1. https://doi.org/10.15585/mmwr.ss6706a1.

Barlow, D. H., & Hersen, M. (1973). Single-case experimental designs: Uses in applied clinical research. *Archives of General Psychiatry*, **29**(3), 319– 325. https://doi.org/10.1001/archpsyc.1973.04200030017003.

Boisvert, M., Lang, R., Andrianopoulos, M., & Boscardin, M. L. (2010). Telepractice in the assessment and treatment of individuals with autism spectrum disorders: A systematic review. *Developmental Neurorehabilitation*, **13**(6), 423– 432. https://doi.org/10.3109/17518423.2010.499889.

Brobst, J. B., Clopton, J. R., & Hedrick, S. S. (2009). Parenting children with autism spectrum disorders: The couple's relationship. *Focus on Autism and Other Developmental Disabilities*, **24**(1), 38– 49. https://doi.org/10.1177/1088357608322699.

Burd, L., Fisher, W., & Kerbeshian, J. (1987). A prevalence study of pervasive developmental disorders in North Dakota. *Journal of the American Academy of Child and Adolescent Psychiatry*, **26**(5), 700– 703. https://doi.org/10.1097/00004583-198709000-00014.

Carroll, R. A., Kodak, T., & Fisher, W. W. (2013). An evaluation of programmed treatment-integrity errors during discrete-trial instruction. *Journal of Applied Behavior Analysis*, **46**(2), 379– 394. https://doi.org/10.1002/jaba.49.

Cohen, J. (1988). *Statistical power analyses for the behavioral sciences*, Lawrence Erlbaum Associates.

CONSORT 2010 (2020, May). *CONSORT Transparent Reporting of Trials*. Retrieved from https://www.consort-statement.org/consort-statement/flow-diagram

Crowley, J. G., Peterson, K. M., Fisher, W. W., & Piazza, C. C. (2020). Treating food selectivity as resistance to change in children with autism spectrum disorder. *Journal of Applied Behavior Analysis. Advance online publication.* https://doi.org/10.1002/jaba.711.

Dominick, K. C., Davis, N. O., Lainhart, J., Tager-Flusberg, H., & Folstein, S. (2007). Atypical behaviors in children with autism and children with a history of language impairment. *Research in Developmental Disabilities*, **28**(2), 145– 162. https://doi.org/10.1016/j.ridd.2006.02.003.

Dumas, J. E., Wolf, L. C., Fisman, S. N., & Culligan, A. (1991). Parenting stress, child behavior problems, and dysphoria in parents of children with autism, Down syndrome, behavior disorders, and normal development. *Exceptionality*, **2**(2), 97– 110. https://doi.org/10.1080/09362839109524770.

Eikeseth, S. (2009). Outcome of comprehensive psycho-educational interventions for young children with autism. *Research in Developmental Disabilities*, **30**(1), 158– 178. https://doi.org/10.1016/j.ridd.2008.02.003.

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Elkeseth, S., & Cross, S. (2009). Meta-analysis of early intensive behavioral intervention for children with autism. *Journal of Clinical Child and Adolescent Psychology*, **38**(3), 439– 450. https://doi.org/10.1080/15374410902851739.

Fisher, W. W., Felber, J. M., Phillips, L. A., Craig, A. R., Paden, A. R., & Niemeier, J. J. (2019). Treatment of resistance to change in children with autism. *Journal of Applied Behavior Analysis*, **52**(4), 974– 993. https://doi.org/10.1002/jaba.588.

Fisher, W. W., Luczynski, K. C., Hood, S. A., Lesser, A. D., Machado, M. A., & Piazza, C. C. (2014). Preliminary findings of a randomized clinical trial of a virtual-training program for applied behavior analysis technicians. *Research in Autism Spectrum Disorders*, **8**(9), 1044– 1054. https://doi.org/10.1016/j.rasd.2014.05.002.

Fisher, W. W., Retzlaff, B. J., Akers, J. S., DeSouza, A. A., Kaminski, A. J., & Machado, M. A. (2019). Establishing initial auditory-visual conditional discriminations and emergence of initial tacts in young children with autism spectrum disorder. *Journal of Applied Behavior Analysis*, **52**(4), 1089– 1106. https://doi.org/10.1002/jaba.586.

