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An Evaluation of an E-Learning Training Course to Teach Instructors to Implement Discrete Trial Teaching

Joy S. Pollard
Utah State University

AN EVALUATION OF AN E-LEARNING TRAINING COURSE TO TEACH INSTRUCTORS TO IMPLEMENT DISCRETE TRIALS

by

Joy S. Pollard

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Approved:

_____	_____
Thomas S. Higbee Major Professor	Sarah Bloom Committee Member
_____	_____
Timothy Slocum Committee Member	Bob Morgan Committee Member
_____	_____
Andrew Samaha Committee Member	Dr. Mark McLellan Vice President for Research and Dean of the School of Graduate Studies

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Logan, Utah

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ABSTRACT

An Evaluation of an E-learning Training Course to Teach Instructors to Implement Discrete Trial Teaching

by

Joy S. Pollard, Doctor of Philosophy

Utah State University, 2012

Major Professor: Dr. Thomas S. Higbee
Department: Special Education and Rehabilitation

Children diagnosed with autism spectrum disorder often require early intensive behavioral interventions (EIBI) to learn new skills and decrease maladaptive behaviors. Discrete trial instruction (DTI) is a strategy behavior analysts often incorporate in EIBI programs. Researchers have demonstrated that DTI is very effective, but it requires intensive training for teachers to implement the strategy with high fidelity. Therefore, researchers have recently begun to investigate more time-efficient methods to train instructors to implement DTI. One method, e-learning, is a multi-media, computer-based training that typical includes audio narration, videos, and graphics. E-learning is a low-cost, time-efficient alternative to the traditional face-to-face training method. Very little research has been conducted thus far to evaluate the effectiveness of e-learning for teaching behavioral intervention techniques. Therefore, the purpose of this study was to investigate the use of e-learning to teach university students to implement discrete trial instruction with children with autism. Four participants completed the e-learning training

package and we found that all participants' fidelity when implementing DTI increased in role plays with an adult. All participants also were able to accurately implement DTI when teaching a child with autism and we observed generalization to untrained instructional programs. All participants were able to complete the training in an average of 2 hours and the social validity questionnaire indicated that participants felt the training was interesting and useful to help them learn how to implement DTI.

(106 pages)

PUBLIC ABSTRACT

An Evaluation of an Online Training Module to Teach Instructors to Implement Discrete Trial Teaching

by

Joy S. Pollard, Doctor of Philosophy

As the rates of autism are continuing to increase each year, it is imperative that we are able to train teachers to work with these children. Training teachers to use effective teaching strategies can be a time consuming endeavor and is challenging because schools may not have the resources to hire an expert trainer to provide this training. A solution may be to use e-learning. This would allow teachers in rural areas the ability to access the training, while also providing a cost-savings to school districts. The current study evaluated an e-learning training course, which is a multi-media computer-based training, to teach university students to implement an evidence-based teaching strategy called discrete trial instruction. We found that all four participants were able to complete the training in an average of 2 hours. In addition, all participants demonstrated an increase in their knowledge about discrete trial instruction, as demonstrated by increases in test scores. Finally, all participants were able to implement the teaching strategy with adults during role plays and, more importantly, with a child with autism.

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Joy S. Pollard

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INTRODUCTION

Effective Interventions for Children with Autism

Diagnoses of autism spectrum disorders (ASD), a pervasive developmental disorder characterized by deficits in language and social interactions (American Psychiatric Association [APA], 2000), continue to increase each year (Centers for Disease Control (CDC), 2009). The CDC recently reported that prevalence rates have increased and 1 in 88 children are now diagnosed with an autism spectrum disorder (ASD). Given that the rates of autism continue to increase, it becomes imperative that service providers and teachers are trained to provide high-quality services to these children.

To date, interventions based on research from behavior analysis have the strongest empirical support for improving outcomes (i.e., skill acquisition and behavior reduction) for children diagnosed with autism (National Standards Report, 2009). One such treatment, early intensive behavioral interventions (EIBI), begins at an early age (usually around 2-3 years) and is typically taught in a one-on-one teaching ratio. The EIBI approach, based on the UCLA Young Autism Project (Lovaas, 1981), has been widely studied and demonstrated to be an effective treatment for children with ASD (Eldevik et al., 2009; Howlin, Magiati, & Charman, 2009; Thomson, Martin, Arnal, Fazzio, & Yu, 2009). Though there are many variations to EIBI programs, they usually are intensive, meaning that instructors deliver EIBI in a structured setting for 20 – 40 hours per week and treatment may continue for 2 or more years (Eldevik et al., 2009). During this time,

the child may receive multiple treatment sessions per day, five or more days per week, with each session lasting 2-3 hours.

Although, many instructional strategies are used during these sessions, discrete trial instruction (DTI) is one of the primary behavioral teaching methods that make up EIBI programs. DTI is a highly effective teaching strategy for teaching skills in a variety of domains (e.g., pre-academic, academic, self-help, social and play skills) to children with ASD and other developmental disabilities (Smith, 2001). DTI breaks larger skills into smaller teachable components. The basic teaching unit in DTI, the "discrete trial", has four parts: (a) a discriminative stimulus (or instruction) cueing the child to respond; (b) a prompt that is delivered if it is necessary to assist the child to respond correctly; (c) the child response to the teacher's instruction; (d) and the teacher's consequence to the child's response (Smith, 2001).

Teachers usually deliver instruction in one-on-one settings and individualize the curriculum for each child. DTI is a teacher-led intervention in which the teacher presents a high rate of learning trials within a session (up to 12 per minute). Although the structure may vary between programs, children usually spend about 2-5 min in a DTI session and then receive a 1-2 min break before beginning the next DTI session (Smith, 2001). Because of the intensity of these sessions, discrete trial instruction is extremely effective for rapidly building skills in children with ASD (Smith, 2001). Children who receive these intensive services demonstrate increases in IQ as well as adaptive behavior, such as language, play, and social skills. Moreover, children who increase these crucial skill areas often require less restrictive learning environments at school (Dawson et al., 2009; Lovaas, 1987).

In addition to the therapeutic benefits, there are also financial advantages to providing EIBI to children with ASD. Researchers estimate that individuals with ASD require services that cost approximately $3.2 million throughout their lifetime (Ganz, 2007). Jacobson, Mulick, and Green (1998) calculated a cost-benefit estimate for providing early intensive behavioral intervention (EIBI) to children diagnosed with autism. They created a model based on costs for educational and adult developmental disability services in Pennsylvania for individuals aged 3-55 years old. Specifically, the model assumed that children who received EIBI would have varying functioning levels and responsiveness to treatment, with some children who would ultimately participate in general education without supports (normal functioning), some children in special education with minimal supports (partial effects), and some children still requiring intensive special education following EIBI (minimal effects). They calculated these estimates based on an initial $33,000/year investment for 3 years of EIBI (ages 2-5 years old). Overall estimates indicate that these services can lead to a savings of between $656,000 and $1,082,000 over the course of the individual's lifetime (i.e., 3-55 years-old) depending on the treatment effects (i.e., minimal effects to normal functioning in general education classroom) (Jacobson et al., 1998).

In addition to the reported therapeutic and cost-analysis benefits, DTI meets the National Standards Report on Autism Spectrum Disorder's criteria for evidence-based practices (2009). DTI also meets Horner and colleagues' (2005) standards of evidence-based practices when using single subject research designs. They suggested five criteria that a practice/intervention should meet to qualify as evidence-based. Specifically, a practice may qualify as evidence-based when:

1. Researchers operationally define the practice so others can replicate it with high fidelity.
2. Researchers define the context in which to implement the practice including: (a) the specific conditions; (b) qualified individuals to implement the practice; (c) populations of individuals the practice they expect the intervention to be effective with; (d) and the dependent measures they expect to be affected.
3. Researchers document they implemented the practice with fidelity.
4. Researchers document a functional relationship between the practice and the dependent variables.
5. At least three researchers in different sites, replicate the experimental effects across at least of five studies that include a minimum of 20 participants.

In sum, the evidence from the research has provided a strong case for training instructors to implement DTI with students with autism.

Teacher Training

Barriers

Due to the effectiveness of discrete trial instruction (DTI), researchers have investigated methods to train instructors and caregivers to implement this teaching technique. Thomson et al. (2009) reviewed 17 studies in which researchers investigated various methods to train individuals to implement discrete trial instruction. Training packages used in the studies included a combination of methods in which the instructor: (a) reviewed written and vocal information on implementation of discrete trials; (b) modeled correct implementation of DTI; (c) rehearsed correct implementation of DTI; (d)

provided performance feedback through vocal and/or written feedback on the trainee's implementation of DTI. In the majority of the studies described in the review (13 out of 17 studies) the investigators delivered the majority of the training sessions in a face-to-face format using some combination of the training methods described above.

Although researchers have used a variety of teaching methods for training teachers, the most commonly used model is the traditional face-to-face format; however, there are several limitations to this training model. First, researchers have not developed a standardized DTI training, so it is unknown whether all instructors (e.g., teachers, staff) are receiving the same instruction. Second, there is a shortage of qualified individuals who are able to provide training in DTI, so teachers in remote areas may not have access to training. Third, the above teaching strategies can be time intensive, requiring 2.6 to 25 hrs or more of training time (Downs, Downs, & Rau, 2008; Fazzio, Martin, Arnal & Yu, 2009; Koegel, Russo, & Rincover, 1977; LeBlanc, Ricciardi, & Luiselli, 2005; Sarokoff & Sturmey, 2008; Thiessen et al., 2009; Thomson et al., 2009). Finally, the time required for an expert to train teachers to a high level of fidelity can be costly for school districts. These limitations can make it difficult to train teachers to a level of competency (e.g., implementing DTI with 85% fidelity or better), which is essential when teaching students. Researchers have demonstrated that low teaching fidelity of DTI can lead to poor student performance; high teaching fidelity is needed to promote higher percentages of correct responding (Downs et al., 2008). Because teaching fidelity of DTI is directly related to student performance, it is critical that researchers develop a time and cost efficient training method for teachers and caregivers.

Alternative Training Methods

As a result of the challenges with the traditional face-to-face training model, researchers have developed alternative methods to train individuals to implement discrete trial instruction (Arnal et al., 2007; Catania, Almeida, Liu-Constant, & Reed, 2009; Fazzio et al., 2009; Thiessen et al., 2009). Promising methods include: self-instruction manuals, which are self-paced manuals that provide content, examples, and quizzes for trainees to complete; video models, which are videos depicting correct implementation of the teaching skill and may include an audio description of the teaching components; and e-learning courses, which are also self-paced modules presented on a computer that contain vocal and written descriptions of the content, examples, quizzes, as well as video models (Granpeesheh et al., 2010).

One purported advantage of these training methods over others is that they decrease or eliminate the need for an expert to directly train staff - directly addressing the obstacles regarding the time, cost, consistency, and quality of the training materials. Table 1 summarizes the findings for alternative training methods to teach DTI. For example, researchers in four of the six studies reported that participants were able to finish the training content in 5 hours or less, thus significantly decreasing training expenses (Arnal et al., 2007; Catania et al., 2009; Fazzio et al., 2009; Thiessen et al., 2009). Furthermore, because all instructors view the same training materials, these three strategies ensure that all instructors are exposed to the same content. Finally, researchers or trainers can widely distribute these training methods so teachers in rural areas from all over the world can access the training material.

Table 1

Alternative Training Methods Results

Study	Training	Average fidelity of implementation	Average Duration
Arnal et al. (2007)	Self-paced manual	67% (82%)[a]	2 hr 14 min
Catania et al. (2009)	Video Modeling	92%	7 min
Fazzio et al. (2009)	Self-paced manual	66% (92%)[a]	2 hr 36 min
Granpeeshesh et al. (2010)	E-learning	NA	10 hrs
Scherman et al. (2010)	Computer-aided PSI	85%	12 hr 48 min
Thiessen et al. (2009)	Self-paced manual	88%	4 hr 30 min

[a] Percentages represent scores following an additional training component to the intervention listed.

Overall, the studies conducted thus far show promising results. Three of the five studies reported that participants met fidelity of DTI following the training (Catania et al., 2009; Scherman, 2010; Thiessen et al., 2009). Participants in the remaining two studies did eventually meet criterion, but they required additional training before they met criterion (Arnal et al., 2007; Fazzio et al., 2009). In all, these training methods are an attractive alternative and may solve many of the current problems with training teachers.

Self-Instruction Manuals

Though self-instruction manuals have many benefits, few researchers have investigated their effectiveness when training individuals to conduct discrete trials. In one study investigating the effectiveness of a self-instruction manual, investigators provided university students with a 21-page training manual and asked participants to study each

section (Arnal et al., 2007). The manual covered basic principles and procedures of applied behavior analysis and the teaching components of DTI. The researchers used an AB design and asked participants to role play with an adult. They then provided participants with a description of each of the teaching tasks during baseline and gave no further instructions. Next, researchers asked participants to complete the 21-page manual and a mastery test before role playing with the adult again. Participants required an average of 2 hours and 14 minutes to complete the manual. Even though all participants demonstrated an improvement in fidelity of DTI from baseline (range 27% - 52%), their performance following the training manual only increased to a mean of 67% (range 49% - 75%) fidelity. Thus, the self-instruction manual alone was not sufficient to increase teacher accuracy of DTI to acceptable levels.

