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Comparison of the Efficacy of Online Versus In-Vivo Behavior Analytic Training for Parents of Children With Autism Spectrum Disorder

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Individuals diagnosed with autism spectrum disorder often receive Early Intensive Behavioral Intervention to acquire skills and manage problem behaviors. However, gains made in the clinic cannot generalize to other contexts without caregiver support. Currently, the most common method of providing caregiver training is in vivo, which is resource intensive and inaccessible to many. The purpose of this study was to evaluate the relative efficacy of content delivered via self-directed online training modules relative to group in vivo training. After a 6-week training, participants in online and in vivo groups showed significant improvements in positive parent–child interactions and knowledge of Applied Behavior Analysis content compared to the waitlist control group, suggesting comparable effectiveness of both training methods. These results suggest that asynchronous online training can serve as a cost-effective alternative for the delivery of parent training and potentially other behavior-analytic services.

Keywords: parent training, online training, ABA, telehealth, autism

Autism spectrum disorder (ASD) is characterized by deficits in social communication and social interaction, and excesses in stereotypic and maladaptive behaviors (American Psychiatric Association, 2013). A commonly used, and empirically validated, treatment for children with ASD is based on learning principles of Applied Behavior Analysis (ABA), which focuses on creating socially significant change in children's lives (Baer, Wolf, & Risley, 1968). ABA has been particularly successful in creating meaningful outcomes for individuals with ASD, by focusing on Early Intensive Behavioral Intervention (EIBI) to mitigate behavioral deficits (Lovaas, 1987). EIBI provides 30 to 40 hr per week of behavior analytic services to children under the age of 4.

Although EIBI is effective in producing positive outcomes in the behavior of children with ASD, the intervention itself is not enough to create sustained behavior change (Fava et al., 2011). Parent involvement is integral in order for skills acquired through EIBI to generalize across environments and maintain over time. Despite the importance of parent involvement, the informational content and teaching approach for training parents remains an active and important area of research today (e.g., Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Wainer & Ingersoll, 2013).

Strauss et al. (2012) evaluated what information is most useful to promote implementation and maintenance of treatment by parents. When comparing ABA-based parent training to an

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eclectic treatment, children whose parents received ABA-based training engaged in less problem behavior and parents reported lower levels of stress. Relatedly, Bearss et al. (2015) examined the efficacy of a parent-training group receiving a comprehensive overview of topics in ABA (e.g., how to determine the cause of problem behavior, how to manage it, and how to teach new skills) compared with a parent-training group provided with educational content related to advocacy, current treatment options, and how to plan for a child's education. Parents who received training in ABA were better equipped with the specific techniques needed to reduce their child's disruptive behavior. These findings suggest that providing parents with ABA-based training ensures greater success in decreasing disruptive behaviors and parental-stress levels.

Another area of research regarding parent training is the teaching method used to deliver information. Several teaching methods have been utilized, such as in vivo training and delivering the information remotely. Within ABA, the most commonly used approach is to train parents in vivo using behavioral skills training (BST), which consists of providing instructions, modeling, rehearsal, and immediate feedback (Sarokoff & Sturmey, 2004). Hsieh, Wilder, and Abellon (2011) found that parents readily learned how to teach their child to request for items using BST. Relatedly, Fava et al. (2011) assessed the efficacy of training parents to implement EIBI sessions in the home. The results showed that parents effectively implemented EIBI in the home, as shown by improved scores on standardized outcome measures, as well as substantial decreases in challenging child behaviors and parental stress levels. The findings reported by Fava et al. and Hsieh et al. suggest that training parents in vivo to implement ABA-based treatment is effective in producing meaningful change in their child's behavior.

Although there is strong evidence to support the usefulness of ABA-based content delivered via in vivo parent training sessions, these sessions are resource intensive, requiring face-to-face training provided by a behavior specialist or Board Certified Behavior Analyst. In addition, families often face other barriers to obtaining services, such as lack of providers near their home or long waitlists for enrollment at local treatment facilities. Because of the limited access to treatment for many families, recent research has examined alternative modes of delivery to make behavior analytic services readily available in a more cost and time effective manner.