Freedman, B. H., Kalb, L. G., Zaboltsky, B., & Stuart, E. A. (2012). Relationship status among parents of children with autism spectrum disorders: A population-based study. *Journal of Autism and Developmental Disorders*, **42**(4), 539– 548. https://doi.org/10.1007/s10803-011-1269-y.

Geiger, K. B., LeBlanc, L. A., Hubik, K., Jenkins, S. R., & Carr, J. E. (2018). Live training versus e-learning to teach implementation of listener response programs. *Journal of Applied Behavior Analysis*, **51**(2), 220– 235. https://doi.org/10.1002/jaba.444.

Grow, L., & LeBlanc, L. (2013). Teaching receptive language skills. *Behavior Analysis in Practice*, **6**(1), 56– 75. https://doi.org/10.1007/BF03391791.

Hartley, S. L., Barker, E. T., Seltzer, M. M., Floyd, F., Greenberg, J., Orsmond, G., & Bolt, D. (2010). The relative risk and timing of divorce in families in children with an autism spectrum disorder. *Journal of Family Psychology*, **24**(4), 449– 457. https://doi.org/10.1037/a0019847.

Higgins, W. J., Luczynski, K. C., Carroll, R. A., Fisher, W. W., & Mudford, O. C. (2017). Evaluation of a telehealth training package to remotely train staff to conduct a preference assessment. *Journal of Applied Behavior Analysis*, **50**(2), 238– 251. https://doi.org/10.1002/jaba.370.

Horlin, C., Falkmer, M., Parsons, R., Albrecht, M. A., & Falkmer, T. (2014). The cost of autism spectrum disorders. *PLoS One*, **9**, e106552. https://doi.org/10.1371/journal.pone.0106552.

Howard, J. S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. A. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities*, **26**(4), 359– 383. https://doi.org/10.1016/j.ridd.2004.09.005.

Howlin, P., Goode, S., Hutton, J., & Rutter, M. (2004). Adult outcome for children with autism. *Journal of Child Psychology and Psychiatry*, **45**(2), 212– 229. https://doi.org/10.1111/j.1469-7610.2004.00215.x.

Howlin, P., Magiati, I., & Charman, T. (2009). Systematic review of early intensive behavioral interventions for children with autism. *American Journal of Intellectual and Developmental Disabilities*, **114**(1), 23– 41. https://doi.org/10.1352/2009.114:23;nd41

Ingersoll, B., & Berger, N. I. (2015). Parent engagement with a telehealth-based parent-mediated intervention program for children with autism spectrum disorders: Predictors of program use and parent outcomes. *Journal of Medical Internet Research*, **17**(10), e227. https://doi.org/10.2196/jmir.4913

Ingersoll, B., Wainer, A. L., Berger, N. I., Pickard, K. E., & Bonter, N. (2016). Comparison of a self-directed and therapist-assisted telehealth parent-mediated intervention for children with ASD: A pilot RCT. *Journal of Autism and Developmental Disorders*, **46**(7), 2275– 2284. https://doi.org/10.1007/s10803-016-2755-z.

Jobin, A. (2020). Varied treatment response in young children with autism: A relative comparison of structured and naturalistic behavioral approaches. *Autism*, **24**(2), 338– 351. https://doi.org/10.1177/1362361319859726.

Keen, D., Couzens, D., Muspratt, S., & Rodger, S. (2010). The effects of a parent-focused intervention for children with a recent diagnosis of autism spectrum disorder on parenting stress and competence. *Research in Autism Spectrum Disorders*, **4**(2), 229– 241. https://doi.org/10.1016/j.rasd.2009.09.009.

Klintwall, L., & Eikeseth, S. (2014). Early and intensive behavioral intervention (EIBI) in autism. In V. Patel, V. Preedy, & C. Martin (Eds.), *Comprehensive guide to autism* (pp. 117– 137). Springer. https://doi.org/10.1007/978-1-4614-4788-7_129.

Leach, N., Barrett, K., & Morgan, G. (2011). *BM SPSS for intermediate statistics: Uses and interpretation*, Routledge.