Therefore, the researchers conducted a second study in which they asked three university students to complete the same self-paced training manual and then score a video of another individual implementing DTI. Researchers then provided feedback on participants' accuracy when scoring the fidelity of DTI implementation by the person on the video. Participants required an average of 3 hours and 44 minutes to complete the manual and video scoring exercise. Following the completion of the intervention, all participants demonstrated an increase in DTI implementation from baseline (range 28%-42%) to treatment (range 72% - 97%); however only one participant reached the 90% criterion.

Although Arnal et al. (2007) observed an increase in fidelity of DTI implementation, only one participant out of seven, reached criterion. Therefore, Fazzio and colleagues (2009) replicated and extended Arnal et al. using the same 21-page

manual. Fazzio and colleagues incorporated a feedback plus demonstration component in their study. During feedback, researchers provided participants with verbal feedback about the components of DTI that they implemented correctly. Participants were then given descriptive feedback about components they implemented incorrectly and the researchers demonstrated correct implementation of those components three times. The researchers reported the average duration to complete the training was 2.6 hours for participants to master the content. Although participants demonstrated an increase in accuracy of implementation, they once again did not meet the 90% criteria and fidelity of implementation, which increased to an average of 66%. Once researchers provided participants with feedback, which included a live teacher model of the skill, participants' fidelity increased to a mean of 92% (range of 87-97%) (Fazzio et al., 2009). Thus, the self-instruction manual alone was not sufficient to increase teacher accuracy of DTI to acceptable levels.

In a subsequent study, Thiessen et al. (2009) expanded the manual used in Fazzio et al. (2009) by incorporating more frequent test questions throughout the training modules as well as incorporating self-practice exercises after each section. During self-practice exercises, researchers asked participants to imagine they were instructing a child with ASD and to role play teaching using discrete trial instruction. Four university students participated and all other procedures were similar to the previous study. The researchers reported that training time increased to an average of 4.5 hours, but the average accuracy of DTI implementation increased to 88% without any additional feedback. Participants' accuracy in implementing discrete trials surpassed the 80% criteria designated by the researchers. However, treatment fidelity during generalization

to the child with ASD fell to an average of 77%, which did not meet criteria. Overall, it appears that a more detailed training with multiple self-practice opportunities and frequent test questions on content may be an important component of a self-paced training manual because participants' fidelity increased to acceptable levels (88%); whereas in the previous study, when researchers used the abbreviated manual, participants did not meet competency (66% fidelity). It also is important to highlight that fidelity decreased when working with a child with autism. Therefore, these self-paced training manuals, which were all based on the same original core manual, may not be sufficient for training participants to actually teach children with autism. Additional research will need to be conducted to draw conclusions about this format of training.

A limitation of the studies discussed above is that fidelity only reached acceptable levels in one of the three studies (Thiessen et al., 2009), and this was only after the investigators implemented additional training beyond the training manual. In addition, when researchers only used the training manual, as in Thiessen et al. (2009), fidelity dropped to 77% when teaching a child with autism. While the manuals alone were not sufficient to increase participants' treatment fidelity to an acceptable level, self-paced instruction manuals may be a complement to the traditional model of training by decreasing the time required for an expert to train new DTI instructors.

Video Modeling

Another evidence-based teaching strategy that may improve the efficiency of training and increase implementation of instructor's teaching skills is video modeling (National Standards Report, 2009). Video modeling is a teaching tool that requires the

viewer to observe a video of another person engaging in a desired behavior (Charlop-Christy, Le, & Freeman, 2000). The researcher then provides the viewer an opportunity to imitate the same behavior either immediately after viewing the video or after a delay. While video modeling has long been shown to be effective for helping individuals with autism and other developmental disabilities develop new skills, investigators have only recently began to investigate the effectiveness of video modeling as a method to train practitioners. Video modeling has been used to train practitioners to correctly implement a variety of skills including the implementation of functional analyses (FA), problem solving skills, behavior interventions, and discrete trials (Catania et al., 2009; Collins, Higbee, & Salzberg, 2009; DiGennaro-Reed, Codding, Catania, & Maguire, 2010; Moore & Fisher, 2007).

In one study, researchers compared the effects of three instructional methods to train staff to implement a functional analysis (Moore & Fisher, 2007). They taught three participants to implement the functional analysis using either a lecture format, partial video modeling, or complete video modeling. During lecture training sessions, a trained instructor presented the material face-to-face. The instructor described procedures for implementing an FA as well as provided examples of data for the different types of outcomes (e.g., attention maintained behavior, escape maintained behavior, etc.). The complete video modeling condition included multiple exemplars of therapist behavior as well as responses to client behavior, while the partial video modeling condition only included approximately 50% of those exemplars. The researchers randomly assigned each teaching format to one of the three conditions typically used to evaluate the function

of problem behavior (i.e., play, demand, escape) and counterbalanced conditions across participants.

The researchers found that complete video modeling was the most effective strategy to teach participants the components of running a functional analysis. Partial video modeling and lecture format improved performance for participants but did not increase fidelity to the 80% criterion. Because participants did not reach the criterion for all the FA conditions (e.g., demand, play) when researchers implemented the lecture or partial video modeling format, the researchers taught those same conditions using the complete video modeling. All participants then reached criterion following complete video modeling for eight of the nine conditions trained (i.e., one of each for all three participants). In addition, participants were able to generalize implementing FA sessions to settings that included a client. Overall, these results suggest that video modeling is an effective strategy to train staff and may be more effective than traditional teaching procedures. It is also important to note, that although video modeling is an effective tool for staff training, there must be sufficient exemplars within the video model.

In another example, Collins and colleagues (2009) trained staff to implement a multi-step problem-solving procedure in a group home. The researchers provided staff members with written procedures for the problem-solving intervention and gave face-to-face training on how to implement the intervention. This initial training session was consistent with the typical training for staff members at the agency; however, the data indicated that none of the participants were able to implement the procedure with high fidelity following this initial training. Next, the researchers asked staff members to view a video demonstrating the correct implementation of the seven problem solving steps. The

researchers reported that, following video modeling, all staff learned to implement the problem-solving procedure with a mean percentage of 91% fidelity. Furthermore, a high level of treatment integrity maintained during a 2-4 week follow-up and generalized to novel problems and to clients in the group home.

Researchers have also used video modeling to increase treatment fidelity of interventions designed to reduce maladaptive behaviors. DiGennaro-Reed and colleagues (2009) taught three teachers to implement a behavior intervention with students in their classroom. During baseline, the researchers provided an hour-long training for the teachers that included vocal and written instructions on how to implement intervention. The investigators asked teachers to complete a five question posttest and provided feedback about errors. During video modeling, participants viewed a video that was approximately 4 - 6 min long and covered topics such as differential reinforcement, functional communication training, least-to-most prompting, and transition warnings. Participants viewed the video prior to each observation period. Following the initial training during baseline, participants' fidelity of implementation averaged 41% (range 23%-67%). Following video modeling, all participants increased treatment fidelity for the behavior intervention to an average of 84%, but performance was variable (range 20%-100%). Therefore, researchers implemented a feedback component, in which the researchers provided the participant feedback prior to watching the next video and observation session. During this phase, fidelity increased to 100% for all three participants and maintained during a 1-week follow-up.

These results suggest, that although video modeling may be an effective method to increase teachers' fidelity when implementing behavior interventions, researchers may

be required to provide additional performance feedback before participants are able to implement interventions with high fidelity. This suggests that if the video modeling is not initially effective at increasing fidelity, merely observing the same video may not be sufficient to increase skills, and additional feedback may be required. Therefore, practitioners may use video modeling as a preliminary strategy to increase participants' skills to a higher level of fidelity before bringing in a professional to provide performance feedback and coaching. This may be a potential solution to address the shortage of expert trainers, as well as the expenses related to training sessions. Researchers need to conduct a cost-benefit analysis to determine if this may be a viable option.

Although many researchers have investigated strategies for training staff to implement discrete trials (Bolton & Mayer, 2008; Catania et al., 2009; Fazzio et al., 2009; Koegel et al., 1977; Sarokoff & Sturmey, 2008; Thiessen et al., 2009), only one study has used video modeling to do so. Catania et al. (2009) trained instructors to conduct discrete trials simply by providing a one-page description of the lesson plan and showing them a 7-min video of how to conduct DTI. After the video, researchers tested participants to assess their accuracy implementing discrete trials with an adult role playing a child with autism. During video modeling, accuracy increased for all participants with an average of 92% fidelity. Furthermore, the skill generalized across tasks and to students (range 80%-100%) and remained high during the one-week follow-up (mean = 99%). While these findings are promising, there are few studies investigating video modeling as a staff training tool. Therefore, researchers need to continue to validate the effectiveness of video modeling for staff training.

Although some researchers have effectively taught instructors to implement discrete trials using self-paced instruction manuals and video modeling, others have had less success with increasing teacher fidelity (Catania et al., 2009; Fazzio et al., 2009; Thiessen et al., 2009). Because these methods have produced variable results, researchers may need to investigate additional teaching tools. One such tool is computerized instruction, which includes computer-aided personalized systems of instruction (CAPSI) and e-learning.

Computerized Training

Given the benefits of self-paced trainings and advances in technology, researchers have explored computerized training as a tool to teach instructors to implement teaching strategies. Research has been conducted in the areas of e-learning and computer-aided personalized systems of instruction (CAPSI).

CAPSI

Pear and Kinsner (1988) developed CAPSI and based this strategy on core components of Keller's personalized system of instruction (PSI). Though there are variations in the application of PSI to courses, these courses usually (a) have clear study objectives, (b) are divided into smaller units, (c) presented in written format, (d) allow students to proceed at their own pace, (e) require students to master the content prior to advancing to the next unit, (f) provide students with immediate feedback on unit tests, (g) have proctors that oversee testing and administration of the course (Crosbie & Kelly, 1993). Investigators have traditionally applied PSI to university courses and researchers have found that students participating in a PSI course have better outcomes and also rate

PSI courses higher than traditional university courses (Kulik, Kulik, & Cohen, 1979). CAPSI is a computerized version of PSI, in which a course administrator presents the content and quizzes via computer.

Although researchers have primarily used PSI and CAPSI to teach university courses, one study used CAPSI to teach instructors to implement DTI. Scherman (2010) created a CAPSI course using the self-paced manual studies in previous research (Arnal et al., 2007; Fazzio et al., 2009; Thiessen et al., 2009). They recruited five university students and asked them to complete the CAPSI training. Participants completed the CAPSI training in an average of 12 hours and 48 minutes. The researchers reported that participants' average fidelity of implementation of DTI while role playing with an adult was 55%, which increased to an average of 85% after completing the computerized training. While findings of this study are promising, the literature on computerized instruction to train DTI is limited. First, Scherman did not assess fidelity of implementation of DTI with a child with autism. Second, Scherman was reported in a master's thesis and has not been published in a peer-reviewed journal. To date, we have found no studies published in peer-reviewed journals that trained teachers using CAPSI and assessed participants' implementation of DTI while role playing with an adult or teaching a child with autism. Therefore, there is a need for additional research on CAPSI to determine if this is an effective tool to train teachers to actually implement these DTI with children with autism.

E-learning. Another computerized instructional method is e-learning, which is "instruction delivered via a computer that is intended to promote learning." E-learning is now widely available via the internet and may include multi-media components, such as

narration, videos and other graphics (Mayer, 2003). Similar to CAPSI, e-learning also includes examples, practice, and feedback components (Clark & Mayer, 2011). Clark and Mayer reviewed research on instructional design and effectiveness of e-learning courses and described seven design principles that should be considered when creating an e-learning course. Because e-learning is an attractive training alternative, it is important that creators consider the research regarding design and development of e-learning courses. Based on the research, Clark and Mayer recommended that e-learning courses implement the following principles:

- Multimedia Principle: Include both text and graphics, rather than words alone
- Contiguity Principle: Coordinate printed words and graphics so they appear near one another in place and time.
- Modality Principle: Use audio narration rather than printed text when graphics are the center of focus.
- Redundancy Principle: Avoid on-screen text when using an audio narration with graphics.
- Coherence Principle: Avoid extraneous graphics, audio, and words.
- Personalization Principle: Use conversational, rather than formal tone of voice when narrating; use on-screen coaches; make the author visible.
- Segmenting and Pre-training Principles: Break a continuous lesson into smaller segments; ensure the learner know the names and characteristics of key concepts.

Overall, the research suggests that following the principles outlined by Clark and Mayer (2011) will promote better learner outcomes when students are acquiring

knowledge and applying that knowledge in the intended situation. E-learning courses that do not apply these principles do not achieve the same results (Mayer, 2003).

Although there is research to support the effectiveness of e-learning, there is little evidence to support the effectiveness of this teaching strategy when teaching instructors to implement interventions with children with autism. Researchers have only conducted two published studies assessing the use of e-learning programs to train teachers to teach children with autism (Granpeesheh et al., 2010; McCulloch & Noonan, in press). McCulloch and Noonan used an online training program from Autism Training Solutions to train three paraprofessionals to implement mand procedures with children diagnosed with autism or developmental delays. The online e-learning course included a pre- and posttest, video models with voice-over, graphics and text. During baseline, participants' scores were variable and either remained low or their implementation was on a significant downward trend. Participants then completed the trainings, which required an average of 5.3 hours to complete (range = 3 - 8 hours).