One alternative mode of delivery that has been investigated is telehealth, which refers to providing health-related information over the Internet in the form of synchronous video calls, readings, or modules created by trained professionals. For instance, Wacker et al. (2013) used telehealth in the form of video calls to provide parents of children with ASD with information on how to decrease problem behaviors using functional communication training. Synchronous telehealth training was found to be comparable to in vivo training in terms of the effectiveness in training parents to conduct functional analysis and implement functional communication training, resulting in comparable decreases in problem behavior. Importantly, telehealth was a more cost-effective method to provide training to parents compared to in-home behavior therapy (also see Suess, Wacker, Schwartz, Lustig, & Detrick, 2016). Lindgren et al. (2016) further examined whether synchronous telehealth was a cost-effective method to provide parents with information on the basic principles of ABA. Children from three groups (i.e., in-home therapy, clinic-based telehealth, and home-based telehealth) showed a 90% decrease in their rate of problem behaviors, when parents implemented the strategies taught during training. There were no significant differences between the three groups, suggesting all delivery methods were equally effective. Importantly, both the home- and clinic-based telehealth decreased the cost of parent training by 75% and 64%, respectively, compared to the in-home parent training.

It is important to note, however, that telehealth services using synchronous video calls (e.g., Lindgren et al., 2016; Suess et al., 2016; Wacker et al., 2013) are still relatively resource intensive, as they require specialists to be available during the time of instruction. As a more cost-effective alternative, Pollard, Higbee, Akers, and Brodhead (2014) examined the effectiveness of an interactive computer training to determine whether services could be provided asynchronously (i.e., without a trained professional present during training). Specifically, they evaluated whether parents could learn to conduct discrete-trial training via prere-

corded modules. On average, there was a 68% increase from pre- to posttraining on a knowledge assessment for those who participated in the interactive computer training. Similarly, Jang et al. (2012) examined the effectiveness of online modules in an eLearning program designed to teach parents the principles and procedures of ABA. The online parent training modules were effective in teaching parents about ABA compared to a control group receiving delayed access to training. Relatedly, Wainer and Ingersoll (2013) evaluated the efficacy of a self-directed, Internet-based, distance-learning program to teach imitation training to parents. The distance-learning method of delivering information to parents improved child generalization of imitation skills and reduced parental stress levels.

Taken together, the findings from Jang et al. (2012); Pollard et al. (2014); and Wainer and Ingersoll (2013) suggest services can be effectively provided via asynchronous telehealth, which can significantly reduce the costs associated with the presence of a trained professional. However, none of these studies directly compared Internet-based training to more traditional in vivo training formats. Thus, it is unclear whether the results of asynchronous online training are comparable to those from in vivo training. The purpose of the present study was to compare the relative efficacy of web-based, self-paced training modules to in vivo parent training by assessing changes in parent–child interactions, knowledge of ABA material, parental stress, and parental competence.

Method

Participants

Eighteen parent–child dyads were recruited through a university-based autism center (see Table 1). The inclusionary criteria were (a) the

Table 1
Participant Demographic Information

	n (%)			
Participant demographics	In-vivo 7 (38.9)	Online 6 (33.3)	Control 5 (27.8)	Total 18 (100.0)
Parent characteristics				
Gender				
Female	6 (85.7)	4 (66.7)	4 (80.0)	14 (77.7)
Ethnicity				
White	4 (57.1)	3 (50.0)	4 (80.0)	11 (61.1)
African American	2 (28.6)	0	0	2 (11.1)
Asian	0	1 (16.7)	0	1 (5.6)
Other	1 (14.3)	2 (33.3)	1 (20.0)	4 (22.2)
Education				
High school graduate/GED	1 (14.3)	1 (16.7)	1 (20.0)	3 (16.7)
Some college	2 (28.6)	3 (50.0)	1 (20.0)	6 (33.3)
College degree	2 (28.6)	1 (16.7)	3 (60.0)	6 (33.3)
Advanced degree	2 (28.6)	1 (16.7)	0	3 (16.7)
Socio-economic status				
Less than 25,000	1 (14.3)	0	2 (40.0)	3 (16.7)
25,000 to 50,000	1 (14.3)	4 (66.7)	0	5 (27.8)
50,000 to 75,000	3 (42.9)	1 (16.7)	2 (40.0)	6 (33.3)
Above 75,000	2 (28.6)	1 (16.7)	1 (20.0)	5 (27.8)
Marital status				
Single	2 (28.6)	1 (16.7)	3 (60.0)	6 (33.3)
Married	5 (71.4)	4 (66.7)	1 (20.0)	10 (55.6)
Divorced	0	1 (16.7)	1 (20.0)	2 (11.1)
Child characteristics				
Gender (% male)				
Male	5 (71.4)	6 (100.0)	3 (60.0)	14 (77.7)
Chronological age				
Average	3.5	4.8	4.8	4.4

parent was living with the child and had no prior training on ASD or ABA and (b) the child had a diagnosis of ASD and was 8 years of age or younger.

