Training Novice Instructors to Implement Errorless Discrete-Trial Teaching: A Sequential Analysis

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ABSTRACT

Discrete trial teaching (DTT) is a common instructional method incorporated into intensive behavioral intervention programs for children diagnosed with autism. Errorless learning strategies are frequently recommended during DTT because they often result in more efficient and effective instruction. The purpose of the present study was to conduct a sequential analysis of the efficacy of three methods for teaching errorless DTT procedures to novice instructors: (a) a self-instruction manual, (b) an instructional video, (c) and brief performance feedback. Three participants mastered DTT following self-instruction and the remaining three participants required all three interventions. The present study extends the literature on training DTT skills by (a) illustrating an efficient, sequential method of staff training, (b) introducing an improved self-instruction manual, and (c) clearly delineating guidelines for implementing an errorless prompt fading strategy during DTT.

Keywords: autism, discrete-trial teaching, errorless learning, staff training

Discrete-trial teaching (DTT) is a common instructional technique incorporated into many early and intensive behavioral intervention (EIBI) programs for children diagnosed with autism spectrum disorders (Frea & McNerney, 2008; Smith, 2001). Extensive training is required for novice DTT instructors to ensure high rates of skill acquisition for students (Smith, 2001). Unfortunately, high demand for services, budgetary limitations, and high staff turnover rate may prevent agencies from being able to offer such extensive supervised training (Jacobson & Mulick, 2000); thus, time-efficient DTT staff-training protocols are needed. The purpose of the present study was to conduct a sequential analysis (e.g., DiGennaro Reed, Coddington, Catania, & Maguire, 2010) of the effectiveness of training procedures to teach novice instructors to implement a commonly used DTT intervention that incorporates most-to-least prompting.

One efficient method of training instructors to implement DTT is through the use of a self-instruction manual. Research in this area generally involves having naïve instructors review

an instruction manual (e.g., Fazzio & Martin, 2006) as well as study questions over key elements of the manual. Participants are often administered a quiz on the manual content, and then asked to demonstrate their skills with a confederate. Although this method of instruction often results in substantial improvements in DTT skills (e.g., Arnal et al., 2007; Salem et al., 2009; Thompson, Martin, Fazzio, Salem, Young, & Yu, 2012), most participants require additional instruction (e.g., video demonstration, rehearsal, feedback) in order to demonstrate mastery and generalization of relevant skills (Fazzio, Martin, Arnal, & Yu, 2009; Thiessen et al., 2009).

Some studies have demonstrated the effectiveness of rehearsal and performance feedback without prior self-instruction and have resulted in mastery of DTT skills (Gilligan, Luiselli, & Pace, 2007; LeBlanc, Ricciardi, & Luiselli, 2005). Behavioral skills training (BST) packages typically involve providing staff with instructions, models of examples and nonexamples of the target skills, opportunities for rehearsal, and feedback on performance (Miltenberger, 2008). For

example, Sarokoff and Sturmey (2004) demonstrated that BST was effective in teaching DTT skills and Sarokoff and Sturmey (2008) demonstrated that DTT skills taught using BST generalized across curricular programs and other children. Similar results have been demonstrated with public school teachers (Downs, Downs, & Rau, 2008) and with parents as instructors (Lefasakis & Sturmey, 2007). Furthermore, improvements in instructor DTT skills following BST have also resulted in reductions in student stereotypy (Dib & Sturmey, 2007). Behavioral skills training has also been successfully modified by incorporating video instructions (Ryan & Hemmes, 2005), and feedback on video-scoring also resulted in mastery of DTT skills (Crockett, Fleming, Doepke, & Stevens, 2007). Thompson et al. (2012) incorporated video instruction in a self-instruction package used to teach DTT skills to novice instructors, and 2 of the 4 participants who watched the videos reached an average performance of at least 90% correct. Catania, Almeida, Liu-Constant, and DiGennaro Reed (2009) demonstrated that the use of video modeling as the sole training

strategy was effective in teaching DTT skills to 2 of 3 participants, providing some evidence that video modeling alone may be an efficient means of training some novice instructors to implement DTT.