Lindauer, S. E., DeLeon, I. G., & Fisher, W. W. (1999). Decreasing signs of negative affect and correlated self-injury in an individual with mental retardation and mood disturbances. *Journal of Applied Behavior Analysis*, **32**(1), 103– 106. https://doi.org/10.1901/jaba.1999.32-103

McConachie, H., & Diggle, T. (2007). Parent implemented early intervention for young children with autism spectrum disorder: A systematic review. *Journal of Evaluation in Clinical Practice*, **13**(1), 120– 129. https://doi.org/10.1111/j.1365-2753.2006.00674.x.

Nefdt, N., Koegel, R., Singer, G., & Gerber, M. (2010). The use of a self-directed learning program to provide introductory training in pivotal response treatment to parents of children with autism. *Journal of Positive Behavior Interventions*, **12**(1), 23– 32. https://doi.org/10.1177/1098300709334796.

Parsons, D., Cordier, R., Vaz, S., & Lee, H. C. (2017). Parent-mediated intervention training delivered remotely for children with autism spectrum disorder living outside of urban areas: Systematic review. *Journal of Medical Internet Research*, **19**(8), e198. https://doi.org/10.2196/jmir.6651.

Peterson, K. M., Piazza, C. C., Ibañez, V. F., & Fisher, W. W. (2019). Randomized controlled trial of an applied behavior analytic intervention for food selectivity in children with autism spectrum disorder. *Journal of Applied Behavior Analysis*, **52**(4), 895– 917. https://doi.org/10.1002/jaba.650.

Peterson, K. M., Piazza, C. C., Luczynski, K. C., & Fisher, W. W. (2017). Virtual-care delivery of applied-behavior-analysis services to children with autism spectrum disorder and related conditions. *Behavior Analysis: Research and Practice*, **17**(4), 286– 297. https://doi.org/10.1037/bar0000030.

Peterson, K. M., Piazza, C. C., & Volkert, V. M. (2016). A comparison of a modified sequential oral sensory approach to an applied behavior-analytic approach in the treatment of food selectivity in children with autism spectrum disorder. *Journal of Applied Behavior Analysis*, **49**(3), 485– 511. https://doi.org/10.1002/jaba.332.

Pickard, K. E., Wainer, A. L., Bailey, K. M., & Ingersoll, B. R. (2016). A mixed-method evaluation of the feasibility and acceptability of a telehealth-based parent-mediated intervention for children with autism spectrum disorder. *Autism*, **20**(7), 845– 855. https://doi.org/10.1177/1362361315614496.

Reed, P., Osborne, L. A., & Corness, M. (2007). The real-world effectiveness of early teaching interventions for children with autism spectrum disorder. *Exceptional Children*, **73**(4), 417– 433. https://doi.org/10.1177/001440290707300402.

Reichow, B. (2012). Overview of meta-analyses on early intensive behavioral intervention for young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, **42**(4), 512– 520. https://doi.org/10.1007/s10803-011-1218-9.

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *The Cochrane Database of Systematic Reviews*, **10**, CD009260. https://doi.org/10.1002/14651858.CD009260.pub2

Remington, B., Hastings, R. P., Kovshoff, H., degli Espinosa, F., Jahr, E., Brown, T., … MacLean, W. E., Jr. (2007). Early intensive behavioral intervention: Outcomes for children with autism and their parents after two years. *American Journal on Mental Retardation*, **112**(6), 418– 438. https://doi.org/10.1352/0895-8017(2007)112[418:EIBIOF]2.0.CO;2.

Rispoli, M., Neely, L., Lang, R., & Ganz, J. (2011). Training paraprofessionals to implement interventions for people with autism spectrum disorders: A systematic review. *Developmental Neurohabilitation*, **14**(6), 378– 388. https://doi.org/10.3109/17518423.2011.620577.

Roane, H. S., Fisher, W. W., & Carr, J. E. (2016). Applied behavior analysis as treatment for autism spectrum disorder. *The Journal of Pediatrics*, **175**, 27– 32. https://doi.org/10.1016/j.jpeds.2016.04.023.

Scahill, L., McDougle, C. J., Aman, M. G., Johnson, C., Handen, B., Bearss, K., … Vitiello, B. (2012). Effects of risperidone and parent training on adaptive functioning in children with pervasive developmental disorders and serious behavioral problems. *Child & Adolescent Psychiatry*, **51**(2), 136– 146. https://doi.org/10.1016/j.jaac.2011.11.010.