Experimental Design and Group Assignment

A between-subjects design was used in this study. Each parent–child dyad was matched to one of three groups based on their pretraining assessment scores on four dependent measures (described below). Matching was conducted to ensure each group contained participants with similar initial scores on the four dependent measures. Specifically, at the start of training, the average pretraining assessment score across the dependent variables was similar across groups (i.e., parents who performed similarly were assigned to different groups). Seven parent–child dyads were assigned to in vivo parent training sessions, six parent–child dyads were assigned to the online, self-paced parent-training program, and five parent–child dyads were assigned to the waitlist control group. Five additional parent–child dyads, four from the waitlist group and one from the online group, withdrew from the study before completion. Their data are not included in the analyses.

Materials

Upon enrollment in the study, each parent–child dyad received a welcome package, which included a welcome letter, general information about ASD (e.g., signs and symptoms) and ABA (e.g., methods used), and additional resources (e.g., behavioral resources available within the county).

Six parent-training modules were developed specifically for this study. The training modules covered the following topics: (a) introduction to ASD (e.g., diagnosis, prevalence, and etiology); (b) introduction to ABA (e.g., definition of behavior, environmental control of behavior); (c) general behavior management skills (e.g., providing choices, providing clear instructions and consequences); (d) strategies for managing problem behavior (e.g., extinction, functional communication training, and differential reinforcement of alternative behaviors); (e) strategies for increasing communication skills (e.g., mand training); and (f) how to teach a new skill through the use of natural environment training. The training topics were selected to incorporate information previously reported as effective in parent training studies (e.g., Bearss et al., 2015). Each module consisted of a researcher narrating a PowerPoint presentation. Additionally, video models and active parent responding questions were included throughout each module. Active parent responding questions were presented as multiple-choice questions. Participants were not required to respond correctly to proceed with the module. The only difference between the online and in vivo modules was that the modules were prerecorded for the online group and these participants were unable to interact with the researcher in real time.

Dependent Measures

Each parent–child dyad completed two assessment sessions during which all four dependent measures were evaluated in a treatment room at a university-based autism center. The first session occurred before exposing participants to the training modules (i.e., pretraining), and the second was conducted once participants had completed the training modules (i.e., posttraining). For participants assigned to the waitlist control group, posttraining assessments were conducted following a 6-week training delay to account for the time during which participants in other groups were exposed to the training modules.

Parent-child interaction. During a 5-min play session in which participants had access to several toys, researchers collected data on both positive and negative interactions between the parents and their child (see Table 2; Barnett, Niec, & Acevedo-Polakovich, 2014; Eyberg, Nelson, Duke, & Boggs, 2005; Hembree-Kigin & McNeil, 1995). The frequency of positive interactions was scored throughout the 5-min interaction. The parent–child interaction score was calculated as the proportion of positive interactions over all interactions during the play session (Hembree-Kigin & McNeil, 1995).

Knowledge assessment. The knowledge assessment comprised 20 multiple-choice questions drawn from the bank of active parent responding questions asked throughout the training modules.

Parental stress. Parental stress was measured using the Parenting Stress Index—Short

Table 2
Scoring for the Parent Child Interaction Sessions

Type of interaction	Name of interaction	Description of interaction	Example of interaction
Positive	Neutral Talk	Talking about relevant aspects of the interaction	"The guide is making noise"
	Behavior Description	Labeling what the child is doing	"You are putting the ball in the hoop"
	Reflection	Repeating what the child says (echoic) or does (imitation)	Child says "oo-oo"; parent says "oo-oo"
	Labeled Praise	Presenting a positive statement that labels what the child did well	"Great job putting the toys away"
	Unlabeled Praise	Presenting a positive statement without labeling what the child did well	"Good job"
Negative	Questions	Asking a question with an intended response	"Why are you doing that?"
	Negative Talk	Talking down to the child	"Do not do that!"
	Commands	Presenting a demand	"Watch me do it"

Note. These interactions are based on the Parent-Child Interaction Therapy Literature (PCIT). See Eyberg et al. (2005) for more information regarding these categories of interactions.