Discrete-trial teaching often includes various prompt-fading strategies (e.g., graduated guidance, time delay) to gradually transfer stimulus control from a prompt to the appropriate discriminative stimulus (S^D) (e.g., instructions, pictures, flashcards) while avoiding prompt dependence. Errorless learning (EL) is a term that encompasses a variety of procedures aimed at reducing learner errors during instruction (Mueller, Palkovic, & Maynard, 2007). When implementing EL, a hierarchy of prompts is determined prior to instruction, and these prompts are ranked from the highest level of intrusiveness to the lowest. Although in clinical practice the terms *errorless learning* and *most-to-least (MTL) prompting* are often used interchangeably, in published research studies, MTL prompting is typically used to describe a prompt fading strategy with a hierarchy that begins with full physical guidance (Batu, Ergenkon, Erbas, & Akmanoglu, 2004; Cuvo, Leaf, & Borakov, 1978; Demchak, 1990). In clinical settings, practitioners often use physical guidance or MTL prompts when working with students. For example, MTL has been used when teaching pedestrian skills (Batu et al., 2004), Internet skills (Jerome, Frantino, & Sturmey, 2007), janitorial skills (Cuvo et al., 1978), and activity schedules (Massey & Wheeler, 2000) to individuals with developmental disabilities.

Overall, the results of current research on prompt fading strategies indicate that MTL prompt fading is often more efficient and sometimes more effective than other prompt fading strategies (Csapo, 1981; Day, 1987; Gentry, Day, & Nakao, 1979; McDonnell & Ferguson, 1989; Miller & Test, 1989). Recent recommendations for practitioners promote the use of EL procedures (Kayser, Billingsley, & Neel, 1986; McDonnell & Ferguson, 1989) and these strategies are used during DTT in EIBI programs (Love, Carr, Almason, & Petursdottir, 2009), although clear guidelines for their use in this type of instruction have yet to be developed.

Several studies have demonstrated effective strategies for training instructors to implement DTT procedures either with confederates or children with autism. Many of these studies (e.g., Fazio et al., 2009; Thiessen et al., 2009) use confederates while teaching DTT skills, and only include children with autism to demonstrate generalization. Of these studies, none have included the use of a clear MTL prompt strategy as part of their DTT protocols. Thus, the purpose of the present study was to conduct a sequential analysis of the effectiveness of training procedures to teach novice instructors to implement a commonly used DTT intervention that incorporates MTL prompting. The present study extends research on self-instruction (Arnal et al., 2007; Fazio et al., 2009; Thiessen et al., 2009) by evaluating the effects of a revised self-instruction manual based on Fazio and Martin (2006). It also extends research on video modeling (e.g., Catania et al., 2009) and brief performance feedback (e.g., Gilligan et al., 2007) to improve

DTT skills. Finally, a confederate learner was used during skill demonstration standardize training experiences across participants and ensured that participants were exposed to the full range of relevant learner variables during training (Iwata et al., 2000).

Method

Participants and Setting

Six novice instructors participated in this study. Participants were newly hired, less-than-part time employees (< 20 hours per week) or volunteers of a nonprofit, in-home autism treatment program. Lisa was a 25-year-old female who was completing her final semester in an undergraduate psychology program. She had no experience with individuals with autism or other developmental disabilities. Theresa was a 22-year-old female who had completed several general education college-level courses and had some experience working with at least one individual with autism. Donna was a 33-year-old female who had completed several college courses and was working full time as an assistant in a public special education classroom for individuals with learning disorders. Lisa, Theresa, and Donna had no experience with DTT or other behavioral instructional strategies, and none had completed any behavior analysis course work.