Following training, participants' accuracy implementing mand training with the child with autism or developmental delays increased, though their accuracy still remained variable. Although one participant reached 100% accuracy, this same participant demonstrated 80% accuracy during the first baseline session. The remaining two participants demonstrated variability in their fidelity of the procedures when working with the children. One participant only averaged 50% accuracy following training, and though the mean was not reported for the other participant, she only had one session reach over 80%. Though participants did demonstrate an increase in performance, additional research is needed because only one participant met acceptable levels of

accuracy of mand training procedures and maintained the teaching skills while working with the children during follow-up.

In another study, Granpeesheh et al. (2010) recruited 97 individuals to complete an e-learning program to learn how to implement discrete trial instruction. They assigned 55 to complete in-person training, and 33 to complete the online training. The e-learning training consisted of modules that covered 17 topics including: introduction to autism, introduction to discrete trial teaching, prompting, discrimination training, and so fourth. The modules included slides with narration, as well as videos demonstrating correct implementation of the procedure. Modules also were self-paced and allowed the participant to advance through slides. Following the online modules, participants attended a 2-hour live discussion with a trainer who provided opportunities to answer questions.

For those participants who participated in the in-person training sessions, all content and videos were identical to those used in the e-learning course. During the lectures, the trainer led a group discussion and role playing to practice procedures discussed during the training. Granpeesheh et al. (2010) reported the total duration of the e-learning course was approximately 10 hours, while duration for live training was approximately 16 hours. Investigators asked participants to complete a pre- and posttest consisting of 32 questions, worth a total of 75 points. Scores on the pretest were low for both groups (approximately 10 points or lower). However, after completing the training sessions, scores increased for both groups and results indicated that these increases were statistically significant for both groups ($p < .01$). In addition, results indicated the live training sessions were more effective than the online modules ($p < .01$). Despite these statistically significant findings, the average percentage of correct questions was 80% or

less. Most importantly, the results only included quiz scores; researchers did not assess participants' implementation of the teaching skills during role plays with adults or while teaching a child with autism. Given that the ultimate goal is for instructors to *implement* these skills with high fidelity, research is significantly lacking on using e-learning courses to train instructors to implement teaching strategies.

Despite the limited empirical evidence supporting its effectiveness, e-learning courses aimed at teaching instructors to implement ABA-based teaching strategies, have recently become more widely available via the Internet because of the many potential advantages. Service providers and schools may choose internet-based trainings to prepare instructors and staff to teach their students because: (a) it ensures there is consistency within the content; (b) it is cost effective; and (c) can easily be disseminated to staff and teachers throughout school districts and companies. For example, Autism Training Solutions (www.autismtrainingsolutions.com) and Card e-learning™ (www.skillselearning.com) are two Internet sites that are available for individuals or groups to purchase access to e-learning modules. Other Internet sites, such as Autism Internet Modules (www.autisminternetmodules.org) and Autism Distance Education Parent Training Modules (http://media.mindinstitute.org/education/ADEPT/Module1Menu.html) are available at no cost.

Given the barriers that impede dissemination of evidence-based teaching strategies, it is not surprising that researchers have investigated several alternative methods for staff training including self-paced instruction manuals, video modeling, and computerized training (i.e., CAPSI and e-learning). These training methods address many of the limitations of the current face-to-face training methods. Investigators found that all

training methods reduced or eliminated the need for an expert trainer. In addition, all training methods also were more time efficient, which directly affects the cost of training staff. Despite these advantages, there are still limitations primarily due to the lack of research. One method, self-paced instruction manuals, has the most research to support its effectiveness (three studies). Although this tool was not initially successful, it has been refined through several iterations and researchers have demonstrated that teachers can improve DTI accuracy using this method alone. Another training method, video modeling also has research to support its effectiveness as a staff training tool, although only one study has been conducted to evaluate its effectiveness on teaching instructors to implement DTI. Finally, computerized training has the least amount of research with only one, *unpublished* study using CAPSI (Scherman, 2010) to investigate staff's implementation of DTI during role plays with an adult. The computerized training tool with the least amount of research, e-learning, may be the most promising because e-learning can incorporate all the best features of the previous two methods (e.g., self-paced instruction with video models incorporated throughout an interactive training). The interactive component within e-learning includes content questions and other exercises that the participant is required to complete throughout the training. Often, participants must respond correctly before advancing through the content, requiring participants to 'master' the training material. This is all monitored by the computer, which eliminates the need for a trainer to be present. Because e-learning incorporates many features of other training methods that have been demonstrated to be effective teacher training tools (e.g., video modeling, self-paced instruction manuals), it seems worthy of additional research.

Thus, the purpose of this study was to extend the existing research literature by investigating the use of an e-learning course to train university students to teach specific skills (e.g., receptive identification of objects) using discrete trial instruction. We assessed the effects of the e-learning course on participants' fidelity of implementation of discrete trial instruction when role playing with an adult as well as when teaching a child with autism. We also assessed participants' generalization of discrete trial implementation when teaching untrained skill sets.

Research Questions

1. How long will participants require to complete the e-learning course?
2. Will the e-learning course increase participants' post-test scores to 80% or better?
3. Given that participants reach the 80% criterion on post-tests, how many attempts will participants require before reaching criterion?
4. To what extent will the e-learning course increase university students' accuracy of implementation of DTI when role playing with an adult?
5. To what extent will the e-learning course increase university students' accuracy of implementing DTI when working with a child with autism?
6. Will participants' implementation of discrete trials generalize to untrained skills sets?
7. To what extent will participants find the e-learning course informative about DTI, as measured by a social validity questionnaire?

METHODS

Participants

We recruited eight undergraduate students who were enrolled at Utah State University to participate; however, only four participants completed the study. Two participants reported they were unable to complete the study because of the time requirement. The time requirement, however, was due to the experimental design and not the time to complete the training. A third participant was dropped because of issues with experimental control. She began to demonstrate the skill during baseline while teaching a child with autism; however, at the time we observed that the child was responding correctly to all instructions, therefore we were unable to score her implementation of error correction procedures.

We recruited participants by speaking to an undergraduate special education class about the research and incentives for participation. We provided participants with compensation in the form of extra credit in their university course as well as a $25 gift card. Faith was a 20 years old, sophomore in college and was majoring in communication disorders. Casey was 23 years old and was in her fifth year in college. Her major was English and history education. Ava was 19 years old, majoring in communication disorders and was a sophomore in college. Finally, Kari was a 21 year old junior, majoring in communication disorders and deaf education. Participants had no prior formal training in discrete trial instruction.

Two children diagnosed with ASD participated in the study during the assessments. Both children were 4 years old and had been receiving services at ASSERT

for approximately 18 months, which consisted of several teaching strategies including DTI. Both children were able to speak in 3-5 word sentences.

Setting and Materials

We conducted training sessions in an office located in the ASSERT preschool classroom containing a table and two chairs in the corner of the office. We also assessed each participant's discrete trial implementation during both role play with an adult and with a child with ASD in the same office. We provided participants with a brief written description of discrete trial instruction (Appendix A), as well as skills to teach (e.g., matching, expressive or receptive object labeling; Appendix B & C). Other materials included: the necessary materials for teaching (e.g., flash cards or three-dimensional objects), small edibles and toys to use as reinforcers, pencils and data sheets. We used a scoring sheet (Appendix D) to assess participants' discrete trial skills listed in Appendix A. We documented all experimental sessions (in which DTI skills were assessed) using a digital video recorder for the purpose of assessing treatment integrity and inter-observer agreement.

We provided a desktop computer for completion of the on-line training modules. We created the modules using Adobe ® Captivate ® 5.5 software. We also used a Flip Video™ digital video camcorder to document the sessions and create training videos for the video-modeling components of the training.

Development of E-Learning Modules

We created the e-learning modules using Adobe ® Captivate ® 5.5 software, which is a software program that incorporates media, audio, quizzes, and other interactive components to create e-learning modules. The modules were converted from the Adobe Captivate® file into a Shock Wave Flash Video (SWF) and uploaded to Instructure Canvas, which is an online course management system. We used a Flip Video digital video camcorder to create training videos for the video-modeling components of the training. The content in the e-learning modules was created using a combination of PowerPoint™ presentations from ASSERT, which were developed over the years by Board Certified Behavior Analysts, and the research literature previously investigating teacher training methods (Arnal et al., 2007; Fazzio et al., 2009).

Specifically, we restructured the organization of the content from the ASSERT training PowerPoints™ to coincide with the assessment tool and description of DTI components that we used in the study (Appendix D). We first created a narrative script covering information from the ASSERT training content and recorded the audio into each of the slides in Adobe Captivate®. Next, we imported graphics, such as clip art, videos, or pictures and timed the presentation of the information with the audio narration. We created two types of video models demonstrating correct and incorrect implementation of skills. In some videos, adults role played teaching a child with autism and in others, the adult was recorded teaching a child with autism. We also included text in the presentation, but it was minimal (2-5 words presented on the screen) and we only used text to clarify a graphic or when we did not have a graphic that would accurately reflect the content. For example, if there were several pictures on the screen, then a one-word

description may have been used to clarify what the picture represented. Finally, the narration was added into the presentation as closed captioning and it was timed so the text appeared when the corresponding audio was playing. Closed-captioning was only displayed on the screen if participated selected to turn it on. When the modules were completed and uploaded to Instructure canvas, we asked a research assistant to complete all four modules to ensure that the flash file was playing smoothly and look for spelling errors or anything else that may not have been working correctly (e.g., a picture appearing at the incorrect time).

We divided the e-learning course into four modules: (a) data collection and program overview; (b) discrete trial instruction (managing antecedents); (c) discrete trial instruction (managing antecedents continued – prompting strategies); and (d) discrete trial instruction (managing consequences). Table 2 describes the components of DTI covered in each module, as well as the overall percentage of items on the evaluation that were presented in each module. We applied the seven principles described by Clark and Mayer (2011) when creating the e-learning course. In an attempt to follow the segmenting principles, we divided the training into four modules to minimize the amount of content in each module. We minimized the amount of text on the screen and incorporated graphical representations (multi-media, redundancy and modality principles). When text was presented on the screen, we presented it simultaneously with narration and/or graphics and in close physical proximity to those graphics (Contiguity principle). In addition, the entire training was narrated in a conversational tone of voice (Personalization principle). Additionally, we included other evidence-based teaching techniques throughout the modules. Each module we created included written

information, audio narration, videos demonstrating proper and improper implementation of skills, self-guided practice opportunities, quiz questions interspersed throughout the modules, and pre- and post-tests (Catania et al., 2009; Crosbie & Kelly, 1993; Fazzio et al., 2009; Moore & Fisher, 2007).

During self-guided practice exercises, we provided participants with materials to use and asked them to practice specific skills during the modules as suggested by previous research conducted by Fazzio et al. (2009), in which participants demonstrated greater increases in their DTI skills when this component was included. For example, we asked participants to practice laying out materials on the table, giving an instruction, removing the materials, and collecting data. We also interspersed open-ended questions throughout the modules to provide frequent opportunities to give immediate feedback to participants. We did not cover any information about the untrained skill sets (i.e., non--verbal imitation with objects, expressive numbers, receptive letters) that were measured in the generalization sessions.

We also instructed participants to complete a pre- and posttest for each module to provide frequent feedback opportunities. These pre- and posttests were incorporated into the e-learning course and each consisted of 10 questions (Appendix E). Tests were administered through Canvas Instructure © and consisted of multiple-choice, fill-in-the-blank, and matching questions about the material covered in the module. We created a pool of 20 questions and programmed the e-learning course to choose 10 questions from the pool each time it generated a pre- or posttest. We separated each set of 20 questions into three or four topic areas and set the parameters so that each quiz generated had the same number of questions about each content area.

Table 2

DTI Components Covered in Each Module

Module	Components	Percentage
Data Collection & Program Overview	• Presentation of correct verbal and nonverbal Sd • Correct data collection procedures	32%
Managing Antecedents	• Environmental arrangement • Procedures to gain child's attention and deliver instructions	27%
Prompting Strategies	• Prompting techniques • Procedures to implement prompts	11%
Managing Consequences	• Session pacing • Providing consequences • Error correction procedures • Specific training on each skill set	30%

We required participants to pass each post-test after completing the module with a score of 80% or better (i.e., 8 out of 10 correct responses) before they could advance to the next module. If participants did not meet the 80% criterion, they were directed to review the quiz and were shown the correct answers. A new posttest was generated and the questions were drawn from the pool of 20. Therefore, there may have been some overlap with questions when posttests were readministered. Participants were to complete the post-tests until the criterion was reached. Although the duration to create the e-learning modules was not specifically recorded, it required approximately 5 weeks and 150 hours. However, much of this time was spent learning how to use the Adobe Captivate software.

Dependent Measures

We assessed *duration of training* by recording the total duration for each participant to complete all four modules by passing all the tests with a score of 80% or better. At the beginning of each module a timer was started and was not stopped until the participant met the 80% criterion on the posttest. The duration for each module was then summed to derive the total duration of training for each participant. We also assessed *module test scores* for each participant. We instructed participants to complete a pre- and post-test for each module and calculated scores by dividing the number of correctly answered questions by the total number of questions and multiplying by 100. We also recorded the *number of attempts* each participant required for each posttest before they reached criterion and were able to advance to the next module.