Form (PSI-SF; Abidin, 1995). Parents completed the 36-item questionnaire on a Likert-type scale, where SA (1) stood for *strongly agree* and SD (5) for *strongly disagree*. A lower PSI-SF score indicated lower levels of parental stress.

Parental competence. Parental competence was measured using the Parenting Sense of Competence Scale (PSOC; Gibaud-Wallston & Wandersmann, 1978; Ohan, Leung, & Johnston, 2000). Parents answered 16 questions/statements on a Likert-type scale, where a rating of (1) represented *strongly disagree* and (6) represented *strongly agree*. Thus, a higher score indicated a higher sense of competence.

Procedure

Pretraining. Each parent–child dyad came to the university-based autism center to complete the pretraining measures. During this session, dyads completed the parent–child interaction session, 20-question knowledge assessment, PSI-SF, and PSOC. Dyads were then matched (described above) to one of the three groups, once the assessments had been completed.

Training.

In vivo parent-training group. The parent–child dyads assigned to the in vivo parent-training group attended weekly training sessions at the university-based autism center in a group format. There was one session per week for a total of six weeks. During each session, parents responded to active parent responding questions by writing down the answer they chose. The correct answer was then discussed as a group. Parents could ask questions throughout the module, however, questions regarding specific child examples were not addressed within session. The sessions ranged in length from 60 to 75 min, depending on the topic, and were led by the first and third authors. One of the six trainings was delivered in a one-on-one format, as parents were unable to attend the group training.

Online parent-training group. The parent–child dyads assigned to the online parent-training group had access to the training modules through a secure login to Canvas, a learning management system. Parents completed the modules at their own pace, which researchers could monitor via a separate login to

Canvas, with a maximum time of six weeks to complete all modules. Parents could begin a module and resume that same module at a later time. However, they could not access later material within the module they were completing or future modules until they completed the current module. Therefore, parents were required to complete modules in the same sequence as those in the in vivo group and respond to active parent responding questions throughout each module. Responses to active parent responding questions were completed via an online quiz. The correct answer to each question was displayed on the screen after the parent responded to the question. The online modules ranged in length from 30 to 40 min, depending on the topic. Completion time for each parent is unknown, because Canvas recorded the duration the course was open on a computer, rather than the duration parents were completing activities within the course.

Control group. The parent–child dyads assigned to the waitlist control group only had access to the information in the welcome package while parents assigned to the other two groups completed the parent-training series. Following the posttraining assessment, parents in the control group were provided access to the online parent-training modules.

Posttraining. After six weeks, each parent–child dyad returned to the university-based autism center to complete posttraining measures (see pretraining above).

Social Validity Questionnaire

At the conclusion of the study, participants in the in vivo and online parent-training groups completed a social validity questionnaire (see Table 3). The questionnaire asked parents to rate the training course using a four-point Likert-type scale, where a rating of (1) indicated *strongly disagree* and (4) indicated *strongly agree*. Mean ratings were calculated for each item by dividing the sum of individual item ratings by the number of participants within that group.

Interobserver Agreement

Two independent observers collected data for the two 5-min parent–child interaction sessions. Data collection occurred remotely via video recordings, following a training session to ensure

Table 3
Social Validity Questionnaire Results

Statement	In-vivo *M*	Online *M*	Overall *M*
The strategies I learned about in this program helped me to interact better with my child.	3.7	3.3	3.5
The content of this program was easy to understand.	3.3	3.3	3.3
Reinforcement of appropriate behavior was easy to use at home with my child.	3.5	3.2	3.4
I feel using reinforcement of appropriate behavior had a positive impact on my child's behavior.	3.7	3.7	3.7
I will continue to use reinforcement of appropriate behavior with my child.	3.7	3.7	3.7
I feel the length of the sessions (about 1 hour) was enough to learn about and practice the strategies.	3.5	3.2	3.4
Six sessions were enough to learn about, practice, and receive feedback on the use of the strategies.	3.0	3.3	3.2
The time commitment of this training was manageable.	3.2	3.5	3.4

Note. Statements were rated on a four-point Likert-type scale, where (1) indicated *strongly disagree* and (4) indicated *strongly agree*.

the observers were reliable. Frequency data were collected for each of the positive and negative interactions within the 5-min interaction session. Interobserver agreement (IOA) was calculated using total count per positive and negative interaction. IOA was collected for 38% of parent–child interaction sessions. Total count per positive and negative interaction IOA averaged 84% (range, 62%–93%).