The remaining participants, Donald, Michael, and Heather, all held full-time jobs as classroom assistants in a nonpublic school for individuals with developmental disabilities. All 3 participants were primarily responsible for assisting in the education and care of adolescent or young-adult students and all 3 had received minimal training in general behavioral strategies at the beginning of their employment; however, none of the participants could clearly describe the strategies, and none had implemented these strategies in at least a year. None of these participants had received any training in EL prompt fading strategies or had worked with young children diagnosed with autism. Donald was a 24-year-old male who had completed a few general college-level courses. Both Michael, a 26-year-old male, and Heather, a 26-year-old female, had completed high school but had no college experience.

Sessions were conducted in a private office or a conference room in an outpatient clinic for children with autism spectrum disorders. All sessions were video recorded for subsequent data collection, and the experimenter (the first author) was present for each session. Each session lasted up to 10 min, during which participants were asked to implement DTT with the experimenter (the confederate). Participants completed two to four sessions during each visit. Visits were conducted 2 to 4 times per week. The duration of each visit varied based on the phase of the study and participant availability. During intervention phases, visits sometimes included an instructional component (e.g., review of the self-instruction manual) followed by 1 to 3, 10-min DTT sessions with a confederate. The duration of these two-part visits ranged from 1.5 to 3 hours.

Table 1. Discrete-Trial Teaching Target Behaviors and Definitions

Target Behaviors Definitions

Organize data sheet prior to session	<ul style="list-style-type: none"> (a) Listed each target 1 time each in probe section (b) Listed each target 3 times each in teaching trials section (not consecutively)
Materials presented correctly	<ul style="list-style-type: none"> (a) Flashcards presented in different order than the previous trial (Exception for the first trial of each DTT session) (b) Target item placed in different location (left, right, center) than the previously presented target item (c) Flashcards were even spaced (d) All of the flashcards presented equidistant from the participant (e) All three flashcards were presented at the same time (f) No other materials were located in the instructional area
Materials presented correctly (probe sessions only)	<ul style="list-style-type: none"> (a) One item (or target set) was placed in front of the participant and the other identical item (or target set) was placed in front of the participant (b) No other materials were located in the instructional area in front of the participant on the table
Appropriately secure the child's attention	<ul style="list-style-type: none"> (a) Used one appropriate phrase (e.g., "look") one time and/or nonverbal method of securing the confederate's attention (b) Waited to provide the instruction until the participant was looking either at the participant or at the instructional materials on the table (c) Refrained from touching each individual card or otherwise drawing attention to an individual card prior to instruction (d) Refrained from using an inappropriate means of gaining the confederates attention (e.g., snapping fingers, tapping table) (e) Refrained from saying the name of any of the flashcards prior to instruction (f) Secured attention within 3 seconds of providing the instruction
Delivered appropriate instruction	<ul style="list-style-type: none"> (a) Used a short phrase with a clear lead, and no additional descriptors, such as: "Give me __," "Where's the __," "Find the __," "Show me the __," or "Hand me __" (or something similar) (b) Used a phrase that indicated the correct confederate response (i.e., picking up the card, extending the arm with card in hand towards the instructor) such as, "point to __," or "touch the __." (c) Refrained from using extra descriptors (e.g., "give me the grey dog") (d) Refrained from using an incorrect target label (e.g., "birdy" vs. "bird")
Waited 3 seconds for a response (probe trials only)	<ul style="list-style-type: none"> (a) After delivering the instruction, refrained from providing a prompt, removing the flashcard, or delivering another instruction before 3 seconds elapses (b) If the confederate engaged in an error response before 3 seconds elapses, this was automatically scored as correct
Provided immediate and correct prompt level (as needed) (teaching trials only)	<ul style="list-style-type: none"> (a) First teaching trial for a given target: Following the instruction or while the instruction was being provided, participant immediately provided the <i>same</i> prompt level that was used to bring about the correct confederate response for the <i>probe</i> trial for that target OR waited 3 seconds for the confederate to respond if the confederate responded correctly and without prompts during the probe trial (b) All other teaching trials for a given target: Same as above except that participant used one prompt level <i>lower</i> (less intrusive) than the prompt level used to bring about the correct response in the previous <i>teaching</i> trial