We also measured participants' *implementation of discrete trial skills* during both role plays with the adult (trained and untrained programs) and with a child with ASD using the tool in Appendix D (Jeanson et al., 2010; Thiessen et al., 2009). We included 15 of the 21items listed on the discrete-trial teaching evaluation form tested by Jeanson and colleagues (2010), which had a high interobserver reliability and social validity. We chose to measure 15 of the 21 components, because we could measure each of those components for all 20 discrete trials; whereas the other six components could only be measured once at the beginning or end of the session. We recruited the help of two board certified behavior analysts (BCBAs) and obtained verbal agreement that the components listed on the assessment tool were necessary components of a discrete trial and that no critical components were missing. In addition, Thomson et al. (2009) also described the DTI components in a review of studies measuring treatment fidelity of DTI, which

provided additional evidence of the content validity of the components we used. Finally, the tool was modified several times until the two BCBAs agreed that the calculated score appeared to accurately reflect the pilot participant's accuracy of DTI implementation.

During the first set of modifications, two researchers scored a video of a pilot participant implementing DTI. Initially, the assessment tool included the consequences for both correct and incorrect responses for each trial, so that each component was scored for every trial. There were 15 individual components of DTI that were scored for each individual trial (i.e., 300 components required scoring as correct, incorrect, or not applicable). After scoring a pilot participant's video, the researchers found that five of the components were consistently getting scored as "not applicable" for more than 80% of the trials. Therefore, we decided to modify the assessment tool and merge five of the components so that only 10 components were scored for the 20 trials (i.e., 200 components scored).

Next, we scored another pilot participant's video and found that there continued to be several components scored as "not applicable" (NA). For example, if the child gave a correct response, then the researchers scored all the components for providing consequences for an incorrect response as "NA." Therefore, scoring participants' accuracy was very tedious and time consuming. We decided to separate the components and created a tree diagram so that once the participant responded, the researcher was guided to the appropriate list of behaviors for consequences for either a correct response or an incorrect response.

At this point, another video was scored and we noticed that there were several components of the assessment that were scored as correct but it did not accurately reflect

correct teaching. Therefore, we modified the assessment tool one last time. For example, participants were getting a correct score on pacing, which was defined as an inter-trial interval of 5 s or less. However, they were not removing materials or collecting data. We added the behaviors of removing materials and collecting data to the criteria for pacing. This change brought obtained scores into better alignment with best practices of teaching. We continued to score videos until we met criteria for reliability, which was three assessments at 90% or better. A complete description of the requirements needed for participants to get a correct score on the DTI components is provided in Appendix D.

We assessed participants' performance when implementing 20 discrete trials by marking whether each component was correctly implemented for each trial (Appendix D). We chose to measure implementation of 20 trials for three different programs (e.g., non-verbal imitation, expressive shapes - Appendix B and C) so we could gain more accurate information on participants' implementation of discrete trial teaching across a variety of teaching programs and because we were concerned that an instructor may demonstrate artificially high fidelity if only expected to teach a small number of trials.

We scored each component as correct (+), incorrect (-) or not applicable (/) and converted the frequency count to a percentage by dividing the number of correctly completed components by the total number of components (subtracting the components that were not applicable for a given trial) and multiplying by 100. Finally, as a measure of *social validity*, we asked participants to complete a survey about their experience with the e-learning course (Appendix F).

Experimental Procedures

We used a multiple baseline across participants' experimental design to evaluate the effects of e-learning training modules on participants' implementation of discrete trial skills during role plays with adults and teaching sessions with children with autism.

Teaching Sessions

We provided participants with a written description of the discrete trial teaching components (Appendix A) and a description of the three skills to be taught during role plays/teaching sessions (Appendix B or C) prior to each session. We also provided participants with the materials needed to teach the skills during the session (e.g., flash cards, reinforcers) and gave participants a time limit of 15 min to study the provided materials prior to the first session and 5 min to study before each session thereafter.

We taught participants to implement three skills (i.e., non-verbal imitation, expressive shapes, and receptive colors – Appendix B) and we broke each skill down into smaller discrete skills, referred to as "targets." For example, within the overall skill of imitation, the child may have two "targets" that includes clapping and waving. We provided participants with two specific targets to teach from each of the three skill areas and these targets remained consistent across all sessions when role playing with an adult. During teaching sessions with a child with autism, we provided participants with materials to teach the same skills but varied the targets to include nonsense shapes and unknown colors. We provided the participant with materials for two nonsense shapes and one unknown color, so three of the six targets were unknown to the child. We did this in an effort to provide opportunities for error correction procedures to be used during

sessions; however, one child quickly learned the unknown targets, so we created six nonsense shapes and three unknown colors (i.e., lavender, teal, and fuchsia) and randomly selected two unknown shapes and one unknown color during those teaching sessions. During generalization to untrained programs, we provided participants with different skills (i.e., nonverbal imitation with objects, receptive letters, and expressive numbers) and targets to teach (Appendix C).

Prior to each session, we instructed participants to "Teach these skills using discrete trial teaching to the best of your ability. Try to teach all the targets in each program an equal number of times." If participants asked a question, we responded by saying "I am sorry, but I cannot answer any of your questions at this time." We developed five different response sequences (Appendix G) that the adult followed during role plays that indicated when the researcher should attend to the participant prior to an instruction, as well as how to respond to the instruction provided (e.g., correctly, incorrectly, or not at all). In an effort to maintain the same level of difficulty across sessions, we created all response sequences so each had the same number of correct and incorrect responses (13 correct, five incorrect, and two nonresponses); the only difference was the sequence in which the researcher emitted those correct and incorrect responses. We randomly assigned response sequences prior to each assessment and used a random number generator without replacement to ensure that participants were not assigned the same sequence multiple times in a row.

Baseline

We did not provide participants with any training during baseline except exposure to the description of the skills and DTI components (Appendix A and B). We

wanted assess performance level when given a description of DTI and the skills to be taught during role plays/teaching sessions. We instructed participants to role play with the researcher (acting as a student with autism) until they completed 20 trials (one session). In addition, we conducted one probe while teaching a child with ASD.

Training

Following baseline, participants began the e-learning modules. Participants completed each module in an office at the ASSERT preschool with a researcher present. Participants were required to complete a pre-test prior to each module and a post-test following the completion of each module. When participants reached criterion for each module post-test (80%), we assessed their DTI skills during role plays with an adult. We conducted the first role play session in the training phase immediately following the completion of the module, and the second role play occurred prior to beginning the next module. When participants completed the final module, we continued role plays with an adult until their fidelity of implementation reached criterion and stabilized. We used identical procedures during role plays in the training phase as were used during baseline. Participants completed all four modules within 2 weeks.

Teaching a Child with Autism

Given that the goal of the training was for instructors to implement DTI with students in their classrooms, we assessed participants' implementation of DTI skills when working with a child with autism. We conducted teaching sessions with a child with ASD when the participant completed all four e-learning modules and met the 85% teaching fidelity criterion in role-play assessments. We used procedures identical to those used in

the previous phase, except we asked participants to implement discrete trials with a child with ASD who was not following a script. We recruited two children to participate in the study during teaching sessions with a child with ASD. In addition, participants taught the same child during all phases of the study.

Performance Feedback and Coaching

We provided performance feedback and coaching for one participant (Ava). Ava was not maintaining her accuracy of implementation during teaching sessions with the child with autism; therefore, we conducted one 10 minutes feedback session after the fourth session during the teaching-a-child-with-autism phase. During the feedback session, the researcher used the scoring sheet (Appendix D), as a guide to provide her with feedback on the components of DTI that she was not implementing correctly. We asked Ava to role play with the adult and provided her feedback on those components that she was not demonstrating correctly before asking her to work with the child again.

Generalization

We assessed generalization of discrete trial implementation to three untrained programs (i.e., non-verbal imitation with objects, expressive numbers, and receptive letters; Appendix C). The general format of the untrained programs was similar to the trained programs, except different skills were being taught. Both trained and untrained programs included programs to teach expressive language, receptive language (ability to follow directions), and imitation skills (Appendix C and D). We used the same procedures as those in the previous conditions, except we gave participants a one-page

description of the three new skills (Appendix D) they were not specifically trained to teach.

Fidelity of Measurement Procedures and Inter-Observer Agreement

We assessed inter-observer agreement (IOA) for all components of DTI during role play/teaching sessions and evenly distributed IOA across all phases of the study and all participants. We scored an agreement when both observers recorded that the participant either completed the component correctly, incorrectly or that the component was not applicable for the same trial (Appendix D). We calculated IOA by dividing the number of agreements by the total number of agreements plus disagreements and converting the ratio to a percentage. We assessed IOA via videotape for 31%, 30%, 30%, and 30% of sessions for Faith, Casey, Ava, and Kari, respectively. IOA was 95% (range = 88%-100%) for Faith; 97% (range = 90%-100%) for Casey; 91% (range = 69% - 98%) for Ava; and 95% (range = 90%-99%) for Kari.

We also assessed fidelity of measurement procedures evenly throughout all phases for 41%, 42%, 39% and 43% of sessions for Faith, Casey, Ava, and Kari, respectively. We assessed fidelity of measurement procedures to determine if the researcher (a) gave the correct written instructions, (b) provided no other feedback or instructions to the participant, (c) followed the correct response sequence during the role plays for 90% of the trials (e.g., correct, incorrect responses), and (d) provided the correct training materials. Treatment fidelity during role plays averaged 98% (range = 86% - 100%) for Faith; 98% (range = 86% - 100%) for Casey; 99% (range = 86% -99%) for Ava; and 99% (range = 86% - 100%) for Kari.

RESULTS

Duration and Test Scores

E-learning Modules

Table 3 displays the amount of time required for each participant to complete the four modules, including the pre- and posttests. Overall, participants were able to complete all four modules in an average of 115 minutes (range = 109-122 min). Participants were able to complete modules one through four in an average of 31 minutes (range = 25–39 min), 23 minutes (range = 22-25 min), 20 minutes (range = 17-25 min), and 41 minutes (range = 40-44 min), respectively.

Table 4 displays the data for participants' scores on the pre- and posttests for each module (max. score = 10). All participants' test scores increased following the training module. Faith's pre-test scores averaged 5.5 and increased to an average of 9 following the modules.

Table 3

Duration (min.) for Participants to Complete Modules

	Module 1	Module 2	Module 3	Module 4	Total
Faith	39	25	17	40	121
Casey	25	23	21	40	109
Ava	30	22	18	40	110
Kari	30	23	25	44	122
Average	31	23	20	41	116

Casey's scores average 6.75 prior to the modules and increased to an average of 8.75 after completing the modules. Ava's pretest scores averaged 6 and increased to 9.5 following the modules. Finally, Kari averaged 4.75 prior to the training and posttest scores increased to an average of 9. All except one participant completed the posttests on their first attempt; Faith required two opportunities to pass the posttest for modules one and four.

Discrete Trial Instruction Accuracy

Figure 1 depicts the results for Faith, Casey, Ava, and Figure 2 depicts Kari's performance during role plays with adults and teaching sessions with children with autism. All participants demonstrated low percentages of correct implementation of DTI during baseline. During baseline, Faith's correct implementation of DTI averaged 10% (range 7% - 13%). When we assessed generalization to untrained programs and while teaching a child with autism, her DTI accuracy remained low. Following each module, we observed an increase in her implementation of DTI until she completed all four modules. At that point, her implementation for the last five sessions averaged 96% (range 94% - 98%). We also observed an increase when she taught untrained programs (93%) during role plays with and adult. Her performance when teaching a child with autism also maintained at high rates, with her correctly implementing DTI an average of 93% (range 90%-95%).

During baseline, Casey also demonstrated low accuracy when implementing DTI, averaging 24% (range 18-29%). When we assessed her ability to implement DTI with other skills (i.e., untrained programs), she demonstrated 30% accuracy, and her

Table 4

Participants' Scores on Pre- and Posttests for Each Module

	Module 1		Module 2		Module 3		Module 4	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Faith	5	9[a]	7	10	3	8	7	9[a]
Casey	6	8	6	9	7	9	8	9
Ava	2	8	9	10	7	10	6	10
Kari	2	10	8	9	2	8	7	9
Averag	3.75	8.75	7.5	9.5	4.75	8.75	7	9.25

[a] Data presented represent participant's second attempt on posttest

accuracy when teaching a child with autism also remained low (24%). Once Casey began the training, we observed an initial jump to 49% accuracy. Following the completion of each module, her accuracy continued to increase. Once she completed module four, we observed her DTI accuracy increase to an average of 92% during the final five sessions. Her implementation of DTI to untrained programs also increased to an average of 92% fidelity. Casey's implementation of DTI maintained during teaching a child with autism, averaging 96% (range 88% - 100%).