Results

Figure 1 depicts aggregate percent change from pre- to posttraining scores for each group, across all four dependent variables. For the parent–child interaction measure, depicted in the far left panel, parent–child dyads within the in vivo and online training groups increased their scores, on average, from pre- to posttraining by 17% and 23%, respectively, while parent–child dyads within the waitlist control group decreased their interaction score, on average, by 2%. A repeated-measures analysis of variance (ANOVA) with a Bonferroni multiple comparison test was used to evaluate the differences among the four dependent measures, between pre- and posttraining for each of the three groups (Gravetter & Wallnau, 2013; Rosnow & Rosenthal, 1991). For each dependent variable, group assignment was the between-subjects variable and pre- and posttraining scores was the within-subject variable. Statistical analyses revealed a statistically significant difference between pre- and posttraining, $F(1, 15) = 14.35$, $p = .002$, and an interaction effect, $F(2, 15) = 4.89$, $p = .023$. However, there was no significant effect of the group, $F(2, 15) = .56$, $p = .581$. The Bonferroni posttest revealed a significant difference between pre- and posttraining for the online, $p = .002$, and in vivo, $p = .027$, groups, but not for the waitlist control group, $p > 1.000$ (statistically significant differences depicted with an asterisk).

For the knowledge assessment, depicted in the middle left panel of Figure 1, parent–child dyads within the in vivo, online, and waitlist control training groups increased their scores, on average, from pre- to posttraining by 22%, 15%, and 5%, respectively. Statistical analyses revealed a statistically significant difference between pre- and posttraining, $F(1, 15) = 56.70$, $p < .001$, and an interaction effect, $F(2, 15) = 7.68$, $p = .005$. There was no significant effect of the group, $F(2, 15) = 0.96$, $p = .405$. The Bonferroni posttest revealed a significant difference between pre- and posttraining for the online, $p = .001$, and in vivo, $p < .001$, groups, but not for the control group, $p = .564$.

For parental stress, depicted in the middle right panel of Figure 1, parent–child dyads within the in vivo and online training groups decreased their scores, on average, from pre- to posttraining by 13% and 11%, respectively, while parent–child dyads within the waitlist control group increased their scores, on average, by 6%. Statistical analyses revealed no statistically significant difference between pre- and posttraining for the parental stress measure $F(1, 15) = 4.38$, $p = .054$. However, there was an interaction effect $F(2, 15) = 4.61$, $p = .028$.

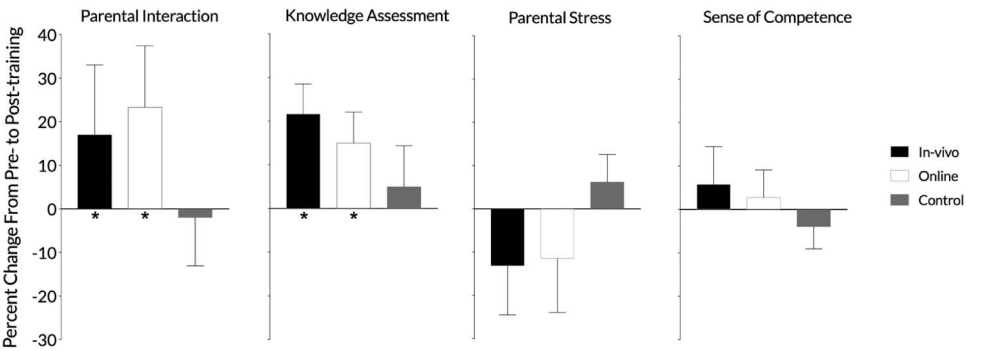

Figure 1. Aggregate percent change from pre- to posttraining scores for each group, across all four dependent variables, is depicted above. The asterisk (*) depicts a statistically significant difference from pre- and posttraining scores for that group ($p < .05$). The error bars depict *SD*.

There was no significant effect of the group $F(2, 15) = 1.20$, $p = .328$.