Correct use/non-use of reinforcers (teaching trials only)	<ul style="list-style-type: none"> (a) Provided a mock tangible reinforcer AND praise immediately following a correct confederate response (prompted or unprompted) (b) Refrained from providing a mock tangible reinforcer alone OR praise alone immediately following a correct confederate response (prompted or unprompted) (c) Did not provide a mock tangible reinforcer or praise to the confederate immediately following an error response by the confederate
Removed cards (following an error response)	<ul style="list-style-type: none"> (a) Removed all of the instructional materials on the table immediately following an error response
Represented materials (following an error response)	<ul style="list-style-type: none"> (a) Flashcards were presented in same order as they were prior to the error (b) Flashcards were even spaced (c) All of the flash cards were presented equidistant from the participant (d) All three flashcards were presented at the same time (e) No other materials were located in the instructional area in front of the participant on the table (e.g., toys)
Represented materials (following an error response in the probe phase only)	<ul style="list-style-type: none"> (a) Materials were presented in the same manner as they were prior to the error (b) One item (or target set) was placed in front of the participant and the other identical item (or target set) was placed in front of the participant (c) No other materials were located in the instructional area in front of the participant on the table
Represent instruction (following an error)	<ul style="list-style-type: none"> (a) Same as “delivered appropriate instruction” except that the target item presented was the same as in the instruction delivered prior to the error response
Provided appropriate prompt (increased by one level following an error)	<ul style="list-style-type: none"> (a) Provided an additional prompt that was one level higher (more intrusive) than the previous prompt attempted just prior to the occurrence of the error (b) Refrained from using inappropriate prompts (e.g., verbal prompt)
Correctly recorded data	<ul style="list-style-type: none"> (a) Probe trials: The target listed on the data sheet matched the target requested in that trial and the prompt level recorded matched the final prompt level required to bring about the correct response in the trial (b) Teaching trials: In addition to the above, “correct” was recorded if the confederate responded correctly (with or without prompts) on the first attempt, or “error” was marked if the confederate engaged in an error response (with or without prompts) on the first attempt
Did not provide tangible reinforcers (probe trials only)	<ul style="list-style-type: none"> (a) Did not provide a tangible reinforcer or praise at any point during the probe trial, even if the confederate responded correctly (with or without prompts)
Conducted probes of all three targets	<ul style="list-style-type: none"> (a) One trial of each of the targets was conducted in the first three trials of the session
Did not present the same target across three consecutive teaching trials	<ul style="list-style-type: none"> (a) Did not present any one of the target items in three consecutive teaching trials
Conducted all three teaching trials of all three targets	<ul style="list-style-type: none"> (a) Each target was presented exactly 3 times during the teaching trials portion of the session, regardless of the order of presentation, meaning that exactly nine teaching trials were conducted

Materials

A table and three chairs were used during each session along with pens, data sheets for the participant to record the responses of the confederate, one-page written instruction for target and generalization DTT tasks, instructional stimulus sets, and mock rewards (e.g., a musical toy telephone, a push-and-go toy tractor, and a small cardboard book) to be used as programmed consequences with confederates. A laptop computer and a remote slide advancer were also present, which was used to display the scripts for the confederate and were out of the participant's view once the session began. During the video modeling phase of the study, the laptop was also used to play a 41-min instructional video that included clips of two different experienced clinicians (Board Certified Behavior Analysts) modeling examples and nonexamples of DTT with a confederate. During the self-instruction phase, a 53-page self-instruction manual, a quiz of the material, a notebook, and a highlighter were also available.

Response Measurement

The primary dependent variable was participant accuracy in DTT implementation (see Table 1). Data on participant behavior during DTT with a confederate were collected from videos of all sessions using a DTT performance checklist. The dependent measure was calculated by dividing the number of correctly performed DTT steps by the total number of correct and incorrect steps and converting the resulting ratio to a percentage. The mastery criterion for performance was 90% of steps performed correctly during three consecutive sessions, each consisting of 12 trials each (three probe trials and nine teaching trials).