During baseline, Ava also demonstrated low accuracy when implementing DTI. Initially, we observed an increasing trend, but her performance began to decline, bringing her average baseline accuracy to 27% (range 13% - 38%). She only implemented DTI with untrained programs with 30% accuracy and remained low (33%) while teaching a child with autism. When Ava began the modules, we did not observe an immediate

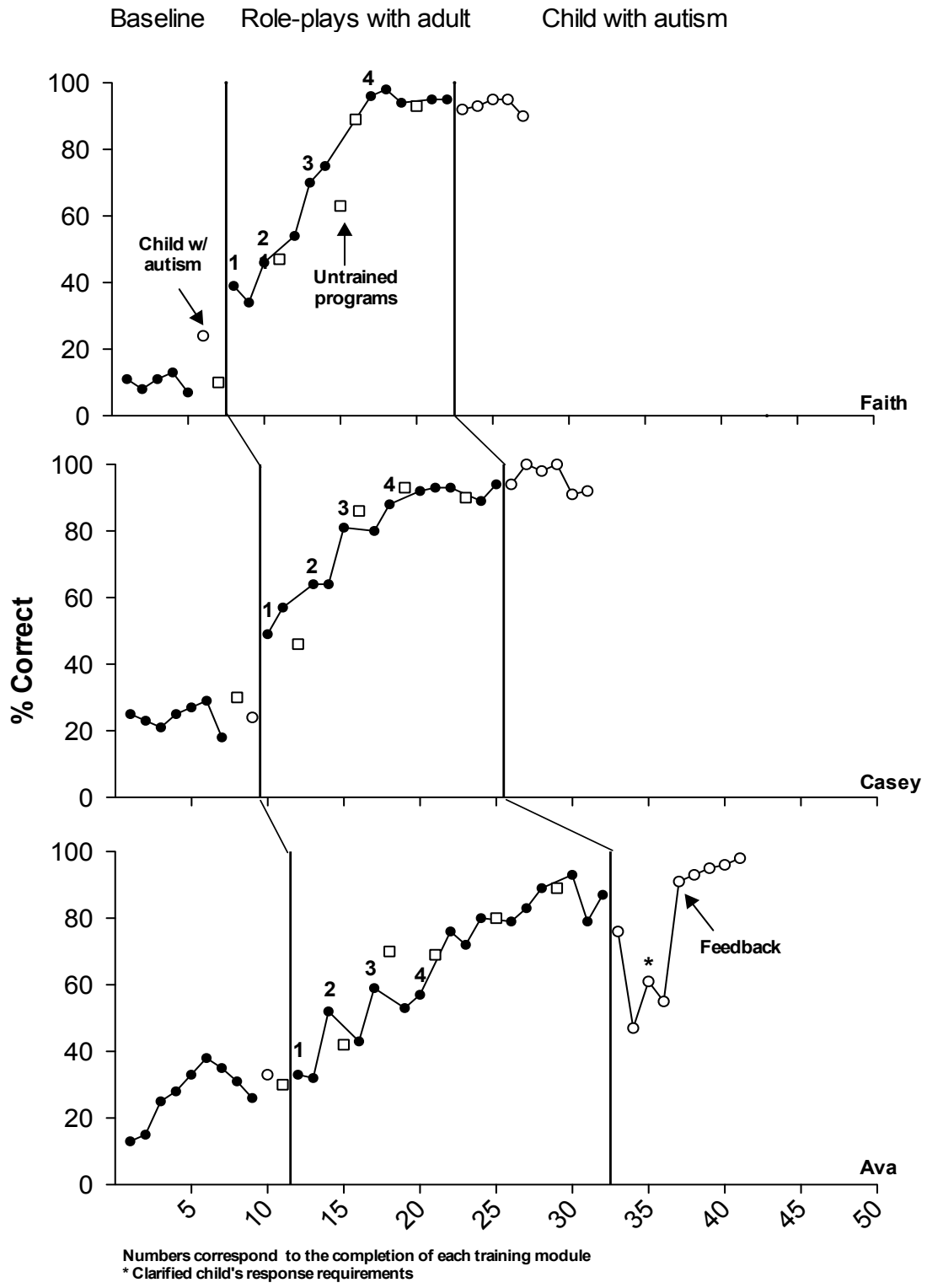

Figure 1. Percentage correctly implemented DTI components for Faith, Casey, and Ava.

increase in accuracy as we did with the previous participants. However, as she completed more training modules, her performance continued to increase, with her averaging 86% accuracy during her final five sessions. Her performance during the generalization to untrained programs also increased to 89% during the last assessment.

Finally, when we assessed her performance with a child with autism, we observed a decrease in her performance. We observed that she was scoring some of the child's responses correct, that we were scoring as incorrect; therefore, we clarified the child's response requirements during session three in the child assessment condition. Specifically, during the receptive programs, she would provide the instruction "Give me ___" and was scoring a correct response if the child touched the correct card. We only scored a correct response if the child pushed the card toward the instructor or picked it up and handed it to the teacher. This clarification, however, did not improve her accuracy; therefore, we were required to provide her with performance feedback (see methods for description of performance feedback). Ava only required one 10 min feedback session with the investigator (the child was not present), and we observed an increase in her performance, with the average accuracy of 95% (range = 91% - 98%).

Our last participant, Kari is shown in Figure 2. Kari, whose baseline is the same length as Faith's, also demonstrated low DTI accuracy during her baseline role play sessions (average 14%; range 12%-17%). Her performance teaching a child with autism and on the generalization probe (i.e., untrained skills) also remained low, with a score of 20% and 21% respectively. After completing module one, her score initially jumped to an average of 26%. Her accuracy continued to increase after each successive module until she completed the final module, with an average score of 89% for the final five role play

sessions. We also observed an increase in her DTI accuracy when teaching untrained skills sets; her accuracy increased from 21% during baseline to 89% following the completion of the training modules. Finally, when we tested her skills with a child with autism, we observed a slight decrease in her performance. The child she was working with was not articulating her responses of the unknown colors with complete clarity (e.g., lavender sound like "Lavder" or "Laveder") and she also was pushing the correct cards to the participants instead of handing them to her. The participant was scoring these responses as incorrect, but the researchers would have scored the response as correct. Therefore, after session five, we clarified what could be scored as a correct response. Subsequently, we observed an increase in her DTI implementation scores.

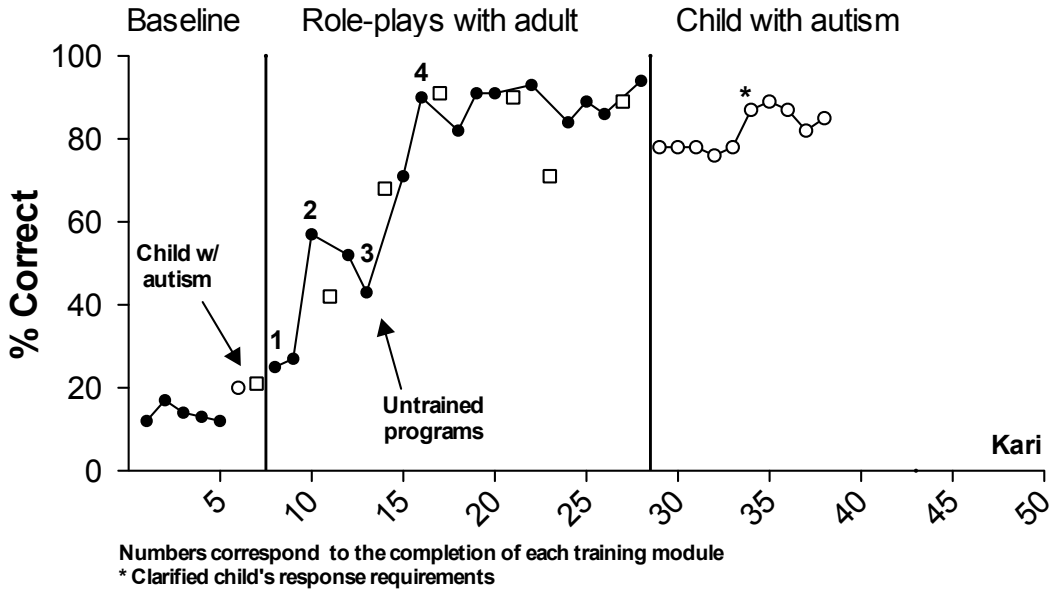

Figure 2. Percentage correctly implemented DTI components for Kari.

Social Validity

Following the completion of the training modules, we asked participants to complete a social validity questionnaire (Appendix F). The questionnaire consisted of eight questions. Seven questions asked participants to rate whether they "strongly agreed", "agreed", "disagreed", "strongly disagreed", or were "neutral" about the statement. Overall, participants reported they 'agreed' or 'strongly' agreed with the statements on the social validity questionnaire. The results of the questionnaire are presented in Table 5. Participants reported that "the modules were great" and one participant reported "I learned so much and I feel confident enough that I could work with children with autism." The only negative report was that the videos did not always work. We suspect it may have been due to the internet connection, because one participant reported that only one video would not play, while another participant had problems with three video clips during one module.

Table 5

Social Validity Questionnaire Results

Question	Response	# Participants
The modules kept my interest during the training.	Strongly Agree Agree	*N*= 1 *N*= 3
I found the modules informative about how to run discrete trial teaching	Strongly Agree	*N*= 4
The modules described the content clearly	Strongly Agree Agree	*N*= 2 *N*= 2
There were plenty of video examples that clearly demonstrated the different components of discrete trial teaching	Strongly Agree Agree	*N*= 3 *N*= 1
I feel like there was enough information in the modules to learn how to teach using DTI	Strongly Agree Agree	*N*= 1 *N*= 3
All the content and videos appeared to run correctly	Disagree Neutral	*N*= 3 *N*= 1
I would recommend the modules to another person interested in learning about DTI	Strongly Agree Agree	*N*= 3 *N*= 1

DISCUSSION

Although previous research has been conducted evaluating the effectiveness of an e-learning course to teach DTI skills to instructors, this is the first study conducted in which participants' implementation of DTI with a child with autism has been assessed. The single published study only assessed participants' pre- and post-test scores on content quizzes (Granpeesheh et al., 2010), while another, unpublished study, reported variable results (Scherman, 2010). Although a demonstration that e-learning can increase test scores is important, the real value in teacher training is the ability to demonstrate that participants can actually implement the skills learned with the target population. The current study is the first to provide direct evidence that e-learning can increase participants' implementation of discrete trials with children with ASD.

Not only was the e-learning course effective in increasing participants' implementation of DTI with adults during role plays, participants were able to use DTI while working with a child with autism. Only one participant required a feedback session and all participants' accuracy increased from a baseline average of 25% to an average of 93%. We also observed an increase from participants' pretest scores to their posttest scores on content quizzes, supporting the results reported by Granpeesheh et al., (2010) and demonstrating that e-learning is effective at increasing participants' knowledge of discrete trial instruction. Furthermore, our results from the social validity questionnaire were favorable, with participants reporting that they "agreed" or "strongly agreed" with the statements about the e-learning modules (Table 6). In addition, we found that the e-learning training package was very time efficient for training participants, requiring approximately 2 hours for participants to complete all four modules. Although it was very

time efficient for participants to complete the modules, it likely will not be feasible for organizations to create their own learning modules. The time spent creating the modules was not included in the analysis, as we anticipate most agencies will utilize already existing modules.

Not surprisingly, we observed some variability between participants' performance of DTI following the completion of the modules. Three of the four participants met criterion during adult role plays immediately following the completion of module 4, whereas one participant's accuracy slowly increased across assessment sessions, suggesting another variable may also have been controlling responding. Ava's performance increased from an average of 27% during baseline to 86%; however this increase was not immediately observed. In addition, there were substantial drops in her accuracy of DTI implementation after the completion of modules two and three. Her DTI accuracy only increased to 67% immediately after the completion of all four modules and did not meet criterion until the seventh assessment session. In addition, her performance initially did not maintain when working with a child with autism. She required one session of performance feedback before an increase in her accuracy was observed.

Despite one participant (Ava) requiring the additional feedback session, these results were rather impressive. We did not anticipate that the e-learning modules alone would increase performance to criterion and anticipated that most, if not all, participants would require some form of feedback to meet criterion. We recruited university students who had no prior teaching experience to participate in the study. We were able to demonstrate that the modules were effective in teaching a population with no prior teaching experience or professional training. However, this may limit the generality of

the findings. For those populations (e.g., teachers) that would continue to implement DTI with students, it is highly likely that the children may shape their behavior. For example, the teachers may accept lower quality responses because a child may have some escape maintained problem behaviors. Therefore, the next step in this line of research would be to assess the effectiveness of e-learning to train individuals with a history of teaching students with autism (e.g., teachers and paraprofessionals) to implement DTI with students in their classroom. Researchers also need to investigate whether teaching skills would maintain while teachers are continuing to implement DTI with their students. The results would have more social significance and generalize to the population of interest.

One benefit of the e-learning modules is that participants were able to complete most modules in approximately 30 min; therefore, one potential training model would be for school districts to build e-learning training into the teachers' school day. For example, a teacher may be required to complete one module per day during their 'curriculum development' or 'classroom prep' time. This potentially would help alleviate some of the cost associated with teacher training. Future researchers should continue to investigate the effectiveness of e-learning with teachers in their school setting.