For the measure of sense of competence, depicted in the far right panel of Figure 1, parent–child dyads within the in vivo and online training groups increased their scores, on average, from pre- to posttraining by 6% and 3%, respectively, while parent–child dyads within the waitlist control group decreased their scores, on average, by 4%. Statistical analyses revealed no statistically significant difference between pre- and posttraining for parental competence, $F(1, 15) = 1.28$, $p = .276$, interaction effect, $F(2, 15) = 3.56$, $p = .054$, or a difference between the groups, $F(2, 15) = 0.91$, $p = .425$.

Figures 2 through 5 depict individual-subject data across all four dependent variables. In all four figures, open data points depict pretraining scores and closed data points depict posttraining scores. Figure 2 depicts percent positive interaction for all three groups. Overall there was an increase from pre- to posttraining scores for parent–child dyads within the online and in vivo groups, while scores for parent–child dyads within the waitlist control group remained the same or decreased. Similarly, there was an increase in percent correct on the knowledge assessment from pre- to posttraining scores for parent–child dyads within the online and in vivo groups, while scores for parent–child dyads within the waitlist control group remained fairly similar (see Figure 3).

Figure 4 depicts percentile stress for each parent–child dyad within all three groups. Overall stress remained the same or decreased from pre- to posttraining scores for parent–child dyads within the online and in vivo groups, while scores for parent–child dyads within the waitlist control group remained the same or increased.

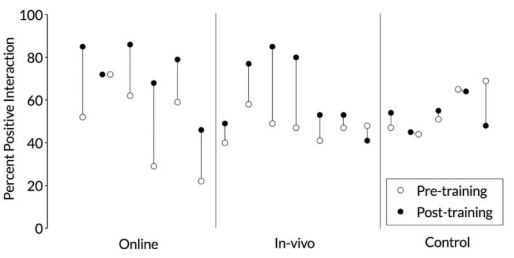

Figure 2. Percent positive interaction for each participant across the three groups is depicted above. Open data points depict pretraining scores and closed data points depict posttraining scores.

Figure 3. Percent correct on the knowledge assessment for each participant across the three groups is depicted above. Open data points depict pretraining scores and closed data points depict posttraining scores.

Figure 5 depicts sense of competence score for each parent–child dyad within all three groups. Overall sense of competence score remained the same or increased from pre- to posttraining scores for parent–child dyads within the online and in vivo groups, while scores for parent–child dyads within the waitlist control group remained the same or decreased.

Table 3 depicts the mean ratings from the social validity questionnaire, separated by group. Parent–child dyads in both the online and in vivo groups agreed with the statements on the questionnaire (e.g., "the strategies I learned about in this program helped me to interact better with my child"). These results suggest the training course provided useful information to the parents.

Discussion

The current study sought to examine whether online, self-paced parent training could be an

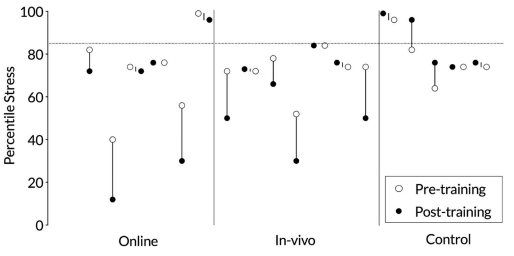

Figure 4. Percentile stress for each participant across the three groups is depicted above. Open data points depict pretraining scores and closed data points depict posttraining scores. The dotted line depicts percentile clinically significant stress.

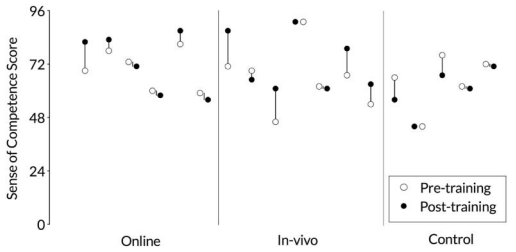

Figure 5. Sense of competence score for each participant across the three groups is depicted above. Open data points depict pretraining scores and closed data points depict posttraining scores.

efficacious alternative to in vivo parent training. Specifically, the aim was to compare the relative efficacy between online and in vivo training by evaluating changes in parent–child interactions, knowledge of ABA material, parental stress, and parental competence measures completed prior to and immediately following the completion of parent-training modules. Parent–child dyads in the online and in vivo groups significantly increased their scores in the parent–child interaction and knowledge assessment. There was no such difference for parent–child dyads in the waitlist control group. This finding suggests online and in vivo delivery methods were equally efficacious in terms of improving parental interactions with their child and increasing parental knowledge of ABA strategies, which could enhance the generalization and maintenance of skills acquired in behavioral therapy.