Participants were also given a short quiz containing fill-in-the-blank and short-answer questions based on material in the self-instruction manual to determine their level of knowledge of DTT after they had read the manual. The experimenter scored the quiz immediately following its completion. Each quiz was worth 20 points and the passing score was 90% correct or higher.

Confederate behaviors. Confederate-behavior scores were calculated to determine the accuracy with which the confederate responded according to the script assigned for a particular DTT session. Data were collected using a checklist of 1 of 5 possible scripts of confederate behaviors. Confederate behavior was scored by dividing the number of correct steps by the total number of correct and incorrect steps and converting the resulting ratio to a percentage. Confederate behavior was assessed for at least 29% of each participant's sessions and averaged at least 92% accuracy.

Interobserver agreement. Interobserver agreement (IOA) between two independent observers was assessed for participant performance during at least 28% of sessions using the point-by-point method. Mean IOA was at least 89% for each participant. Point-by-point IOA was also calculated during 70% of all of the sessions in which confederate behaviors were

assessed. Mean IOA for confederate behaviors was at least 93% for each participant.

Procedures

Training structure. A sequential analysis of the independent variables was conducted to determine the most efficient way to train participants. Each intervention was implemented until the participant met the mastery criterion or until data stabilized as determined by visual inspection of the last three data points in each participant's graph. Phases were ordered according to the efficiency of intervention. For example, the self-instruction manual is both cost and time efficient; therefore, it was the first intervention. Each participant received only the interventions that were necessary to master the steps of DTT. If a participant failed to master DTT with the self-instruction manual, video instructions and modeling were implemented. If the mastery criterion was still not met, performance feedback was implemented. At whatever point the participant reached mastery, a generalization task and follow-up assessment occurred.

For each session, a confederate learner (the first author) was used in lieu of a child with autism in order for the participant to practice his or her DTT skills. A script was provided to the confederate via a laptop computer, prompting her to engage in five correct responses and seven error responses in semirandom order across trials (see Table 2). When an error response was scripted, the confederate engaged in that particular error response each time the trial was represented until the participant (a) provided the prompt level indicated in the script, (b) provided a more intrusive prompt than the one indicated in the script, or (c) the participant delivered the instruction a total of four times for a given trial.

Experimental design. A nonconcurrent multiple-baseline design across participants was used to evaluate the effects of the different interventions.

Baseline. Participants were provided with a data sheet to record the responses of the confederate, a one-page written description of a discrimination training program, instructional stimuli, and mock rewards. Participants had up to 10 min to review these materials. When a participant indicated that he or she was ready, or after 10 min had elapsed, the participant was asked to conduct DTT with the confederate. The participant did not have access to the one-page instruction during the session with the confederate. The session ended after one session had been completed or 10 min had elapsed. No feedback was provided regarding participant performance. Participants received a short break between each DTT session.

Self-instruction manual. Following baseline, participants were provided with a 53-page self-instruction manual (modified from Fazio & Martin, 2006), a notebook, a highlighter, and a pen. The manual is available at http://www.abainternational.org/Journals/bap_supplements.asp. The experimenter instructed the participant to study the manual for up to two hours and complete the study guide questions at the end of each section. Participants were not required to take notes but were free to do so. Next, the participants were given a quiz for which no time

Table 2. Definitions of Each Confederate Response

Confederate Responses	Definitions
Correct (C)	Selected (with or without prompts) the flashcard that corresponded with the instruction provided and extended arm with picture in hand toward the participant
No response (NR)	Did not respond to the flashcards at all, and if a prompt resulted in the confederate touching a flashcard, then the confederate must quickly moved her hand away
Wrong (W)	Immediately selected a flashcard other than the one indicated in the instructions provided, extended arm with flashcard in hand towards the participant without ever coming into contact with the other flashcards
Scroll (S)	Touched a flashcard other than the one that was indicated in the instructions provided, then selected the flashcard that corresponded with the one indicated during the instruction, and extended arm with flashcard in hand towards the participant
Select correct and hold (SCH)	Selected (with or without prompts) the flashcard that corresponded with the instruction provided, but failed to extend arm with picture in hand toward the participant.
Select correct and throw (SCT)	Selected (with or without prompts) the flashcard that corresponded with the instruction provided, and then tossed the card towards the participant
Select two cards (S2)	Selected (with or without prompts) the flashcard that corresponded with the instruction provided plus an additional flashcard, and extend arm with both pictures in hand toward the participant