Sherer, M. R., & Schreibman, L. (2005). Individual behavioral profiles and predictors of treatment effectiveness for children with autism. *Journal of Consulting and Clinical Psychology*, **73**(3), 525. https://doi.org/10.1037/0022-006X.73.3.525.

Simacek, J., Dimian, A. F., & McComas, J. J. (2017). Communication intervention for young children with severe neurodevelopmental disabilities via telehealth. *Journal of Autism and Developmental Disorders*, **47**(3), 744– 767. https://doi.org/10.1007/s10803-016-3006-z.

Smith, T. (2013). What is evidence-based behavior analysis? *The Behavior Analyst*, **36**(1), 7– 33. https://doi.org/10.1007/BF03392290.

Smith, T. (2014). Behavior analysts can be interdisciplinary too: A review of Durand's Autism Spectrum Disorder. *Journal of Applied Behavior Analysis*, **47**(4), 866– 879. https://doi.org/10.1002/jaba.157.

Strauss, K., Vicari, S., Valeri, G., D'Elia, L., Arima, S., & Fava, L. (2012). Parent inclusion in early intensive behavioral intervention: The influence of parental stress, parent treatment fidelity and parent-mediated

generalization of behavior targets on child outcomes. *Research in Developmental Disabilities*, **33**(2), 688– 703. https://doi.org/10.1016/j.ridd.2011.11.008.
Tiger, J. H., Fisher, W. W., Toussaint, K. A., & Kodak, T. (2009). Progressing from initially ambiguous functional analyses: Three case examples. *Research in Developmental Disabilities*, **30**(5), 910– 926. https://doi.org/10.1016/j.ridd.2009.01.005.
Tonge, B., Brereton, A., Kiomall, M., Mackinnon, A., King, N., & Rinehart, N. (2006). Effects on parental mental health of an education and skills training program for parents of young children with autism: A randomized control trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, **45**(5), 561– 569. https://doi.org/10.1097/01.chi.0000205701.48324.26.
Tonge, B., Brereton, A., Kiomall, M., Mackinnon, A., & Rinehart, N. J. (2014). A randomized group comparison controlled trial of 'preschoolers with autism': A parent education and skills training intervention for young children with autistic disorders. *Autism*, **18**(2), 166– 177. https://doi.org/10.1177/1362361312458186.
Tonge, B. J., Bull, K., Brereton, A., & Wilson, R. (2014). A review of evidence-based early intervention for behavioural problems in children with autism spectrum disorder: The core components of effective programs, child-focused interventions and comprehensive treatment models. *Current Opinion in Psychiatry*, **27**(2), 158– 165. https://doi.org/10.1097/YCO.0000000000000043.
Vismara, L. A., Colombi, C., & Rogers, S. J. (2009). Can one hour per week of therapy lead to lasting changes in young children with autism? *Autism*, **13**(1), 93– 115. https://doi.org/10.1177/1362361307098516.
Vismara, L. A., McCormick, C., Young, G. S., Nadhan, A., & Monlux, K. (2013). Preliminary findings of a telehealth approach to parent training in autism. *Journal of Autism and Developmental Disorders*, **43**(12), 2953– 2969. https://doi.org/10.1007/s10803-013-1841-8.
Vismara, L., Young, G. S., & Rogers, S. J. (2012). Telehealth for expanding the reach of early autism training to parents. *Autism Research and Treatment. Article ID*, **121878**. https://doi.org/10.1155/2012/121878.
Wade, S. L., Cassedy, A. E., Shultz, E. L., Zang, H., Zhang, N., Kirkwood, M. W., … Taylor, H. G. (2017). Randomized clinical trial of online parent training for behavior problems after early brain injury. *Journal of the American Academy of Child & Adolescent Psychiatry*, **56**(11), 930– 939.e932. https://doi.org/10.1016/j.jaac.2017.09.413.
Wainer, A. L., & Ingersoll, B. R. (2015). Increasing access to an ASD imitation intervention via a telehealth parent training program. *Journal of Autism and Developmental Disabilities*, **45**(12), 3877– 3890. https://doi.org/10.1007/s10803-014-2186-7.
White, I. R., Horton, N. J., Carpenter, J., & Pocock, S. J. (2011). Strategy for intention to treat analysis in randomised trials with missing outcome data. *British Medical Journal*, **342**, d40. https://doi.org/10.1136/bmj.d40.