Given that only one 10-min feedback session was required to increase the participant who did not meet criteria to an average of 95% fidelity, these e-learning modules accomplished the goals we set forth. Using the modules, we were able to efficiently train our participants to teach specific skills to children with autism using discrete trial instruction. For organizations to take advantage of the time and cost efficiency when using e-learning modules, they should consider using modules that have

already been developed. Agencies may lose the time and financial benefits if they choose to create the e-learning modules within their own organization.

Limitations and Future Research

Although we found favorable results, there were some limitations to the current study that deserve mention. When we were assessing participants' implementation of DTI skills with a child with ASD, we observed that the children were often responding correctly, even though we included unknown targets into the assessments. Therefore, some of the teaching sessions with a child with autism may have been artificially inflated during the baseline conditions because we did not have many opportunities to observe and score participants' error correction procedures. Because we were concerned about the validity of our assessment of participants' DTI skills, we subsequently added in additional unknown targets. We then randomly selected those targets for sessions that were conducted following the completion of the training to address this issue. Therefore, those sessions conducted during the latter part of the study were actually more difficult for participants because the children made more errors during these sessions. As such, we feel confident that the percentages depicted are an accurate representation of participants' accuracy when implementing DTI.

Another limitation to the current study is that we needed to clarify the criteria for a correct response for the children participating in teaching sessions. Two participants, Ava and Kari, were scoring lower on the assessments with the child because there was disagreement on whether the child responded correctly or incorrectly. If the participants scored a response as correct, and we scored the child's response as incorrect, this

significantly lowered the participant's score because it affected the scoring of several of the DTI components. For example, Ava was scoring some responses as correct, when we considered the response to be incorrect. When this occurred, she got all eight components on the error correction procedures incorrect, because she did not conduct error correction procedures. Likewise, Kari was scoring responses incorrect, that we were scoring as correct. This decreased her score because she did not provide the appropriate consequence for correct responses. This, however, only affected three components on the DTI scoring sheet (providing the consequence immediately, pairing the praise with an edible or physical contact, and correct interspersal), therefore, her scores did not decrease as much as Ava's.

These false positives and false negatives were partly due to the content covered in the e-learning modules. We did discuss that a child may respond correctly, incorrectly, or not at all, but the specific definition of correct and incorrect responses were not covered in the training modules. This is partly because this will differ based on the child, making it difficult to have a representative example in the module. For example, some children would be required to correctly articulate a word if the teacher knows that child can do it or if that is one of the child's goals, whereas another child may not be required to do so. When we expand the e-learning modules, we will need to include this additional information so participants are able to make those finer discriminations between responses. In addition, because this is a decision that would need to be made for each individual child, future researchers may want to include child specific information in addition to the e-learning modules defining what will constitute a correct response during teaching sessions.

Another limitation is that there may have been an interaction between the modules and the role-plays because we repeatedly measured participant performance to demonstrate the increase in accuracy of DTI implementation across modules as they learned additional content. Although an increase in accuracy of DTI would likely not have occurred from role-play alone, there is a possibility that the combination of role-plays and modules may have had an effect on participants DTI accuracy. For example, Ava's score may have increased because of the repeated practice and not just because of the content that she learned during the modules. This was unavoidable because of the experimental design chosen and it is not possible to separate the effects; however, it should be noted that this is a possibility and future researchers may want to investigate this potential interaction.

Another potential limitation of the current study is that we chose not to measure maintenance of participants' DTI implementation because the participants were not actively working with children in the university-based preschool. Because our participants would not have the opportunity to use their DTI skills with children, we felt these results would not accurately capture maintenance of the skill and consequently have low social validity. In other words, we would have simply been measuring whether participants remembered what they were taught to do, without them having any opportunities to use the skills between the training and follow-up. Although we did not measure maintenance in the current study, it will be critically important that future researchers assess maintenance of skills taught using e-learning with populations that will continue to use the skills with children with autism.

Another potential limitation in this study is that the assessment sessions were only 2-3 minutes long. Although we increased the number of trials that participants' implemented to 20, from the previous researchers who have assessed 12 trials, this increase may not have been necessary. Previous researchers have assessed whether teachers are able to implement discrete trials, and the number of trials is usually low. Although, it may be necessary to assess a small number of trials due to time constraints, researchers should investigate whether this is a true reflection of their teaching ability in a classroom. Because a teaching session is going to last longer than 2-3 minutes, investigators may want to assess a teacher's accuracy at different points in time throughout a session. For example, a sample of 10 trials could be collected in the first, second, and third portion of a 2-hour session. The researchers could then compare whether accuracy maintains during the entire session and use this information when assessing teaching skills in future studies.

Furthermore, the components assessed were only a small subset of very basic components of how to teach using DTI. There are more components that need to be assessed when trying to train a teacher to teach an entire 2-hour DTI session. These components, such as preparing the session with enough skills and materials to last the entire duration, providing reinforcement breaks at different intervals throughout the session, and assessing preference of reinforcers are all important components of a teaching session that were not trained or assessed in this study. This was a preliminary study to evaluate the effects of e-learning when teaching basic DTI skills and will be expanded for future studies to study more complex components of DTI. Future

researchers may wish to create additional e-learning modules and investigate whether participants can acquire the skills to teach an entire teaching session with a child.

Another concern is the validity of the assessment tool and the time required to score participants' accuracy of DTI. Although we selected the components of DTI from previous studies that have researched the components, the validity of the assessment tool is still a concern. To address the issue in the current study, we obtained verbal agreement from two BCBAs about the evaluation tool and modified the assessment tool until they agreed that it had high face validity. However, researchers need to conduct additional research on DTI evaluation tools. In addition, we need to investigate a more time efficient method of assessing participants' DTI skills. Because we scored each individual component for every trial, the scoring of participants' implementation of DTI was time consuming, requiring 20-40 minutes per teaching session. Also, scoring each individual component of DTI for every trial made live scoring very difficult, so all coding was completed from the videotapes collected. Future researchers should continue to develop the assessment tool and conduct research on the validity and reliability of DTI measurement tools. Future researchers also need to identify an assessment tool that can accurately assess DTI skills while coding live. We used the instrument described by Jeanson et al. (2010) as a guide for our assessment tool. They reported they used the tool during live observations; however we were unable to do so. Perhaps, a more intensive training would be needed for assessors to quickly and accurately assess DTI implementation.

One last limitation of the current study is that we did not measure participants' teaching effects on the children diagnosed with autism. That is, we demonstrated that

participants were able to implement the teaching procedure with high fidelity, but we did not demonstrate whether the children with autism acquired skills during the teaching sessions. Given that the purpose of training teachers to a high level of fidelity is to improve student outcomes, investigators need to conduct additional research that demonstrates children's performance also increases as a result of improvements in teacher skills.

Implications and Conclusions

In the current study, we taught four university students to implement discrete trial instruction with a child with autism using e-learning. Three of the four participants acquired the skills to implement DTI using only the e-learning modules, and one participant only required one 10 minutes feedback session to reach criterion. In addition, the e-learning modules were completed in a timely manner (average 2 hours) and received high scores on the social validity questionnaire. These results are promising, suggesting that e-learning may be a viable teaching tool for training individuals to teach using DTI. This study is the first step toward training teachers to implement a teaching session that is composed of discrete trials; but we should continue to develop these trainings. We need to conduct more research to observe whether other teaching strategies, based on the principles of ABA, can be taught using this training method. There are many teaching strategies that comprise an early intensive behavioral intervention program (e.g., PRT, mand training, etc.), and investigators need to assess those teaching strategies as well.

Considering this training was effective in training university students to implement DTI, we should continue to research whether this would be an effective method to teach teachers and paraprofessionals to use evidence-based teaching strategies. Additionally, this research may provide some support to the many e-learning training courses that are currently available to train teachers. However, these results should be interpreted with caution. As discussed above, there are many factors to consider when developing an e-learning module and not all e-learning training courses available may have considered the research behind the science of e-learning.

Therefore, investigators need to conduct additional research on the various e-learning training courses available and begin to define e-learning standards. Research will need to be conducted to necessary components that must be included into an e-learning course for it to be effective and generalize to other e-learning courses. Until then, researchers will need to validate individual e-learning courses to show that they result in the behavior change they are designed to produce. In addition, comparison studies may be warranted to identify the trainings that are more time efficient and effective at training various skills. Although e-learning training appears to be a promising teaching tool, there is little research to support the use of this method. Because of the many advantages to using this type of training, investigators must continue to research e-learning across a variety of populations and training material. With this tool, we would be able to provide trainings to teachers throughout the world as long as they had access to a computer with internet access. E-learning may be the solution to the current dilemma we face with dissemination of training to teachers and providers. As such, it seems worthy of additional research.

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APPENDICES

APPENDIX A

Discrete Trial Teaching Handout

Components of Discrete Trial Teaching

Managing Antecedents

1. **Materials are ready**
2. **Gain child's attention**
3. **Presentation of correct discriminative stimulus**
4. **Presents Prompt Immediately**
5. **Intersperses trials across and within programs**
6. **Instructor maintains quick pacing**

Managing Consequences

1. **Provides consequence immediately**
2. **Records data**
3. **Tangibles/edibles are paired with praise**
4. **Differentially reinforces responses**
5. **Clears materials**
6. **Tests for independence**
7. **Prompts after incorrect response**
8. **Fades prompts**
9. **Moves to new target after a correct response**

* Adapted from Thiessen et.al (2009)

APPENDIX B

Trained Skills Sets (i.e., programs)

Program Name: Non-Verbal Imitation (NVI)

S^D_{NVI}= Perform action

S^D_{VI}= "Do this."

R= The child repeats the action.

Brief Description:

This program focuses on teaching imitation with the goal of generalized imitation (i.e. the child imitating any novel model). Give the child the instruction "Do this" while simultaneously modeling or showing them what to do. For example, the instructor would say "Do this" while simultaneously clapping his or her own hands. Be careful not to say "clap hands" while presenting the instruction - only say "Do this"

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to imitate clap hands if the instructor simply lifts their hands, then only this much prompting should be provided.

Targets to Teach

Clap hands

Wave

Program Name: Receptive Shapes

S^{D}_{NV1}= Presentation of materials

S^{D}_{V1}= "Give me (shape)"

R= The child hands the instructor the correct shape

Brief Description:

This program focuses on teaching the child to receptively identify shapes. Place three cards on the table, equally spaced apart, and present the verbal instruction "Give me ____"

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to receptively identify the shape with a gesture prompt (e.g., instructor points to correct card), then that prompt should be used before a physical prompt.

Targets to Teach

Circle

Square

Program Name: Expressive Colors

S^{D}_{NV1}= Presentation of materials

S^{D}_{V1}= "What color?"

R= The child expressively labels the color

Brief Description:

This program focuses on teaching the child to label colors. The instructor should hold up a color card and present the instruction. The child should label the color.

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to label the red with a partial verbal prompt (e.g., "R"), that should be used before a full verbal prompt.

Targets to Teach

Red

Blue

Appendix C

Untrained Skills Sets (Programs)

Program Name: Non-Verbal Imitation with Objects (NVI – Objects)

S^D_{NVI}= Perform action

S^D_{VI}= "Do this."

R= The child repeats the action.

Brief Description:

This program focuses on teaching imitation with the goal of generalized imitation (i.e. the child imitating any novel model). Give the child the instruction "Do this" while simultaneously modeling or showing them what to do. For example, the instructor would say "Do this" while simultaneously rolling the car across the table. Be careful not to say "Roll car", only say "Do this."

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to imitate hitting a block on the table with a partial prompt at the wrist, then only this much prompting should be provided.

Targets to Teach

Hit block on table

Roll car across table

Program Name: Receptive Letters

S^{D}_{NV1}= presentation of materials

S^{D}_{V1}= "Give me letter ____"

R= The child hands the instructor the correct letter

Brief Description:

This program focuses on teaching the child to receptively identify letters. Place three cards on the table, equally spaced apart, and present the verbal instruction.

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to receptively identify the letter with a gesture prompt (e.g., instructor points to correct card), then that prompt should be used before a physical prompt.

Targets to Teach

A

B

Program Name: Expressive Numbers

S^{D}_{NV1}= presentation of materials

S^{D}_{V1}= "What number?"

R= The child expressively labels the number (e.g., "1")

Brief Description:

This program focuses on teaching the child to label numbers. The instructor should hold up a number on a card and present the instruction. The child should say the number.

Prompt Sequence:

Use least-to-most prompting. Use the least amount of prompting necessary for the child to get a correct response. For example, if the child is able to label the star with a partial verbal prompt (e.g., "St"), that should be used before a full verbal prompt.