limit was provided. Most participants completed the quiz in approximately 20 to 30 min. The experimenter scored and corrected the quiz and then reviewed any incorrect answers with the participant. Following the quiz, participants were asked to demonstrate what they had learned with a confederate, and these sessions were identical to those conducted in the baseline. The participants were not allowed to review their instruction manuals or notes after the quiz had been taken or at any other point in the study, and no feedback was provided regarding their performance with the confederates.

Video instructions and modeling. At the beginning of this phase, participants viewed a 41-min instructional video developed for the study. Participants viewed the video only once. Examples and nonexamples of correct implementation of DTT steps were demonstrated in the video along with both text and narration of each clip. The video covered the same content in the same order as the self-instruction manual. After the participants had viewed the video, they were asked to implement DTT with a confederate just as they had in the previous two phases. The participants were not allowed to review the video after seeing it the first time, and no feedback was provided on performance with confederates.

Performance feedback. This phase began with the experimenter reviewing common participant errors that were

observed in previous sessions and answering any questions that the participant had regarding implementation of DTT. Next, the participant was asked to practice DTT with the confederate. During this practice, participants received praise for correct implementation of a given DTT step and immediate corrective feedback from the experimenter in response to errors. Additionally, participants were asked to re-present the trial following corrective feedback until it was completed successfully. This continued until the participant completed one session (three probe trials and nine teaching trials) without errors. Each feedback session lasted approximately 10 to 15 min per session, and only two feedback sessions were required for Heather and Donna, while three sessions were required for Michael. Finally, the participants were asked to implement DTT with the confederate again without feedback being provided, just as they had in baseline, in post-feedback sessions.

Generalization probe with a novel program. This phase was the same as baseline, except that participants were given the stimulus set and the one-page instruction for a different skill acquisition protocol (teaching imitation with objects) with which they had no experience implementing.

Follow-up probe. Consistent with the clinical practice of the agency where the study took place, a follow-up probe session was conducted 3 to 5 days after each participant demonstrated

Figure 1. Results for Lisa, Donald, and Theresa depicting the percentage of steps performed correctly while implementing discrete-trial training with a confederate. Results for Michael, Heather, and Donna depicting the percentage of steps performed correctly while implementing discrete-trial training with a confederate. Note: Gen Task = Generalization Task.

mastery of DTT with a confederate to assess skill maintenance. Participants completed one DTT session with a confederate, and the instructions and materials provided were the same as those provided in baseline. No feedback was provided by the experimenter regarding participant performance.

Results

Session-by-session results for Lisa, Donald, and Theresa are depicted in Figure 1. For Lisa, low and stable correct performance percentages were observed in the baseline condition, with a mean of 27% correct. Lisa scored 90% (a passing score) on the quiz over the self-instruction manual. She demonstrated immediate, substantial improvement in performance following self-instruction, and her performance gradually improved, eventually reaching the mastery criterion. Her mean performance during post self-instruction sessions was 86%. Performance during the generalization probe was 75%, but returned to 91% during follow-up.

Results for Donald were similar to Lisa's, except that Donald's baseline performance was somewhat higher, with an average of 49% correct. Donald passed the quiz of the self-instruction manual with a score of 90%. His implementation of DTT also improved following self-instruction and he met the mastery criterion after six sessions, with a mean of 87%. His performance during the generalization probe was quite high at 99%. This level of performance was higher than his best performance during the post self-instruction sessions. Upon analyzing the types of errors that Donald made during instruction, it was observed that Donald regularly presented the flashcards in the wrong order during the discrimination program. When implementing the imitation program, stimuli were not presented in a particular order, thus this particular presentation error could not be made. His performance during the follow-up probe was only slightly below the mastery level at 88%.