For the parental stress and parental competence measures, however, there were no significant changes from pre- to posttraining. It was expected that parental stress would decrease, and parental competence would increase, as a result of receiving parent training (Johnston & Mash, 1989; Strauss et al., 2012). It is important to note, however, both of these measures depended on parental self-report, which may be impacted by current environmental conditions unrelated to parenting (Cousino & Hazen, 2013). For instance, the PSI-SF includes statements such as "I do not enjoy things as I used to," and the PSOC includes statements such as "sometimes I feel like I'm not getting anything done." Thus, it is possible other factors within the parents' environment may be impacting their stress and competence levels measured by these assessments.

Research has shown that parental involvement is crucial for generalization and maintenance of skills acquired through behavioral interventions (Fava et al., 2011). Parent training can provide additional support for families receiving behavioral services, as well as encourage and support more effective parent–child interactions, that can have a lasting impact in the home and the school environment (Serketich & Dumas, 1996). Unfortunately, some families do not have access to behavioral treatment, due to dearth of trained professionals in their geographical area or lack of insurance or other funding to cover the costly service, leading to lengthy waitlists (Koerting et al., 2013). Online parent training provides a way to circumvent some of these barriers and provide parents with an efficient and cost-effective way to access empirically validated information to foster learning opportunities for their children in the home environment. Online parent training is not intended to replace EIBI; instead it could serve as an adjunct service to direct behavioral services or an intermediate service for individuals facing barriers preventing them from receiving in vivo services (e.g., on waitlist for EIBI clinic). Importantly, providing the training in the form of online modules is more efficient than synchronous telehealth methods (e.g., video calls), because a trained professional does not need to be present during the time of training, resulting in lower costs (Lindgren et al., 2016).

Other potential barriers to accessing parent training were identified in this study. Due to unforeseen circumstances, two parents within the in vivo group could not attend the scheduled group training on one occasion. Therefore, sessions had to be rescheduled and sometimes sessions did not end up being conducted in a group format. Parents reported time constraints or illness as preventing them from attending the regularly scheduled sessions. In these circumstances, online training provides a method to circumvent unforeseen barriers, as parents within the online group could complete the training on their own time.

There are several limitations and areas for future research. First, although the present study had a relatively small group of parents assigned to each group, significant improvements on two dependent measures were identified. Future research should assess the effects of online parent training with a larger sample size to provide

additional support for the efficacy of online training modules with a more heterogeneous group (e.g., rural vs. urban settings). Second, it is possible that the requirement for parents to attend in vivo sessions for pre- and posttraining may have been an obstacle for some families. Thus, researchers could evaluate the feasibility of conducting the dependent measures remotely, which would allow a broader sample of participants to have access to the online training modules. Third, this study relied on parental self-report for two of the dependent variables. Future research could use direct measurement when assessing parental stress and competence levels. Fourth, the present study did not assess outcome data for the children within each dyad. Child outcome data is an important variable that deserves attention, as the mode of training may impact not only caregiver behavior but also child outcomes. Fifth, there was a 1-year difference in the average age of children within dyads assigned to the in vivo versus online training groups. This age difference could have impacted the dependent variables. Therefore, future research in this area could attempt to control for the age of children across groups, even when outcomes of parents are assessed. Lastly, it would be beneficial for researchers to formally run a cost-benefit analysis and assess generalization of skills acquired through asynchronous training to determine whether this training format is truly less resource intensive. Within this assessment, researchers could determine if there are specific variables that might modulate the effectiveness of self-paced online training.

The present findings support previous research showing parent training containing behavior-analytic material produces significant differences in parental knowledge of material presented (Jang et al., 2012; Pollard et al., 2014; Wainer & Ingersoll, 2013) and enhances parental interactions with their children (Gillett & LeBlanc, 2007; Laski, Charlop, & Schreibman, 1988). Furthermore, the present study contributes to the parent-training literature by being the first to directly compare online and in vivo parent training and, importantly, finding no significant difference in their relative efficacy regarding knowledge and parent–child interaction, the two objective measures assessed in the study. Given the possibility of circumventing barriers, such as cost and accessibility of services, online training may be a more efficacious alternative to providing parent training for families of children with ASD.

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