Targets to Teach

1

2

Appendix D

Instructor Evaluation Tool and Definitions

Managing Antecedents

1. **Gain child's attention:**
    a. Instructor ensures that the child is looking at the instructor or materials present
        i. If instructor gives instruction before looking at child, score as (-)
    b. If they do not end previous trial (looking away min. 1 s), then score as incorrect

2. **Presentation of correct discriminative stimulus (both verbal and nonverbal):**
    a. The instructor gives the correct verbal instruction and presents correct materials (if applicable) as specified on program sheet.
    b. The instructor cannot add or omit any words (e.g., "ok, touch red")
    c. Instructor must place all materials in a field of 3
    d. If materials were used, they should be presented in a different order from previous trial.
        i. "Do this"
        ii. "what color?"
        iii. "Touch shape"

3. **Pacing (inter-trial interval 5 s)**
    a. No more than 5 seconds occurs before the presentation of the next trial
        i. Time begins either after the verbal praise has ended or materials have been cleared
        ii. If data was not collected (Correctly), score as incorrect

4. **Correct Interspersal of trials**
    a. Moves on to another target after a correct, indep. Response
    b. Runs the same target (i.e., test for independence) after a prompted response

Managing Consequences for Correct Responses

5. **Provides a Consequence Immediately**
    - **a.** Waits 5 s. for child to respond
    - **b.** Provide praise immediately (within 1 s) and edibles/physical within 3 s
    - **c.** Materials are removed
    - **d.** If ONLY praise or ONLY edibles were provided, score as incorrect

6. **Edibles/Physical are all paired with praise & praise statements varied**
    a. Verbal praise (e.g., "fantastic!") is given with any edibles
    b. Praise statements are varied (different from previous trial)

7. **Records data Correctly after consequence but before the next trial**
    a. Data is collected immediately after praise and prior to the next instruction being presented

Managing Consequences for Incorrect Response

1. **Ends trial immediately (within 3 s) by blocking the response and either looking away (minimum of 1 seconds) or saying "try again"**
    a. The instructor ends an incorrect response as within 3 seconds
    b. Instructor does not add any words or say any other statement
    c. Clears materials
2. **Records data correctly before presentation of next trial**
    a. Data is collected before another instruction is given
3. **Pacing**
    - **a.** No more than 5 seconds elapses between the end of the previous trial and the beginning of the next trial
    - **b.** If they do not collect CORRECT data, score as incorrect
4. **Regains child's attention**
    a. Instructor ensures child is attending (i.e., looking at the instructor or materials)
    b. If they do not end previous trial (looking away min. 1 s), then score as incorrect
5. **Represent correct verbal/non-verbal SD with prompt**
    a. The same verbal instruction and materials are re-presented following an incorrect response or prompted trial
6. **Presents Prompt Immediately** (if necessary; defined as if the learner did not respond correctly to the previous instruction)
    a. The instructor presents the prompt either simultaneously or immediately after the instruction before the child responds.

b. The instructor must provide a prompt after (-)

7. **Provides a Consequence Immediately**
    - **a.** Praise only
    - **b.** Provide consequence: End trial within 3 s
        - **i.** Incorrect: Says "try again" or instructor breaks eye contact & turns away
    - **c.** Materials are removed
    - **d.** If they did not prompt, then automatically score as incorrect

Correct response

8. **Provides consequence immediately**
    - **a. ONLY provides praise (no edibles) within 1 s.**
9. **Records data correctly before presentation of next trial**
    a. Data is collected before another instruction is given

Incorrect response

10. **Begin at #1 again under consequences for incorrect response**

Instructor Evaluation

Date: _____ Participant: _____ Observer: _____

Session Number:_____ Phase:_____ IOA: _____Y _____N_____

	Managing Antecedents	1	2	3	4	5	6	7	8	9	10	11	12	13	Total	Percent
A	Secure child's attention															
B	Presentation of correct verbal and nonverbal Sd															
D	Pacing															

Managing Consequences <u>Correct</u> responses

	Managing Consequences	1	2	3	4	5	6	7	8	Total	Percent
A	Provides consequence immediately										
B	Edibles are paired with praise & Praise statements are varied										
C	Records data correctly										
D	Correct Interspersal										

<u>Data</u>

		1	2	3	4	5	6	7	8	9	10		
X	Data/target for trials												Not scored

Managing Consequences <u>Incorrect</u> responses

	Managing Consequences	1	2	3	4	5	Total	Percent
A	Ends trial – blocking materials/looking away							
B	Records data correctly and before presentation of next trial							
C	Pacing							
D	Regains child's Attention							
E	Represent correct verbal/nonverbal instruction with prompt (prompt must be simultaneous)							
F	Prompt simultaneous or immediately after SD							

Correct ↓

		1	2	3
G	Conseq. Immediate/praise only			
H	Records correct data			

Incorrect ↓

		1	2
G	Ends trial – blocking materials/looking away		
H	Records data correctly and before presentation of next trial		
I	Pacing		
J	Regains child's attention		
K	Represent correct verbal/nonverbal instruction with prompt (prompt must be simultaneous)		
L	Prompt simultaneous or immediately after SD		
M	Only provides praise and provides immediately		
N	Records correct data		

Appendix E

Test Questions

Module 1

1. A larger, general skill is broken into smaller teachable components that we call:
    a. None of the above
    b. Targets
    c. Program
    d. SD

2. When teaching the child to imitate, if the instructor says "do this, clap hands", and the child claps their hands, the instructor should record it as: (choose the best answer)
    a. +
    b. -
    c. p+
    d. p-

3. Non-verbal imitation is an example of a:
    a. Instruction
    b. SD
    c. Target
    d. Program

4. Match the following term with the correct description:
    a. Imitation
    b. Receptive Language
    c. Expressive Language
    d. Generalization

5. What information can be found on the program sheet? (Choose all that apply?)
    a. Prompting procedures (hierarchy)
    b. Verbal SD
    c. Targets
    d. Brief description of how to teach the program
    e. Non-verbal SD

6. When graphing data, only graph the first _____ trials.

7. If the student gets a correct response when the instructor provides a prompt, code it as:
    a. p-
    b. -
    c. NR
    d. +
    e. p+

8. If the student gets an incorrect repose, when the instructor provides a prompt, code it as:
    a. p+
    b. NR
    c. +
    d. -
    e. p-

9. When collecting data on the dat sheet, you should start:
    a. from the right of of the row and move to the left
    b. from the bottom and move up
    c. on the left row and move to the right
    d. at the top of the column and move down

10. Data should be collected after _____ trial.

11. Match the following term with the correct description:
    a. Imitation
    b. Receptive Language
    c. Expressive Language
    d. Generalization

12. A program may have which type of SDs: (Choose all that apply)
    a. Quiet SD
    b. Verbal SD
    c. Neutral SD
    d. Non-verbal SD

13. When teaching the child to imitate, if the instructor says "do this, clap hands", and the child claps their hands, the instructor should record it as: (choose the best answer)
    a. p+
    b. +
    c. p-
    d. –

14. The instructions and a brief desription of how to run a program can all be found on:
    a. SD
    b. Data Sheet
    c. Target
    d. Program Sheet

15. Non-verbal imitation is an example of a:
    a. SD
    b. Program
    c. Instruction
    d. Target

16. When graphing data, only graph the first _____ trials.

17. If the student gets a correct response when the instructor provides a prompt, code it as ____.

18. Data should be collected after _____ trial.

19. How many trials do you reference when graphing the data?

20. If the student does not respond at all, code it as _____.

Module 2

21. Match the following types of SDs with the best example:
    a. Verbal SD
    b. Gestural SD
    c. Visual SD

22. The SD that should be used while teaching can be found on the:
    a. None of the above
    b. Program Sheet
    c. All of the above
    d. Target

23. Which is an example of a non-verbal SD?
    a. "Give me red"
    b. Adult modeling an action
    c. "What color?"
    d. "What is your name?"

24. Which is an example of a verbal SD?
    a. Pointing to the color?
    b. "What color?"
    c. Adult modeling an action
    d. The materials used for the program

25. When gaining the child's attention you should never:
    a. Snap your fingers
    b. Rapidly repeat attention getting stimuli
    c. prompt the child to gain his/her attention
    d. Say his/her name multiple times

26. If the child was not attending when the instructor gave the instruction, the instructor should:
    a. Wait the full 5 seconds and then end the trial before beginning another trial
    b. Immediately prompt the child to look
    c. Immediately re-state the SD
    d. Immediately end the trial

27. The best indicator that the child is attending is when he/she is:
    a. Playing with the program materials
    b. Sitting quietly with hands in lap
    c. Looking at the instructor's eyes
    d. All of the above

28. Before beginning a teaching session, materials should be placed:
    a. In a plastic bag
    b. On the floor
    c. Within arm's reach (of the instructor)
    d. Any location

29. Materials should be removed from the table after: (Choose the best response)
    a. When the instructor thinks it is appropriate
    b. Every five trials
    c. After incorrect responses
    d. Every trial

30. When setting up materials, they should be placed: (Choose all that apply)
    a. Equal distant apart from each other
    b. Equal distant apart from the child
    c. In any position on the table

31. The best way to gain and keep a child's attention is to: (Choose all that apply)
    a. None of the above
    b. Wave a toy in front of their face
    c. Have good pacing
    d. Have strong reinforcers

32. If the child was not attending when the instructor gave the instruction, the instructor should:
    a. Wait the full 5 seconds and then end the trial before beginning another trial
    b. Immediately prompt the child to look
    c. Immediately end the trial
    d. Immediately re-state the SD

33. The best way to gain the child's attention is to:
    a. Say "look at me" multiple times
    b. Point to your eyes to prompt them to look
    c. Say his/her name several times
    d. Use a visual shield

34. Which is an example of a non-verbal SD?
    a. "Give me red"
    b. "What is your name?"
    c. Adult modeling an action
    d. "What color?"

35. Match the following types of SDs with the best example:
    a. Verbal SD
    b. "Sit down"
    c. Gestural SD
    d. A point to the chair
    e. Visual SD
    f. A picture of the correct location

36. The SD that should be used while teaching can be found on the:
    a. Target
    b. All of the above
    c. None of the above
    d. Program Sheet

37. The instruction should be given:
    a. None of the above
    b. As many times as needed
    c. Multiple times
    d. Only once

38. Before beginning a teaching session, materials should be placed:
    a. In a plastic bag
    b. On the floor
    c. Any location
    d. Within arms reach (of the instructor)

39. When setting up materials, they should be placed: (Choose all that apply)
    a. Equal distant apart from each other
    b. Equal distant apart from the child
    c. In any position on the table

40. Materials should be removed from the table after: (Choose the best response)
    a. When the instructor thinks it is appropriate
    b. Every trial
    c. After incorrect responses
    d. Every five trials

Module 3

41. Match the type of verbal prompt with the best example:
    a. Full verbal prompt
    b. "Sarah"
    c. Partial verbal prompt
    d. "Sar"
    e. Volume prompt
    f. "SARAH"

42. Match the following type of prompt with the correct description of each:
    a. Verbal prompt
    b. Words, phrases, or sentences given to the child to prompt them to engage in a specific behavior
    c. Gestural prompt
    d. Pointing, motioning, or nodding towards something in the environment to indicate that the child should engage in a specific behavior
        i. Model prompt
        ii. Instructor performs exact behavior that the child should engage in
        iii. Physical prompt
        iv. Child is physically guided to engage in a behavior

43. How many times should the child be non-responsive before the instructor provides a prompt?
    a. 0
    b. 2
    c. 3
    d. 1

44. A prompt is given _____ the child responds.

45. When providing a prompt, you should:
    a. Provide it before the child starts to respond
    b. Wait to see how the child will respond
    c. Provide it as soon as the child begins to respond incorrectly so they do not practice the wrong response
    d. All of the above

46. After the child responds incorrectly, the instructor should:
    a. provide a prompt on the next trial
    b. Run another trial to see if the child will get a correct
    c. provide praise
    d. provide a prompt during the same trial

47. Beginning with the least intrusive prompt and then increasing to more intrusive prompts if the child responds incorrectly is considered:
    a. good teaching
    b. least-to-most prompting
    c. most-to-least prompting
    d. prompt fading

48. Prompts should be _____ as quickly as possible to help prevent the child from becoming prompt dependent.

49. Prompts must be _____ as quickly as possible to prevent prompt dependence.

50. Which physical prompt would be considered the least intrusive?
    a. Partial prompt at forearm
    b. Full hand over hand
    c. Partial prompt at elbow
    d. Partial prompt at wrist

51. How many times should the child respond incorrectly before the instructor provides a prompt?
    a. 3
    b. 0
    c. 2
    d. 1

52. After the child responds incorrectly, the instructor should:
    a. provide a prompt during the same trial
    b. Run another trial to see if the child will get a correct
    c. provide a prompt on the next trial
    d. provide praise

53. A prompt is given:
    a. Simultaneously with the SD
    b. Immediately after the SD
    c. When the child starts to respond incorrectly
    d. Anytime after the SD

54. A prompt is given _____ the child responds.
55. Match the type of verbal prompt with the best example:
    a. Full verbal prompt
    b. "Sarah"
    c. Partial verbal prompt
    d. "Sar"
    e. Volume prompt
    f. You put: "Sarah"

56. Prompts are used in order to:
    a. help the child become prompt dependent
    b. help the child after he/she has responded incorrectly within the same trial
    c. help the child contact reinforcement
    d. help the child engage in the correct response

57. Decreasing the amount or level of support when prompting a child so that they can begin to respond independently is referred to as:
    a. good teaching
    b. Prompt fading
    c. prompt dependence
    d. least-to-most prompting

58. Which type of prompt would be considered least intrusive when teaching the child to receptively identify colors (e.g., gives instructor the color red when asked "Give me red")
    a. partial elbow
    b. gesture prompt
    c. full hand over hand
    d. partial wrist

59. Prompts should be _____ as quickly as possible to help prevent the child from becoming prompt dependent.

60. General rule is to use the _____ amount of prompting to evoke the correct response.

    a. least
    b. most
    c. best

Module 4

61. What is the verbal SD for non-verbal imitation?
    a. Model of the action
    b. "Give me____"
    c. "Do this"
    d. "What is it?"