Figure 2. Mean percentages of error responses by category observed following self-instruction for Michael, Heather, and Donna.

Theresa's results were consistent with those of the previous two participants. Her performance during baseline was low at 25% correct. Theresa scored 90% on the self-instruction manual quiz. Her performance then averaged 93% following self-instruction, 94% during the generalization probe, and 96% at follow up.

Session-by-session results for Michael, Heather, and Donna are depicted in the right column of Figure 1. Michael's performance was low and stable during baseline with a mean of 28% correct. Michael scored 80% (below passing) on the quiz of the self-instruction manual. His performance improved slightly in the post self-instruction sessions, with a mean of 40%. Michael's performance further improved after watching the instructional video, which included modeling of DTT steps. In this phase, his mean performance was 80%. Following performance feedback, performance reached mastery level in three sessions with a mean of 94%. His performance decreased during the generalization probe to 57%, but recovered during the follow-up probe to 96%.

Heather scored 37% correct during baseline, 70% (below passing) on the quiz, 72% following self-instruction, and 83% following video-based instruction. She reached mastery with a mean of 96% correct during post-feedback sessions. Her performance maintained during the generalization and follow-up probes with scores of 98% and 94%, respectively.

Donna scored 23% correct in baseline, 68% (below passing) on the quiz, 53% following self-instruction, and 77% after observing the instructional video. Mean performance following feedback was 94%. Performance during the generalization probe decreased slightly to 87% and then rebounded during follow up at 96%.

All six participants demonstrated improvement following self-instruction, with three reaching the mastery criterion in this phase. These same 3 participants scored 90% on the quiz following self-instruction, whereas the other participants, who did not respond as effectively to self-instruction, did not earn a passing grade on the quiz. These final 3 participants progressed through all of the remaining intervention phases, reaching mastery only after receiving direct feedback on their performance. Half of the participants in the study performed at or above mastery level during the generalization probe, and 4 of the 6 participants performed above mastery level during the follow-up probe.

An analysis of the errors of the 3 participants who did not master the steps of DTT following self-instruction is depicted in Figure 2. The mean percentages of errors in the categories of "materials and instruction" and "responding to errors" were above 50% for all 3 participants.

Discussion

The results indicate that the self-instruction manual alone was sufficient for half of the participants to correctly implement the DTT protocol with a confederate. The remaining participants reached mastery only after progressing through all intervention phases. This first finding is somewhat surprising as it is inconsistent with previous research conducted in this area in which self-instruction reliably resulted in only 20% to 25% of participants reaching mastery-level performance (Arnall et al., 2007; Fazzio et al., 2009; Thiessen et al., 2009; Thompson et al., 2012). This difference is likely due in part to differences between the manual used in the present study and the earlier manuals (Fazzio & Martin, 2006; 2007). The current manual

excluded unnecessary behavioral terminology and any information that was not directly relevant to the implementation of DTT. It included instructions and examples of only one prompt-fading strategy (i.e., MTL) and one teaching protocol (i.e., discrimination of animal flashcards), incorporated multiple colorful illustrations as well as prompts to review material and practice (see Figure 3), and included a detailed, step-by-step practice section, which described in detail the three probe trials and nine teaching trials (see Figure 4). All 3 participants who failed the quiz lost points on similar questions (i.e., identifying instructor errors and describing how an instructor should proceed in two different DTT scenarios). It is possible that a revised self-instruction manual, incorporating more emphasis on these two areas may result in improved quiz performance as well as DTT instructional performance.