62. When providing praise, we should _____ the different statements that we use.

63. When should you identify a reinforcer?
    a. Before beginning a session
    b. After the child gets an incorrect response
    c. After collecting data
    d. After the child gets a correct response

64. When providing praise, we should vary: (Choose all that apply)
    a. the tone
    b. nothing
    c. the inflection
    d. statements

65. How can an instructor indicate to the student that a response was incorrect?
    a. Turn head away and break eye contact
    b. Say "try again"
    c. Giving a small amount of reinforcement
    d. Say "no"

66. After the child gets a correct independent response, the instructor should: (Choose all that apply)
    a. Run the same target again
    b. Switch to a new target
    c. Provide a prompt
    d. Provide reinforcement

67. Following a correct response the instructor could provide: (choose all that may apply)
    a. verbal praise plus physical attention
    b. verbal praise only
    c. verbal praise plus edible
    d. turn away and collect data

68. When the child gets a correct, independent response, the instructor should provide praise: (Choose all that apply)
    a. If he/she thinks the child deserves it
    b. After collecting data
    c. Before collecting data
    d. Before or while simultaneously removing materials

69. What are the different ways in which a child may respond? (Choose all that apply)
    a. Not at all
    b. Correctly
    c. Incorrectly
    d. Fabulously

70. Data should be recorded: (choose all that apply)
    a. Immediately after providing a consequence
    b. At the end of the session
    c. After each trial
    d. After every 5 trials

71. After the child responds, the instructor should:
    a. Begin a new trial
    b. Collect data, then provide a consequence
    c. Provide a consequence, then collect data
    d. Collect data only

72. Data should be recorded: (choose all that apply)
    a. Immediately after providing a consequence
    b. After every 5 trials
    c. After each trial
    d. At the end of the session

73. Following an incorrect response, the instructor should: (choose all that apply)
    a. provide verbal praise plus an edible
    b. say "try again"
    c. provide verbal praise
    d. turn away and collect data
    e. provide verbal praise plus physical attention

74. How can an instructor indicate to the student that a response was incorrect?
    a. Turn head away and break eye contact
    b. Giving a small amount of reinforcement
    c. Say "no"
    d. Say "try again"

75. Following an incorrect response, the instructor should:
    a. represent the materials in a random order
    b. represent the materials in the same order
    c. Any of the following
    d. not remove the materials

76. After the child gets a correct independent response, the instructor should: (Choose all that apply)
    a. Provide a prompt
    b. Run the same target again
    c. Switch to a new target
    d. Provide reinforcement

77. When should you identify a reinforcer?
    a. After the child gets an incorrect response
    b. After collecting data
    c. Before beginning a session
    d. After the child gets a correct response

78. When providing praise, we should _____ the different statements that we use.

79. Praise is most effective when it is:
    a. Varied
    b. Independent of a response
    c. Food
    d. Consistent

80. What is the verbal SD for receptive shapes?
    a. "What shape?"
    b. "Give me ____"
    c. "Do this"
    d. Pointing to the object

Appendix F

Social Validity Survey

1. The modules kept my interest during the training.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

2. I found the modules informative about how to run discrete trial teaching.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

3. The modules described the content clearly.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

4. There were plenty of video examples that clearly demonstrated the different components of discrete trial teaching.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

5. I feel like the there was enough information in the modules to learn how to teach using discrete trial teaching.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

6. All the content and videos appeared to run correctly (e.g., the video did not cut out in the middle).

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

7. I would recommend the modules to another person who was interested in learning how to teach using discrete trial teaching.

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

8. What comments or suggestions do you have for future modifications to the training modules?

Appendix G

Response Sequences

Sequence 1			
NR *	-	+ *	- *
- *	+	-	+
+*	+ *	-	+
+ *	NR	+	+*
+	+ *	+ *	+
Sequence 2			
+ *	- *	NR *	+
-	+	- *	+
- *	+*	+	NR*
+	+	+ *	+
+ *	+	-	+ *
Sequence 3			
-	+ *	- *	NR
+ *	-	+ *	- *
+ *	-	+	+
NR	+	+*	+ *
+ *	+ *	+	+
Sequence 4			
NR *	- *	-	+ *
-	+	+	-
+*	+*	+ *	- *
+ *	+*	NR	+
+	+	+ *	+
Sequence 5			
- *	-	+ *	NR
+ *	+	-	- *
+*	+ *	-	+
+*	NR	+	+ *
+	+ *	+ *	+

CURRICULUM VITAE

Joy S. Pollard, MA, BCBA
Utah State University
joypollard@gmail.com
Department of Special Education and Rehabilitation
575-635-7729
Logan, Utah

EDUCATION

Utah State University, Logan UT (August 2008- present)
190 Main Hill Logan, UT 84322
Ph.D. Candidate, Disabilities Disciplines, with a specialization in Applied Behavior Analysis
Expected Graduation Date: May 2012
Advisor: Dr. Thomas Higbee

Middle Tennessee State University, Murfreesboro, TN (August 2006-May 2008)
1301 East Main St # 204 Murfreesboro, TN 37132-0001
M.A., Clinical Psychology, with specialization in Behavioral Analysis, 2008
Thesis: A Peer-Mediated Social Skills Intervention for Toddlers with Autism
Committee: Dr. Kim Ujcich Ward, Dr. Monica Wallace, Dr. Dana Fuller

New Mexico State University, Las Cruces, NM (August 2000 - December 2005)
1780 East University Avenue, Las Cruces, NM 88003-1229
B.A. Psychology, December 2005
Major: Psychology

PROFESSIONAL CERTIFICATION

Board Certified Behavior Analyst – Certification number: 1-09-5156

PROFESSIONAL MEMBERSHIPS

Association for Behavior Analysis International – Member since 2007
Utah Association for Behavior Analysis – Member since 2010

TEACHING EXPERIENCE

Utah State University
Spring, 2010
Instructor: Undergraduate course in Applied Behavior Analysis II: Course designed to follow an introduction to applied behavior analysis. Taught and supervised 34 students implementing a behavior intervention plan in a school or home setting.

Spring, 2009
Teaching Assistant: Undergraduate Applied Behavior Analysis II
Graduate Level course in Applied Behavior Analysis

PEER REVIEWED MANUSCRIPTS

Betz, A., Higbee, T., Kelley, K. N., Sellers, T. P., & **Pollard, J. S.** (2011*)* Increasing response variability of mand frames with script training and extinction. *Journal of Applied Behavior Analysis, 44,* 357-362.

Betz, A.M., Higbee, T.S. & **Pollard, J.S.** (2010) Promoting generalization of mands for information used by young children with autism. *Research in Autism Spectrum Disorders,* 4, 501-508.

Pollard, J.P., Betz, A. & Higbee, T.S. *(In press).* Script-Fading to promote unscripted bids for joint attention in children with autism, *Journal of Applied Behavior Analysis*.

MANUSCRIPTS IN PROGRESS

Bloom, S.E., **Pollard, J.S.,** Sellers, T., Keyl, A. & Samaha, A.L. A teacher-conducted trial-based functional Analysis.

Pollard, J.S., Higbee, T.S., & Kelley, K.N. An evaluation of interactive video and in vivo teacher instruction on tact acquisition in young children with autism.

Pollard, J.S. & Higbee, T.S. Assessment of individual preferences for teaching procedures and behavioral treatments: A Review

PROFESSIONAL PRESENTATIONS

Betz, A.M., Higbee, T.S., Kelley, K.N., Sellers, T.P. & **Pollard, J.S.** (2012, February). *The application of script fading and extinction procedures to increase response variability and novel mand frames in young children with autism.* Paper presented at the 30th annual western regional conference of the California Association for Behavior Analysis, Garden Grove, CA.

Brodhead, M., Higbee, & **Pollard, J.S.** (2012, February). *The use of activity schedules to promote social and on-task behaviors during a game of hide-and-seek.* Paper presented at the 30th annual western regional conference of the California Association for Behavior Analysis, Garden Grove, CA.

Pollard, J.S., Higbee, T.S., & Kelley, K. (2011, May). *An evaluation of interactive video and in vivo teacher instruction on expressive object labeling in children with autism.* Paper presented at the 37th annual conference of the Association for Behavior Analysis International, Denver, CO. Also presented at the 29th Annual Conference of the California Association for Behavior Analysis, Burlingame CA, February, 2011.

Kelley, K., Higbee, T.S., & **Pollard, J.S.** (2011, May). *Comparison of video and teacher instruction on tact acquisition in early learners with autism.* Paper presented at the 37th annual conference of the Association for Behavior Analysis International, Denver, CO. Also presented at the 29th Annual Conference of the California Association for Behavior Analysis, Burlingame CA, February, 2011.

Pollard, J.S., Betz, A. & Higbee, T.S. (May, 2010) A Script-Fading Procedure to Promote Unscripted Bids for Joint Attention in Children with Autism. Symposium presented at 36th annual meeting of the Association for Behavior Analysis International, San Antonio, Texas. Also presented at the 28th Annual Conference of the California Association for Behavior Analysis, Irvine CA, February, 2010.

Bloom, S.E., Iwata, B.A., Fritz, J.N., Hammond, J.L., & **Pollard, J.S.** (May, 2010). Cross-function transfer of mand forms. In B.A. Iwata, Chair, *Translational Research on Reinforcement Effects.* Symposium presented at 36th annual meeting of the Association for Behavior Analysis International, San Antonio, Texas. Also presented at the 28th Annual Conference of the California Association for Behavior Analysis, Irvine CA, February, 2010.

Bloom, S.E., Lambert, J.M., **Pollard, J.S.,** Sellers, T.P., Dayton, E., Samaha, A.L., & Keyl-Austin, A.A. (May, 2010). Evaluation of a teacher-conducted trial-based functional analysis. In S.E. Bloom, Chair, *Functional Assessment of Problem Behavior and Factors that Influence Effectiveness of Interventions.* Symposium presented at 36th annual meeting of the Association for Behavior Analysis International, San Antonio, Texas. Also presented at the 28th Annual Conference of the California Association for Behavior Analysis, Irvine CA, February, 2010.

Kelley, K., **Pollard, J.P.** & Higbee, T.S. (March, 2010) Comparison of Interactive Video Instruction and In Vivo Teacher Instruction on Acquisition and Generalization of Expressive Object Labeling in Children with Autism. Symposium presented at the Annual Utah State University Intermountain Graduate Research Symposium, Logan, Utah.

Betz, A., Higbee, T.S., **Pollard, J.P.** (2009, May). The Generalization Effects of Teaching Mands for Information During Discrete Trial Training With Young Children with Autism. Paper presented at the 35th annual convention of the Association for Behavior Analysis, Phoenix, AZ.

WORKSHOPS

Pollard, J.S., Snyder, K. & Higbee, T.S. (June, 2010). Assessing Challenging Behavior. Workshop presented to special education teachers and paraprofessionals in Granite School District, Logan UT.

Pollard, J.S. & Higbee, T.S. (June, 2010). Effective Teaching Strategies for Children with Autism. Workshop presented to Special Education Teachers and Paraprofessionals at the 8th annual Utah Conference on Effective Practices in Special Education and Rehabilitation, Logan UT.

Higbee, T.S., Keyl, A.A., Snyder, K., **Pollard, J.P.,** Kelley, K.K., & Sellers, T.S. (February, 2010). Using Activity Schedules to Promote Appropriate Independent and Interactive Play Skills for children with Autism. Half-day workshop presented at California Association for Behavior Analysis, Irvine, CA.

Higbee, T., **Pollard J.,** and Kelley, K. (October, 2009). *Strategies for Promoting Independence and Spontaneous Language Use in Children with Autism.* Half-day workshop presented at Nevada Association for Behavior Analysis, Reno, NV.

Pollard, J.S. & Higbee, T. (June, 2009). Promoting Play and Social Skills in Children with Autism. Workshop presented to Special Education Teachers and Paraprofessionals at the 7th annual Utah Conference on Effective Practices in Special Education and Rehabilitation, Logan UT.

PROFRESSIONAL EXPERIENCE

Consultant Park City School District, August 2010-present
McPolin Elementary Schooll, Park City, UT
Duties: Trained the District Autism Specialist to provide consultation to general and special education teachers; trained professional staff to design, implement, and train others to implement teaching strategies based on principles of behavior. Monitored staff performance, conducted behavior assessments, and created curriculum and behavior plans.

Co-Director of Program Quality, August 2010-present

Behavioral Intervention Services of Los Angeles, CA
Duties: Reviewed progress reports and initial assessments to ensure quality.

Case Manager and Supervisor, June 2008-August 2010
ASSERT Preschool, Logan, UT
Duties: Supervised instructors with working with children with autism, created curriculum and oversaw programming, documented and tracked students' progress, conducted parent and staff trainings, worked and trained in home with parents, created individual behavior plans for home and school, consulted with families outside of the ASSERT preschool on challenging behavior and academic deficits

Instructor, January 2006-June 2008
Autism Education Center, Brentwood TN
Duties: Implemented discrete trial training and other behavioral procedures with children with autism, analyzed and implemented changes in curriculum, implemented individual behavior plans, updated and analyzed student progress