Quiz scores following self-instruction seemed to correlate with intervention success. For example, all 3 participants who passed the quiz with scores $\geq 90\%$, reached mastery in post-self-instruction sessions. This finding is important because it indicates that the current manual was not only effective for some participants, but that the quiz might be a useful method of screening novice instructors to determine whether

self-instruction alone will result in mastery of DTT skills. In practice, this might translate into all newly hired instructors receiving a self-instruction manual on their hire date and being subsequently quizzed on the information. Individuals with passing scores would follow a different training sequence than those who did not, thus potentially saving training resources.

Many human-service agencies create staff training modules based on requirements provided by different funding sources as well as on employee responsibilities. Strategies such as large-group lecture-style trainings, CD-ROM, or online training modules require varying levels of agency resources, and the effectiveness and efficiency of the training strategies are rarely analyzed. This study provides a framework for analyzing the on-the-job-impact of staff training interventions in a sequential manner, which may benefit both researchers and practitioners who may find this model useful when analyzing various procedural components or interventions in the future (e.g., DiGennaro Reed et al., 2010).

The present study also clearly demonstrated a method for teaching novice instructors to implement an MTL prompt fading strategy as a part of DTT. Although many MTL procedures are easy to implement, when systematically incorporated into

Figure 3. A section of the manual illustrating full physical prompts with photographic illustration.

Probe Trial 2: Bird

- Arrange the flashcards and secure the child's attention.

“Look”

- Present the instruction for the first probe. “Where is the bird?”
 - You begin waiting, and the child responds correctly by handing you the bird
 - Say nothing
 - Pick up the flashcards
 - Record the data. Your datasheet should look like this.

Target: bird ☒ Ind ☐ GP ☐ PP ☐ FP

Figure 4. A section of the manual illustrating a single probe trial in the context of a full session.

DTT they are somewhat more difficult. Unfortunately, poor implementation of any prompt fading strategy might result in many problems for the learner (e.g., delayed acquisition, prompt dependency, increased errors) and it is likely that the more cumbersome the procedure, the greater chance for errors during implementation. Despite the difficulty of the DTT procedures defined in this study, all 6 participants reached mastery level, indicating that the training strategies were effective. This study may be used as a guide for practitioners who have little background in the implementation of MTL strategies and/or who are responsible for training new staff to implement these procedures.

A confederate adult learner was used in the present study to ensure that each participant received a similar training experience. Although all participants reached mastery-level performance with the confederate, it is unclear how the participants would have responded to individuals with autism or confederates who more closely resemble learners with autism. For example, the confederate in this study did not speak or make noises during the session and did not engage in any noncompliant, distracting, or otherwise challenging behaviors that instructors are likely to encounter during instructional sessions with learners with autism. However, several studies have shown that when participants are taught to implement DTT skills to confederates, the skills generalize such that they are able to implement the skills to learners with autism (e.g., Fazzio et al., 2009; Thiessen et al., 2009). Nevertheless, one might incorporate a series of confederate scripts during training that present increasingly difficult challenges to novice instructors before they implement instructional strategies with learners with autism. Future research that incorporates generalization opportunities with children diagnosed with ASDs may be helpful in providing recommendations to supervisors and trainers on the best methods of teaching instructors who have no prior history with the population.

The results of the present study should be evaluated in light of several potential limitations. First, although all of the participants mastered the mechanics of DTT, some of them lacked enthusiasm and variety when demonstrating praise. A future edition of the self-instruction manual and instructional video may need to emphasize this feature as a crucial feature of effective praise. Another potential limitation is that the DTT checklist used in this study did not include physically blocking learner errors or observing the intertrial interval. However, after reviewing a sample of sessions from each participant, it was observed that participants who failed to observe the intertrial interval were also committing other instructional errors. This may indicate that the intertrial interval is truly a byproduct of other DTT steps; therefore, it may not be necessary to teach or track that particular step. An additional limitation is that generalization was only evaluated with one novel program (e.g., imitation with objects) for only one probe session. Future research should evaluate whether these staff training procedures result in generalization across a variety of protocols. Despite these limitations, the current training protocol appeared to be

effective and efficient in training clinically relevant teaching skills.

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